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VALVE NOMENCLATURE AND TYPES.

AS long ago as April of last year *The Wireless World* raised the question of whether the time had not come when greater attention should be paid to the standardisation of valves with a view to limiting the number of types by dispensing with those valves which are becoming obsolete and considering the possibility of retaining only a choice of one or two voltages, instead of the 2-, 4-, and 6-volt valves as at present. It was also stated then that a standard method of valve nomenclature was many years overdue.

In this issue Prof. E. V. Appleton, F.R.S., contributes a special article to *The Wireless World* under the title "Are there too many Types of Valves?" and he discusses the reasons which have brought about the present multiplicity in types. He recommends that a discussion by readers of *The Wireless World* on the subject would materially assist the valve manufacturers in deciding upon what steps should be taken towards an attempt at standardisation. Prof. Appleton puts in a special plea for a standard method of naming valves. He points out that the names should be as short as possible, compatible with a clear distinction between the different types, and deplores the present chaotic fashion in which many of the manufacturers distinguish between one valve and another in a way that may be intelligible to the manufacturer but which leaves the user in a state of bewilderment. Only in the instance of one valve manufacturer has any serious attempt been made to arrive at a satisfactory nomenclature which will give an indication of the valve type.

We commend this subject to the consideration of our readers, because it is those who are users of valves who are probably most competent to express an opinion on what types it is necessary to retain and what system of nomenclature it would be most helpful to adopt.

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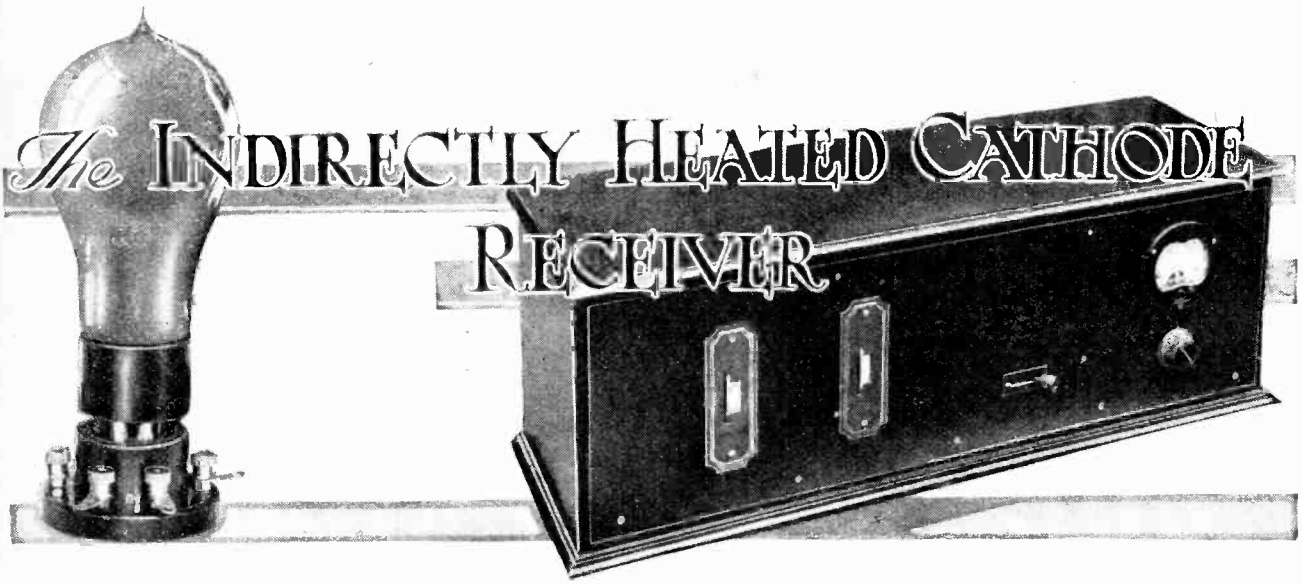
STATION IDENTIFICATION.

THE volume of correspondence which we are receiving on the proposal to establish a system of station identification grows from day to day, and it has now become quite impossible to publish even a representative selection of letters in our Correspondence columns. We have, therefore, attempted to analyse the views of our readers as indicated in their letters. Only a very few hesitate to endorse the proposal whole-heartedly, and then on the grounds that they feel some concern as to whether the signal would not strike a discordant note, interrupting the enjoyment of the programmes, especially when it emanated from the local station. Our readers have put forward a great number of alternative suggestions, but mostly of some complexity, and we feel that the time has now come when it is necessary to arrive at some definite proposal, because, so long as there are alternative proposals, it is difficult to take the next step in pushing forward the adoption of any scheme. We return, therefore, to the original idea of numbering all transmitters of Europe and arranging for the signal of identification to take the form of corresponding musical notes, the pitch of the note being varied to indicate digits and tens in the composition of the number. Thus we propose that 25 should be transmitted as two notes on, say, "middle c," and five notes an octave higher; 32, three notes on "middle c," two notes an octave higher, and so on.

We welcome views, but would ask our readers for the moment to confine themselves to criticisms of this system rather than to submit alternatives.



The Indirectly Heated Cathode Receiver

A Long-range Three-valve Receiver for Battery, D.C. and A.C. Mains Operation.

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

FROM a theoretical consideration, a valve with an indirectly heated cathode should be very much more efficient than a valve with the more usual type of cathode, namely, the filament, and it is well worth while spending a little time to consider why this should be so. There are several problems involved, and although their detailed study is quite intricate the basic principles at issue are comparatively simple to understand.

First of all, in the ordinary type of valve the cathode is heated by the passage of an electric current through it. This current, besides heating the cathode sufficiently to evaporate electrons from it, produces other effects, one of which is a field round the filament, and another a potential gradient (*i.e.*, a difference of voltage between any two points) along the filament. The effect of the field due to the cathode-heating current on the electrons forming the plate current is to tend to make them go round the filament instead of going to the plate. In most valves this effect is small, but is undoubtedly present, and thus lengthens the path of electrons proceeding from filament to plate, and obviously will be greater the greater the filament current.

The set described in the accompanying article embodies one stage of H.F. amplification having the remarkably high measured amplification of 58. This extreme efficiency is rendered possible by the use of indirectly heated filament valves whose mutual conductance is considerably higher than that of ordinary filamented valves. Readers who have not A.C. mains can feed the heaters of these valves from L.T. accumulators, the current consumption being compensated for by the gain in efficiency.

The Magnetron Effect.

This effect is called the *magnetron effect*. It is desirable in most valves, of whatever amplification factor, to try to make the mutual conductance as high as possible (*i.e.*, to obtain as large a change as possible of plate current for a given grid voltage change), and, apart from constructional alterations, in dimensions especially, the way to do this is to use a cathode with a larger total emission. Unfortunately, such a cathode of filament type will involve a larger heating current, with consequent increase of magnetron effect, which thus imposes a limit on permissible filament dimensions.

The effect of the potential gradient down the filament rather depends on the amplification factor of the valve and will be discussed later. Another desirability in a valve is to make the ratio of anode to cathode diameter as near unity as possible—actually, of course, this latter ratio is not possible with any normal type of construction—and the ordinary filament type is practically limited in diameter by the above-mentioned magnetron effect.

In receiving valves the heating current is also limited to a large extent, while the anode-cathode diameter ratio in an ordinary valve is, of course, very high. It would certainly be possible considerably to minimise the magnetron effect with thick filaments by doubling them back on themselves as closely as possible, so that the fields due to each half become neutralised as far as possible. Unfortunately, this involves constructional difficulties.

The second effect—the potential gradient down the filament—becomes rather important in high-magnification valves. This is perhaps best explained by taking the numerical case of a valve with a 4-volt filament and a magnification factor of, say, 30, and supposing it to be run as an amplifier with $-1\frac{1}{2}$ volts grid bias and 100 volts on the plate. The positive side of the grid bias battery is connected to the negative side of the filament heating battery, so that the grid will be $1\frac{1}{2}$ volts negative to the *negative end of the filament*, but $5\frac{1}{2}$ volts negative to the *positive* end of the filament, and

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between these values at other points along the filament.

In the case considered, 100 volts on the plate corresponds approximately to $\frac{100}{30}$, or about $3\frac{1}{2}$ volts, on the grid, so that when the grid is $3\frac{1}{2}$ volts negative to the filament the repulsion effect of the grid on the electrons round the filament just balances the attractive effect due to the voltage on plate, while for negative voltages greater than $3\frac{1}{2}$ the negative effect predominates. Since a definite positive effect of several volts is required before appreciable plate current flows, it follows that less than half of the filament is supplying electrons for the plate current, and the nearer the negative end of the filament the more the electrons that are being supplied per unit length of filament. When it is further realised that the actual ends of the filament are not emitting electrons at all, because they are cooled by conduction of heat down the filament supports, it will be seen that only a very small length of the filament is doing useful work.

From what has been said, it follows that a greater part of a given filament will be doing useful work in supplying electrons in a valve of low amplification factor than in a valve of high amplification factor, and so it would be expected that the mutual conductance of a range of valves using the same filament would decrease, slowly at first, and then more and more rapidly as the amplification factor increases, and in practice this is found to be the case.

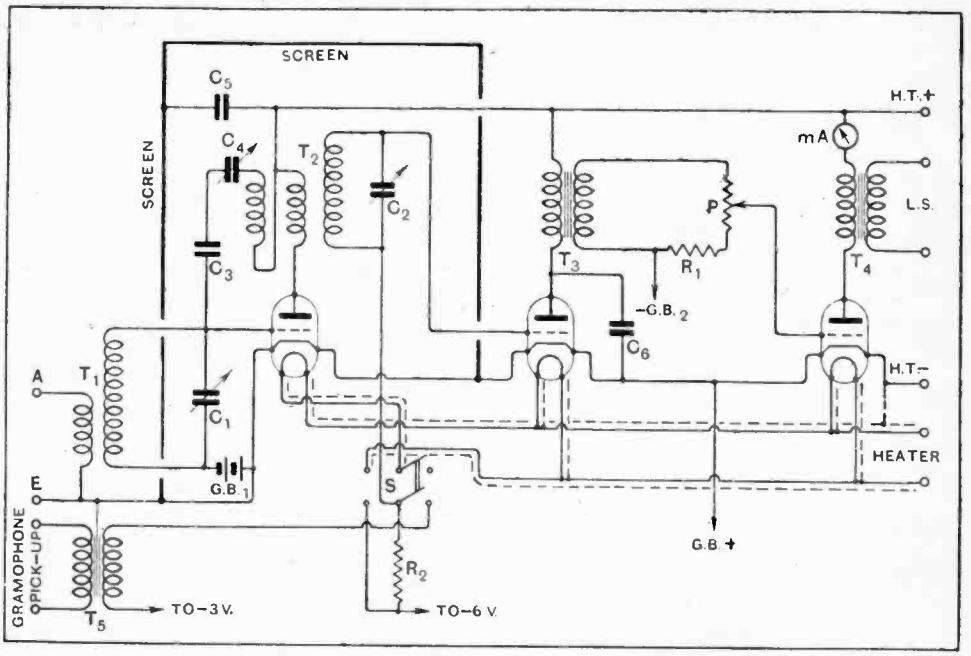

Fig. 2.—The circuit diagram.

On the other hand, the externally heated cathode valve need not suffer from the magnetron effect, since the cathode can be made an effective screen for the heater. Since the cathode carries no heating current, it may be made of sufficiently large diameter, so as to make the anode-cathode diameter ratio quite low and so increase the mutual conductance of the valve. Also, this increasing of cathode diameter automatically provides much larger cathode area on which emitting materials may be deposited, and the saturation electron current obtainable is thereby very greatly increased. In fact, if desired, the cathode may be run at a lower temperature than a corresponding filament and still give much larger total emission than the latter.

Again, the indirectly heated cathode carries no heating current, so that the whole of it is at the same poten-

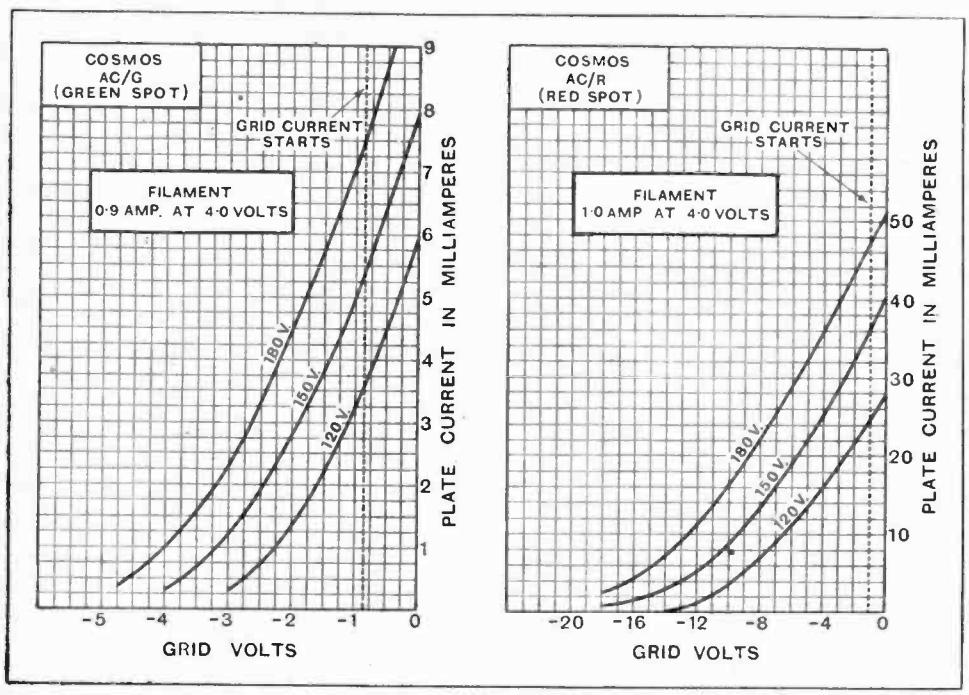

Fig. 1.—Grid volts—Anode current curves for Cosmos indirectly heated cathode valves.

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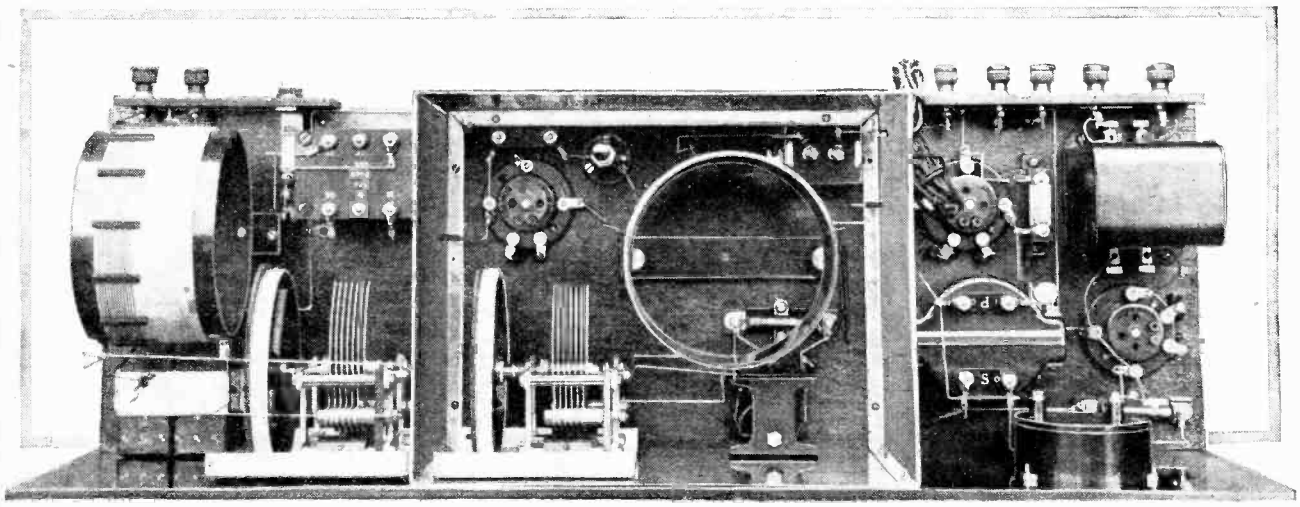
tial with respect to the grid, and thus the most striking difference in characteristics between ordinary filamented valves and indirectly heated cathode valves lies in those of high amplification factor.

Two other practical points in favour of the indirectly heated cathode type are robustness of construction (the heater being quite a thick wire), giving freedom from microphonic effects and long life, and also the very great advantage that, since the heater is shielded by the cathode, it may be heated equally as well by alternating as by direct current. However, the writer would like to emphasise the great advantages of the indirectly heated cathode valve as a valve of remarkable characteristics, quite apart from the added advantage of suitability for A.C. low-tension supply.

A number of these valves have been put on the market and have proved quite successful, but the latest addition



Plan view of the receiver.

—the Cosmos A.C. valve—has the attractive combination of indirectly heated cathode and close-spacing construction, the maximum advantage due to these two factors being obtained when the amplification factor is high.

The characteristics of the Cosmos AC/G green spot valves and those of the AC/R red spot are shown in Fig. 1.

Remarkably High Mutual Conductance.

For the AC/G valve the mutual conductance is enormous when judged by ordinary valve standards—about 2 milliamperes per volt for an amplification factor of 36—and the heater current is only 1 ampere at 4 volts. The latter figures are quite comparable with valves of the 4½-volt 0.8 ampere L.S. class.

For the AC/R valve the amplification factor is about 10, and the mutual conductance 4 milliamperes per volt, giving an A.C. resistance of about 2,500 ohms. The heater current is 1 ampere at 4 volts. It should be noted that the L.S.5a valve has an amplification factor of 2.5 and an A.C. resistance of 2,750 ohms, with a 4½-volt filament taking about 0.8 ampere.

This comparison shows that for the same output the AC/R valve only requires one-quarter of the input voltage swing that is required by the L.S.5a. The chief advantage of the L.S.5a, however, is its capability of being used up to 400 volts on the plate, while the AC/R is limited to 180 volts.

In passing, it might be remarked that a valve on the lines of the AC/R with a much lower amplification factor so as to get a much lower A.C. resistance would be extremely suitable for feeding coil-driven loud-speakers with efficient field systems and consequently fairly low impedance moving coils.

A valve with an amplification factor of 36 and a mutual conductance of 2 milliamperes per volt, giving an A.C. resistance of 18,000 ohms, has considerable possibilities, especially for H.F. amplification. With an ordinary receiving valve the best that has been done so far for an A.C. resistance of 18,000 ohms is an amplification factor of about 15 to 17, corresponding to a mutual conductance of less than 1 milliampere per volt.

A H.F. transformer of the type used in the Everyman Four designed for a primary impedance of 18,000 ohms will give an overall amplification of the stage of about 30 with an ordinary valve, but with a valve of double the mutual conductance and the same A.C. resistance the amplification should be doubled; thus with the AC/G valve a H.F. amplification of the order of 60 per stage should be quite possible with no more difficulty than an amplification of 30 with ordinary valves, and *with the same selectivity*, since the latter depends on the valve resistance, or, if desired, lower amplification with greater selectivity may be obtained.

After checking the characteristics of the AC/G and AC/R valves the writer decided to design a set using these valves, as they were so attractive, and, in view of the large H.F. amplification expected and the comparatively large magnification factor of the AC/R, it was decided to use three valves only, an AC/G as H.F., an AC/G as detector (anode bend), and an AC/R as output valve. The completed set now to be described certainly justified expectations.

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The Circuit Employed.

The complete circuit is given in Fig. 2. The set is intended for use alternatively for gramophone reproduction, since this is almost a *sine qua non* in a modern receiver.

There are several interesting points in connection with the circuit. First, for radio reception, the second valve is a detector, but for gramophone reproduction the second valve is used as an amplifier and the H.F. valve is cut out. The change-over from radio to gramophone is effected by the switch S, which alters the grid bias on the detector valve.

Full constructional details of the set will be given in the concluding instalment of this article in the issue of March 21st, 1928.

READERS' IDEAS.

A SIMPLE FUSE.

It is well known that a thin strip of tinfoil will make an excellent fuse for insertion into any of the H.T. leads of a receiver in order to safeguard the filaments should a filament and H.T. wire inadvertently come into contact within the vitals of the set. Provided that foil of constant thickness and constant length is used, it is obvious that one can make a fuse which will blow at any predetermined value by simply cutting it to the necessary width.

It is not always easy to cut the edges of the foil straight and "clean," but the simple method shown will obviate this difficulty. A steel rule is placed on the foil to be cut, and a sharp knife used with the

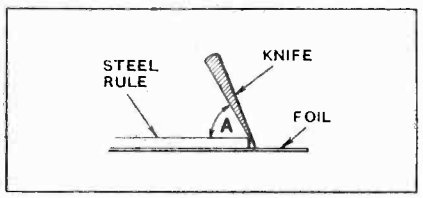

Fig. 1.—Constructing a simple fuse from tinfoil.

blade of the knife making an angle A as shown in Fig. 1. Then the foil is cut again with the knife held in a perpendicular position. It will be clear that any width of foil can then be cut by merely adjusting the angle of the knife in the initial cut. Using foil 2 mils. thick, it is possible in this manner to construct fuses which will blow at current values of some hundreds of milliamperes upwards.—G. B.

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AN EXPERIMENTAL UNIT.

One often desires to be able to compare the performance of different makes or ratios of transformers in a receiver, or even to compare the performance of a transformer with a choke-coupled, resistance-coupled, or so-called double-impedance unit. If switches are used, great complications occur.

The simplest method of accomplishing this object is to build up a small ebonite platform which can be mounted on the baseboard with

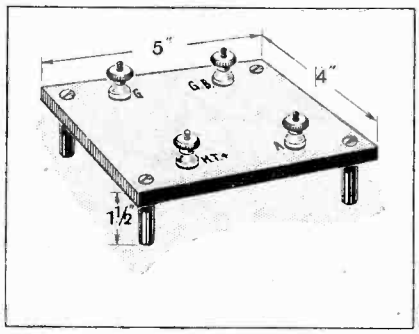

Fig. 2.—A small experimental unit for comparing the performance of various low-frequency coupling methods.

ordinary wood screws and washers. Four sockets or four terminals are mounted on this platform, and with the addition of four short lengths of flexible wire fitted with a plug at one end and a spade at the other, the unit is complete.—H. L. P.

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A NOVEL JIG.

The marking of the coil formers for a receiver such as the "Two-H.F. Everyman" calls for a great deal of precision if it is desired that each transformer fits easily into the sockets. If a large number of these formers have to be marked out, much time and labour can be saved by constructing a simple jig, the construction and use of which is completely self-evident.—H. H.

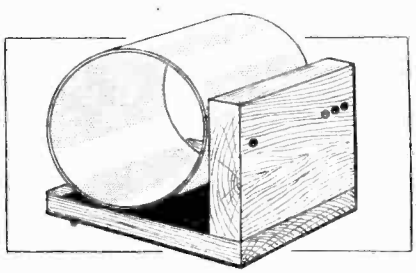

Fig. 3.—A jig for the accurate spacing of pins and sockets in the "Two-H.F. Everyman Four" type of H.F. transformer.

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FIXING THE GRID BATTERY.

The fixing of the grid bias battery in a receiver is still somewhat of a problem to many home constructors, and although special metal clips for holding these batteries can be obtained for a few pence, it often occurs that it is inconvenient to purchase them at a time when they are required, more especially in experimental work when sets are often wired up very hastily on a baseboard.

It is none too simple to cut these clips out from sheet tin and still preserve a neat appearance. Most experimenters, however, will have in their possession a few old variable condenser vanes, relics of the days

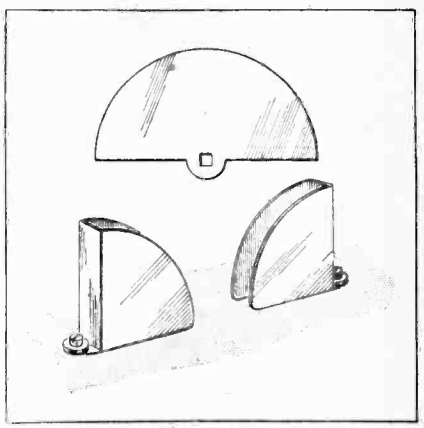


Fig. 4.—Making grid bias battery clips from old variable condenser vanes.

when we were bound to construct these devices ourselves from parts. By the simple process of bending up to the shape indicated in Fig 4 excellent clips for holding grid batteries can be made. They can be attached to the baseboard by passing a screw fitted with a small washer through the hole intended for the centre spindle. They can be applied to any size of battery, the latter being quite rigid when inserted.—E. P. H.

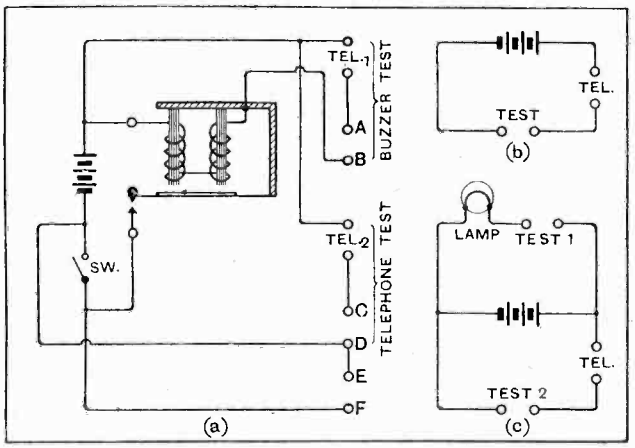
SIMPLE TESTING CIRCUITS.

Inexpensive Devices for Tracing Faults.

By "RADIOPHARE."

THE tracing of faults in a wireless receiver is not an easy matter. This statement is made advisedly; we all suffer, to an extent depending on the length of our experience, from that feeling of utter helplessness which overcomes the owner of a set that has become dumb. The very natural tendency to delve at random into its vitals, if not immediately productive of results, should give way to a more systematic course of procedure, by means of which the fault may generally be located more quickly and easily. It is advisable, before troubles develop, to acquire both the knowledge of how to carry out point-to-point tests and the necessary apparatus.

Although measuring instruments are helpful for making these tests, they are by no means essential, and a great deal may be done with simple and inexpensive devices, always provided that a voltmeter is available for checking the condition of batteries. It is strongly recommended, however, that whatever kind of testing circuit is adopted should be made up in permanent form, as improvised arrangements are likely to fail at the critical moment.



Three easily-constructed testing units.

The simplest form of tester is shown at (b) in the accompanying diagram. This comprises a pair of phones connected in series with a small flashlamp battery and terminals for two leads (marked TEST), the ends of which are applied across the piece of apparatus under suspicion. If there is continuity in this circuit a click will be heard in the phones; its loudness will depend on the resistance of the external circuit. A slightly more elaborate arrangement is shown at (c). This has an alternative lamp-tester connected across the common battery; this is more convenient for testing windings, etc., with a resistance of but a few ohms. To put it into operation, the testing leads are connected to terminals marked TEST 1, and are transferred to TEST 2 for simple telephone testing.

The circuit of a more ambitious tester is shown in diagram (a). This includes a buzzer, such as may be obtained for two or three shillings, in addition to terminals for telephone tests as described above, which are operative when phones and testing leads are joined, respectively, to the terminals marked TEL.$_2$ and C, D. To use the buzzer, its switch is closed, phones are joined to TEL.$_1$, and test leads to A, B; thus they are both in parallel with the magnet windings, across which quite a considerable momentary voltage is produced at each opening of the vibrating contacts. Now the ear is much better able to appreciate slight changes of intensity of a more or less musical note than of single clicks, and it is for this reason that the buzzer test is valuable as an aid to obtaining an idea as to whether high resistances (such as grid leaks, etc.) and fixed condensers have something approximating to their rated values. Admittedly, the buzzer provides a comparative test only, but it can be surprisingly helpful, particularly when the user has had practice of its operation. Let us imagine that the receiver under test has anode resistors of 100,000 ohms and 250,000 ohms, with grid leaks of 0.5 megohm and 1 megohm. As the ends of the testing leads are applied across each of these, in the order given, the volume of sound heard in the phones should be approximately doubled at each change. The same applies to condensers; there is no mistaking the change in intensity when the testing leads are transferred from a capacity of, say, 0.0002 mfd. to one of 0.0003 mfd.

Regarding condensers, it must be pointed out that the above test is *not* quite conclusive, as the sound heard in the phones may be due to low insulation resistance between the two sets of plates. To check this point, the ordinary phone test should be applied; on completing the circuit a click will be heard, due to the flow of charging current; if the insulation is good, there should be no click on breaking the circuit. This explains why the buzzer tester should be used with due care and consideration in any circuit containing appreciable capacity, and also indicates one of its advantages. For instance, a defective L.F. transformer winding will pass quite an appreciable "buzz" if the break is in the centre of the coil (due to capacity between the two halves), but if it is located at either end, no sound will be audible. Thus the amateur will know that it *may* be possible for him to effect a repair without the necessity for rewinding, as the break is probably situated in one of the leading-in wires.

An additional pair of terminals marked E, F, in series with buzzer and battery, is provided for testing low-resistance circuits.

High insulation resistance is necessary in all testing devices; with this proviso, any convenient form of construction may be adopted. Short-circuits through the user's body should be avoided by fitting insulating sleeves to the ends of the testing leads; the so-called "pin terminals" are very suitable for this purpose.

ARE THERE TOO MANY TYPES of VALVES

Suggestions to Simplify the Selection of Valves.

By Prof. E. V. APPLETON, F.R.S.

THE intensive development work carried out by receiving valve manufacturers during the last few years has brought about two things. In the first place it has resulted in the production of some most excellent valves which are satisfactory both as regards performance and life; in the second place it has resulted in a multiplicity of valve types that is simply bewildering. No one wishes valve development to stand still, but I feel quite sure that valve makers ought to be sufficiently satisfied with valve development to make the effort to standardise and retain some types and eliminate others.

The present bewildering choice of valves makes some of us recollect almost with regret those days when there were two types of hard valves, the "R" type and the "B" type. The "R" type of valve was a general-purpose receiving valve with an amplification factor of about 8 to 10. The "B" valve was a specially hard phosphorus-gettered valve with an amplification factor of about 20, and was mainly used for low-power transmitters. In those days, therefore, very little time was required to decide which valve to use. Nowadays it is quite different, and much time is wasted in choosing valves. Of course, a lot of time can be wasted in making up one's mind about anything, but when the difficulty of the problem arises mainly from the embarrassingly wide choice something can be done in the way of removing it.

Cannot the four-volt filament valve be dispensed with and the present multiplicity of types and markings simplified?

Prof. Appleton here discusses the origin of the many types, suggests the abolition of the four-volt series and introduces a nomenclature that indicates the purpose of a particular valve.

I know that the problem is a complicated one, and assumes essentially different aspects when regarded from the point of view of the valve user, who has to make his choice from the hundreds of valve types on the market, and from the point of view of the manufacturer, who must search ceaselessly for novelties and for filaments of lower and lower energy consumption. My main object in writing this article is to raise the question in the hope that other valve users will also give their opinions on the subject. It seems to me that a fairly wide discussion by technical people, such, I suppose, the majority of *Wireless World* readers must be, might very well assist the valve manufacturers in any attempts at standardisation they may decide to make. We must remember that the majority of valve users are non-technical broadcast listeners, and it is probably their non-critical buying of valves that supports the retention of many valve types, since the manufacturer naturally goes on making types which sell. But in raising the question of valve type multiplicity at all it is incumbent on me to indicate, even if only briefly, some of the points that I think the valve manufacturers could consider at once.

Two, Four or Six Volts?

In the first place, I would like to ask whether it is necessary for us to have valves with 2-volt, 4-volt and 6-volt filaments. Could not the requirements of all types of users be met with a 2-volt series and a 6-volt series? Could not the 4-volt series be eliminated without inconvenience to anyone? In writing this I am fully aware that the Editor of this journal some time ago made a plea for retaining the 4-volt type and eliminating the 2-volt and 6-volt series. But this suggestion was doubtless prompted by the fact that the 2-volt filament was not in those days regarded as being very satisfactory when compared with the higher voltage filaments. Nowadays that difficulty does not arise to any serious extent. Of course, the question must also be considered as to whether it is not possible to go to the extreme and have only one standard filament voltage of the two I have chosen. To settle such a question we must consider one or two fundamental points in connection with the thermionic emission of valve filaments.

For a given type of filament, *i.e.*, pure tungsten or thoriated tungsten, the electron emission per watt of filament energy consumption is a constant for a given operating temperature. Thus for the same emission we require lower and lower current the higher the filament voltage. Thus the use of 6-volt filaments means less frequent battery charging, and on these grounds alone one might choose the 6-volt filament as the standard type. But it must be remembered that the portable set user requires a filament battery of the smallest possible bulk and weight,

Are There Too Many Types of Valves?—

the current consumption being necessarily of secondary importance, so that here a 2-volt filament is most useful. Thus it would seem to be necessary to keep both 6-volt and 2-volt types.

But is it necessary to keep all types of valves in both filament-voltage ranges? It seems to me that the 2-volt range could be restricted to three or at most four types, namely, high-frequency amplifying valve, detector valve, low-frequency amplifying valve, and power valve. In the 6-volt series a much finer graduation of types would be useful, since anyone who is sufficiently technical to be able to choose his valves with discrimination from such a series would usually not be likely to have battery difficulties.

As an expression of purely personal opinion I do not feel that at present the filaments with the lowest energy consumption are the best for general use. But other valve users may have had a different experience, and thus may be of a different opinion.

Name and Purpose.

I would also like to put in a plea for a standard method of naming valves. The names should be as short as possible compatible with a clear distinction between the different types. The name of the valve should tell us something about it. It is true that the name B8 indicates a valve with a distinguished forefather, the original B valve itself, but is such a name justifiable? What can one gather from the following names (I am taking examples entirely at random): S.P.18/R.R., K.L.1, S.S.7A., F.E.R.3? There seems to be no reason at all why these valves cannot be re-named in accordance with a general scheme which is already partly in use. We require the name to tell us (*a*) the valve maker, (*b*) the nature of the function the valve is designed to perform, (*c*) the filament voltage, (*d*) the filament current. It seems quite unnecessary for the name to include some indication of the type of filament (*e.g.*, bright emitter or dull emitter). The ordinary valve user for broadcast purposes does not require such information, and the more technical user can in most cases derive such information himself from the filament current consumption. Thus I feel that the much-used letters D.E. might well be eliminated.

The scheme of valve nomenclature which is gradually winning its way, and which could be extended, is that originally suggested by the makers of Burndept valves. The type name includes both letters and numbers, the letters indicating the function of the valve, and the numbers the filament voltage and current. Thus a valve of type H.510 would be a high-frequency amplifying valve requiring 5 volts for the filament and a filament current of 0.10 ampere; a type H.L.220 would be a general-purpose ("high- or low-" frequency amplification) valve for a 2-volt filament requiring 0.20 ampere through it. To make such a scheme of universal application we need only prefix this by the name of the valve maker. Considerable latitude might be necessary with regard to the letters in this name, and it might even be necessary to use these letters on occasion instead of one or two. But it would only be necessary for the name by which the valve was known (*e.g.*, in advertisements) to be indicated. The use of letters for indicating the type of valve, whether it be power type three-electrode valve or shielded four-electrode valve, at the same time prevents the use of the initials of the maker's name or names as a distinguishing factor. Thus, the P.M.1A. valve would become the Philips-Mullard R.C.210, or the Philips-Mullard H.210, as the case may be. If a valve, as often happens, performs two functions well and the makers wish to stress this, I do not see why the index letters should not indicate this. In any case it is incumbent on the makers who produce the valve to devise also for us a name which indicates the functions which they wish to stress.

General Note.

Mr. R. L. Rowland, North View, Wivelsfield, Haywards Heath, has been allotted by the R.S.G.B. the research number BRS 131, and will be glad to report on tests of C.W. or telephony on wavelengths between 15 and 200 metres.

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The Portuguese cruiser *Adamastor* (XEP 1MA) is at present in Chinese waters. She works with Europe every day from 21.00 to 24.00 G.M.T. on 33.5 metres, and will welcome reports.

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A correspondent in Birmingham reports confirmation of his reception of NC 4HH, Mr. G. Brickett, 260, Athbasca Street East, Moose Jaw, Saskatchewan, on January 17th, at 1630 G.M.T. Mr. Brickett, who was working on 20.4 metres, stated that this was the first time his signals had been reported heard in England.

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Short-wave Stations.

A correspondent states that the British naval stations working on 35 metres do not use the call-signs appearing in the "Berne List," but such as AP4, CW4, DU4, etc.

TRANSMITTERS' NOTES

German Short-wave Station, A Correction.

We regret an error on page 166 of our issue of February 15th. We now understand that the short-wave transmissions heard regularly on 37.8 metres are not those of the high-power transmitter at Zeesen, but are sent out from a 5 kW. station at Döberitz. The short-wave transmitter at Zeesen is not yet completed, but it is expected that it will be in operation before next summer. The station, we understand, is primarily intended to benefit Germans living in the Colonies or outside the range of the other Government stations. The programmes will be organised by a special branch of the Committee at Königswusterhausen, and will probably include a considerable proportion of propaganda.

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New Call-signs and Stations Identified.

2DP D. E. Pettigrew, 20, Hollin Park Mount, Oakwood Lane, Roundhay, Leeds.

2MV Malvern College Radio Society, Malvern Worcester, transmitting on 150 to 200 metres and will welcome reports.

5PS (Portable) C. S. Bradley, 10, Montenotte Rd. N.8, works in conjunction with G 6CL and will welcome reports.

6GC J. G. Carlson, 116, Ashgrove Avenue, Cleadon Estate, South Shields. (Change of address.)

6LN E. P. Allen, Meadowcroft, Radcliffe-on-Trent, Notts, transmitting on 45 metres and will welcome reports.

6PA (Ex 2AFG), H. C. Page, 40, Ferme Park Road, Stroud Green, N.4.

6SO (Ex 2BOC), J. Soten, 55, Grendon Road Polesworth, near Tamworth, Staffs.

6VJ (ex BQQ), A. Cross, 333, Anlaby Rd., Hull. This call-sign was formerly owned by Mr. W. J. Featherstone, Hull.

2AMA E. Benham, 65, New Church Rd., London, S.E.5.

2ATA H. Bacon, 69, The Headlands, Keswick, Cumberland.

2BCQ L. Davis, Junr., 144, Alexander Rd., Acocks Green, Birmingham, is willing to stand by and report by post on either telephony or C.W. at the following times, 1000–1200, 1300–1600, and 1700–1900 G.M.T.

ETP LK c/o The Manager, Bureau of Poland, Bielowskigo 6, Ziembicki, Lwow, Poland.

XEL AQS Geophysical Institute, Jan Mayen Island, Norway, listens for amateurs between 1600 and 1700 G.M.T.

XEM SDYA Swedish s/s "Burgundia" (Operator, Mr. Hjertsquist).

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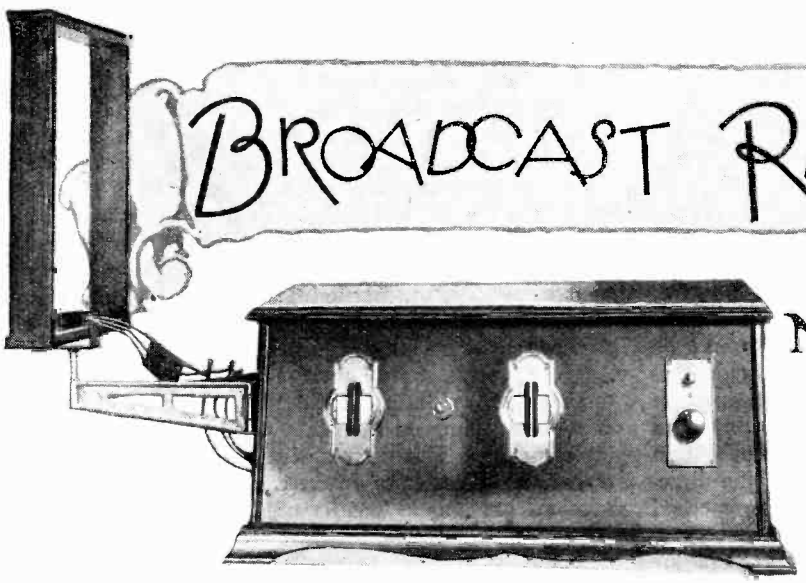
QRA's Wanted.

FX, IDM, IR1, JAN, KZED, KZET, OCNY, OC3, OXZ, POP, PTA, PTB, PTK, PTS, RLJ, SQAZ, SQBM, SQBW, SQBX, 5BC.

BROADCAST RECEIVERS



MARCONIPHONE TYPE 61

Range and Selectivity with Ease of Control and Without Detriment to Quality.

OF the innumerable developments in the technique of receiver design which have taken place since the commencement of broadcasting, none has created more interest than the screened grid four-electrode valve. Since its revival last year on a commercial basis it has formed the subject of a number of heated controversies which still continue unabated. Is it better than a three-electrode valve in a neutralised H.F. circuit? If the amplification per stage is not greater than that already obtainable with three-electrode valves, in what respect does it constitute an advance on previous methods?

An examination of the Marconiphone Model 61 receiver greatly assists in settling these controversial points. It is apparent that the amplification per stage in this set is probably not more than that obtainable with a three-electrode valve in a neutralised circuit designed for high amplification, and in any case less than would be obtained with certain valves with indirectly heated cathodes; evidently the screened grid valve has not been adopted solely on account of its possibilities for high amplification. If it were merely a case of beating the three-electrode valve in the matter of amplification, no doubt the makers could have produced a better valve for the purpose than the S.625.

Advantage of the Screened Grid Valve.

The real advance which the screened grid valve has made possible is that results *equivalent* to the neutralised three-electrode valve can be produced with much greater economy of means and effort. To cover the broadcast band from 200 to 2,000 metres with three-electrode H.F. valves a set of interchangeable transformers of more or less delicate construction is required; switching is almost out of the question, and the process of re-neutralising has to be gone through every time the wave-band is changed. Compare this with the screened grid valve receiver; instead of specially constructed H.F transformers simple tuned-anode circuits suffice and the coils can be wired permanently into the receiver with a switch to change over from long to short waves. Further, several stages can be used with perfect stability, and the individual selectivity of each stage may be considerably reduced—result, increased overall selectivity without detriment to quality, and much easier tuning.

The Marconiphone Model 61 receiver employs six valves in all; three H.F. stages with S.625 screened-grid valves, a detector, an L.F. amplifier, and a power output valve. No outside aerial is required, as a rotatable frame aerial mounted on a bracket at the left-hand side of the cabinet is used to collect energy from the ether.

Four Tuned Circuits.

There are four independent tuning controls (frame and three H.F. stages), and some difficulty was anticipated in operating simultaneously so many dials. The writer has hitherto held the view that two tuning controls is the maximum number permissible, but as a result of his experience with this set he has had to revise his ideas on this subject. The use of thumb-control condensers arranged in pairs is undoubtedly the secret of the easy tuning of this receiver; during the preliminary stages of tuning in a station dual control is used, the pairs of drums being rotated simultaneously. The final and independent adjustment of each dial is then only a matter of seconds. Each dial is calibrated approximately in wavelengths.

Between the pairs of dials is a push-rod which changes the wavelength range of all three H.F. stages simultaneously. Two separate frame aerials are provided for long and short waves. These are easily interchanged, a plug and socket connector being provided for the three leads (the frame has a centre-tapped winding).

On the right-hand side of the front panel are mounted the filament switch and volume control. The latter is a rheostat controlling the temperature of the three H.F. valve filaments.

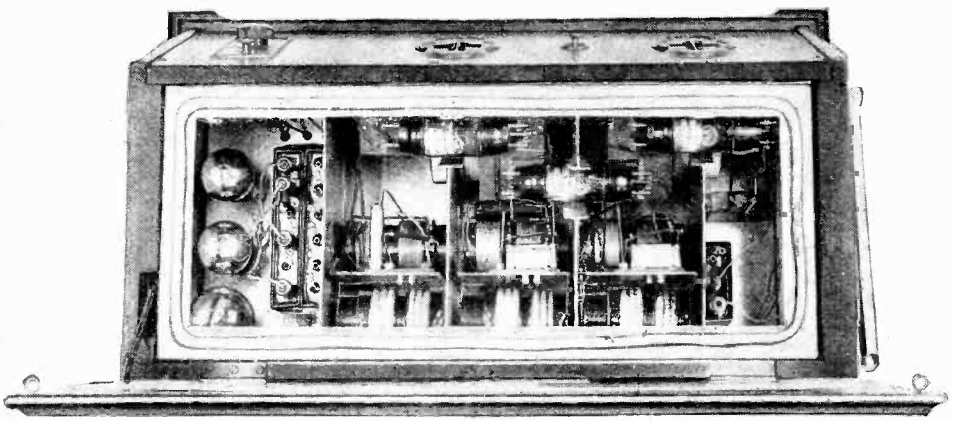
The instruction book issued with the receiver gives some useful hints on tuning. It recommends that five or six powerful stations distributed over the wavelength scale should be carefully tuned-in and their positions marked in pencil on the dial. This gives a series of

Broadcast Receivers.—

basic points at which the dials may be set before searching with dual control for weaker stations.

The tuning of the local station requires some care if distortion is to be avoided. According to the instruction book, the first dial (on the left), which controls the frame aerial, and, whenever possible, the third and fourth dials, should always be tuned exactly to resonance with the incoming signal. Detuning is then limited to the second dial, and the reduction of signal strength should be shared by this dial and the filament volume control. If, after making these adjustments, overloading is still experienced, detuning of the third and fourth circuits may be resorted to, one dial being moved upwards a few degrees and the other an equal number of degrees in the opposite direction. In practice this scheme works admirably, and at 1¾ miles from 2LO, where it is difficult to obtain sufficient reduction of volume by making use of the directional properties of the frame aerial, the detuning method was adopted with complete success.

The mention of overpowering volume from 2LO naturally raises the question of selectivity. In this respect



Interior of the Marconiphone Model 61. Note the braided metal beading for making contact with the metal lining of the lid.

the Model 61 satisfies all normal requirements. It is not perhaps so sharp as some superheterodyne receivers, but the designer has chosen to limit himself to moderate selectivity in order not to impair quality of reproduction or ease of tuning. Even so, at the above-mentioned distance, 2LO does not cause trouble for more than 50 kilocycles on either side of its allotted frequency (830 kC.); Stuttgart (788 kC.) and Petit Parisien (880 kC.) come in clearly without any background from 2LO, and it is obvious that at other more distant places in the London area stations even closer in wavelength will be successfully received. Over the remainder of the dial 10 kC. separation of stations is easy; thus Witzleben (620 kC.) can be tuned-in clear of Daventry 5GB (610 kC.) by making use of the directional properties of the frame aerial. As a matter of interest an attempt was made to pick up 2LO with the frame aerial and leads disconnected. With the set adjusted to its most sensitive condition the London transmission would only just be heard, a fact which pays high tribute to the effectiveness of the screening.

With three stages of H.F. one expects a high degree of sensitivity; on the lower wave-band a station can be heard on nearly every degree of the dial, and on the long waves Königswusterhausen and the Russian stations emulate 5XX in volume. Some of the Continental relay stations on the short waves are all but obliterated by mush, and not more than a dozen stations are worth listening to from an entertainment point of view; but a dozen alternative programmes are sufficient for most people, and the receiver can hardly be blamed for the chaotic state of the ether. There is a slight background hiss due to the high magnification of the H.F. valves when the set is in its most sensitive condition, but on all the worth-while stations this, and a good deal of extraneous background, can be suppressed by means of the filament dimming control.

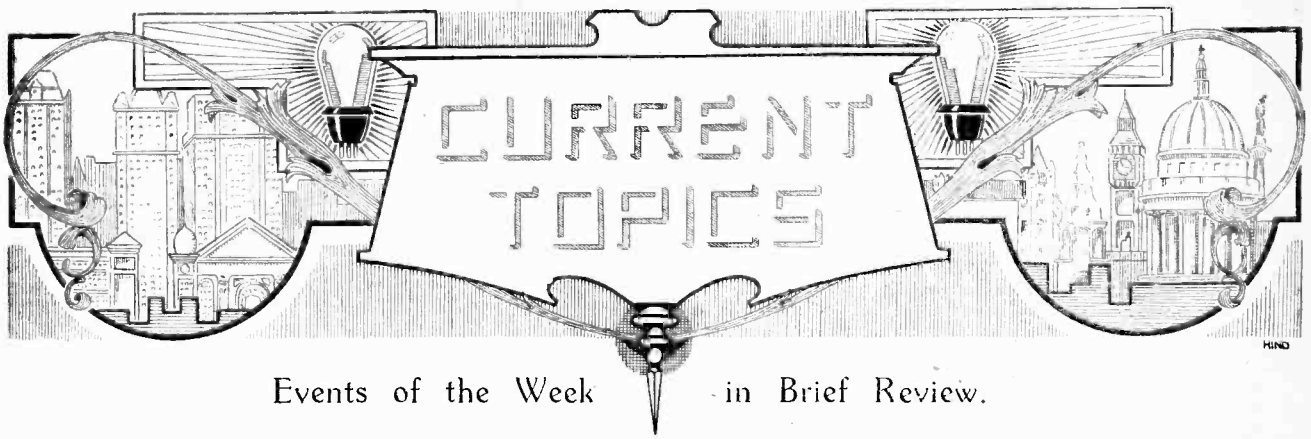
The filament control must also be used to correct any tendency to oscillation in the H.F. circuits. This occurs at certain points on the dials when all four circuits are in resonance. This regenerative effect is most useful when trying, as a matter of interest, to pick up a faint transmission, but should not be used for any other purpose, otherwise bad quality will result.

There are one or two points of technical interest in the design. The tuned anode coils are wound astatically on cylindrical formers, a subsidiary metal partition being placed between the long- and short-wave coils in each compartment. The external magnetic fields of the coils are therefore limited, and the very efficient screening is easily able to cope with the residual field. In the short-wave coils there are two single-layer sections wound side by side with a short gap and joined in opposition; a similar arrangement is adopted in the long-wave coils, but in this case the turns are pile-wound.

Resistance coupling is used for both stages of the L.F. amplifier following the anode bend detector. Inside the L.F. amplifier compartment is a small iron-cored choke, and this we are informed is for the purpose of tone correction—tone-raising to be precise. The balance of tone is excellent, and the reproduction is equal to that of any local station receiver specially designed for quality.

The filament current consumption with a D.E.5A. in the last stage is 1.2 amp., and the anode current with 150 volts on the last valve is about 25 milliamps. This is a heavy load for dry cell H.T. batteries, and only the "super-capacity" type are practicable; the instruction book recommends H.T. accumulators and, incidentally, deprecates the use of battery eliminators for this particular set.

The price is £48 15s., to which must be added £3 15s. for royalties, and accessories would amount to about £15. The performance obtainable is, however, certainly worth the money, and we congratulate the designer on the skilful manner in which he has succeeded in combining so high a degree of sensitivity and selectivity with high-quality reproduction and ease of control.



Events of the Week in Brief Review.

A WORD TO RETAILERS.

"Vendors of wireless sets should regard it as their duty to their customers to inform them that licences should be taken out. They would be more careful if they were liable to a penalty."—Sir Harry Hatt, Chairman of the City of Bath Bench.

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AN ENCOURAGING RESPONSE.

Owing to complaints regarding the programmes from the Dublin and Cork broadcasting stations, the Broadcasting Advisory Committtee of the Free State recently invited suggestions from the listening public. Of the 27,000 licence-holders in the Free State only thirty-eight responded!

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EXIT A SPARK STATION.

No wireless listener will mourn the closing down, on Saturday, February 18th, of BVN, the well-known spark station at Flamborough Head. The station duties are being taken over by the new Post Office continuous wave station at Mablethorpe. BVN was first established in 1916 as an Admiralty D.F. station to give warning of the approach of enemy Zeppelins.

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QUARTZ RESONATORS.

Some Practical Applications of Quartz Resonators" is the title of a paper to be read by Mr. G. W. N. Cobbold, M.A., and Mr. A. E. Underdown at a meeting this evening (Wednesday) of the Wireless Section of the Institution of Electrical Engineers. The meeting will be held at 6 p.m. at the headquarters of the Institution, Savoy Place, W.C.2.

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DUTCH BROADCASTING BILL.

Broadcasting in Holland will shortly come under stricter Government supervision than hitherto. Last week the Second Chamber passed a Broadcasting Bill and the new law will be put into effect by Order in Council. As far as is possible the hours of transmission are to be equally divided among the various broadcasting interests, which include several religious bodies of different denominations.

A proposal for taxing all persons in possession of wireless apparatus has been vetoed.

LOOKING AHEAD

A "Television Experimental Society" is being formed in Brighton.

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ANY OFFERS?

From the "Small Ads." in the *New York Times*:—

Commercial Broadcasting Station, established in New England, for sale, fully equipped; may consider partner.—X2305, *Times* Annex.

Local Broadcasting Station For Lease; good proposition.—X2277, *Times* Annex.

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PIRATES WITH PORTABLES.

A Post Office overseer conducting the prosecution in a wireless licence case at Yarmouth last week said it was difficult nowadays to tell whether a man was carrying his lunch or a wireless set. Unless the Wireless Telegraphy Act was obeyed thousands of inspectors would have to be employed.

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A LETTER FROM BANGKOK.

A wireless enthusiast in Bangkok, Siam, has written to Mr. Gerald Marcuse, of Station 2NM, Caterham, reporting reception of telephony on Sunday, January 22nd, at 6 p.m., G.M.T. The writer says: "It seems rather difficult for communication between your country and mine. During the period of my experimental career for one year I have got DX (from) nearly all parts of the world with two-way communication, but never get England."

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THE MOVING COIL LOUD-SPEAKER—A NEW PUBLICATION.

How to build and operate a moving coil loud-speaker is fully described in a new booklet now available from the publishers of *The Wireless World*. In addition to many full-page drawings giving precise details of construction, circuit diagrams to suit various conditions are given. The booklet has been prepared by F. H. Haynes and is an expansion of his articles which have appeared in recent issues describing *The Wireless World* moving coil loud-speaker. Price 1s. 6d. (post free 1s. 8d.), Iliffe and Sons, Ltd., Dorset House, Tudor Street, London, E.C.4.

INTERNATIONAL WIRELESS SHOW IN BELGIUM.

The International Wireless Exhibition will open at Liége on Saturday next, March 10th, continuing until March 25th.

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HYDE PARK ORATORY BY LOUD-SPEAKER.

The Prime Minister's speech to the Young Conservatives in the Albert Hall on Saturday next will also be heard through a public address system by the crowds in Hyde Park at a spot half a mile from the hall.

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FOREIGN BUYERS OF BRITISH WIRELESS GEAR.

Wireless exhibitors at the British Industries Fair have received orders for portable sets, components, and loud-speakers from clients in Egypt, Holland, Sweden, Denmark, and the United States.

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THE MARCONI SERVICES.

An idea of the vast amount of territory now covered by the "Via Marconi" Telegraph Services is afforded by an interesting new booklet issued by the Marconi Company, which describes the main telegraph office at Radio House, London, and the wireless stations at Ongar, Brentwood, Carnarvon, Dorchester, and Somerton. There are numerous illustrations and an excellent map showing how the tentacles of wireless now spread in all directions.

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CHEAPER 'PHONING TO AMERICA.

An important reduction in the minimum charge for a telephone call to the United States or Canada took place on Sunday last, when the minimum charge of £15 for three minutes' conversation was reduced to £9. The "Report Charge" (which is made in place of the normal charge when a "particular person" call cannot be effected) became £1 instead of £2.

From the same date the hours of service were extended from 12.30 p.m. to 1 a.m. (G.M.T.), instead of from 12.30 p.m. to 11 p.m., as previously.

The extension of the service to a number of additional towns in Canada will shortly take place.

AUSTRALIA-CANADA BEAM SERVICE.

A regular beam service is shortly to start between Australia and Canada. During recent tests communication has been secured for periods of between eighteen and twenty-two hours daily.

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PRIVACY IN WIRELESS TELEPHONY.

A device to secure privacy in wireless telephone conversations was demonstrated in Washington on February 24th by the Bell Telephone Company. According to a *Times* correspondent, Mr. Grace, the demonstrator, took a phonograph record of natural speech which had been so distorted by transforming high-frequency tones into low frequencies that the sounds from it were gibberish. A form of microphone was then used which transferred the sounds to a filter apparatus which gave understandable speech through loud-speakers.

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F.B.I. AND GOVERNMENT WIRELESS SERVICES.

The Federation of British Industries, in a letter to the Chancellor of the Exchequer and the Postmaster-General, urges that all wireless and cable services now operated by the Government should be transferred to commercial hands.

The letter adds that the federation views "with considerable concern the repeated deficits on the services operated by the G.P.O." It is felt that commercial operation is more likely to lead to beneficial results, both to the general taxpayer by relieving him of the present deficit, and to the wireless and cable user by improving the services.

ELECTRODELESS DISCHARGE THROUGH GASES.

The Council of the Physical Society announces that the thirteenth Guthrie Lecture is to be given by Sir Joseph Thomson, O.M., F.R.S., on "Electrodeless Discharge through Gases." The lecture will be held on Friday, March 9th, 1928, at the Imperial College of Science and Technology, South Kensington, commencing at 5 o'clock. No tickets are required.

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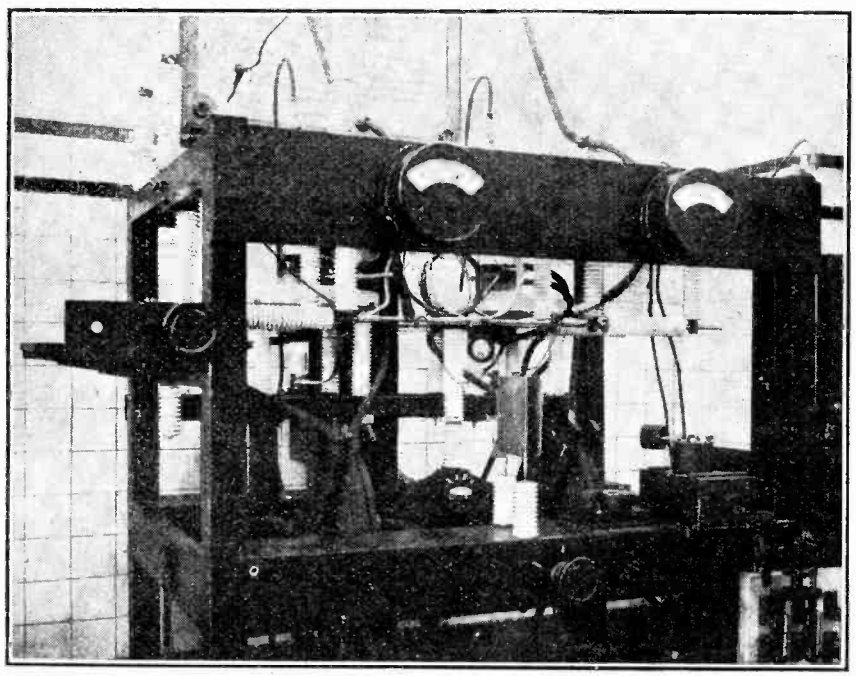
LOAN PROSPECTUS BY WIRELESS.

A new record in wireless picture transmission has been created by the Radio Corporation of America in collaboration with the Hallgarten Company. The "picture" consisted of a half-page newspaper announcement of a Buenos Aires 41,000,000 dollars loan for publication in European newsapers. It was sent from the Central Traffic offices of the Radio Corporation direct to London, whence photographic copies were taken by waiting aeroplanes to Paris. A few hours later the advertisement was published in the French papers simultaneously with its appearance in New York.



COMMEMORATING A WIRELESS ENGINEER. The transmitter of the well-known station ANH at Bandoeng, Java, which was designed and erected by the late Dr. C. J. de Groot. On the wall behind the transmitter is a memorial tablet to the designer who, it will be remembered, died while on his way to attend the International Radio Conference at Washington.

WIRELESS AT WESTMINSTER.

FROM OUR PARLIAMENTARY CORRESPONDENT.

Television.

In the House of Commons last week Mr. Malone asked the Postmaster-General whether he was taking any steps to keep in touch with recent developments in television, and whether he had considered the application of existing radio legislation to this invention.

Sir William Mitchell-Thomson said that the answer to both parts of the question was in the affirmative. His technical adviser considered that television was still only in the experimental stage.

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Nationality of Wireless Operators.

Mr. Briant asked the Postmaster-General under what regulation, if any, a natural-born British subject was not eligible for the Post Office certificate of proficiency in radio telegraphy; and why the fact of being a son of an allied alien debarred him from the occupation of wireless operator on British ships.

Sir William Mitchell-Thomson replied that the International Radiotelegraph Regulations prescribed that a person employed as a wireless operator on a ship must hold a certificate issued by the Government to which the ship was subject. It had been the general rule in this country since 1919 that such a certificate should be issued only to a natural-born British subject whose father was also a natural-born British subject. This rule was made after consultation with all the Government Departments concerned, and was considered necessary in view of the special character and the duties of an operator in charge of a ship's wireless installation.

TRADE NOTES.

The Latest from America.

The World at Your Command is the title of the latest radio catalogue issued by the Rothermel Corporation, Ltd., 24-26, Maddox Street, Regent Street, London, W.1. This 62-page booklet embraces many of the leading American lines in components. The catalogue will be sent to any applicant on receipt of 9d. to cover postage and packing.

You're There with a Bandbox is the expressive title of another booklet, issued by the same firm, describing the Bandbox 6-valve Receiver, which is "as small as a row of a dozen books and as unobtrusive as a well-trained servant."

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A New Valve Test.

An express train recently assisted in demonstrating the strength of the filaments of Ediswan P.V.2 valves. A case of 50 valves fell off the platform of Ponders End station, and the express, coming along at the critical moment, wrecked the box and scattered the valves over the permanent way. When collected 41 valves were found to be in perfect condition, four were completely smashed, two had broken filaments, 2 had filaments intact, but distorted, and one was missing.

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The Brown Budget.

The February issue of the house organ of S. G. Brown, Ltd., North Acton, contains a vivid little essay "The Voice of England," in which the writer touches upon the romance of broadcasting over Europe from Daventry.

NEW APPARATUS

A Review of the Latest Products of the Manufacturers.

"BERCLIF" COILS FOR THE "STANDARD FOUR."

Messrs. Simmonds Bros., of Shireland Road, Smethwick, Staffs, who have acquired a reputation for the production of "Everyman Four" coils have now entered the market with a set of coils for the "Standard Four"[1] which are characterised by the same clean workmanship and finish.

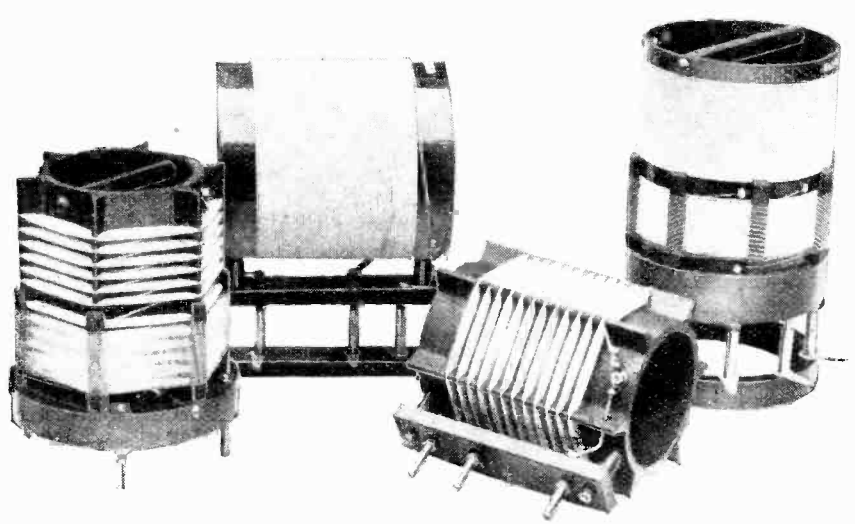
To facilitate commercial production the makers have deviated slightly from the original specification, but in such a way that any alteration of the electrical constants of the coils is negligible. Instead of terminating the primary and neutralising windings on the spacing strips a short gap is left in the secondary winding of the short-wave H.F. transformer in order that terminal pegs may be fixed in the Paxolin former. This avoids the projecting screws on the spacing strips and facilitates neat wiring of the unit.

The long-wave transformer has a secondary consisting of 252 turns in 12 slots and turned and grooved ebonite spacers are used to support the primary and neutralising windings, thus ensuring perfect uniformity.

Bases for aerial and H.F. transformers are also supplied, and are constructed of best quality ebonite. The sockets for the short-wave H.F. transformer are mounted on a base ring which gives the maximum insulation for the minimum volume of dielectric.

The price of the complete set of four coils and two bases is £3 17s. 9d.

[1] See *The Wireless World*, November 30th, 1927.



Complete set of "Berclif" coils and bases for the "Standard Four" receiver.

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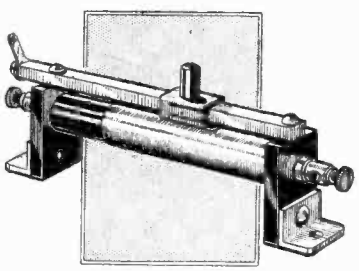
THE "LORIOMETER."

Constructed in the same form as the "Loriostat" baseboard rheostat, this potentiometer has a resistance of just over 1,000 ohms and is just the thing for fixing the grid bias of an anode bend detector. It can be screwed to the baseboard inside the set, and, once adjusted, requires no further attention.



The "Loriometer," a 1,000-ohm potentiometer for baseboard mounting.

The resistance is wound as a single layer of enamelled wire on an ebonite tube $\frac{3}{8}$in. in diameter, and space is allowed at one end for the slider in order to obtain an "off" position. The slider works on a square rod and is smooth in action, giving a sure and continuous contact.

The price of this component is 2s. 6d., and it may be obtained from Messrs. A. W. Stapleton, 19a, Lorrimore Buildings, Lorrimore Street, London, S.E.17.

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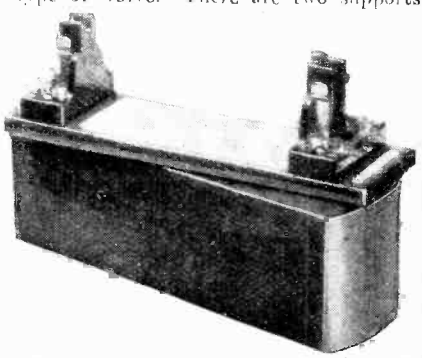
BURNDEPT SCREENED GRID VALVE HOLDER.

This component is well up to Burndept standard in quality and finish, and has been produced to meet the demand for an adjustable holder for the screened-grid type of valve. There are two supports,



Burndept adjustable holder for screened grid valves.

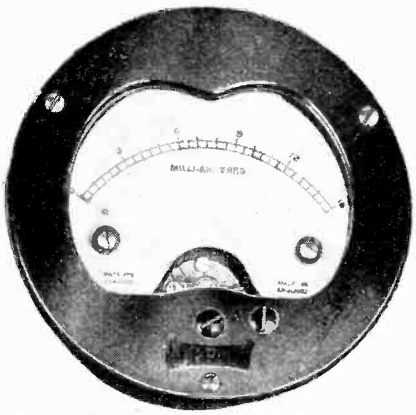
one for each end of the valve, and the contacts are so arranged that it is impossible to reverse the valve connections.

It is intended that each section should be mounted on a wooden pillar of section 2in. × 1in., one on each side of the metal partition in the set. The parts are supplied mounted on a baseboard which may be used as a template in fixing the positions of the holes for the holding-down screws. These screws pass through slots in the mouldings, which allow a movement of $\frac{3}{8}$in. to compensate for difference in the lengths of valves.

The price of this component, which, incidentally, is used in the Burndept "Screened Four," is 4s.

FERRANTI METERS.

The introduction of these meters at the Show proved that the production of small precision instruments was not necessarily the monopoly of foreign firms and that British workmanship and materials were quite equal to the task of supplying the demand for this class of instrument.



Ferranti flush-type milliammeter for panel mounting.

Since the Show we have had plenty of opportunity of observing the performance of Ferranti meters, and quite recently tests have been made on one of the milliammeters (0-15 range) with a view to ascertaining the degree of accuracy. For over half the scale the readings coincided with those of a sub-standard milliammeter (accuracy ½ per cent.), and at no point was the reading more than 1½ per cent. different from the sub-standard.

The replaceable safety fuse incorporated in the case is a most useful refinement for which we have been waiting for some time. Accidents will happen, and it is a relief to know that, instead of having to send the instrument back to the makers with the consequent delay and comparatively heavy repair charges, a new fuse can be fitted and work continued in ten minutes. The point is, can a fuse be produced that is sufficiently certain in action to be a real protection to an instrument taking so small a current? To satisfy ourselves on this point an overload current of about 100 per cent. was applied and the needle carefully watched; the fuse had gone before the pointer had traversed more than one-third of the scale, so that the pivots were not called upon to withstand the shock of a full scale deflection.

The aluminium girder type pointer and frosted silver scale give the instrument a distinctive appearance, and the moulded ebonite case considerably reduces the weight.

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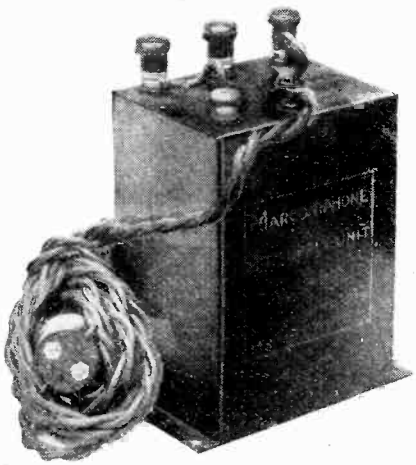
MARCONIPHONE D.C.3 ELIMINATOR

This eliminator is designed for use with receivers employing not more than two valves, and is available in two types, B.935, for 120 to 125-volt, and B.936 for 200 to 250-volt mains.



Marconiphone D.C.3 eliminator for two-valve sets.

We have had an opportunity of testing the model for 200-250-volt mains, and find it perfectly silent in operation, and in every way satisfactory for the purpose for which it is designed. There are two H.T. tappings, one giving about 2 milliamps. at 60 volts for a detector valve, and the other 10 milliamps. at 120 volts for a medium power output valve, so that the unit is well suited to the demands of the average two-valve loud-speaker set. The variation of output terminal voltage with load is shown graphically.

A detailed and lucid instruction card sent out with each unit deals with every possible circumstance which is likely to arise when installing the unit.

The price of this model is 35s.

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LANGHAM RADIO SPEAKER.

The cone diaphragm of this loud-speaker is housed in an extremely artistic and well-finished cabinet, from which the sound escapes through a fret covered with gauze. The figure of Pan adorns the front and enhances the atmosphere of enchantment while listening to music—one can always look the other way while football results are being read!

The quality of reproduction is in keeping with the artistic external appearance and speech and music are equally good. Results are just as pleasing when listened to from a distance, a test which often reveals resonances which are not heard when listening in the same room.

The movement is adjustable from the front with a screwdriver, but frequent adjustments should not be required.

An artistic cabinet loud-speaker, the Langham "Spirit of Pan."

The price of the instrument is £5 5s. in oak or £5 10s. in mahogany or walnut, and the makers, Messrs. Langham Radio, 59, New Oxford Street, London, W.C.1, give a two years' guarantee and also arrange sales on deferred terms.

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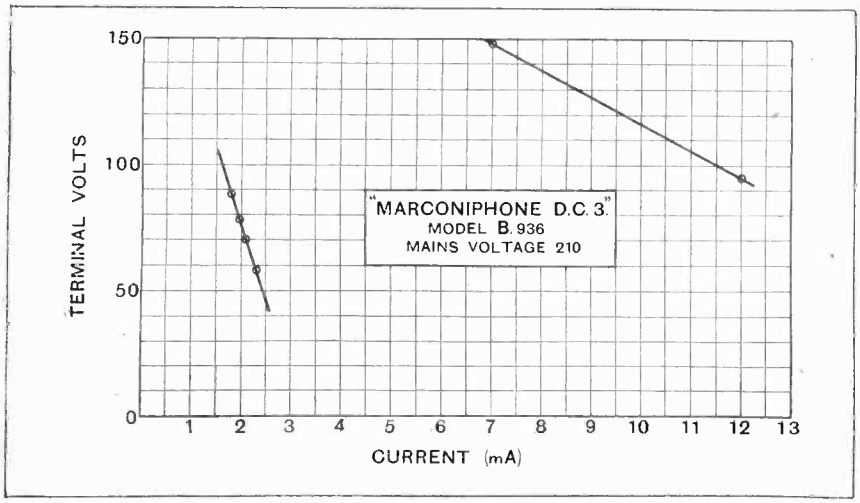
LOUD-SPEAKER DESIGN FOR FRETWORKERS.

The design of a cone loud-speaker cabinet offers many opportunities to the fretwork enthusiast. In a recent issue (January 28th) of *Hobbies*, the weekly journal for fretworkers, an interesting design is published, together with details for fitting a cone speaker with a Lissenola unit. The design of the cabinet is acoustically sound, and can be recommended to anyone who wishes to make his cone loud-speaker a handsome article of furniture.



Voltage output from the Marconiphone D.C.3 under various load conditions.

HIGH-NOTE LOSS IN RESISTANCE AMPLIFIERS.

Part II.—The Measurement of Working Impedances and Capacities.

By A. L. M. SOWERBY, M.Sc.

(*Continued from page 216 of previous issue.*)

AT the conclusion of Part I of the present article, we were in possession of a formula and a curve from which the percentage loss of amplification of a high note, of frequency 5,000 cycles, can be calculated for any interstage coupling of which various constants are known.

The data required for the calculation of the loss due to the coupling between the valves shown in Fig. 5 are the value of the anode resistance R, and the impedance R_a of the valve V_1, both expressed in megohms, and the total value in micromicrofarads of the various stray capacities, which are lumped together and represented by the condenser C.

Of these the first requires no comment, for the value of an anode resistance as given by the makers can be relied upon within the limits of accuracy that our somewhat approximate calculations require, and this value does not vary with the manner in which the resistance is used. The remaining two figures are very much less easy to find, for they depend on a large number of different factors. It will therefore be necessary to make some demands upon the reader's attention while the causes and magnitudes of these variations are discussed. We will tackle first the varying impedance of the valve, and try to reduce its vagaries, as far as may be, to definite figures.

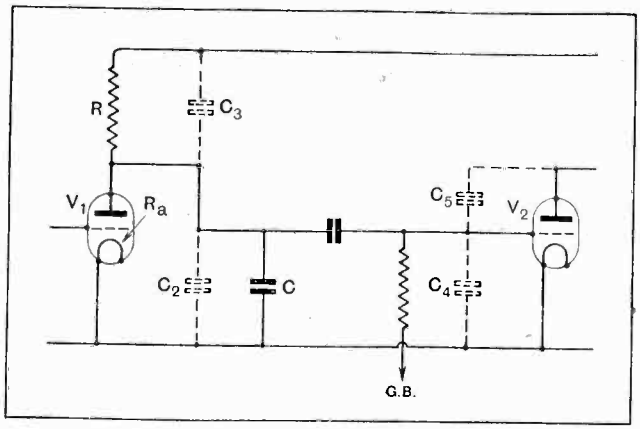


Fig. 5.—A resistance-coupled stage in which not only the incidental capacities but also the magnitude of R_a and R have a profound effect on the suppression of high notes.

The Working Impedance of a Valve.

It is a well-known fact that the impedance of a valve varies very considerably with the anode voltage applied to it, growing less, up to a point at least, as this voltage is increased. This effect exists with valves of all types, but is most strongly marked when we are dealing with valves of high impedance, such as are generally employed for resistance coupling. If we take a valve of this type and measure its impedance in the normal way with no resistance in its plate circuit, and while using a high-tension voltage not far short of the maximum for which the valve is rated, we shall obtain a value which is, within the limits of the variations of individual valves, the same as that given by the makers in their catalogue. If we now reduce the high-tension voltage to a third or a quarter of this maximum value, and repeat the measurement of impedance, we shall obtain another, and a much higher, figure.

In practical use in an amplifier the valve (V_1 in Fig. 5) will be working with a resistance connected in its plate circuit, so that the high-tension voltage applied to the valve itself will be considerably lower than that of the H.T. battery, owing to the voltage drop in the resistance R. The *working* value of the valve-impedance will therefore be that which corresponds to the voltage that is actually applied between plate and filament of the valve, which will depend not only on the voltage of the H.T. battery, but also upon the value of the resistance R. It is this elusive working value of R_a that we must find and employ in our calculations of high-note loss.

The manner in which the impedance of a valve varies with the value of the anode voltage applied can be most readily and quickly seen by examination of a characteristic curve of a typical high-impedance valve. For this particular purpose the characteristic usually shown, in which plate current is plotted against grid voltage, is not the most convenient, since it does not show the impedance of the valve directly. In place of it there is drawn, in Fig. 6, the curve giving the anode current for various values of anode voltage, the grid of the valve being maintained throughout at the same potential. The curve shown was taken experimentally from a B.T.H. B8 valve, which is a typical member of the high-impedance class.

The impedance of a valve, or, as it is more correctly termed, the "anode A.C. resistance," may be measured, like any other resistance, by an application of Ohm's Law, which is just as true for alternating current as for direct, provided that there is no inductance or capacity in the circuit. If we wish to find the impedance of the valve whose characteristic is shown in Fig. 6, we must first decide the plate voltage at which the impedance to alternating current is required. If this is 100 volts, the steady plate current given by the curve is 171 microamperes, as shown at O. Assuming, for the sake of a concrete case, that the alternating voltage applied to the valve has a peak value of 5 volts, then, when superposed upon the steady 100 volts of the H.T. battery, it will cause the resultant anode voltage to oscillate between 95 and 105 volts, the amount of variation in the upward direction —5 volts—being expressed graphically by the line OA. The plate current of the valve will vary in sympathy with this change of plate voltage, the limit of variation in the

High-note Loss in Resistance Amplifiers.—

upward direction being shown by the point B, corresponding to a plate current of 199 microamperes. Thus an alternating voltage of peak value 5 volts (OA) will drive an alternating current of peak value 28 microamperes (AB) through the valve; its resistance to alternating currents, or impedance, is therefore $\frac{OA}{AB} = \frac{5}{28}$ megohms, or 178,000 ohms.

It will be seen at once that the impedance, being equal to the fraction $\frac{OA}{AB}$, is determined entirely by the *slope* of the characteristic curve, and that a steep curve, since it makes OA small and AB large, is associated with a lower impedance. Conversely, a less steep curve implies a higher impedance, so that at low plate voltages the impedance of the valve whose characteristic is shown rises very rapidly, as is indicated by comparative flatness of the lower portion of the curve.

To obtain an accurate value of the working impedance of the valve in any practical case it is necessary to determine the plate voltage that is actually applied to the valve after allowing for the voltage drop in the resistance, and then to find, from a curve similar to that of Fig. 6, the impedance that corresponds to this plate voltage. Apart from the fact that such a process would be very

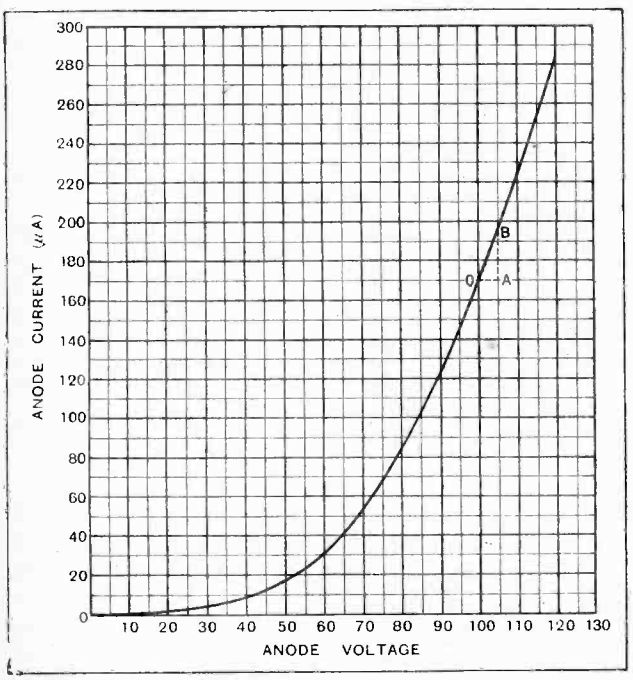


Fig. 6.—Anode current plotted against anode voltage for a B.T.H. B8 valve. $\frac{OA}{AB}$ gives the A.C. resistance of the valve for the *actual* H.T. volts applied between plate and filament.

tedious, it calls for the use of a sensitive microammeter, which is an instrument few amateurs possess. The writer has therefore made a number of measurements from which an approximate estimate of the working impedance can be obtained rapidly for any case that is likely to arise.

Measurements were made of the working impedances of five typical valves with amplification factors ranging from 16 to 44, using a number of different anode resistances in turn, and keeping throughout to a battery voltage of 120 volts. Owing to various practical difficulties that need not be detailed here, the figures obtained are not as reliable as one would like, but the results, such as they are, are presented as smoothed curves in Fig. 7. The horizontal scale in that figure represents the rated impedance of the valve, measured without anode resistance at a plate voltage of 120, and is the value given on the box

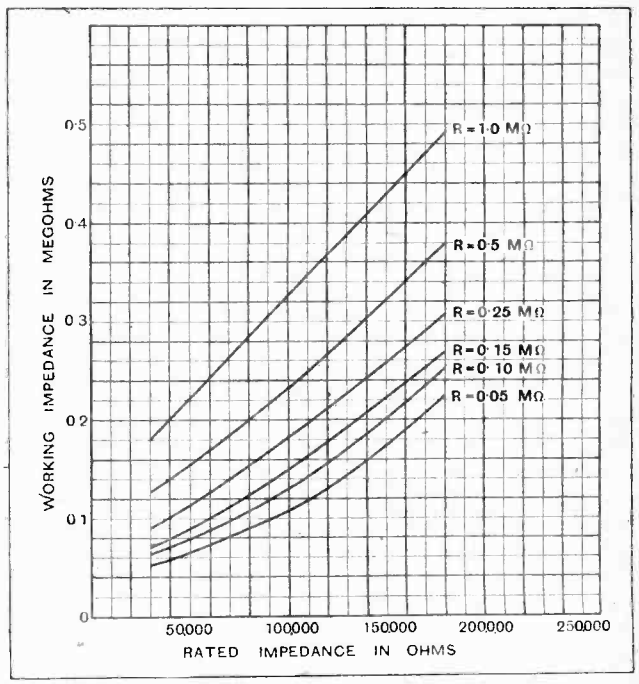


Fig. 7.—Curves showing relation between nominal valve impedance as given by makers and actual working impedance using various values of anode resistances.

or in the maker's catalogue. The vertical scale shows the working impedance when the valve is given the correct grid-bias for amplification and is supplied from a 120-volt anode battery. Each curve refers to one value of plate resistance, which is marked against it in megohms.

To take a concrete example, let us suppose that we are using a valve of nominal impedance 100,000 ohms with a resistance of 250,000 ohms in its plate circuit. Following up the curve marked "R = .25 MΩ" (for 250,000 ohms is .25 megohm) we find that the working impedance corresponding to a rated impedance of 100,000 ohms is .18 megohm. This figure, then, must be used for R_a in the formula at which we arrived in the first part of this article, and from which the high-note loss is found.

It must be emphasised that a figure obtained from the curves of Fig. 7 is at best a poor substitute for one derived from a detailed examination, made under actual working conditions, of the valve to be used. On the other hand, it is obviously impossible for the writer to give full detailed curves for all possible working conditions of even the few valves he has examined, and it is hoped that the data provided, which give at least a rough

High-note Loss in Resistance Amplifiers.—

approximation to the truth, will be acceptable to those interested in this subject.

The Working Value of the Stray Capacity.

Having obtained curves from which the working impedance of the valve in whose plate circuit the resistance is connected can be deduced, at all events approximately, let us turn our attention to the remaining working value that we have to estimate for our calculations. This is the value of the stray capacity C.

It will be remembered from Part I that C is a convenient fictional condenser introduced for the purposes of calculation, and that it is really made up of several separate capacities. We must now go a little more deeply into these, and try to estimate numerically the amount that each of them contributes towards the total.

The individual capacities from which C was built up in Part I. and into which we must again resolve it for a few moments, are shown dotted in Fig. 5.

First and foremost, C includes the sum of C_2 and C_3, which are respectively the plate-filament capacity of V_1 and the stray capacity of the anode resistance, and of the holder and wiring associated with it. Provided that there is no switching connected to the plate of the valve, the total of these two capacities will probably amount to about 12 micromicrofarads. It is pleasant to note that the writer's measurements indicate that this value, which includes valve-holder and carefully-planned wiring, does not vary to any serious extent when the valve or the resistance is changed, so that we may employ the figure mentioned for any case that may arise without introducing appreciable error.

The capacity C_4, which is that between the grid and filament of the second valve V_2, including valve-holder and grid leak, gives another comparatively constant figure, which may also be taken as about 12 micromicrofarads. This capacity is that measured when the valve V_2 is not lighted.

Magnification Factor and Valve Capacity.

So far, then, we have arrived at a constant value of about 25 micromicrofarads for C, this being the sum of all the capacities yet considered.

C_5, however, the grid-plate capacity of V_2, lands us immediately in difficulties. It has already been stated that it is in order to regard this capacity, for the purpose of the calculation of high-note loss, as being equivalent to a much larger condenser connected in parallel with C_4, and it was this larger equivalent condenser that we incorporated into our total value C.

The magnitude of this contributor to the total capacity is very much larger than that of the others we have considered; moreover, it is variable. Its exact magnitude is $(A + 1)$ times that of C_5, where A is the voltage amplification produced by V_2, so that it will depend to some extent upon the resistance or other components connected in the plate circuit of this valve, and upon the high-tension voltage and grid bias applied. But since in any normal receiver the amplification produced will be from two-thirds to three-quarters of the amplification factor of V_2, we can make a reasonably accurate approximation by taking into consideration no variable quantity other than this. That is to say, if we multiply C_5 by three-quarters of the amplification factor of V_2 the result will not be far removed from the true value of the capacity which we must add, on account of C_5, to the total stray capacity of the circuit.

High Magnification Valves and Distortion.

It only remains now to give a figure for C_5. Measurements on several valves of the types generally used for resistance amplification, but of widely different amplification factors, gave results that were surprisingly close to one another, considering the very different structure of the valves. The average capacity, including holder and wiring, was a little less than 10 micromicrofarads. Three-quarters of this is 7 micromicrofarads, so that if we multiply the amplification factor of the valve by 7 we have, in micromicrofarads, the contribution of C_5 to the total stray capacity.

Adding up the various values that we have discussed, we arrive at a very simple formula for evaluating C for our high-note loss calculations; it is $C = 7\mu + 25$, where μ is the amplification factor of the second valve, V_2 of Fig. 5.

It will at once be noticed that when the modern type of R.C. valve is employed, the total value of C is going to be dangerously high. If a valve of amplification factor 40, for example, follows the coupling resistance, C will amount to 305 micromicrofarads, or, in perhaps more familiar units, .0003 microfarad. In other words, the stray capacity in such a case is as great as the variable condenser normally employed for tuning purposes in a high-frequency amplifier. The full retention of high notes in an amplifier in which capacities of this magnitude exist is virtually impossible

But the present part of this article has already covered the ground allotted to it, and after this necessary digression on the subject of working values of valve impedance and stray capacity, we will return, in the concluding instalment, to the discussion of the magnitude of the high-note loss to be expected in amplifiers of various types.

(To be concluded.)

RECENT INVENTIONS

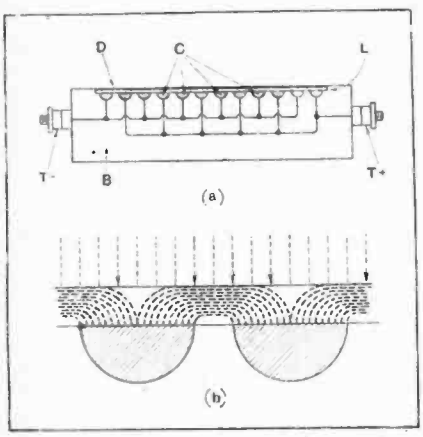
The following abstracts are prepared, with the permission of the Controller of H.M. Stationery Office, from Specifications obtainable at the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each.

Microphones.
(No. 278,443.)

Application date: July 8th, 1926.

A carbon microphone is so arranged that the changes of current set up by the impact of sound waves are in substantially the same direction as the applied air pressure instead of being at right-angles to it as usual. As shown in (a) a number of carbon-rod electrodes C are set in a massive non-resonant body B of wood. The rods lie flush with the insulated surface of the wood, and are covered with a layer L of carbon powder and a thin diaphragm D. The rods C are connected alternately to the positive and negative terminals T+, T− of the microphone.

If the dotted-line arrows in (b) represent the impinging sound wave, the thicker dotted lines will indicate the resultant distribution of current flow. It will be seen that the latter is substantially in the same direction as the sound wave, and not at right-angles to it, as in the normal arrangement where the microphone



Carbon microphone with unorthodox arrangement of electrodes. (No. 278,443.)

electrodes are mounted transversely to the received sound wave. Patent issued to H. J. Round.

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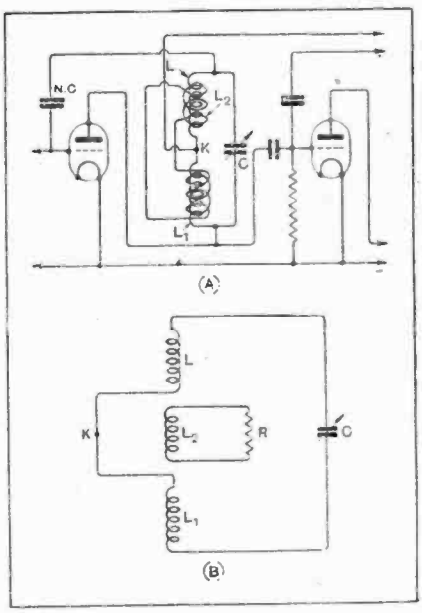
Stabilised H.F. Amplifiers.
(No. 278,812.)

Application date: July 17th, 1926.

With the usual type of neutralising connection between the plate and grid circuits of an amplifying valve, there is a tendency to the production of powerful parasitic oscillations of a frequency much higher than that of the signal. These disturbances are probably due to the inherent resonance of each half of the tapped inductance. The upper half L of the plate coil is connected to the grid circuit through the neutralising condenser NC, whilst the lower half L1 is joined directly to the anode of the valve. The mid tapping K is, of course, connected to the H.T. battery which is a point of stable high-frequency potential.



Method of minimising parasitic oscillations in tapped coils. (No. 278,812.)

When a parasitic oscillation is built up in one half of the coil, the tuning condenser C for the whole circuit forms a tight capacity coupling with the other half of the coil. As a result of this coupling the phases of the parasitic oscillations at the outer ends of the anode inductance are the same. In other words, the parasitic currents at any given moment are both flowing away from or towards the mid-point tapping K. On the other hand, the main current due to the signal frequency flows through the anode inductance continuously from end to end.

The present invention takes advantage of the phase difference existing between the desired and parasitic frequencies to provide means for damping out the latter. This object is achieved by tightly coupling an additional closed-circuit coil L_2 to the main inductance, the direction of the windings being such that voltages induced in the additional winding by the signal frequencies are balanced out, whilst those due to the parasitic frequencies are added together. The resultant current in the closed circuit due to the parasitic disturbances is then dissipated, either in a special series resistance R, or by forming the coil L_2 of resistance wire. The coil L_2 may be arranged to have considerable capacity to the coils L, L_1, and if formed of resistance wire may then be left open-circuited.

Patent issued to N. P. Hinton, H. G. Bell and the Metropolitan-Vickers Co.

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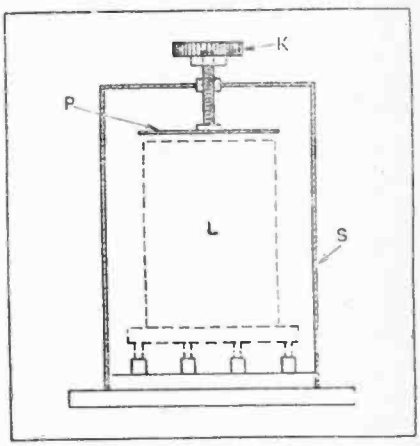
Screening Inductances.
(No. 278,208.)

Application date: November 25th, 1926.

A metallic screen S enclosing a high-frequency coil L is so arranged that small variations can be made in the inductance value of the coil. This is particularly useful where a number of high-frequency circuits are designed to be tuned simultaneously by means of ganged



Varying the inductance of a metal-screened coil. (No. 278,208.)

or geared condensers. In the arrangement shown in the figure, this elasticity is obtained by means of a small metal plate P mounted on a screwed spindle so that it can be moved to or from the coil by a knob K. Instead of using a moving plate such as P the screen S may be made in two or more portions, which may be screw-threaded together or otherwise arranged to telescope. Patent issued to Lt.-Col. K. E. Edgeworth.

News from All Quarters: By Our Special Correspondent.

Sir John Reith and a Rumour.—Success of "Charlot's Hours."—Popular Hotel Music.—Sunday Broadcasting.—"Speed": A New Experiment.—Listeners' Strikes.

Sir John Reith.

Although the rumour concerning the resignation of Sir John Reith is denied at B.B.C. headquarters, it would not surprise many who know the "D-G." to learn that he was seeking new outlets for his creative energy. Sir John is essentially an organiser; he excels at the business of putting things "on their feet."

The one drawback to energy of this sort is that the organiser not infrequently pays the price for his own efficiency. The machine he has so ably set in motion begins to take care of itself, and becomes comparatively uninteresting.

So we need not be surprised if the rumours persist.

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Mr. Charlot's Success.

André Charlot seems to have struck the right note with his own peculiar vintage of variety programme. Certainly there has been nothing in earlier programmes quite like "Charlot's Hours," and their success is proved by the volume of correspondence from listeners. The average number of letters addressed to André Charlot after each performance is 3,000.

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Competitions for Listeners.

In the new series of twelve, the first programme of which will be given tomorrow (Thursday), Mr. Charlot is developing the principle of getting the listener to help. He extends an invitation to all listeners to send in jokes, sketches, ideas—anything, in fact, from which it is possible to extract entertainment value. Competitions will be arranged, and more limericks are promised.

The "stars" for the coming series include Ethel Baird, Rex Evans, and Ralph Coram, son of the well-known ventriloquist.

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Sir Oliver Lodge.

The second talk by Sir Oliver Lodge in the experiment of half-hourly broadcasts now being tried on 5GB will be given on March 22nd. Sir Oliver Lodge will again deal with "Scientists I have known."

FUTURE FEATURES.

London and Daventry (5XX).

MARCH 11TH.—Military Band Concert, Belgian National Programme.

MARCH 12TH.—Programme S.B. from Cologne.

MARCH 13TH.—"The Land of Heart's Desire," by W. B. Yeats.

MARCH 14TH.—"Joseph and his Brethren," an opera in three acts by Mehul.

MARCH 15TH.—"College Days," a programme of students' songs.

MARCH 16TH.—National Symphony Concert, relayed from the People's Palace, Mile End.

MARCH 17TH.—Running Commentary on the Rugby International, England v. Scotland.

Daventry Experimental (5GB).

MARCH 11TH.—Albert Sandler and the Grand Hotel, Eastbourne.

MARCH 12TH.—"Joseph and his Brethren," an opera in three acts by Mehul.

MARCH 13TH.—Programme from Cologne.

MARCH 14TH.—Two Comic Operas from Birmingham.

MARCH 15TH.—Hallé Concert from the Free Trade Hall, Manchester.

MARCH 16TH.—Vaudeville.

MARCH 17TH.—Chamber Music.

Cardiff.

MARCH 14TH.—Welsh Programme.

Manchester.

MARCH 13TH.—"Down to the Sea in Ships," some glimpses of life on board an ocean-going merchantman.

Glasgow.

MARCH 17TH.—A Concert by the Caledonian Strathspey and Reel Society.

Aberdeen

MARCH 12TH.—Scottish Programme.

Belfast.

MARCH 17TH.—"Saint Patrick," a narrative play of the life of Ireland's Saint, by F. K. Fahy.

Why Hotel Music is Popular.

I am not surprised at the growing popularity of hotel music for broadcasting purposes. The repertoire of these orchestras is the result of long experience in appealing to a public who desire music as a happy background to conversation. The music requires no mental concentration, but it is good, tuneful stuff, admirably suited to the loud-speaker.

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An Imaginative Scot.

One of the best hotel combinations is the Carlton Hotel Octet, which can be heard on most Saturdays between 1 and 2 p.m. The incidental noises of the restaurant are rather pronounced, but many people do not object to that.

I heard the other day of an Aberdeen man whose imagination is developed to such an extent that merely listening to an hotel orchestra saves him the cost of a lunch.

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Albert Sandler in London.

Albert Sandler's forthcoming departure from the Grand Hotel, Eastbourne, must not be regarded as an indication that he will no longer be heard by wireless. In his new sphere as leader of the orchestra at the Park Lane Hotel he will probably broadcast at no distant date.

Sandler's successor at Eastbourne is Thomas Jones, director of Pattison's Orchestra, and well known to Birmingham and 5GB listeners as the leader of the Birmingham Piano Quartette.

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Music from Mayfair.

Another hotel orchestra which may shortly be heard for the first time is Ambrose's Band at the Mayfair Hotel, Berkeley Street.

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A Sullivan Night at 2LO.

A Sullivan concert will be broadcast from 2LO on March 21st, with Caroline Hatchard (soprano), Charles Leggett (cornet), and the Wireless Chorus under Mr. Stanford Robinson, supported by the Wireless Orchestra conducted by John Ansell. Miss Hatchard will sing "The

Night is Calm and Cloudless," "Orpheus with his Lute," and "Where the Bee Sucks." Mr. Leggett and orchestra will play "The Lost Chord." The orchestral selections are from "Patience," "The Mikado," and "Yeomen of the Guard."

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Sunday Broadcasting Problems.

There are at least three points of view concerning the proposal of earlier broadcasting on Sunday evenings. All three will certainly be well ventilated in the course of the next week or two, for the question is to be taken up by the Religious Advisory Committee.

First there is the view of the man who, while appreciating religious services by wireless, feels that they should not encroach on periods when the churches are open. Secondly, there is the view that religious broadcasting can never be wasted at any time, and that many invalids would appreciate a broadcast service when their more fortunate brethren are in church. Thirdly, we have the man whose desire for religious broadcasting is not predominant, and who feels that the period from 6.30 to 8 p.m. can quite reasonably be dedicated to the reception of foreign stations without interruption from the B.B.C.

The consideration of these opinions falls to the Advisory Committee, but there is an equally important problem which the B.B.C. itself may have to face.

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Are Sunday Afternoon Programmes in Demand?

The feeling seems to be growing at Savoy Hill that the Sunday afternoon programmes have a smaller audience than formerly. Whether this is true or not deserves a little investigation. At all events, I have heard the possibility discussed of cutting out the 3.30 to 5 p.m. period and giving a continuous programme from 5 o'clock onwards, with a church service from 6.30 to 8 o'clock.

This would permit of a longer evening concert, commencing at 8 p.m. and continuing until 10.30 or 11.

Would listeners accept the idea? I have grave doubts.

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The Boat Race.

Mr. G. O. Nickalls, the old Oxford Blue, will again take charge of the microphone in company with Mr. J. C. Squire at this year's University Boat Race on March 31st. A fortnight earlier, Saturday, March 17th, Mr. Nickalls will give a talk from 2LO on the prospects of the two crews.

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Another Play Experiment.

Two recent broadcast plays—Valerie Harwood's "Shadows" and Cecil Lewis's "Pursuit"—were both daring departures in technique from the ordinary type of play as adapted for broadcasting. Now we are to have another experiment.

"Speed," as the new play is called, is to be broadcast on April 2nd. Once again the ordinary stage standards are defied and, if my information is correct, they are defied very thoroughly. No fewer than five studios will be necessary for its performance. The dramatis personæ include gods as well as mortals, the theme playing upon the perpetual struggle between men and the invisible powers. In the end the invisible powers are victorious. Every mortal meets with a violent death!

By the way, I hear that the author's pseudonym, "Charles Croker," hides the identity of a well-known playwright with several West End productions to his credit.

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Successor to Sidney Firman.

Sidney Firman and his Radio Dance Band will shortly disappear from the programmes. His present contract with the B.B.C. expires in a few weeks' time, and he is taking advantage of this to launch out with a revue company to tour the provinces, with the support of Col. Harry Day, M.P.

The successor to Sidney Firman will be Jack Payne, the conductor of the Cecilians, the Hotel Cecil dance band. I understand that a new Radio Dance Band is already being formed.

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H.R.H. and the Premier.

The speeches of the Prince of Wales and the Prime Minister at the second annual banquet of the Company of Master Mariners will be relayed from the Mansion House, London, to 2LO and 5XX on March 21st.

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Another Play by Cecil Lewis.

"The Night Fighters," a play by Cecil Lewis, after the style of "Pursuit," which was recently broadcast, will be given from 5GB on March 24th.

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Why Not "Down Phones"?

Is it true that we Britishers are being outdone by other nations in the matter of dignity and sense of fitness?

Take our reactions to broadcasting. If our artistic souls revolt against the inclusion of any particular item in the programmes, what do we do? We grow angry. We debase ourselves. Sometimes we even write to the B.B.C. Oh, my friends, how much better it would be if we took a leaf out of the book of "The American League for the Enforcement of the Radio Act."

The trump card of the A.L.F.T.E.O.-T.R.A. is the "listener's strike." According to a recent letter of sympathy which the League sent from Youngstown to H.M. the King, the League is playing its trump card at the present moment. The grievance this time is not poor programmes, but the congestion of the ether. Whatever the malady, the remedy is a striking one.

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A Point in Favour.

Although at first glance such a strike seems absurd, the fact that it takes place in America furnishes some justification. Over there each broadcasting concern has a very definite interest in the number of its listeners, its advertising value being in direct ratio to the size of its audience. The thought that people are deliberately refraining from listening must be very annoying.

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The Listener Pays.

It is rather refreshing to find Mr. M. H. Aylesworth, president of the American National Broadcasting Company, actually reminding American listeners that they do not get their broadcasting without paying for it. He is, I believe, the first American to make such an utterance.

Judging from the publicity "dope" which gets into the newspapers (to say nothing of the clattrap before the microphone), the ordinary U.S. citizen is expected to believe that broadcasting is one vast philanthropic impulse. Why should he know that broadcast advertisements add appreciably to the cost of the goods advertised?

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Is It True?

Mr. Aylesworth opines that American broadcasting "leads the world in talent, mechanical development and expenditures." If this be true it adds sting to his subsequent remark that "the British Broadcasting Corporation, controlled by the Government, provides the type of programmes that the British desire"!

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Big Cast for "The Gipsy Princess."

A particularly strong cast has been engaged by the B.B.C. for the musical comedy, "The Gipsy Princess," which is to be broadcast from 2LO, 5XX, and other stations to-morrow evening (Thursday). It will include Murri Moncrieff as Niblo, the cabaret manager; Maggie Teyte as Sylva, the cabaret star; Robert Chignell as Prince Cozonne; Miriam Ferris as Princess Anita; and Dorothy Monkman as the Countess Stasi. Leslie Sarony, Ewart Scott, Paul England, Eric Derwent, and Frank Denton will also take part.

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Dance Music in History.

Listeners to 5GB on March 23rd will be gently reminded that dance music is not summed up entirely in the syncopated productions of modern jazz bands. "Dancing Through the Ages" will be the title of the programme on that date. It will be a resumé of dance music from the earliest times up to the present day, and will be given by the Birmingham Studio Orchestra in co-operation with Lloyd's Rhythmic Dance Band, with incidental explanations by William Lloyd.

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"Saint Patrick."

March 17th is St. Patrick's Day, and Belfast will give the first broadcast performance of "Saint Patrick," a narrative play of the life of Ireland's Saint, by F. K. Fahy. This has been specially written for the occasion, and is believed to be the first dramatised version of the Saint's life.

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

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

OUTSIDE BROADCASTS.

Sir,—I should like to add my voice to that of Mr. Kyrle Leng on this subject. It is just about a year ago that you published a letter from me drawing attention to the generally poor and varied quality of the transmission of piano music. Since then there certainly has been some improvement, but that there is still a great deal of distortion, particularly in the case of outside transmissions, nobody who has a good modern receiver and who compares one transmission with another can doubt. Now, sir, is not distortion of this kind a measurable quantity? And would it not be possible for *somebody* with the necessary apparatus to issue reports on it? If this were done, then we should all know just how far in any given case either our sets or the transmission were to blame. And that is just what everybody who aims at undistorted results wants to know and what is so exceedingly difficult to determine at present.

West Byfleet. E. C. RICHARDSON.
February 22nd, 1928.

Sir,—I wish to endorse the views expressed by your contributor, Mr. Kyrle Leng, in your last issue.

The distortion noticeable in the majority of these outside broadcasts is such as to make one prefer to listen to a much poorer programme undistorted.

Personally, I consider that the average Hallé concert is a real musical treat, but as served up by the B.B.C. when relayed from 2LO it is less pleasing to listen to than the interminable dance music provided. I cannot conceive of anyone being converted from "low-brow" to "high-brow" tastes when performances in the latter category are so ruthlessly murdered by land wires.

It is for this reason that Capt. Eckersley's dream of relaying Continental concerts by land wires fills me with misgiving. The distances being greater, one assumes the distortion will be worse than in the case of a relay from Manchester, if indeed this be possible.

A certain amount of fading and some atmospherics, both of which accompany direct reception, are less trying than the total misrepresentation attendant upon the use of long land lines. PHILIP H. A. MATTHEWS.

W.9.
February 23rd, 1928.

Sir,—It is very evident from Mr. K. Leng's letter—which appeared in your last issue under the above heading—that he possesses a receiver which is perfection, for, in his own words, the transmissions from 5GB and London "some are poor, some bad, and some an insult to music, wireless and the listener," which means, of course, that the B.B.C. transmissions do not do justice to his receiver.

I have for some considerable time past been endeavouring to get wireless reception with real purity, and whilst I would not presume to say that my set is perfect, yet I can say that I have not heard the "excruciating piano music" broadcast by the B.B.C., neither have I heard "London distorting horribly," and, further, I would say that my reception has improved in quality as I have improved my set.

There is no doubt that outside broadcasts, with some exceptions (notably Eastbourne) do not come through as well as Studio broadcasts, but surely this is not to be greatly wondered at, seeing that the music is often relayed over miles of telephone lines and is, moreover, always mixed up with all the extraneous noises of the audiences, etc., etc.

Personally, I am of the opinion that the B.B.C. have made wonderful advances in relaying outside broadcasts, and though perhaps their transmissions in general may not be perfect, yet I consider they are nearly so, anyway their standard of perfection is far above that which the average receiver is capable of reproducing.

I would suggest to Mr. Leng that he visits the Science Museum at Kensington the next time he has an opportunity, and listens to the wireless demonstration given there. I think he will not notice much "horrible distortion," and am of the humble opinion that he will return home and, in the words of the B.B.C., "look to his set." GEORGE H. TOZER.

Croydon.
February 22nd, 1928.

Sir,—May I endorse the remarks of Mr. Kyrle Leng on the subject of outside broadcasts. I listen to Daventry 5XX and Daventry Experimental, and I have had exactly the same experience as he has with the Bournemouth programmes. My receiver is a more modest one than that of Mr. Leng, and consists of the H.F. and det. valves of the All-Wave Four with an amplifier similar to that used in the W.W. "Alternative Programme Quality Receiver." Used with a Kone speaker, this combination will give a really impressive rendering of music broadcast from the London or Birmingham studios. The Bournemouth programmes, however, and more especially those S.B. from Manchester, are of such poor quality that I have ceased even to switch the set on to see what they are like. I regard the Manchester programmes as the more important because they are more frequently a principal evening feature. The distortion is quite as noticeable in the Manchester announcer's voice as it is in the music. On reversion to London, the London announcer's voice is rendered with perfect quality. This disposes of any possibility that the distortion originates at the receiving end.

It seems to me that a genuine radio engineer would either remedy the defects or else give up transmitting these broadcasts. It is certainly out of place on his part to advocate listeners giving up foreign programmes on the score of their inferior quality. P. B. C. BEASLEY.

Retford, Notts.
February 22nd, 1928.

Sir,—Referring to the letter in your current issue from Mr. Kyrle Leng, of Reading, I was particularly interested in his statement that "London has been distorting horribly lately and piano music is often excruciating." Mr. Leng is no doubt suffering from the same trouble that we get here in Cambridge, namely, bad distortion on transmissions from 2LO direct, after dark. On some nights the quality is consistently bad from about sunset onwards: at other times it will be constantly varying (changing from good to bad within a few seconds, then back again) while very rarely a whole evening will pass without any sign of the trouble. All types of transmission are affected (speech sounding thick and woolly), but piano music shows up the effect best, which appears on certain bass notes, roughly those in the two octaves from middle C downwards. Notes above and below this band are not distorted.

I first noticed this distortion about eighteen months ago, which corresponds to the time when the B.B.C. discarded the magnetophone in favour of the Reisz microphone. However, as a badly distorted programme from 2LO can be received with perfect purity on changing over to 5XX, the B.B.C. would appear to be blameless in this instance!

Having made careful observations on various sets in different parts of Cambridge, I have definitely proved that the distortion

is not due to any local cause, such as the set in use or silent oscillation in an adjacent aerial, neither is it due to heterodyning by foreign stations. As I have never experienced the trouble in full daylight, I can only put it down to night distortion, due to interference between the direct and reflected waves, though I have not previously heard of it happening at the short distance of 50 miles.

The obvious remedy as far as listeners are concerned is to receive the London programme through 5XX, but 2LO is more convenient as it saves changing coils and H.F. transformers.

I shall be interested to hear the views and experiences of other readers in the reception of 2LO at this distance from that station.

W. K. ISLIP,
Secretary, Cambridge and District Radio Society.

158, Tenison Road, Cambridge.
February 22nd, 1928.

CARE OF ACCUMULATORS.

Sir,—I should like very much to know if there is a society or association formed for the purpose of assisting wireless amateurs in disputes with wireless dealers who, undertaking to charge accumulators, through their neglect by improperly overhauling or recharging them, run the owner into expenses for repairs for which the dealer declines to be held responsible.

It appears to me that such a position must frequently arise since most wireless amateurs cannot be expected to be battery experts and are in the hands of the dealers, who undertake to carry out the periodical recharging or reconditioning which is always necessary, and yet these dealers may refuse to be held responsible for any defects caused through their carelessness or improper handling of the accumulators when under their care.

"ENQUIRER."

London, W.4.
February 8th, 1928.

EXPONENTIAL HORNS.

Sir,—I enclose a photograph of the exponential horn as described in your issue of November 23rd, which is finished in mahogany with copper mesh in front behind the grill.

I have never heard music so faithfully reproduced, although I have listened to many loud-speakers, and have hitherto been using a horn and cone (each costing £6) in parallel. The unit is a Brown U/G.A. The large heart-shaped blocks I constructed by facing up 2in. × 5in. timber glued and screwed together and shaped by planing. The back W block was built up similarly, and shaped with a round iron plane.

The metal connection for the unit consists of a copper box (22 gauge) 1½in. × ⅞in. × 2½in. long tapering, the end of which is wrapped round a short length of 1 in. tube slightly flattened into which is soldered ⅜ tube and finally a ¼ tube is soldered into the latter. This was placed in the slot between the small heart-shaped blocks after the large one to which they are attached was fixed to the base, and the back W in position, it only remained then to screw the other large block in position and screw the top and side on. The construction calls for a fair amount of patience and time which the result fully justifies, and it is not an unsightly piece of furniture.

The very attractive piece of furniture made by a reader. It does not suggest the exponential horn loud-speaker which it is.

P. M. STATHAM.

Sidcup.
February 23rd, 1928.

INTERFERENCE.

Sir,—Mr. Colley's letter in your February 15th issue is of interest to me, as reception here is badly interfered with by the S.R. electric trains. The overhead wires are within fifteen feet of my aerial and about seventy feet from the receiver (neut. H.F., det. 1 R.C., 1 trans.). The noise made by passing trains is terrific and completely drowns the programme.

I have got over this difficulty when receiving London by using a small frame. This cuts out the interference entirely and the programme is received at strong loud-speaker strength.

Several B.B.C. and Continental stations are received at good speaker strength every evening on the outdoor aerial, four at least being reliable, but when a train is within a mile either side of the aerial I have to switch off.

With regard to Mr. Du Pre's letter, I find no difficulty in identifying most foreign stations, and careful calculation of dial readings is a good guide to wavelengths as a means of identification.

Captain Eckersley can hold his own opinion on reaching out after foreign stations, but on many occasions I have been bored stiff by the everlasting jazz and turned to Hilversum or Berlin and enjoyed good music for an hour or more. I should like to add that since I have lived in Waddon (six months) I have only once had the programme spoiled by oscillation from a near-by receiver. This kind of nuisance is almost unknown here.

H. R. GRANT.

Waddon, Surrey.
February 20th, 1928.

Sir,—A short while ago your correspondence columns were occupied with letters dealing with the question of Morse interference. Reading these through, I am brought to believe that some of your correspondents appear to know very little about *serious* Morse interruption. On Saturday, January 28th, for example, I was desirous of picking up American broadcasting on the B.C. band. At 11 p.m. not a spark was to be heard off the authorised W.L. At midnight nearly twelve powerful "sparks" descended on to the broadcast band. I remember one was tuned to 350 metres, another to 490, one on 300 and others dotted over any place but 600 metres. At 12.30 a multitude of ships joined the "happy band," and for a moment I believed that my set was at fault, having mistaken the broadcast band for the 600-800-metre range! I cannot, of course, impress too deeply the fact that not one of these loathsome and grossly antiquated contrivances was situated in the British Isles. I would like to ask, is this one of the ways in which our conferences further the cause of broadcasting? Let me quote another short example: During last summer from May until September LY of Bordeaux worked every day and nearly all day using raw *arc* transmission and a "spacer" wave about half a metre different. Its harmonics and multiples covered the range 200-18,000 metres, and received at intervals of a few kilocycles all over that range. Due to this it was definitely a human impossibility to understand a single broadcasting station whilst this atrocity was working—calling Saigon for hours on end. If a few of our gentle British readers can fully comprehend this they will then realise what Morse interference can mean!

Living ordinarily in Lincolnshire, since GKZ was altered, I have found perfect peace in that area—remember, a great deal of traffic goes on in the North Sea—and I am compelled to express my gratitude to those who have agitated for the abolition of interference in England—the only country in Europe where interference is *not* bad. In France, for example, *even the smallest village* has A.C. lighting all over the country—imagine what that means if 50 per cent. of the cables are faulty! It is my opinion that, if half of our broadcast listeners could read "the code," they would find the greater part of the interference came from foreign sources. I can, and I have!

A. E. LIVESEY
(British Radio 6 LI).

Pau—B.P., France.
January 30th, 1928.

IDENTIFICATION OF STATIONS.

Sir,—It seems rather unnecessary to introduce such complications as Morse, Greek, Esperanto, and musical intervals when there is no difficulty at all in identifying a station whose announcer calls as intelligently as the lady announcer at Berne, that is at least a pattern call, for everyone can understand it. "Hullo, Radio Berne." The best solution of most problems of the kind is generally the simplest and most obvious, and in this case the name of the station spoken after each item and then repeated so that listeners would be ready to verify the first impression would present no difficulties to the announcers and offer no problem to the listeners.

The word radio might well always precede that of the station, as by that system of calling everyone would know exactly when the name of the station was uttered.

I should imagine that London's and Daventry's verbose announcements were utterly unintelligible to a Spanish listener with no knowledge of English. ALAN CARTWRIGHT.

West Norwood.

Sir,—Of particular interest has been your correspondence in regard to the B.B.C. outlook on alternative programmes as outlined by Capt. Eckersley. It is quite evident that this gentleman is out of touch with the general body of listeners. To say that reception of distant stations is seldom satisfactory is merely begging the question, and must eventually do considerable harm to the wireless industry. To receive the local station any ordinary "hook-up" will prove satisfactory.

Liverpool. S. H. JONES.

February 16th, 1928.

PERFORMANCE CLAIMS.

Sir,—I really cannot allow "Britisher's" letter in your issue of February 8th on the performance of 0-v-2 receivers pass without commenting thereon.

Will he be convinced as to the efficacy of these sets in conjunction with a really good aerial if I guarantee to get twelve stations at good speaker strength any night, and that, in addition, I should be very disappointed if that number was not exceeded?

I am afraid it sounds rather tall, but I have received over fifty stations at varying degrees of strength, but, so far, I have only definitely identified and logged twenty-five of them. This includes high wavelength stations as well as the broadcast wavelengths.

I will admit, however, that these sets are not particularly selective, or, rather, only selective at the expense of volume, but I find the foreign stations come through at such volume that the set does become quite selective.

For example, very often during an interval in 5GB's programme, I can just hear London, yet at other times I have Toulouse at 391 metres coming in at such strength as to completely drown 2LO.

I think I am just outside the ten-mile radius referred to by "Britisher," but I am sure my reception of 2LO is quite equal to others within the ten-mile radius owing to my superior aerial.

Finally, will "Britisher" take my word that three years ago I used to receive three or four other stations regularly on a crystal set at fair headphone strength, and also that on a straight two-valve set I have had ten stations on the speaker in one evening very frequently, and that being so, what would I get with a multi-valve set? Wait and see.

Becontree, Essex. D. CHAPMAN.

February 9th, 1928.

P.S.—Since writing the above I have carried out a short test without changing my aerial coil. Results: eighteen stations at good strength, of which perhaps only six were absolutely clear of either 2LO or 5GB. If I lived forty miles from 2LO I should want no better set than the 0-v-2.

TALKS.

Sir,—There exists (I think) a need for a little censoring of your otherwise excellent contributor who furnishes "Broadcast Brevities." I refer to his constant sneering at "talks." One would think from his remarks nearly every week that a flow of words proceeded from London and Daventry like unto Langenberg at its worst on a Sunday. An examination of the actual programmes is enough to show that such is not the case. Thus much for quantity; now for quality. Nearly everyone wants a relief from music now and then, and not everybody hails a satisfactory substitute in jazz. The talks themselves are often of great interest to thousands of people, who neither care for ultra-modern composers nor trash, and it is absurd to imply, by constant slighting references, that talk, quâ talk, is boring. If a little lecturette (often given by a charming person) is more boring than the sickening caterwauling slosh poured out by the hour from 5GB, then it is time that a Royal Commission was appointed to enquire into the sanity of the race.

As a matter of fact, the complete absence of talks from 5GB is regretted by many. My own set is highly efficient on the 200-500 metre band, but not designed to tune up to 5XX, and my mother, whose poor sight makes wireless her chief entertainment, has never ceased to complain of the absence of the pleasant talks that we used to get from Birmingham, especially those by explorers and travellers in distant lands. There is no need of any assistance from our premier wireless paper in the "more rubbish" campaign so ably waged in other quarters, and these frequent jibes at talks are likely to have that effect. F.

Moseley, Birmingham.

February 10th, 1928.

CONTROVERSY.

Sir,—If this is ever introduced it will probably result in a tremendous amount of deliberate oscillation by those who strongly disapprove of the matter being produced.

FRANK PINK.

Portsmouth.

February 23rd, 1928.

WIRELESS IN U.S.A.

Sir,—During a short visit last month to New York, Albany and other parts of the U.S.A. I gained the following impressions, which may be of interest to your readers:—

First, radio in America occupies a far more prominent place in national life than it does in this country. Practically every daily and evening paper of any importance publishes a comprehensive wireless supplement of anything from four to ten pages in extent; Sunday papers pay even greater attention to this feature. This supplement discusses fully everything of public interest both as regards new sets and circuits, and at the same time brings the advantages of radio much more to the notice of the public than do our papers in this country.

I found in the States that the lay Press really boosts radio to the extent which it deserves and loses no opportunity of pointing out to its public that to enjoy life fully the installation of radio is a necessity. This contrasts strikingly with the apathy of the Press here. We are afforded a further comparison by the attitude of manufacturers in England, each of whom is content to advertise his own wares against those of his competitor, and takes no pains to awaken new interest in the man who is not already interested in either. An illustration of the difference in public demand for radio between the U.S. and this country is offered by the figures given me of sales of receivers in the Metropolitan area of New York alone. These figures were almost the same as those for the whole of this country over the same period.

With regard to American broadcasting, this certainly has improved greatly, and it is now possible in New York to obtain on any evening twenty to thirty good programmes on an efficient receiver. The only disadvantage is that sometimes broadcast advertisements are rather overdone, but even with these some of the larger stations, although not cutting them out entirely, have taken steps to reduce them to a reasonable minimum.

With reference to radio production, the component market is practically dead. The telephone and loud-speaker market is dying fast, and even the radio set complete with batteries

and loud-speakers is fast becoming defunct. The main sales all over the country are for complete radio installations working from the mains on alternating current. This, although an impossibility here owing to the prevailing electricity conditions, is, of course, an easy proposition in the U.S., as, with very few exceptions, the whole of their current is 60 cycles alternating. Sets themselves are of two types, the low-priced table model, such as the Attwater Kent, and the more expensive console models such as the R.C.A. and the Kolster Radio. I mention these sets as having been the most popular during the past season. The cabinet work on the console type set is certainly very attractive, and has to be really well made owing to the dry climate.

The circuits used in America are very similar to those in this country, except that, in order to obtain selectivity and single-dial tuning, in the majority of cases they use the three high-frequency stages.

Trusting that the above will interest your readers.

S. WILDING COLE, Sales Director,
BRANDES, LTD.

NEWS FROM THE CLUBS.

Hackney Society's Proud Record.

What is probably a record achievement in the annals of wireless societies was referred to at the annual dinner of the Hackney and District Radio Society at the Talbot Restaurant, London Wall, E.C., on February 16th, when over fifty members and friends were present. The hon. secretary, Mr. Sandy, in an after-dinner speech, reminded those present that during the seven years that the society had been in existence, not a week had passed without a meeting of the society. Can any other society beat this record?

Hon. secretary: Mr. G. E. Sandy, 48, Melrose Avenue, S.W.19.

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Selectivity without High Frequency.

New members of the Hornsey and District Wireless Society were specially catered for on Monday, February 20th, when Mr. W. Carter gave a lecture and demonstration on "Selectivity without High Frequency." The circuit used was the very popular arrangement of one detector and two stages of low frequency with the addition of a wavetrap; the latter was declared by members to be an excellent method of obtaining selectivity with loud-speaker strength for beginners who had not yet mastered the intricacies of tuning.

Hon. secretary: Mr. W. Carter, 25, Priory Avenue, N.8.

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Kensington Society Seeks New Members.

At a meeting of the Kensington Radio Society on February 16th Mr. Maurice Child gave an interesting lecture on L.F. transformers.

The society welcomes new members, and applications for membership should be addressed to the Hon. Secretary, Mr. G. T. Hoyes, 71a, Elsham Road, Kensington, W.14.

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L.F. Transformers.

Members of the Coventry Transmitters' Association listened to an interesting lecture on January 31st by Mr. Garside, of Messrs. Ferranti, Ltd., on the topic of low-frequency transformers. The subject was treated theoretically from its first principles.

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

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Captain Round at Muswell Hill.

Captain H. J. Round, the famous experimenter, who is also president of the Muswell Hill and District Radio Society, gave the members a fascinating demonstration of the "Round 6" receiver at the last meeting. This set employs three screened valves, and on a small frame aerial proved its ability to bring in as many stations as one cared to search for.

Captain Round related some of his interesting experiences in wireless research over a number of years. He recalled the amazement of the inhabitants of Glace Bay in 1911 when signals were heard there for the first time from the other side of the Atlantic. He also described his meeting with Major Armstrong, the American inventor of the super-heterodyne. When the invention was demonstrated in Paris, Captain Round was asked to guess how the astonishing results were obtained, but was unable to do so!

At the end of the meeting members were allowed thoroughly to examine the "Round 6" and to study its construction.

Many new members are being enrolled; prospective members—ladies or gentlemen—can obtain syllabus, rules, and membership application form on applying to the hon. secretary, Mr. G. Scott Sessions, 20, Grasmere Road, Muswell Hill, N.10.

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A Good Year.

Despite the expenditure of a comparatively large sum in the purchase of tools and apparatus, the Western Postal Radio Society was shown to be in the full enjoyment of a satisfactory financial position when the treasurer's report was read at the annual general meeting on February 15th. The secretary's report showed that the society was firmly established. Owing to the kindness of the Post Office authorities it had been possible to instal a receiving set in the Western District Post Office building with permission to use the existing electricity supply, 240 volts D.C., for the H.T. requirements. The aim of the society is to secure a perfect example of modern receiving apparatus. Special mention was made of the Golders Green and Hendon Radio Society for their kind invitation to field days during the past year.

Hon. secretary: Mr. E. G. Nurse, W.D.O., W.1.

FORTHCOMING EVENTS.

WEDNESDAY, MARCH 7th.

Institution of Electrical Engineers, Wireless Section.—At 6 p.m. (light refreshments at 5.30). At Savoy Place, London, W.C.2. Lecture: "Some Practical Applications of Quartz Resonators," by Mr. G. W. N. Cobbold, M.A., and Mr. A. E. Underdown.

Stretford and District Radio Society.—At 8 p.m. At 6A, Derbyshire Lane. Lecture by Mr. Bailey (2UF).

South Croydon and District Radio Society.—At 8 p.m. At "The Surrey Drovers" Hotel. Lecture and Demonstration: "Recent Developments in Radio Reception," by Mr. W. K. Alford, of the Igranic Electric Co., Ltd.

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

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

THURSDAY, MARCH 8th.

Leyton and Leytonstone Radio Society.—Discussion on L.T., G.B., and H.T. from mains.

Slade Radio (Erdington, Birmingham).—Lecture: "High Tension Radio Batteries," by Mr. R. Young, of Messrs. Joseph Lucas, Ltd.

FRIDAY, MARCH 9th.

Wigan and District Technical College Radio Society.—Lecture: "The Obtaining of True Radio Reception," by Mr. R. Garside, of Messrs. Ferranti, Ltd.

Leeds Radio Society.—At the University. Lecture No. 5: "Three Valve Set," by Mr. A. F. Carter, A.M.I.E.E.

Association of British Radio Societies (Manchester).—Lecture by Mr. G. Blake, of Messrs. Radious, Ltd.

MONDAY, MARCH 12th.

Holloway Literary Institute Wireless Club.—At 7.30 p.m. At Holloway School, Hilldrop Road, Camden Road, N.7. Demonstration of Loud-Speakers by Messrs. S. G. Brown, Ltd.

TUESDAY, MARCH 13th.

Hounslow and District Wireless Society.—Lecture by a representative of Messrs. S. G. Brown, Ltd., on "Loud-Speakers."

Demonstrating the Shielded Valve.

"Shielded Valves" was the subject chosen by Mr. F. Youle, of the Marconiphone Co., for his lecture before the Hounslow and District Wireless Society at a recent meeting. He described the various methods of neutralising stray capacities, and explained how the shielded valve had been evolved with the object of assisting towards this end. After showing the construction of the shielded valve, Mr. Youle demonstrated a five-valve receiver employing three shielded valves. Ample loud-speaker strength with extreme clarity was obtained from a number of Continental stations. The aerial consisted of a small frame about 18in. square.

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

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Obtaining the Vacuum in a Valve.

The secrets of valve manufacture were disclosed by Mr. J. E. Clark at a recent meeting of the South Croydon and District Radio Society. Perhaps the most interesting part of Mr. Clark's lecture was the description of the method employed to exhaust the valve. It has always been a matter of extreme difficulty to expel the last traces of air from the valve. Mr. Clark described the mercury pump used for this purpose, exhibiting an excellent lantern slide showing the apparatus used.

Hon. secretary: Mr. E. L. Cumbers, 14, Camp den Road, South Croydon.

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A Visit to 2LV.

An interesting "tour" of Liverpool was recently made by members of the Radio Society attached to the Lancaster Storey Institute Students' Association. First the party visited the Gladstone Dock, and by kind permission of the White Star Line, inspected the liner s.s. "Baltic." After a visit to the cathedral in the afternoon, a call was paid to the B.B.C. studio, where the amplifiers were inspected and explained, members also having the opportunity of seeing the relaying apparatus in operation.

Hon. secretary: Mr. G. I. Wright, 31, Westbourne Road, Lancaster.

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Experiments with Multi-feed Aerials.

Mr. W. H. B. de M. Leathes continued his talk on "Experiments with Multi-Feed Aerials" at the meeting of the Institute of Wireless Technology held on Thursday last, at the Engineers' Club, Coventry Street, W.1.

Hon. Secretary, Mr. Harrie J. King, 71, Kingsway, London, W.C.2.

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Developments Reviewed.

A large attendance of members of the Leicestershire Radio Scientific Society welcomed Mr. P. K. Turner on Tuesday, February 14th, when he lectured on recent developments in wireless. Mr. Turner dealt with, among other things, A.C. valves, metal rectifiers, coil-driven loud-speakers and power amplifiers.

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Should Wireless Aerials be Earthed?

The above was the topic discussed at the last meeting of the Bradford Radio Society, at which Mr. S. R. Wright put forward the view that the earthing of the aerial by means of a switch was a danger, and no protection against lightning. The speaker maintained that the aerial, as soon as it was earthed, became a live wire—in fact, a lightning conductor. The proper course to take was to disconnect the aerial from the set and to have some device such as a lightning arrestor with a very low resistance path to earth for electric charge. In the ensuing discussion several members argued that a lightning arrestor which could not save the aerial was no better than an ordinary switch which earthed it.

Hon. Secretary, Mr. A. E. Cowling, 1145, Leeds Road, Thornbury, Bradford.

READERS' PROBLEMS

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

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

Modifying the "Everyman Four."

How can my "Everyman Four" be modified in order that the H.F. amplifier may be included on the long wavelengths? T. S. S.

It would be rather beyond the scope of the Information Department for us to detail the alterations necessary, and, in any case, it should be clearly pointed out that the set does not lend itself to this modification without considerable alteration.

We think our best advice to you is that you should adopt the H.F.-detector portion of the circuit of the "Standard Four" (*The Wireless World*, November 30th and December 7th, 1927). The lay-out of this receiver is such that alterations could be made in an obvious manner with a minimum of trouble and expense.

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A Litz Query.

I gather from the article entitled "Coil Calculations" in your issue for January 11th that, by careful design, solid wire coils may be made to equal the efficiency of the Litz secondary windings used in several of your more recent receivers. Please specify the number of secondary turns for a 250-550 metre transformer, using a $\frac{3}{8}$in. diameter ebonite former. T. A.

We fear that you have rather missed the point regarding these solid wire coils. In order to obtain a low resistance, it is necessary to increase the diameter, with the unfortunate result that the coil becomes somewhat bulky.

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The Coupled Aerial Circuit.

Thank you for your reply to my recent query. As you suggested, I find that the isolation of the separately tuned aerial circuit from the filaments completely eliminates the hum produced when a D.C. eliminator is used. Unfortunately, however, another trouble has arisen. When L.T. negative is disconnected from the earth terminal, signal strength falls appreciably. As there is no great margin of safety in my receiver, I should like to recover this lost energy, and should appreciate your advice. Is it possible that my coils are incorrectly connected? A. G.

If you are using ordinary plug-in coils with compact windings, it is unlikely that an alteration of the connections will have any great effect, but if the coils are single-layer solenoids you should take care that they are connected in the manner shown in Fig. 1, from which you will see that

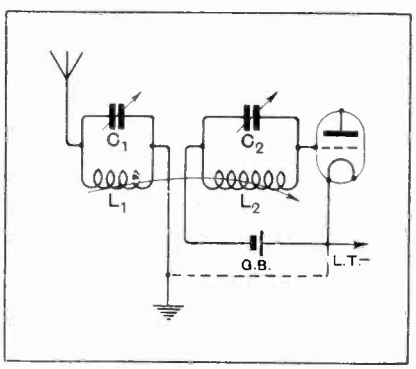

Fig. 1.—The connections of solenoid inductances in a tuned aerial coupler.

the low-potential ends of aerial and secondary coils are adjacent. These coils are indicated, respectively, by L_1 and L_2, with their associated tuning condensers C_1 and C_2. The filament earthing lead is in dotted lines.

It seems probable that you have ignored the fact that a removal of the metallic connection between the low-potential ends of the two coils will make a change in tuning. We suggest that, after taking off the lead joining these two points, you should retune both circuits, when in all probability your trouble will disappear.

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A.C. Charger for 100 Volts 50 Cycles Supply.

I should be obliged if you would supply me with particulars of the winding required for the primary of the transformer in the "Home A.C. Transformer" when this is used on a 100 volts 50 cycle supply mains? F. W. H.

You will require two primary coils each wound with 300 turns of No. 26 D.C.C. wire, and these should replace the coils marked B and D in the theoretical and practical diagrams of this unit in our issue of October 5th, 1927.

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A "Live" Aerial.

I have recently installed a D.C. eliminator, and am surprised to find that my aerial lead-in is "live." Does this indicate that anything is wrong? E. L.

In a conventional direct-coupled set the aerial is in metallic connection with the filament circuit, and consequently with negative H.T. The fact that the aerial is "live" shows that your positive main is earthed, and it does not indicate that there is a fault.

If you wish to avoid the application of a high voltage to the aerial it will be necessary to add a separate circuit, which will be isolated metallically from the filaments.

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A Cure for L.F. Oscillation.

Is the method of stopping L.F. oscillation which was described in your issue of January 4th under the heading of "Low Frequency Oscillation" equally applicable when high-tension current is derived from an eliminator operating on A.C. mains? E. A. S.

The source of H.T. energy makes no difference to the effectiveness of the method in question. It is applicable equally with batteries, or with rectified A.C. or D.C. mains supplies.

RULES.

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

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

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

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

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

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

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

Atmospherics.

Could you give me any information, please, concerning the frequency of atmospheric discharges, and is it possible to construct a rejector to eliminate interference from this source?

J. R. M.

There is very little information available concerning the nature of atmospheric disturbances, but from the few articles that have been published on this subject it would appear that these disturbances take place on a very long wavelength. The wave-form is of a very complicated nature, and consists of many frequencies, the higher ones being in all probability harmonies of the fundamental. This deduction is borne out by the fact that an atmospheric discharge will affect the receiver whether it is tuned to 300 metres or 30,000 metres. Under these conditions it is impossible to state definitely, or even approximately, the frequency of these discharges. Considerable time and money is being spent in research on this important subject, but, nevertheless, atmospherics still remain one of the most serious stumbling-blocks to long-distance reception, and are likely to remain so for some time to come. In the light of present knowledge on the subject their rejection is not yet possible.

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Transformer or Choke Output?

To prevent damaging the loud-speaker windings, I propose to fit either a 1 : 1 transformer or a choke capacity output circuit, but as I have no information available concerning the relative merits of these two arrangements, I should be obliged if you could advise me which to use with a high-resistance loud-speaker.

W. E.

Under normal conditions of working, either of the two output arrangements will be satisfactory, but if a super-power valve with a high anode potential is used, it would be advisable to employ the choke-capacity filter. The reason for this is that a choke to carry a reasonably large current can be constructed to moderate dimensions, whereas a transformer to carry say 35 milliamperes would be considerably more bulky. Further, investigations show that when battery eliminators are used greater freedom from back coupling exists with choke output than with transformer, but the loud-speaker connections must be such that one side is returned direct to L.T. negative.

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Doubling the H.F. Amplification.

I have been informed that a new valve is now available, and when this is used in a receiver will give double the amplification. Can you please give me particulars of this valve?

P. J.

We think you refer to the indirectly heated cathode valves for alternating current supply mains, which, according to the published characteristics, give approximately double the voltage amplification for a given A.C. resistance compared with valves of ordinary type. The advantages of using a valve of this construction in the high frequency position of the "Everyman Four" receiver was discussed in the "Hints and Tips" columns of *The Wireless World* published on December 28th last.

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Volume Control.

Can you please give me particulars of a volume control to incorporate in a 0-v-2 receiver when the first L.F. coupling unit is resistance-capacity?

J. H. G.

A very satisfactory control of volume can be achieved by adopting a tapped anode resistance following the detector valve, and the theoretical diagram of this arrangement is given in Fig. 2.

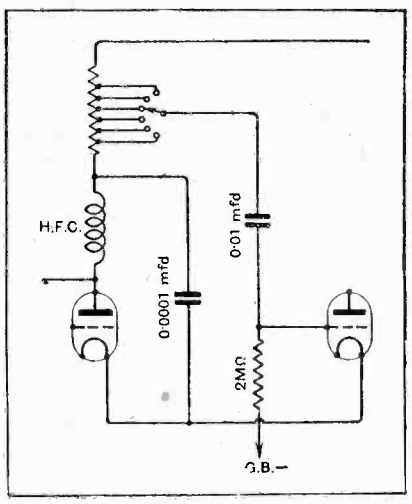

Fig. 2.—Method of controlling volume using a tapped anode resistance.

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The B.B.C. Set and the Gramophone.

Is it possible to use a gramophone pick-up in conjunction with the B.B.C. "Quality Four" described in your issue of May 4th, 1927? If this addition can be made in a simple manner, will you please indicate the connections?

R. T. Y.

The receiver in question lends itself particularly easily for use with a gramophone pick-up. This device should be fitted with a standard coil plug connected to it by means of a short length of twin flexible wire. The detector grid coil is removed, and the pick-up plug is inserted in its place. Detector grid bias is reduced to half its previous value, and arrangements are made for switching off the H.F. amplifier filament.

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Fading—Real and Spurious.

My "Everyman Four" receiver is giving perfectly satisfactory results, except that at night time fading takes place fairly often. Will you please tell me how this trouble may be overcome?

C. T.

Fading is a natural phenomenon, and there is no cure for it. It is possible, however, that the sensitivity of your receiver is less than it should be, or that your local conditions are not good. Either of these circumstances will tend to accentuate the effects of fading.

It is occasionally found that an intermittent faulty connection in the receiver gives an effect akin to real fading, but from the information given we cannot say whether this is so in your case. If it is suspected we would recommend careful stage-by-stage and point-to-point tests.

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Soft Valves?

I am troubled by a loud and steady "rushing" sound in the telephones, which, while not preventing the reception of distant stations, renders their signals almost unintelligible. My set is a 1-v-1 combination, with a super-power valve in the output position. The same effect is noticed when a loud-speaker is used for short-distance work. Quality is by no means good. Can you help me?

W. S. W.

The symptoms you describe would indicate that the last valve (or possibly the detector) has become "soft." This may be indicated by the presence of a blue glow between the electrodes (which will be evident unless the bulb is completely obscured), and it will also be shown by the fact that an excessive anode current, as measured by a milliammeter, is passed. Moreover, this anode current is not likely to be steady, even when no signals are coming through.

We think that the above represents the true cause of the trouble, but it is just possible that there is an imperfect soldered connection, probably in one of the anode circuits.

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"Man-made Static."

On the local station, results from my four-valve receiver are all that could be desired, but when I tune in distant stations reception is interfered with by crackling noises, which are sometimes loud enough to drown the signals. Can you suggest a method of overcoming the trouble?

T. P. S.

From the information you give, it is difficult to say whether the noises originate in the set or if they are due to induction from near-by power circuits. To assure yourself on this point, aerial and earth connections should be removed from the receiver. If the noises disappear completely, it may be assumed with confidence that the trouble is due to induction. This is very difficult to eliminate, but we suggest that you change your earth connection (a buried plate in place of a water pipe is likely to effect an improvement). Better still, you could use a counterpoise in place of an earth. Again, if the receiver does not already include it, you should try the effect of using a loosely-coupled and separately-tuned aerial circuit.

If the trouble is in the set, we can do little but suggest careful stage-by-stage and point-to-point tests, recommending you to pay particular attention to the high-tension battery.

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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.

CONTENTS OF THIS ISSUE.

GRAMOPHONE AMPLIFIERS AND THE PATENT POSITION.

IN spite of the cloud of patents which surrounds the use of the thermionic valve as a high-frequency amplifier and as a detector, there appears to be no monopoly right preventing its free use as a transformer-coupled low-frequency amplifier.

We believe that the Marconi Company, who own the master patents covering most of the standard methods of coupling amplifier valves, lay no claim to this particular arrangement.

At the same time it is well known that the company charge a royalty fee of 12s. 6d. for each valve stage incorporated in a multi-valve set, irrespective of whether the valve is used for high-frequency amplification, for detection, or for low-frequency amplification—transformer-coupled or otherwise.

Circuits which are not Patented.

It may be argued that it is unreasonable to claim such a tribute in respect of low-frequency valve amplifiers not specifically covered by patent rights, and that in the case of a receiver comprising, say, one high-frequency stage, one detector, and two transformer-coupled low-frequency stages, the patent royalties should be limited to the first two valves, leaving the L.F. stages free from any royalty payment.

Although this may appear, at first sight, to be both logical and equitable, it is very doubtful whether a claim for the free use of transformer-coupled L.F. stages in a multi-valve receiver could be maintained in the Courts.

The Strength of a Valid Patent.

It must be remembered that the owner of a valid patent has comparatively wide powers as to the price he can ask and the manner in which he will permit use of his patents. Provided the patentee supplies the reasonable demands of the public at a reasonable price—and in this connection it must be remembered that the merits of his invention will be considered in estimating what is a reasonable price—the law allows him practically a free hand.

Where wireless reception comprises the use of high-frequency valve amplification or grid-leak rectification, patent rights are admittedly involved, and the patentee may accordingly either claim a 25s. royalty (or more) on each of the first two valves, and let the unprotected valve stages go free, or he may, alternatively, and as a matter of his own greater convenience, distribute the patent royalties over the whole of the valve stages in use, so that they represent a uniform amount levied on each stage in the set.

Wireless Circuits which are Free.

In the case where wireless reception can be effected without necessarily involving the use of any patented apparatus, the question takes on a different aspect. For instance, if a simple crystal detector is coupled to subsequent stages of transformer-coupled low-frequency valve amplifiers, there should be no question of the payment of patent royalties, provided a standard type of circuit is used.

Once, however, a patented circuit is involved in the set, although it may only form a part of the receiver as a whole, the amount of the royalty to be paid for the privilege of using the particular circuit is a matter solely within the discretion of the patentee, so long as he does not outstep the limits of the proviso mentioned above.

There are, of course, other considerations which will affect the policy of the patentee in determining what price he will charge and how he will levy his tribute. For instance, if his terms are unduly high, the market

will naturally fall off and his net revenue may suffer accordingly, so that in his own interests he will adopt an intermediate course having due regard to the public demand for, and the value of, his invention.

The Position of the Gramophone Amplifier.

Recent developments in connection with the use of valve amplifiers for reproducing music from gramophone records open up the question as to whether any patent rights are payable in connection with transformer-coupled audio-frequency valve stages used for this purpose.

Here the question depends entirely upon the particular facts involved. A number of patents have been granted covering (*a*) specific methods of coupling the gramophone record to the input of the valve amplifier, and (*b*) systems of valve amplification in which the chain of mechanical and electrical impedances existing between the input "pick-up" and the output stage or loud-speaker are specially "matched" or balanced so as to avoid distortion.

Leaving such special methods out of consideration for the moment, it would appear that no patent royalty can be claimed on a transformer-coupled low-frequency amplifier when used simply and solely for reproducing music from a gramophone record.

The difficulty arises, however, both here and in the case of L.F. amplifiers intended for use with a crystal detector, that once a low-frequency amplifier has been constructed and sold, there is no guarantee that the amplifier will, in fact, be devoted to this specific purpose, and not applied to augment the output from an existing valve wireless set.

A Reasonable Compromise.

In the latter case, from the strictly legal point of view, the L.F. amplifier is probably liable to pay patent royalty as forming part of an integral combination involving patented parts. This follows from the principle previously referred to.

On the other hand, it certainly seems to be an unjustifiable interference with legitimate trade or use either to restrict the manufacture of standard L.F. amplifying sets *per se*, or to attempt to levy a patent royalty upon an article which, in fact, stands outside the scope of any patent grant.

In the circumstances, a reasonable compromise between the interests of the patentees and the general public might be found in requiring the maker of any transformer-coupled amplifier, intended solely for use with a crystal receiver, or for gramophone reproduction, to clearly mark or stamp such amplifier with an inscription stating that it must not be used in conjunction with H.F. or detector valves for wireless reception under the penalties attaching to the infringement of existing patent rights.

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CONTROVERSIAL BROADCASTS.

THE ban on controversial broadcasting has been lifted in as much as the Governors of the B.B.C. are now authorised to broadcast controversial matter at their discretion, provided that no editorial comment is made over the microphone on any controversial subject.

We must confess frankly that we have considerable misgivings as to the effect which this permission may have. We expressed the view earlier this year that the question of broadcasting controversial matter was one of national importance, that the responsibility for making a decision should not be thrust upon the Postmaster-General as an individual nor upon the Governors of the B.B.C., and that, in our opinion, it was a matter which should receive the close consideration of some much more representative body. What has happened actually, is that the Government has not accepted the responsibility, but has merely thrust it upon the Governors of the B.B.C., and left it to them to broadcast controversial matter at their discretion.

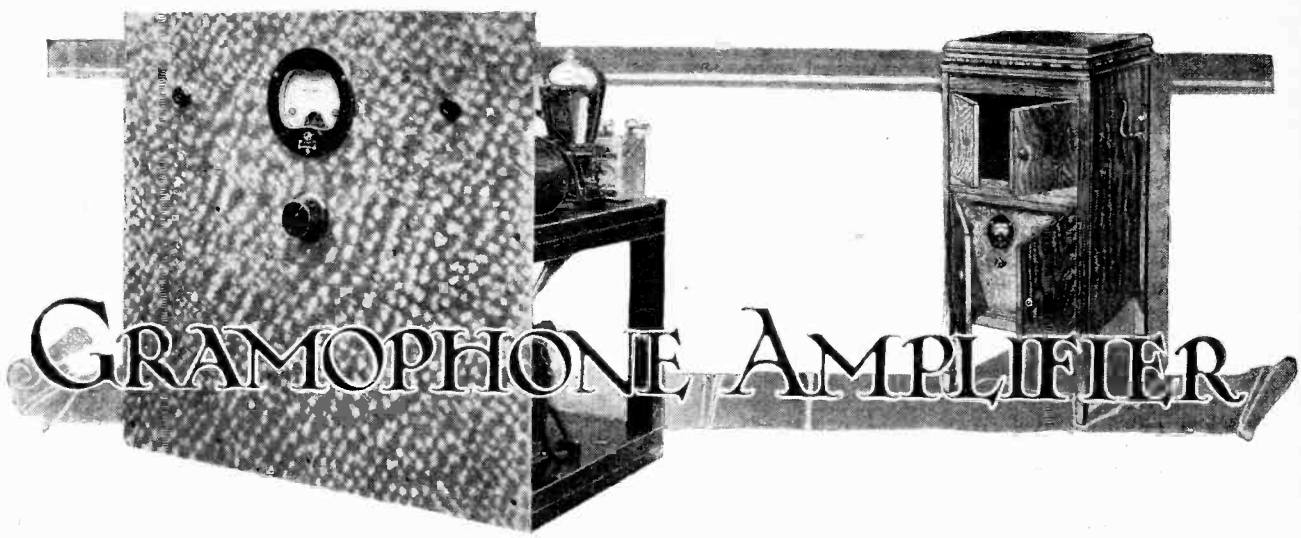
The Problem of Impartiality.

If we could be perfectly satisfied that, with the impartiality of a High Court Judge, the B.B.C. would deal fairly with all sides of controversial questions, we should not feel such uneasiness. We would even agree that no particular harm would be done if occasionally one side in an argument received preferential microphone treatment, provided that it was an accident, but what we foresee as likely to occur is that the Governors of the B.B.C., because they are human, will all unconsciously allow their own opinions or prejudices to influence the controversial broadcasts. To take an extreme case, if we have two sides of a topic of political controversy to be debated, it is quite easy to pick an eloquent speaker to sponsor the side to which the Governors of the B.B.C. may lean and permit to be put up against him a speaker who stutters to champion the less popular cause, and it would only require that this kind of thing should occur every now and then in order to impress upon the public a one-sided argument. We must face the fact that the Government which happens to be in power at the time are virtually the employers of the B.B.C. Board of Governors and Executive Staff, and it is inconceivable that the discretion of the Board of Governors would be so unfettered as to permit them to allow broadcasting to show up the policy of that Government in anything but a favourable light.

The Risk Involved.

It is difficult to see the essential difference between the broadcasting of editorial views on controversial matters and broadcasting debates or talks coming under the same category when the speaker and the nature of the talks may be subject to selection by the B.B.C. authorities. We do not intend to suggest, by these comments, that we mistrust the impartiality of the Board as at present constituted, and nothing would be more gratifying to us than to see this extraordinarily difficult task carried through without cause for regretting that the permission was ever granted. But one has to think of what the future may bring forth if the continuity of integrity of the present guiding spirits in the B.B.C. organisation is not maintained.

So long as the B.B.C. is virtually a Government concern, with Governors appointed by the Government, so long, we fear, will controversial broadcasts tend to favour the policy of whatever Government is in power rather than oppose it.

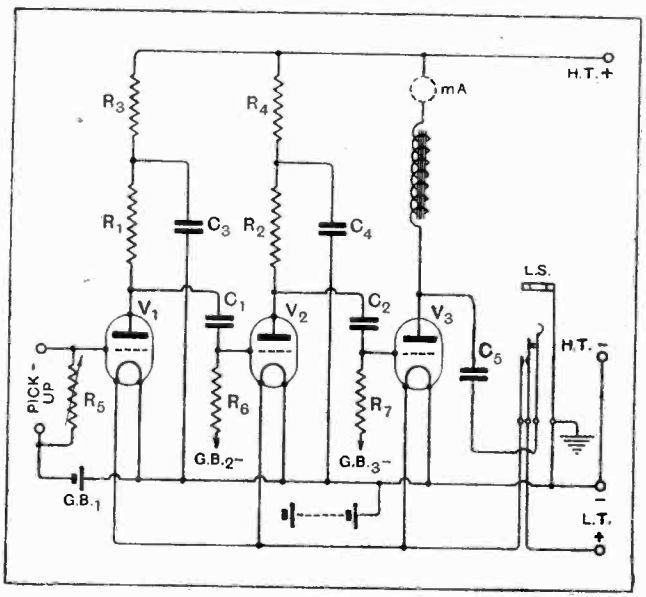


GRAMOPHONE AMPLIFIER

An All-resistance Amplifier Incorporating Important New Features.

INASMUCH as musical reproduction by the modern gramophone is of adequate strength and accepted as being tolerably like the original, a consideration of the reason for using an electrical pick-up and amplifier is indicated. Obviously the power available from the record is strictly limited. We know that for equal sound intensity of all notes of the musical scale that the air displacement is many times greater in the case of the low-frequency bass notes than it is for those of the higher frequencies. The relationship is one varying approximately inversely as the square of the frequency. Thus, when a gramophone reproducer is to create a bass note, a considerable movement must be imparted to its diaphragm so that the zigzagging groove on the record is required to deviate considerably. As the spacing of adjacent grooves is limited in order that a record will be of reasonable length, it follows that the sound energy available in the bass notes is strictly limited.

Incidentally, there is a falling off in the sensitiveness of the ear at the lower frequencies, so that, in order to reach the minimum audibility limit an overall amplification is called for. At the higher frequencies, also, limitations are to be found, and the harmonics through which the peculiar properties of particular sounds are conveyed necessitate a rapid transverse swinging of the groove. A point is reached in the upper frequency scale, where the radius of curvature of the groove is too small for the needle of the reproducer to follow. In the process of recording, the higher frequencies are not created with the full amplitude, and combined with a further possible loss in reproduction, and, again, a falling off in the ability of the ear to register the overtones, amplification is desirable. It is far better, therefore, that the strictly limited mechanical energy available from the revolving record should be converted to alternating electric currents, than that it should be used to directly set up air pressure waves of inadequate amplitude. The electrical reproducer, therefore, gives better bass and augmented upper register, bringing about a more realistic effect.



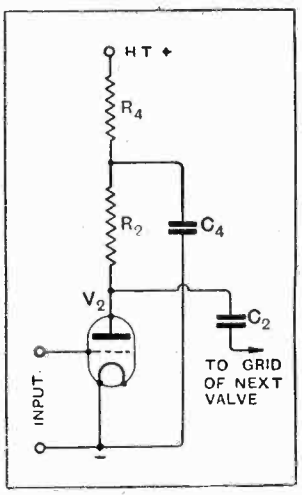
Values have been chosen to accommodate the increasing grid swing of each successive stage. R_1, 100,000 ohms; R_2, 60,000 ohms; R_3, R_4, 20,000 ohms; R_5, 500,000 ohms maximum; R_6, R_7, 3 megohms; C_1, C_2, 0.01 mfd.; C_3, C_4, C_5 2 mfd.

Gramophone records operate without loss in intensity arising from limitations in recording over a frequency range from 200 to 4,000 cycles, and bass frequencies down to 60 cycles, as well as very high overtones up to 6,000 cycles, are only slightly deficient. At one time records were made, though with great difficulty, by causing the sound wave created in the studio to directly operate the cutting stylus. This necessitated the use of volume increasing devices attached to the actual instruments, and a crowding of the artists around the recording horn. Studio echo effect, by which one unconsciously judges distance

Gramophone Amplifier.—

and location of the various sounds, was not satisfactory. The amount of power, under natural conditions, is inadequate for recording. Modern electrical recording affords artists the necessary comfort for good performance, while the situation of the microphone corresponds more correctly to the normal position of the listener so that he receives a correctly regulated echo effect.

The many types of pick-ups used with the electrical reproducer vary considerably in their property to produce an A.C. voltage of a correct linear relationship to the amplitude of the groove as well as in the actual maximum voltage which they create. Thus, a volume control device arranged as a shunt resistance across the pick-up is necessary to regulate the voltage swing applied to the first valve in order that the last valve shall not be overloaded. In the amplifier here described the volume control is directly associated, on the panel, with the plate circuit milliammeter of the output stage so that the input can be reduced to the point where the needle of the ammeter is stationary. Pick-ups are invariably of the high-resistance type, so that an input transformer, with its possibilities of introducing distortion, is avoided. It should be noted, however, that the leads from the high-resistance pick-up to the input valve should be reasonably short to avoid the effects of shunt capacity, which, if appreciable, will cause a cutting off of the higher frequencies and produce a marked lowering of tone.



The anode feed scheme as applied to V_2. The speech currents are diverted from the H.T. battery and pass through C_4 to earth.

The amplifier has been designed with a view to obtaining as even a response as possible to frequencies between about 30 and 8,000 cycles, assuming that a volume of signals that will fully load a modern cone loud-speaker fed from a P.M.256 or D.E.5A type valve with maximum H.T. voltage applied will be sufficient for the needs of the reader. From measurements that have been made with a number of commercial gramophone pick-ups, it is safe to say that a voltage swing of .3 is the highest that will have to be contended with, while with other pick-ups of less ambitious design the output may be but a fraction of one volt. The amplifier to be described is built specifically to handle an input of approximately $1\frac{1}{2}$ volts swing, but by altering the magnification factor of the first valve or by use of the volume control an adequate intensity of signals in the loud-speaker should be obtained from any pick-up on the market.

IMPORTANT NEW FEATURES.

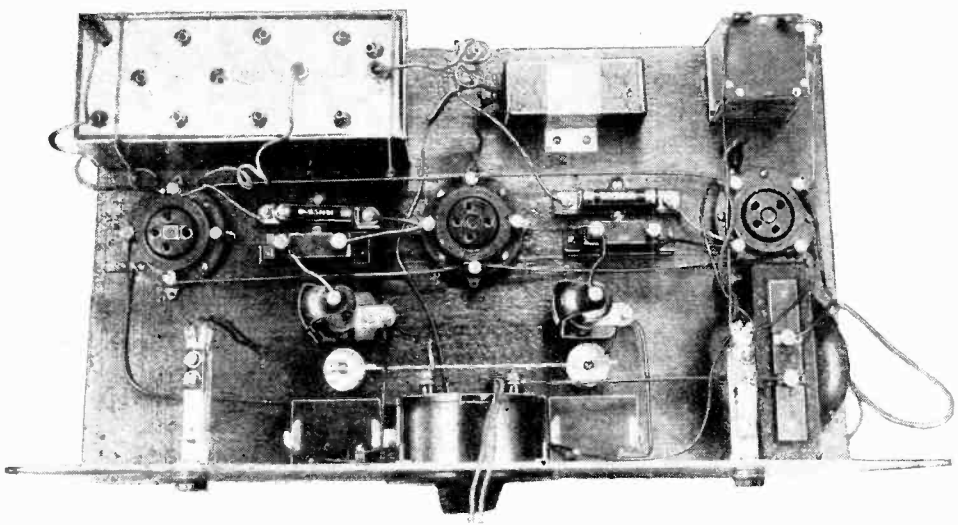
1. Deformation of frequency characteristic due to common anode supply impedance has been eliminated. "Motor boating" is entirely avoided irrespective of the source of H.T. supply.

2. Considerations of time constant in the intervalve couplings have been taken into account so that a proper response is obtained in the bass register.

3. High note loss due to the working capacity of the valves has been mitigated.

An appreciation of these points will undoubtedly lead to the adoption as standard practice of the several modifications here suggested for the first time.

It has been shown in a series of articles in this journal, under the title of "High Note Loss in Resistance Amplifiers," that, in order to obtain a reasonable percentage of notes at, say, 4,000 cycles and above, it is necessary when designing resistance-coupled amplifiers to avoid the use of high magnification-factor valves in conjunction with high anode resistances. The result, however, of employing valves of comparatively low magnification factor together with low anode resistances is naturally to give a lower overall amplification per stage, necessitating two resistance stages, where hitherto one was used, to bring the signal strength up to the required level. The addition of an intervalve transformer with the usual $2\frac{3}{4}$ or $3\frac{1}{2}$ to 1 ratio will obviously overload the last valve unless the volume control is permanently set to shunt away a large percentage of the output of the pick-up. Having decided on the adoption of two stages of resistance coupling, followed by a power valve coupled to the loud-speaker, it is necessary in the detailed design of the amplifier to pay careful attention to the following considerations :—



Plan view of the finished amplifier showing arrangement of parts and the easy method of wiring adopted.

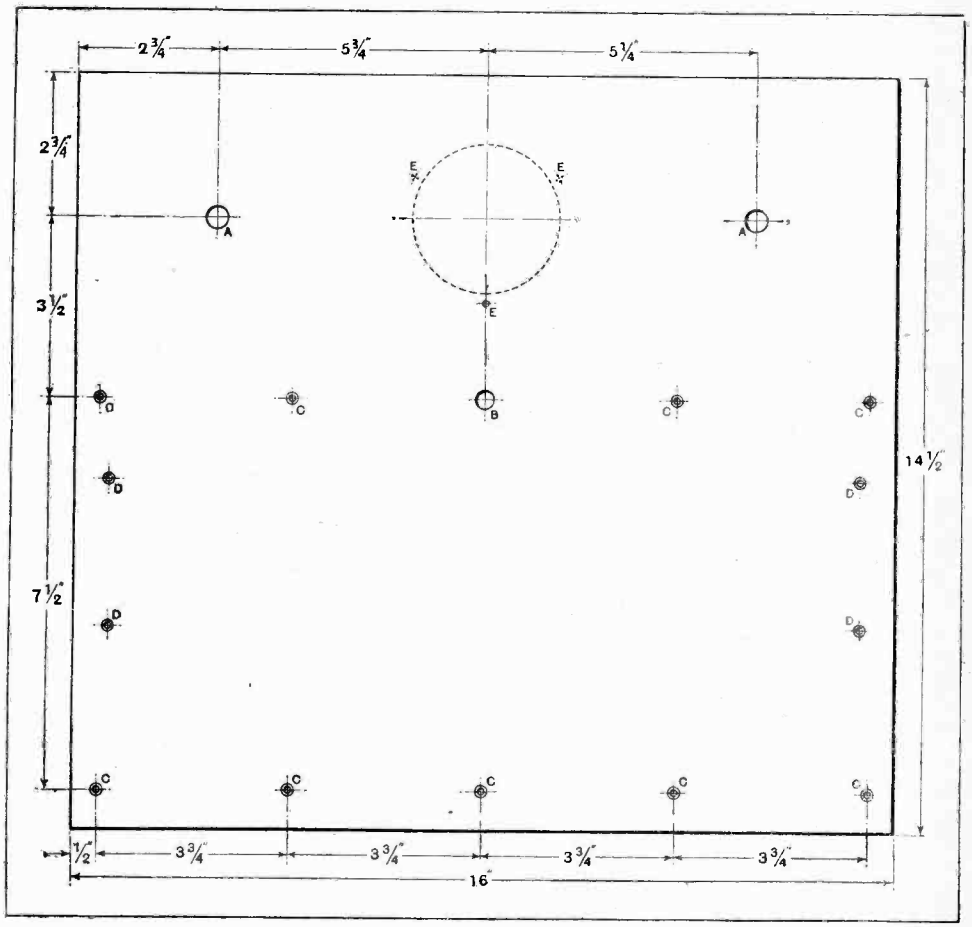
Gramophone Amplifier.—

(1) Eliminating deformation of frequency characteristic (therefore distortion) due to feed-back through common impedance of H.T. battery supply.

(2) Retention of low notes by proper proportioning of grid leak and condenser values while allowing for reasonably low time constant for the combination of these two components.

(3) Retention of high notes by avoiding high working capacities of high magnification valves used with large-value anode resistances.

(4) Graduating the grid-swing applied to each valve in such a way that the last valve is just fully loaded for a given input from the pick-up.

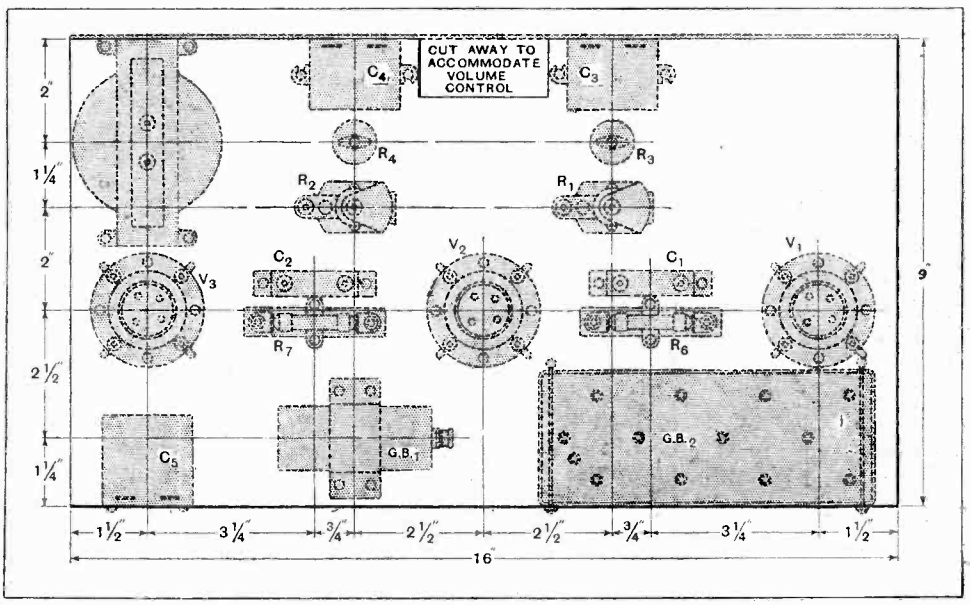


The front panel is constructed in this instance from No. 14 S.W.G. aluminium. A=⅛in., B ⅛in., C=⅛in. countersunk for No. 4 wood screws. D=⅛in. countersunk for No. 6 B.A. screws.

1.—Battery Feed-back.

In an article entitled "Back Coupling in L.F. Amplifiers,"[1] by M. G. Scroggie, it was shown that the impedance of the anode supply could never be entirely neglected, and curves were published showing the mutilation of frequency characteristic when batteries with an internal resistance as low as 100 ohms were used. It is safe to say that a very large number of listeners at the present time are using the large size dry cell H.T. battery in which the internal resistance of each 1½-volt cell when new is from 0.2 to 0.3 ohm, rising with age to 5 ohms per cell, so that it may be assumed that a large H.T. dry cell battery of 160 volts, together with leads, etc., will have a minimum internal resistance of about 25 ohms, which will rise appreciably very soon after being put into use, and may still retain a working voltage with an internal resistance of about 550 ohms. H.T. accumulators obviously have

[1] *Wireless World*, December 14th, 1927.



Dimensional layout showing assembly of components.

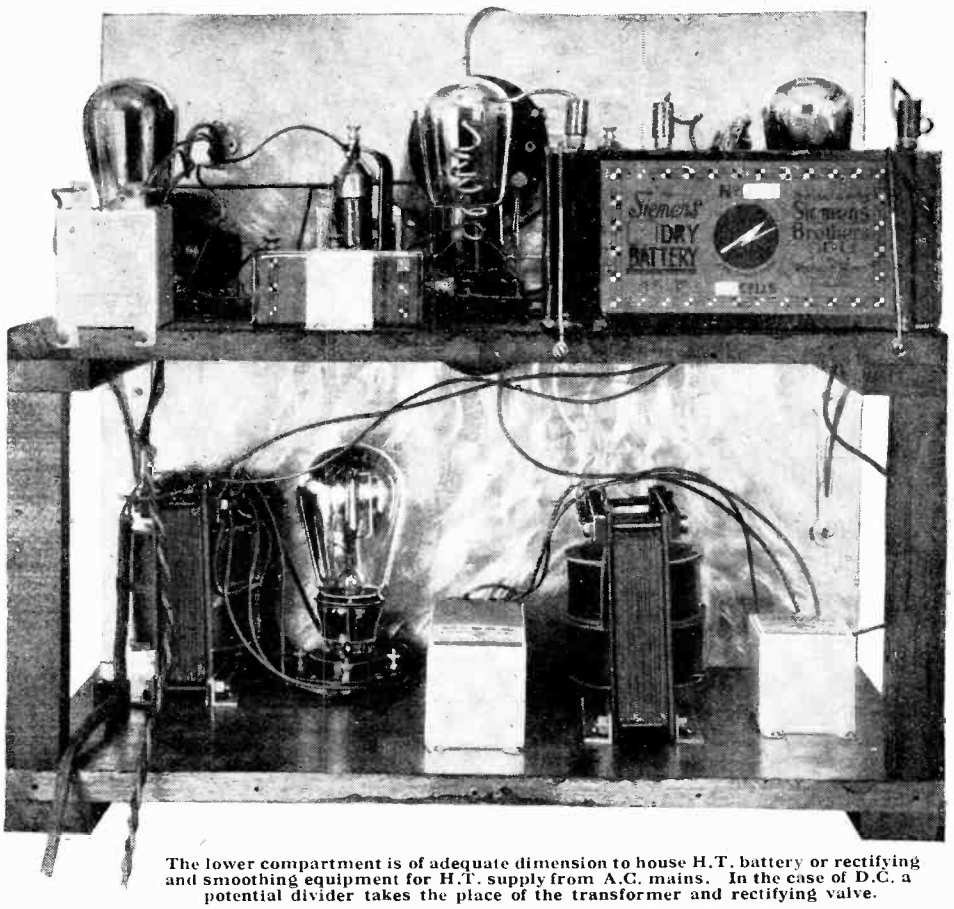
Gramophone Amplifier.—

a lower internal resistance per cell, but when partially discharged the resistance can be sufficient to cause incipient oscillation which creates distortion.

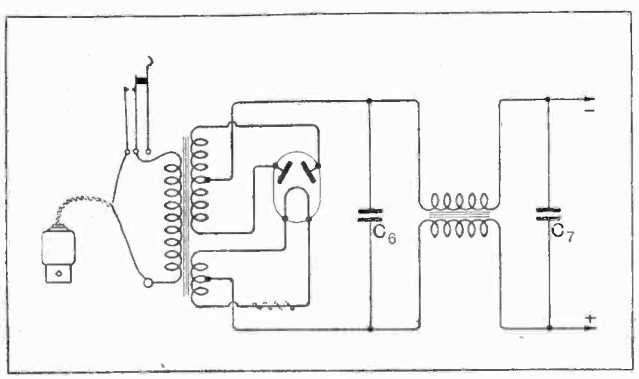
The popular combination of resistance coupling followed by a transformer is extremely prone to instability from battery back-coupling, and may oscillate with an audible howl when the battery resistance is as low as 80 ohms. The two-stage resistance amplifier here described, on the other hand, is reasonably stable, since it requires approximately 900 ohms to produce audible instability (actually "motor-boating" occurred). The test, however, was applied with the choke filter output removed. By diverting the speech frequencies in the plate circuit of the last valve from the H.T. battery by a filter circuit, the effects of feed-back are considerably lessened, but it is safer, in order to prevent coupling from earlier valves, to adopt the expedient of anode feed resistances for all plate circuits except the last. The overall magnification of the amplifier is such that L.F. oscillation was not anticipated, but unless some precaution be taken to prevent interaction between stages a hump in the frequency characteristic occurs.

A description of the anode feed scheme which has been developed by Messrs. Ferranti can be found in the issue of this journal dated January 4th, 1928. In brief, it may be described as a means of separating the speech currents from the direct H.T. current in *each* anode circuit, so that the effect of an H.T. battery of high internal resistance is practically nullified, so much so, in fact, that a popular set (with resistance and transformer coupling) which oscillated with 80 ohms battery resistance failed to give any signs of oscillation, or even diminution of signal strength with 1,500 ohms battery resistance, when the anode feed system was applied to it. It cannot be too strongly emphasised how necessary it is to take precautions to prevent distortion or instability due to incipient or actual L.F. oscillation in sets where there are two or more intervalve stages capable of passing L.F. impulses. A H.F. tuned-anode stage with a grid condenser such as might be used with a screened-grid valve will freely pass L.F. oscillations so that a 1.V.1 set of certain design may easily be as unstable as a 0.V.2 set unless the effects of battery resistance are combated. The shunting of the H.T. battery by reservoir condensers of the order of 2 mfd. is of little or no value when the tendency to oscillate is at low frequency.

The anode feed scheme, as applied to the second valve of the gramophone amplifier, is shown in the diagram on page 266. A discussion on the values of the feed resistances will be given in clause 4. It is hoped at an early date to include in the pages of this journal the results of a series of tests of the various methods advocated for eliminating the effects of L.F. feed-back.



The lower compartment is of adequate dimension to house H.T. battery or rectifying and smoothing equipment for H.T. supply from A.C. mains. In the case of D.C. a potential divider takes the place of the transformer and rectifying valve.

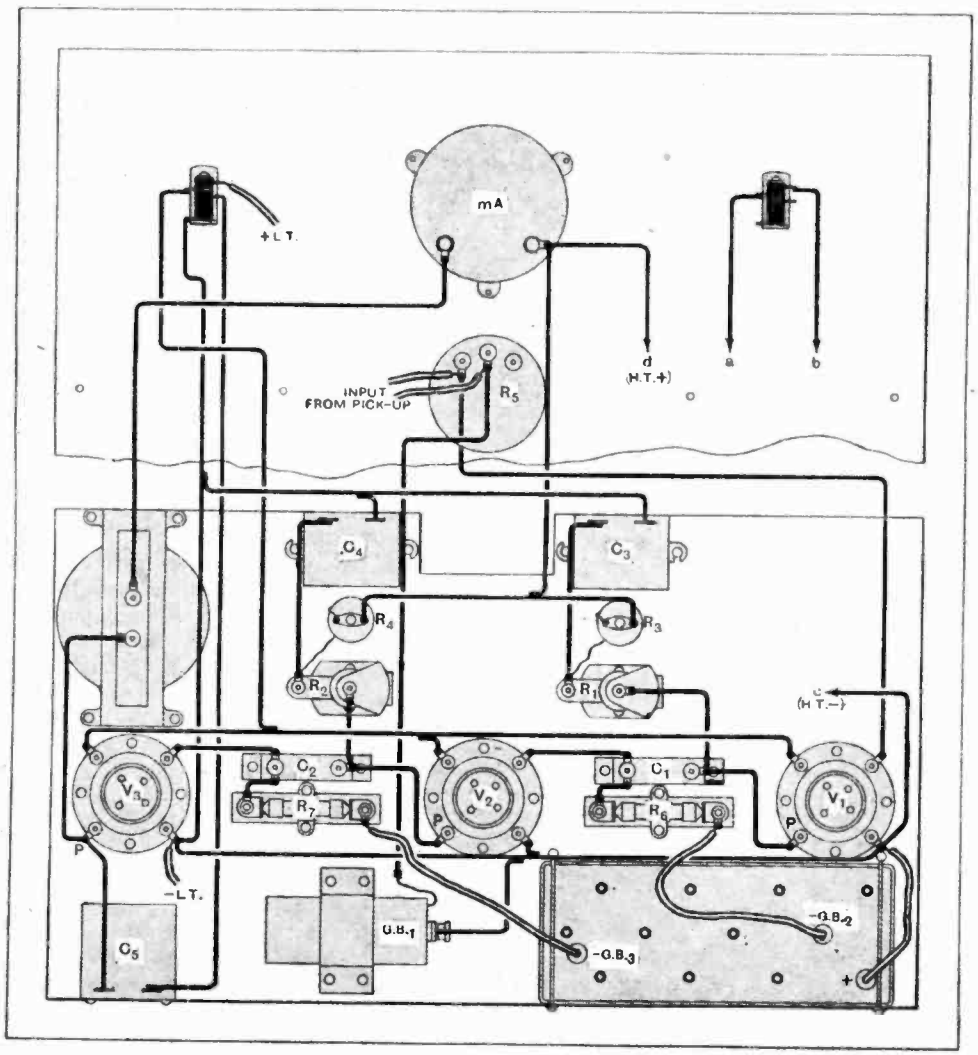


Circuit of A.C. rectifier. C_6, 6 mfds; C_7, 4 mfds. The break switch is accommodated on the instrument panel. The contacts are, of course, insulated from the panel.

Gramophone Amplifier.—

2.—Retention of Low Notes.

The relation between the values of the coupling condenser and grid leak for passing any definite percentage of, say, 30 cycles is given by a formula which has been published from time to time in this journal, but consideration must also be given to the time constant of the condenser-leak combination, for with whatever reasonable margin of safety an amplifier has been designed, there are bound to be sudden peak voltages which will cause grid current to flow. It is important to observe, however, that in an amplifier for gramophone reproduction only, the effect of atmospherics has not to be taken into consideration. The time constant (T) equals the product of the values of the condenser capacity and leak resistance, and to work with convenient units the capacity (C) is best expressed in microfarads and the leak resistance (R) in megohms. Thus $T=CR$, so that, taking 0.005 as a suitable value for T in a single stage amplifier, we can make C = 0.0005 mfd. and R = 10 megohms, and still have theoretically the same time constant as a circuit in which C = 0.01 mfd. and R = 0.5 megohm. In the first case, however, the low notes will definitely be cut off by the low value condenser, and the grid to filament working capacity of the valve will probably have an impedance at low frequencies of the same order as that of the leak; it is therefore in practice inadmissible to use 10 megohms.[1] On the other hand, a leak of 0.5 megohm or under will have a noticeable effect in shunting away signal energy. We must perforce compromise and use a leak between 0.5 and 5 megohms, provided that the value chosen is at least ten times the value of the preceding anode resistance for these two components are virtually in parallel.



Appearance is greatly improved by using stiff wiring of No. 18 S.W.G., though No. 22 wire in sleeving is permissible and renders wiring much easier.

Since overloading due to atmospherics is avoided in the present case, it is safe to employ a time constant of about 0.03 for a two-stage amplifier in which the condenser can be 0.01 mfd. and the leak 3 megohms. These values are employed in the amplifier and will give a satisfactory pass of low notes. It is often forgotten that the choking effect due to grid current will be the same for a 0.5 megohm and a 5 megohm leak, provided the time constant of the circuit is the same in each case.

3.—Retention of High Notes.

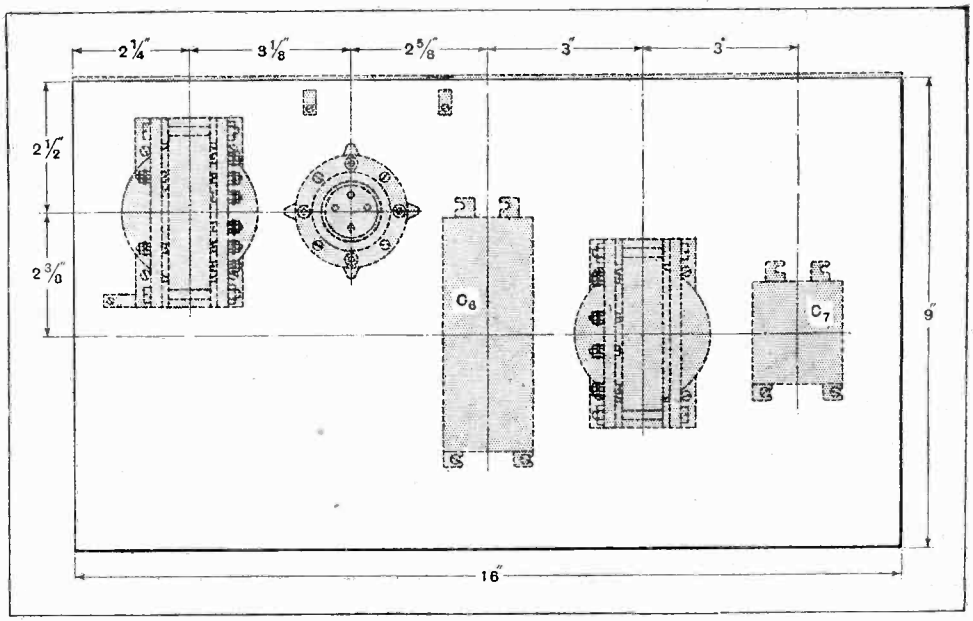
Little more need be said under this heading to amplify the conclusions arrived at in the series of articles entitled "High Note Loss in Resistance Amplifiers" already referred to. Low-magnification factor valves and small value anode resistances have been used, and since no radio frequency amplification nor detection is employed before the amplifier, no plate-filament shunting condenser is required. The total working capacity of any of the valves with the stray capacity of the components is well under 100 micromicrofarads in each case, so that a satisfactory percentage of the highest notes should be retained. There will be no "woolliness" in speech, a condition that is often associated with the use of a high-magnification factor valve as detector, with high anode resistance in conjunction with a resistance-coupled stage.

[1] *Experimental Wireless*, December, 1927. A Graphical Method of Amplifier Design, by Marcus G. Scroggie.

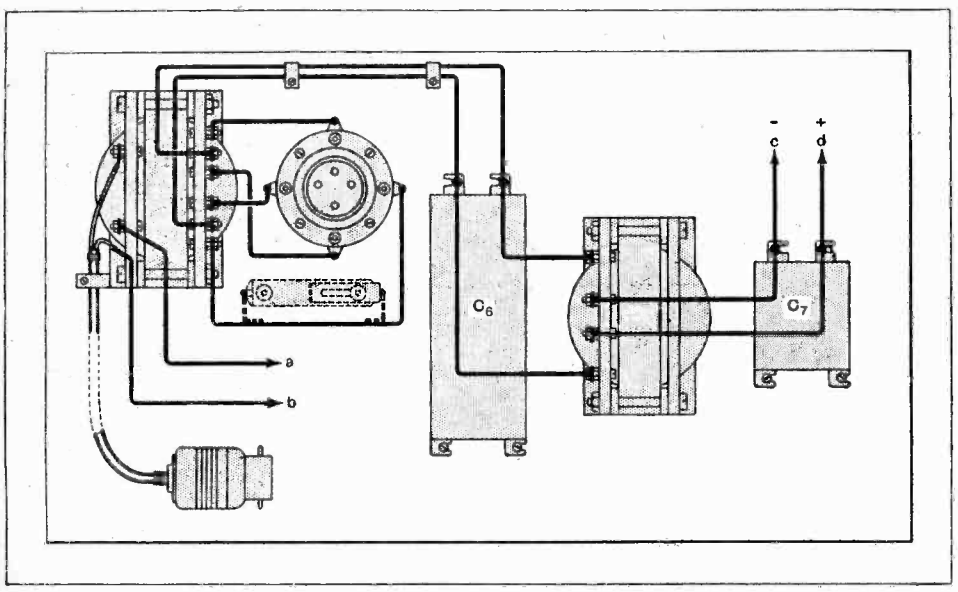
Gramophone Amplifier.—

4.—Graduating the Grid-Swings.

On the assumption that for domestic use about 160-180 volts H.T. feeding a single power output valve of the P.M.256 or D.E.5A class represents the economical limit, we can at once decide on the necessary overall magnification so as to provide about 45 volts grid-swing, which is the maximum signal-handling capacity of the power valve at the H.T. voltage specified. Assuming an average input of $1\frac{1}{2}$ volts (total swing) from the pick-up, it is clear that the two resistance stages have between them to amplify 30 times. A reasonable combination is 6×5; therefore two valves of the D.E.5 class ($\mu = 7$; Impedance = 8,000 ohms) have been chosen. The actual stage amplification A is given by the formula $A = \mu \frac{R}{R + R_a}$, where μ is the magnification factor of the valve as given by the makers, R is the anode-coupling resistance (which should not be less than 5 times the impedance of the valve), and R_a is the *working* impedance of the valve, which will be greater than the figure given by the makers. If the formula be worked out it will be seen that the stage gains are sufficiently near those specified. The grid-swings are approximately as follows: First valve, $1\frac{1}{2}$ volts; second valve, 9 volts; third valve, 45 volts, so that the bias which must be applied is $1\frac{1}{2}$, $4\frac{1}{2}$, and $22\frac{1}{2}$ volts respectively; the bias on the first valve is fixed at $1\frac{1}{2}$ volts to accommodate the optimum grid-swing of the pick-up with the largest output. Should the output of the pick-up used be under one volt it may be found desirable to use a D.E.5B as the first valve. The only problem that arises is whether the second valve (a D.E.5) can handle 9 volts swing on the straight part of its characteristic when an anode feed resistance of sufficient value (say, 20,000 ohms) to prevent L.F. feed-back is used in its H.T.+ circuit, besides the 60,000 ohms coupling resistance when the total H.T. voltage is 160.



Layout of components forming the A.C. rectifier and smoothing circuit. When the lower base-board is fitted up for use with A.C. supply, it will be found advisable to clamp a thin sheet of copper foil under the battens of the upper board as a screen.



Wiring of simple A.C. rectifier. A filament rheostat is recommended for use with a valve of the U5 type. The reference letters show the connections to be made to the amplifier.

An anode current-grid volt curve for the D.E.5, plotted with a 60,000-ohm resistance included in the plate circuit, shows that the lowest possible H.T. voltage to give sufficient straight characteristic is about 100, and with $4\frac{1}{2}$ volts bias the anode current is a little under 1.5 mA. If we divide the greatest voltage drop (60) that we can tolerate by the anode current (0.0015 amp.), *i.e.*, $\frac{60}{0.0015}$ = 40,000 ohms, we obtain the largest value anode-feed resistance that it is possible to use. It will thus be seen that the 20,000-ohm resistance used gives an ample margin of safety.

The above considerations will reveal that poor quality

LIST OF PARTS.—AMPLIFIER.

Panel, 14½×16 in. If of aluminium No. 14 S.W.G., Paxolin or Pertinax 3/16 in., Ebonite ¼ in.
Planed ½ in. Mahogany for Baseboards, 16×9 in. Strips of wood for battens and uprights.
Piece of thin copper foil, 16×9 in.
3 Valve holders (Lotus).
2 Brackets (Camco).
2 Condensers, 0.01 mfd. (Dubilier type 620).
2 Grid leaks with bases (Mullard).
2 Anode resistances with vertical mounts, 100,000 and 60,000 ohms (R.I. and Varley, Ltd.).
3 Condensers, 2 mfds., 500 volt D.C. test (Hydra).
2 Resistances, 20,000 ohms (Ferranti), or ½ oz. No. 47 D.S.C. Eureka wire and 2 small porcelain bobbins.
Output choke, 32 henries (Pye).
Volume controlling resistance 500,000 ohms ("Centralab," Rothermel).
Loud-speaker Jack with filament circuit contacts (Igranic type P. 65), complete with plug.
On and off switch in eliminator circuit insulated from panel.
Grid bias battery, 36 volts (Siemens type 327).
Grid bias cell (Siemens type T).
Milliammeter, 50 mA. (Ferranti, type No. 3).
Price £7 0 0.

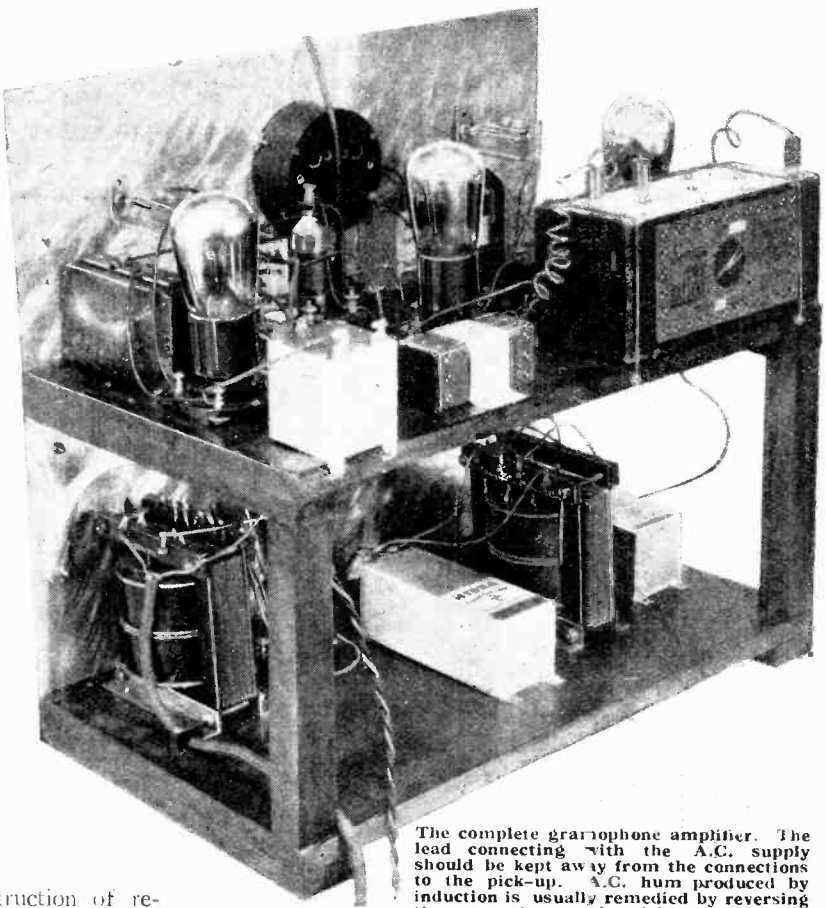
A.C. ELIMINATOR.

Transformer to suit supply with outputs of 3+3 volts for the "U.5" valve and 180+180 volts (Parmeko, Partridge & Mee, Ltd., 12, Belvoir Street, Leicester).
Condenser, 6 mfds. 500 volts D.C. test (Hydra).
Condenser, 4 mfds. 500 volts D.C. test (Hydra).
Double wound smoothing choke (Parmeko).
Filament rheostat, 6 ohms max.
Lamp socket adaptor.
Price £3 10s.

In the "List of Parts" included in the descriptions of *THE WIRELESS WORLD* receivers are detailed the components actually used by the designer, and illustrated in the photographs of the instrument. Where the designer considers it necessary that particular components should be used in preference to others, these components are mentioned in the article itself. In all other cases the constructor can use his discretion as to the choice of components, provided they are of equal quality to those listed and that he takes into consideration in the dimensions and layout of the set any variations in the size of alternative components he may use.

due to battery feed-back, loss of both high and low notes, and distortion due to overloading, should have been eliminated as far as possible in the gramophone amplifier here described.

Probably the most convenient method of building an electric reproducer is to house the amplifier in the space normally provided as a record cabinet. Although this particular design has been adopted here, the amplifier is equally suitable for sliding into a cabinet. For use with the gramophone, external high-tension batteries would be inconvenient, and the amplifier has, therefore, been constructed as a simple arrangement of two baseboards, one above the other, so that the lower section can accommodate H.T. battery, or D.C. or A.C. mains eliminator, with the complete amplifier above. Simplicity of construction has been the primary aim in design. The aluminium panel can be purchased cut to any required size with its machined markings and protective lacquering. An ebonite or bakelite panel ¼in. in thickness can be substituted, or in the case of a "Paxolin" or "Pertinax" panel the thickness need not be more than $\frac{3}{16}$in. The baseboards are of ½in. planed mahogany, battened at the ends, the upper baseboard being bracketed to the panel. Two light uprights at the back clamp the baseboards securely together.



The complete gramophone amplifier. The lead connecting with the A.C. supply should be kept away from the connections to the pick-up. A.C. hum produced by induction is usually remedied by reversing the connections to the pick-up or running an additional lead from the frame of the pick-up to the L.T.—through a 1 mfd. condenser.

Rigid wiring, the practice in the construction of receiving sets, has not been employed, a departure which greatly simplifies construction, and, in this instance, is permissible. The precise dimensional layout of the components is immaterial, though their disposition with regard to each other should be followed, as it will facilitate wiring. Other than the connections to the jacks, the wiring does not involve the use of a soldering iron. No. 22 tinned wire loops from point to point, pieces of sleeving being measured off and slipped over the leads. As already explained, the amplifier has been designed to operate from a single H.T. supply without danger of distortion by back coupling. The small resistances of about 20,000 ohms introduced for this purpose may either be purchased and of a type similar to the anode resist-

Gramophone Amplifier.—

ance, or, owing to the comparatively low resistances, can be readily wound with the aid of a hand brace clamped in the vice. They consist of 100 yards of No. 47 D.S.C. "Eureka" wire.

Whether A.C or D.C. mains are available, the smoothing circuit, consisting of double wound choke and bridging condensers, is adopted. For use with A.C. a transformer and rectifying valve, type U5, are shown.

On open circuit, a potential of 180 volts R.M.S. is obtained across the transformer output winding when 240 volts is applied across the primary, stated to be suitable for 220/240-volt mains. Practically the peak potential of the alternating voltage is given at the output terminals of the eliminator when on open circuit. The moderate resistance of the smoothing choke, transformer winding, and the valve has the effect of reducing the output D.C. potential when on load. Actually a current of 25 mA. is taken by the amplifier, and the voltage across the output shunt condenser when determined was found to be 175.

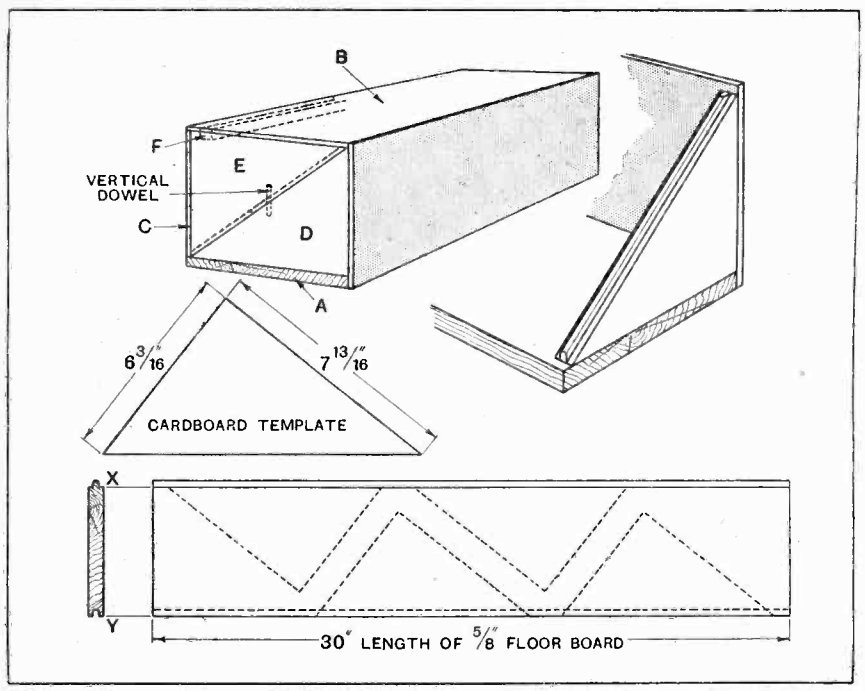
With D.C., if the voltage is less than 190, the supply may be joined directly to the smoothing circuit; if greater, fit an inexpensive potential divider. Like the amplifier entailing merely the screwing down of components to a baseboard, there are no constructional details worthy of mention in the making of the eliminator.

So that the electrical reproducer may be entirely self-contained, except for the L.T. accumulator, the output can connect to a gramophone adapter attached to the tone arm in cases where the gramophone pick-up is provided with a separate tone arm. A better loud-speaker than the one provided in this manner may be considered worth while, though for good moving coil loud-speaker reproduction the voltage swing of the output valve (D.E.5A or P.M.256) is scarcely sufficient. For moving coil loud-speaker operation the output stage may be built as a separate unit and consist of one or more parallel-connected L.S.5A or B.12 valves working with an anode potential of at least 250 volts. A F.H.H./W.I.G.P. output choke of liberal current-carrying capacity and low resistance is required as well as a higher voltage feed condenser.

EXPERIMENTER'S WIRELESS CABINET.

The conventional cabinet is both an extravagance and a nuisance in connection with an experimental set, as battery leads have to be disconnected to withdraw the set from the cabinet.

The design illustrated makes it freely possible to work on the set at a moment's notice, and should not cost more than two or three shillings.



Experimenters cabinet for panel 21in. × 7in. × 3/16in. A = baseboard = 24in. × 8in. × 5/8in. B = top board = 24in. × 8in. × 3/16in.—3-ply. C = backboard = 24in. × 6 3/16in. × 3/16in.—3-ply. Note.—If terminal strips are fitted 6 3/16in. height will have to be cut away to suit strips. D = 2 end pieces cut out of grooved side of floor board long edge of template to match edge 7 E = 2 end pieces cut out of tongued side of floor board long edge of template to match edge X, the depth of tongue being required as a surplus. F = one batten 19 3/4in. long × 1/2in. square.

The panel is attached to the baseboard with two triangular brackets which form half the ends. The cover consists of a top and back of three-ply fastened to two triangular ends which match the brackets.

These triangular ends are cut from grooved and tongued floorboard easily obtainable from any builder and most joiners. The tongue and groove are arranged to lock the top cover in the bottom portion; two wood screws with heads filed off act as vertical dowels. The whole thing can be knocked up in an hour, and, if stained, looks a very creditable job.—J. W. M.

oooo

WOOD STAINS.

The following list of stains will be found most useful by the amateur who elects to purchase his cabinet unstained, and who through considerations of cost prefers to finish off the woodwork himself:—

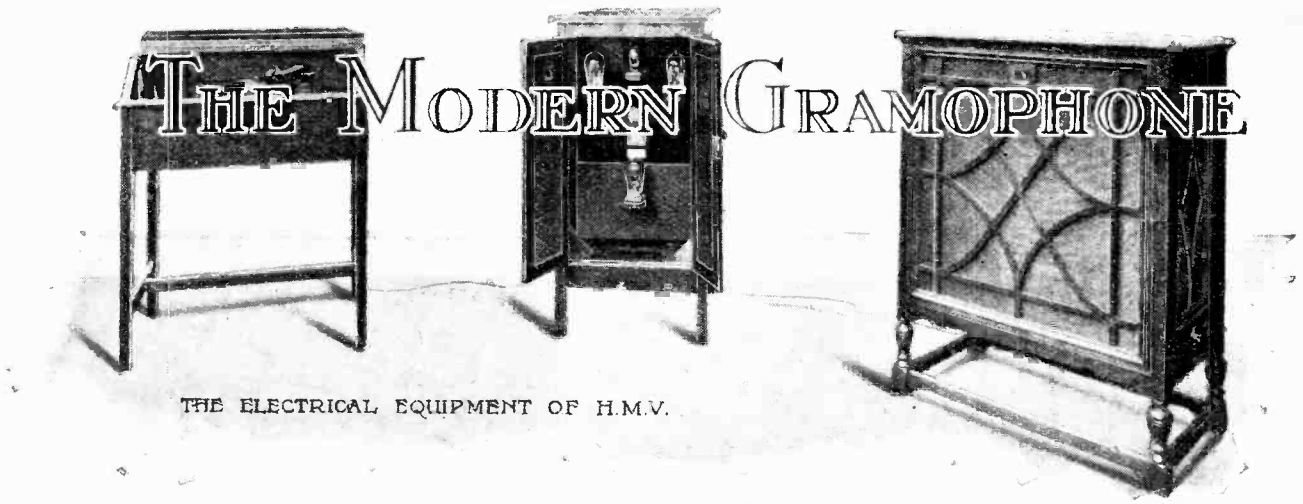
Oak.—Dissolve ½ oz. of permanganate of potash in ½ pint of rain-water. Two or three applications may be needed.

Mahogany.—Dissolve ½ oz. of Bismarck brown in ½ pint of methylated spirit.

Walnut.—Dissolve a handful of common washing soda in a quart of water, adding brown umber until the desired colour is obtained.

Black.—Dissolve ½ oz. of black aniline dye in ½ pint of methylated spirit.—R. W. T.

THE MODERN GRAMOPHONE



THE ELECTRICAL EQUIPMENT OF H.M.V.

Realistic Reproduction by Means of Valve Amplifiers.

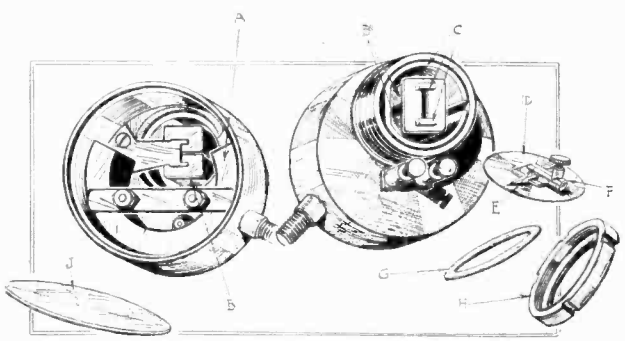
PHONOGRAPHIC reproduction, like broadcast reception, can only be considered perfect when the sound produced exactly corresponds with that which would be heard if listening to the actual performance. Certain obvious limitations prevent such an effect being obtained, though there are important considerations which are generally not appreciated. Studio and room conditions and dimensions have a profound effect upon the extent of similarity between listening to the original and the reproduced. In addition, there is the directional effect created by listening with two ears to the original as compared with listening through a single channel as is the case with all reproduced music. Attention is drawn to these points as it is not merely the frequency characteristic commonly associated with L.F. amplifiers that determines quality, and it is gratifying to learn that a general study of musical reproduction on a quantitative basis is probably more in evidence in the gramophone factory than in the designs departments of our radio manufacturers. Such, however, was found to be the case at the works of the Gramophone Company at Hayes, Middlesex, better known, perhaps, as the manufacturers of "His Master's Voice" products.

That the valve amplifier has revolutionised the processes adopted for recording is an acknowledged fact, and more recently the valve amplifier has been applied to gramophone reproduction. Why should an L.F. amplifier, interposed between the vibrating needle, the reproducer, and the diaphragm of the loud-speaker device improve the quality of reproduction? It would seem that the amplifier can only introduce further risk of distortion.

Primarily the amplifier is used to increase the volume beyond that strictly limited output which can be obtained from the needle running in the groove. A raising of the sound level by the valve amplifier produces a strong bass register from notes normally too weak to be audible. It must be borne in mind that it is the bass notes on the record which are limited in their amplitude by the spacing between adjacent grooves and for an equal sound intensity to a note in the middle register a bass note must be recorded by a much wider swinging of the groove. A limitation in the intensity of notes in the upper register is brought about by the high frequencies requiring a rapidly zigzagging groove of a smaller radius than the needle can follow.

The Pick-up and Record Wear.

These points are of first importance in the design of the pick-up device, and one readily realises that there is just a little more in the design of a gramophone pick-up than the provision of a needle actuated armature before the pole of an electromagnet. Its voltage output must bear a linear relationship to the amplitude of the movement of the needle running in the groove while it must faithfully follow the contour. Excessive wear will result, and a record will be rapidly ruined if there is any tendency to stiffness or armature resonance, the needle damaging the groove by bounding hard against the sides and jumping the bends.



"HIS MASTER'S VOICE" GRAMOPHONE PICK-UP. A, field magnet; B, bobbins on divided end of magnet pole; C, the poles; D, the steel diaphragm; E, iron attachment for needle holder; F, brass end to prevent needles sticki g; G, oil retaining washer; H, diaphragm clamping ring; J, back cover ring.

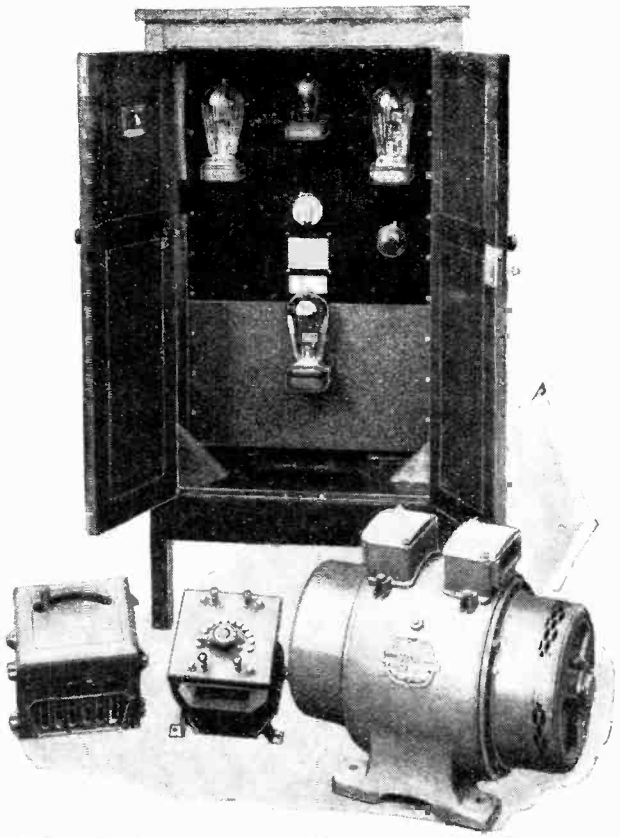
The pick-up manufactured by the Gramophone Co. is of original design. The two poles of the polarised field are presented to a small steel diaphragm to which the needle holder is attached,

The Modern Gramophone.—

the latter being built partly of brass and partly of iron, and serves as a path for the lines of force to prevent magnetic saturation. The brass piece spaces the needle from the magnetic field so as to facilitate release in needle changing. A heavy permanent magnet creates a high flux density across the gap in front of the poles, and the flexing of the diaphragm about a centre point is such that the pick-up is differential in its action. A substantial brass case totally encloses the magnet and its bobbins. It is with interest that one learns that the interior is oil filled, the oil being carefully selected to be of suitable viscosity. It circulates between the poles and produces a degree of damping in a far more satisfactory manner than can be obtained by spring tensioning with elastic rubber stops. To prevent corrosion of the diaphragm, which is no more than three thousandths of an inch in thickness, it is gold-plated.

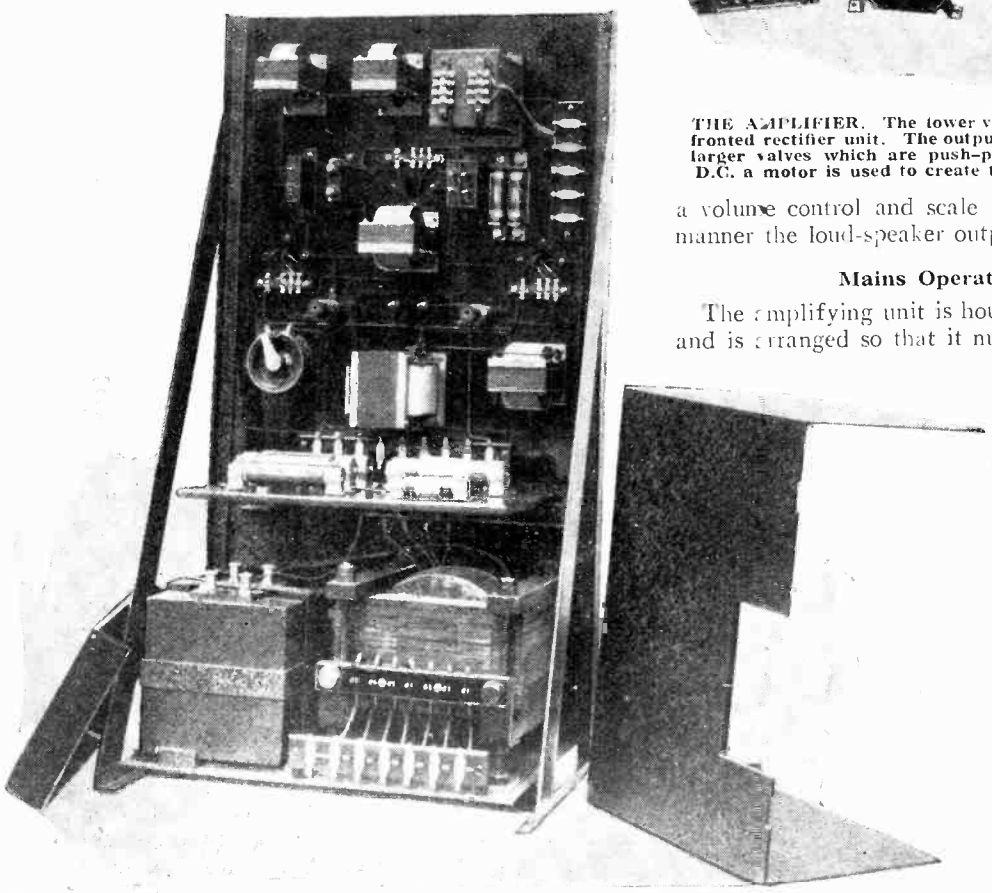
Correct pressure by the needle on the surface of the record is obtained by pivotting the pick-up, a counter weight being concealed in the tone arm.

For use with the standard equipment the pick-up is low resistance wound so that the playing desk may be situated remote from the amplifier and the quality not impaired by the appreciable capacity of the connecting leads. As well as an electrically-driven turntable and accommodation for records, the playing desk is fitted with



THE AMPLIFIER. The lower valve is associated with the metal fronted rectifier unit. The output of the small valve feeds the two larger valves which are push-pull connected. If the supply is D.C. a motor is used to create the necessary A.C. power input.

a volume control and scale which controls in a uniform manner the loud-speaker output.



The amplifier is entirely A.C. mains operated. A screening box totally encloses the rectifier.

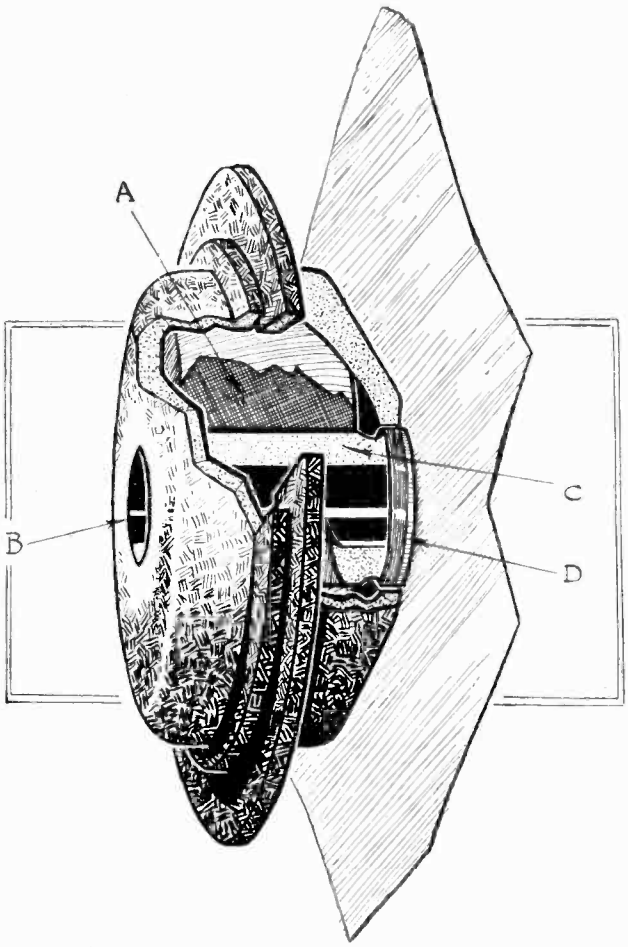
Mains Operated Amplifier.

The amplifying unit is housed in a vertical oak cabinet and is arranged so that it may be set up out of the way and at some convenient point for connecting with the power supply. It is a two-stage amplifier with a modified arrangement of push-pull intervalve coupling. To prevent induction noises the centre point on the primary of the input transformer is earth-connected, the secondary connecting to the grid of a special valve with suitable characteristics. Precautions are taken to prevent parasitic oscillation, and an examination of the circuit system reveals many points of interest in the light of recent knowledge on the subject of oscillation in L.F. amplifiers. "Osram" valves of the D.E.T.1 type, well

The Modern Gramophone.—

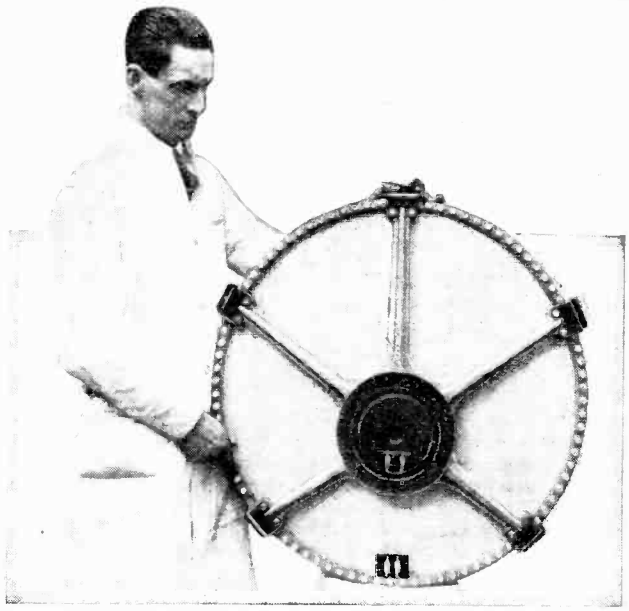
known to transmitting amateurs, are fed by the push-pull transformer, the transformer in the anode circuits having a centre-tapped output winding which is earth-connected. Again, owing to the possibility of the loud-speaker leads possessing appreciable capacity a low-resistance output winding is adopted. Thus, the loud-speaker as well as the pick-up may be installed wherever required with little regard to the length of wiring.

No batteries are employed in the amplifier, so that the possibility of inconsistent working and the troublesome maintenance associated with the use of batteries are avoided. Alternating current supply is rectified by a single valve of the U.6 type, the various potentials required including grid biasing being obtained by a combination of resistances. The filaments are A.C. heated. In the event of A.C. supply not being available a motor generator is supplied. Screening is liberally provided to prevent A.C. ripple reaching the amplifier circuits. A thick panel of black Paxolin, which, as well as being non-brittle, is unaffected by climatic conditions, is used for the



THE COIL DRIVEN DIAPHRAGM. A, field winding; B, ventilating hole through the pole; C, centre pole; D, moving coil attached to diaphragm.

main apparatus panel, and carries in addition to the valves a plate circuit milliammeter to indicate that the output valves are being correctly operated and that the amplifier is not being overrun. Most of the components used, including the transformers and chokes, are built in the Hayes factory. Although amplifier construction is an



The loud-speaker consists of a stretched aluminium diaphragm of large diameter with the coil drive offset from the centre.

entirely new departure in the factory, the layout, assembly, and wiring of the parts follows high-grade electrical instrument-making practice.

A New Loud-speaker Design.

The loud-speaker diaphragm is no less than 30in. in diameter and is of extremely thin, hard aluminium sheet. Substantial cast aluminium rings clamp the edge of the diaphragm, which is in a stretched condition. Uniform tensioning across the surface is tested while the diaphragm is being mounted and when the correct pull is obtained, about 100 bolts clamp the diaphragm to the rings. A chromic plating process renders the surface of the aluminium durable without adversely affecting its elastic properties. The drive is a moving coil of edge-wise-wound copper strip carried on a split aluminium ring mounted on the diaphragm at a point displaced from the centre. Radial arms clamped to an aluminium ring support the field magnet. As sideways movement of the moving coil is not possible, only a small air gap is provided, across which an intense field is created with a consumption of some 25 watts. This diaphragm is capable of free movement through the larger amplitudes required for reproduction of the bass notes, though it does not produce a predominance of bass to the sacrifice of the higher note frequencies. Its larger diameter gives the necessary air displacement at the low frequencies without the need of a baffle board to prevent a neutralising of the compression and rarefaction waves simultaneously emitted from opposite sides of the diaphragm. The loud-speaker is mounted in a large cabinet, with grille cover front.

This equipment is undoubtedly suitable for the reproduction of music in a large public hall, and apart from the merit of its frequency characteristic is more realistic

The Modern Gramophone—

than a coil-driven horn loud-speaker owing to the uniform field produced with absence of marked directional effects. Volume can, however, be reduced to home requirements without a marked raising of pitch usually associated with small output. An examination of the frequency characteristic shows that an almost uniform response between 100 and 4,000 cycles per second. Limitations in the process of recording render an extension of this range unnecessary. Actually a range of frequencies between 50 and 5,000 can be recorded and reproduced with the electrical reproducer with only a slight falling off towards the upper and lower limits. It is probable that no reproducing apparatus is capable of dealing with frequencies below 50 cycles, though the effect of lower notes may actually be created owing to that property of the ear to add the fundamental note of which only the harmonics are present.

RECENT INVENTIONS.

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

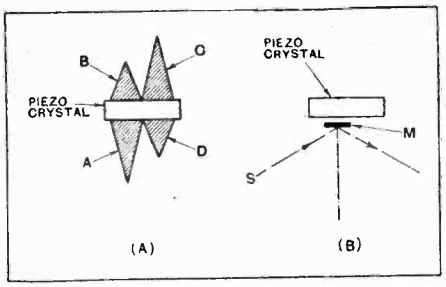
Piezo-Electric Indicators.

(No. 268,367.)

Convention date (Germany): 25th March, 1926.

The inventors have discovered that when a piezo-crystal is set into oscillation at its natural frequency, comparatively powerful air-currents or eddies are set up at certain points along the surface of the crystal. For instance, if a fine powder, such as lycopodium, is strewn over the crystal when impulsed by a high-frequency current, the powder is blown away from the sides of the crystal over the spaces marked A, B, C, D, in Fig. A.

This effect is utilised to give a visual indication of the character of the applied high-frequency oscillations. According to one method, the resulting air currents are caused to play upon a fluid jet or syphon recorder, so that corresponding marks are recorded directly upon a strip of paper or as shown in Fig. B a small mirror M is pivoted close to the piezo oscillator, and is set into oscillation by the air currents so as to vary the track



Method of indicating eddy-currents on surface of piezo-electric crystal. (No. 268,367.)

on a sensitive film of a ray of light from a source S.

Patent issued to the Telefunken Co.

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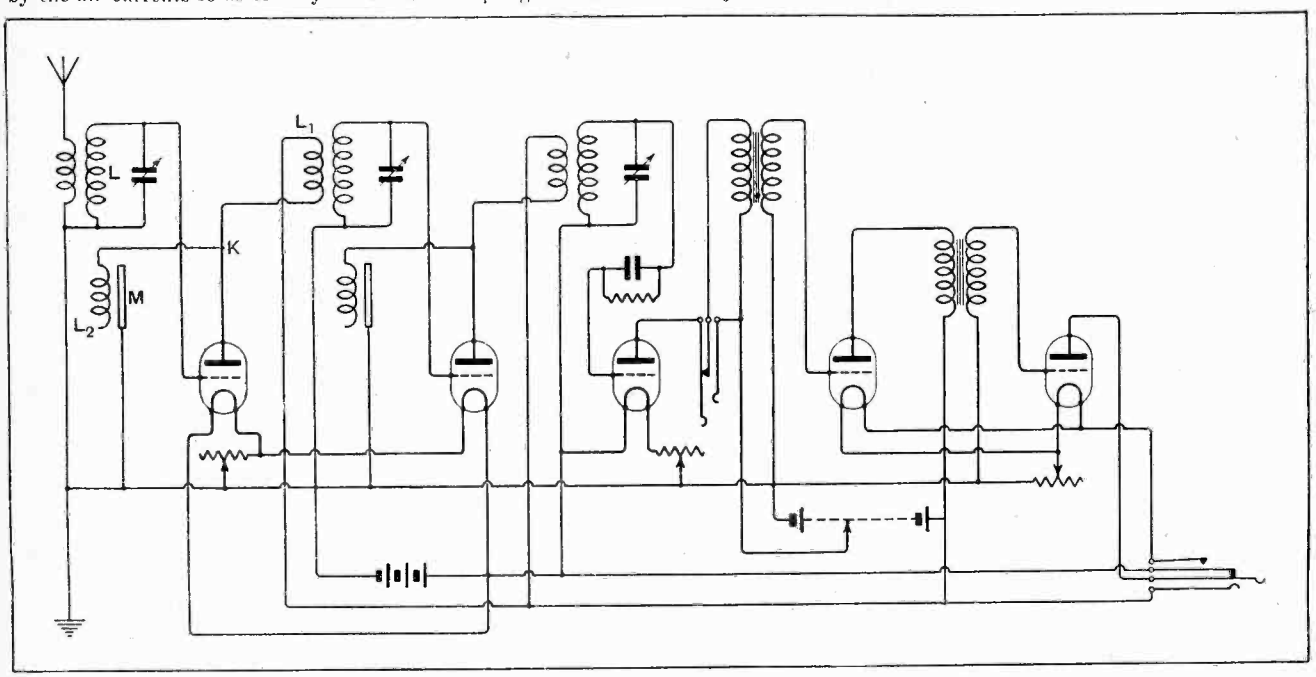
Balancing Circuits for H.F. Amplifiers.

(No. 278,400.)

Application date: May 11th, 1926.

The effect of inter-electrode capacity coupling is balanced out by means of a solid conductor or plate arranged in close proximity to one of the tuning coils or to a coil associated with the latter. This constitutes a somewhat unusual type of condenser coupling by means of which a neutralising voltage is applied from the output to the input circuit.

As shown in the figure, the input coil L coupled to the aerial is operative across the grid and filament of the first valve. To this coil is coupled a coil L 2 which is conductively connected at K to the coil L 1 forming the primary winding of the output transformer of the same valve. The plate element M is placed close to the coil L 2. Voltage fluctuations in the anode circuit are said to be neutralised so far as the grid is concerned by reason of the external capacity coupling between the coil L 2 (which is coupled to the grid coil L and directly connected to the anode coil L 1) and the member M, which is connected directly to the filament circuit. Similar neutralising means are applied to the other high-frequency stages as shown. Patent issued to O. M. Leich.



Method of balancing inter-electrode capacity by use of a plate. (No. 278,400).

Gramophone Pick-ups

Desirable Features in their Construction.

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

CONSIDERABLE general interest has been shown in the last year in the possibilities of the electrical reproduction of gramophone records, more especially by using the amplifier and loud-speaker of the existing broadcast receiver in conjunction with a motor-driven turntable and a "pick-up." A critical discussion of what is desirable in a pick-up, together with the results of tests on various commercial products, will not be out of place. Although many readers are no doubt familiar with the electrical gramophone reproducer, or pick-up, from the articles which have appeared from time to time in these pages, a consideration of the principles involved in the reproduction, both with the ordinary sound-box and with the pick-up, is necessary.

First of all, the whole scheme of electrical reproduction may be divided into four parts, starting from the record, passing on through the mechanical-electrical transformer, that is, the pick-up device, to the electrical amplifier and finishing at the electrical-acoustical transformer or loud-speaker. The first part, involving consideration of the record, lies entirely in the hands of the gramophone companies, and, as is probably well known, these have used the electrical system of recording for some time with great success, as anyone who has heard a modern electrically-cut record on a modern large gramophone will be able to testify. It is possible that the recording of some of the lowest and the highest frequencies is artificially over- or under-emphasised on the records in order to correct for inefficiencies in the sound-boxes and horns of the usual type of gramophone; but even if this is so, electrically-cut records when used with good electrically-reproducing systems do, in fact, give better results as to quality than are obtained on an ordinary type of gramophone. We may, in the writer's opinion, accept the record as it is now until more progress has been made in perfecting loud-speakers and pick-ups, though it may well be that special records will be marketed by the gramophone companies especially for electrical reproduction.

For reasons which will be brought out later in this article, most pick-ups now on the market would give better reproduction, and do far less damage to the record, if the records were cut with a much smaller amplitude of vibration of the groove. This is no real argument for production of such special records, but rather that the average commercial pick-up wants improving.

Leaving part 2, involving considerations of the pick-up, until last for discussion, the third part, the amplifier, calls for little comment, since it is possible already to make a perfect amplifier with comparatively little trouble, so long as we do not want excessive overall amplification nor are very concerned with efficiency.

Part 4, the loud-speaker, is by no means perfect yet, but the modern types are not at all bad and are capable of giving results which are distinctly pleasing to the ear of even those who are musically inclined.

The Function of the Pick-up.

The duties of a gramophone pick-up device may be briefly stated as follows: to convert, in some manner, the movements of a needle in a groove in the record into variations of electric potential between its output terminals, so that the latter variations are exactly equivalent to the variations or ripples in the groove. Many methods of conversion have been tried, and no doubt many more remain to be tried, but the two methods in general use to-day are electrostatic or electromagnetic, or a combination of the two, and of these two the moving-iron electromagnetic seems to be the more popular. However, whatever method of conversion is used, there are certain fundamental considerations in connection with the mechanical side which must be observed.

(*a*) The needle must follow the record-groove exactly throughout its whole length.

(*b*) The speed of the record should be constant.

(*c*) The weight, or rather the effective weight, of the pick-up must be sufficient to satisfy condition (*a*), but must not be so much as to cause undue wear of the record.

Gramophone Pick-ups.—

(*d*) The needle should be free to move in one plane only, and the resistance to motion (*i.e.*, damping) on each side of the position of rest should be equal for equal amplitudes.

(*e*) The damping of the needle must not exceed that for which condition (*c*) is exceeded.

(*f*) Mechanical resonances in the needle and its attachments must have no effect on the output of the pick-up.

These conditions may seem to be self-evident, but they are extremely important, and they are quite closely connected with each other, as the following consideration will show.

If the damping of the needle for amplitudes of vibration met with on the record, is made very high—for instance, in order to damp out unwanted resonances in the

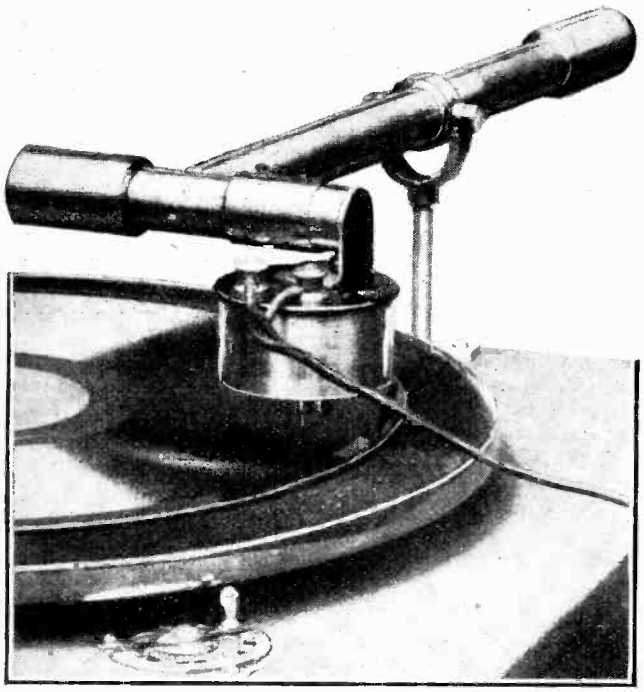


Fig. 1.—A form of tone-arm incorporating a balance weight.

moving-iron system—then the effective weight of the pick-up must be made fairly large in order to keep the needle in the groove. This in turn will lead to excessive wear of the record, and probably, with any ordinary form of clockwork gramophone motor, will also lead to a reduction in speed of the turntable when large amplitudes occur in the record—this latter effect being one of the causes of the "gramophone whine" in the old types of machines.

On the other hand, if the effective weight of the pick-up is not made greater than that of a sound-box, so as to try to obtain reasonable wear of the record, then if high damping of the needle is used, the latter will probably not follow the groove when it has fairly large amplitudes of movement, but will try to "straighten-out" its path by scratching the record—sometimes so badly that when the record is next used with an ordinary sound-box the needle again jumps the groove and follows the scratch-mark, and, in any case, after two or three runs with such a pick-up the scratches will have become regularly ploughed into grooves, and the record quite ruined from a quality

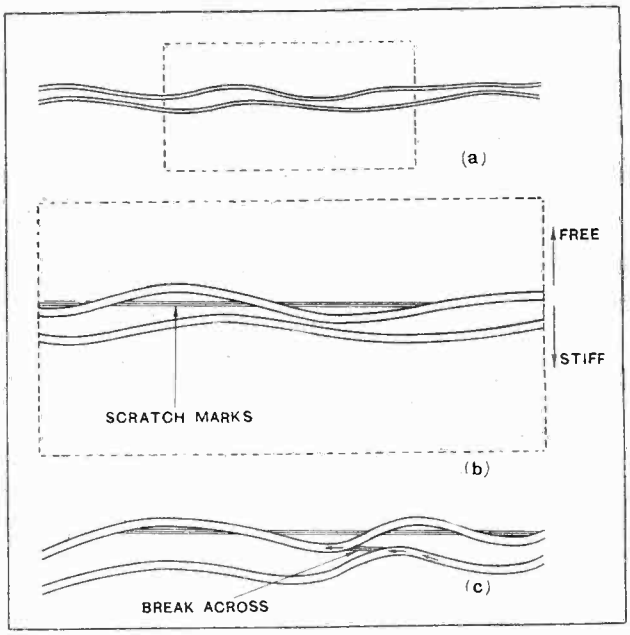


Fig. 2.—(a) Highly magnified section of record before playing. (b) The same section ploughed up by a damped pick-up. (c) Section showing where needle has jumped into next groove.

point of view. More than one pick-up tested by the writer showed this effect on brand new records to a greater or less degree; in fact, nearly all those tested showed it to some extent, the few exceptions being very obviously much less damped than the rest. The appearance of the record under the microscope before and after the pick-up has been used are in many cases most instructive, and manufacturers of pick-ups would be well advised to carry out this simple test with new records. The accompanying illustrations will serve to demonstrate the appearances of the grooves under a high-power microscope (Figs. 2 to 4).

In Fig. 2*a* is shown a small section of a record before playing, and in 2*b* the same section after being ploughed up by a highly damped pick-up. Sometimes the needle may jump into the next groove (2*c*). Fig. 3 shows what happened when the weight of the pick-up was artificially increased to make the needle stay in the groove, the original contour of the groove being shown; the wear on either side is indicated by heavier lines. It is seen that the corners of the undulations have been rounded off, thus widening the groove at these points. In certain forms of

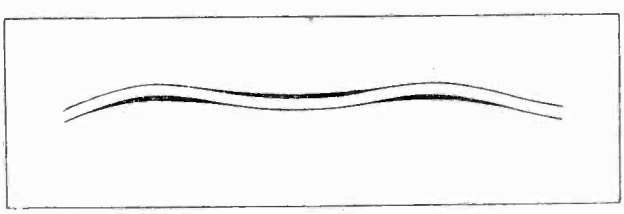


Fig. 3.—The result of artificially weighting the pick-up. Widening and rounding off the grooves have taken place.

Gramophone Pick-ups.—

construction it may happen that the damping of the needle is comparatively low in one direction, but quite high in the reverse directions in the plane of movement. This will cause the needle to be able to follow the undulations of the groove in one direction, but not in the other for large amplitudes, causing either ploughing up or rounding off of the groove according to the weight of the pick-up.

The term "effective weight" of the pick-up has been used in this article to mean the weight on the needle. For systems such as are used in the ordinary gramophone with the sound-box replaced by the pick-up, this weight is, of course, the weight of the pick-up plus a small amount due to the last portion of the tone-arm. It is possible, of course, to use very heavy sound-boxes or pick-ups and to regulate the weight on the needle by means of a counterbalance weight or spring, so that the effective weight can be made variable.

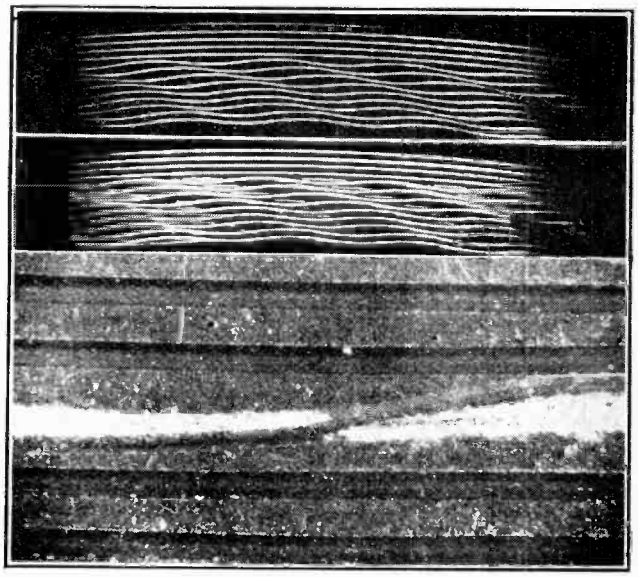
Life of a Record.

It seems reasonable that where a sound-box is replaced by a pick-up, that the weight and the damping of the needle of the latter should not exceed those of the former, so as to obtain at least the same life of record. The life of a record, that is, until it becomes audibly worn, the writer would put at about 30 to 40 playings at most on an ordinary good gramophone, except, perhaps, for dance records, where wear does not matter so much; so that, if possible, the pick-up should be made so as to wear the record less than the sound-box. After all, in the ordinary gramophone all the energy for the sound output has to come from the motor and the record, but in the case of electrical reproduction this is by no means the case, as it does not matter, in reason, how small the electrical output from the pick-up so long as it is a faithful reproduction; the amplifier can be made to attend to the rest.

From this point of view, it would seem that a very light moving system, perhaps not much heavier than the needle itself and largely consisting of the latter, not too heavily damped, and with as little weight as possible consistent with the various conditions which have already been enumerated, may result in a very much longer life for records, apart from the much better quality obtained due to the electrical reproducing. So far we have only considered certain mechanical aspects of the pick-up and have laid down certain mechanical conditions it must fulfil in order to give satisfactory service on the input or mechanical side, and now we must see how these conditions limit the electrical design.

Denman[1] has pointed out that there are two main ways of overcoming the difficulties of mechanical resonance effects associated with the needle and its attachments, namely, the use of the "matched impedance" principle, which is an extremely difficult thing to do, or the use of a damped resonant arrangement. The latter scheme is much the easier to use, and all the commercial electromagnetic pick-ups tested were of this form. The "matched impedance" pick-up is undamped, in the ordinary sense, so that it fulfils all the mechanical conditions laid down, and if it could be thoroughly tried out and the constructional difficulties overcome, it would appear to be one of the most promising types.

In a damped reed type the natural frequency of the reed must be high so as to obviate trouble due to overtones, and the damping will then chiefly be used for the purpose of minimising the response at the main resonant period of the reed. A simple reed of suitable natural frequency fixed at one end, with the needle attached at the other, will be very stiff, even without any artificial damping,



[Courtesy The Gramophone Co., Ltd.

Fig. 4.—Microphotographs showing record wear. The groove several times enlarged. (Top) The groove undamaged after several playings with a well-designed pick-up. (Middle) Owing to excessive stiffness the needle has left the contour of the groove. (Bottom) The groove highly magnified. The white portion is caused by the needle failing to follow the contour of the groove.

which means that the reduction of wear on the record is limited apart from any applied damping. One way to minimise this difficulty would be to use a laminated reed, the laminations having various natural frequencies spread over the musical scale, and the whole being suitably damped.

The Question of Damping.

Another and more promising way of using a moving-iron system is to mount the iron armature preferably on pivots at its centre, so that it is quite free to move in one plane. Damping may then be applied either at the end of the armature not carrying the needle, or at both ends, or in the pivots of the mounting, or even any combination of the three. Two forms of damping which are largely used in measuring instrument practice, but which do not appear to be in favour among manufacturers of pick-ups, are liquid damping and eddy current damping, the former appearing to be the more useful.

A series of eight commercial pick-ups were tested by the writer to see how far they conformed to the ideas and conditions which have already been enumerated.

An H.M.V. sound-box was taken as the standard of weight, and the stiffness of the movement of the pick-up needles compared with the stiffness of that of the sound-box. The various pick-ups are designated by letters, and

[1] *The Wireless World*, Jan. 26th, 1927.

Gramophone Pick-ups.—

Table I shows the relative weights and damping of the pick-ups as received.

Before altering the damping, various electrical tests were carried out which will form the subject of a separate article and will deal with frequency response characteristics for the eight pick-ups.

TABLE I.

Name.	Weight in oz.	Type of damping.	Stiffness.*	Remarks.
H.M.V. sound-box	5¼	—	10	—
A	4½	Adjustable	12	—
B	5¼	Fixed	50	Reed nearly rigid
C	7½	Fixed	20	—
D	5	Adjustable	15	—
E	7	Fixed	25	—
F	2¼	Adjustable	25	—
G	4½	Adjustable	30	Non-uniform adjustment
H	4¾	Fixed	18	—

* This column is approximate only, being estimated from the deflection under static load.

The pick-ups were then tried on new H.M.V. records, dance records being selected as having large amplitudes of vibration in the groove, and the records examined under the microscope for the various effects already described.

Pick-ups A and D and C showed the least damage, and of these A was decidedly the best, only showing effects on really loud records when using a loud-tone needle and none with a soft-tone needle. Pick-ups D, C and H showed very little effects of wear after several times round when a soft-tone needle (*i.e.*, a long, thin one) was used—H showing the effect of non-uniform damping with a thick and short needle. As would be expected, pick-up G showed this effect rather well. Pick-up B was easily the worst for wear, as might be expected from the excessive damping.

Some Shortcomings.

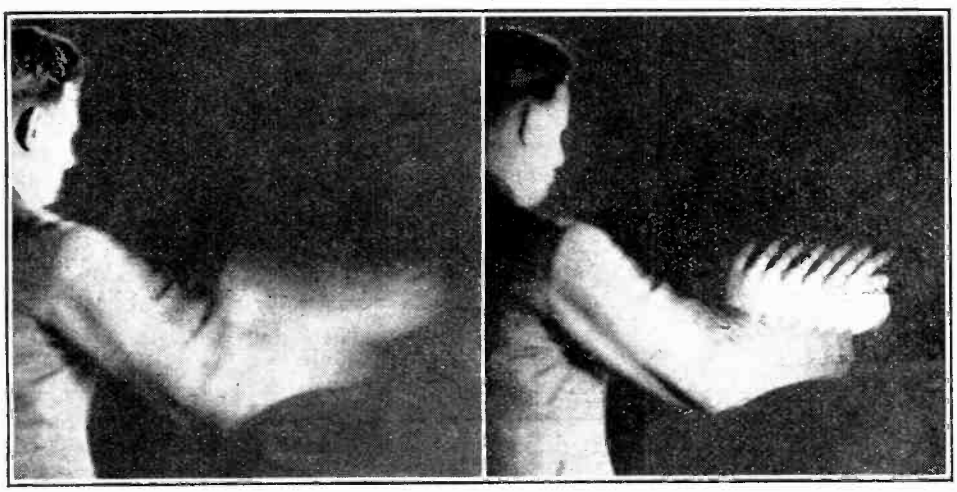
So far, nothing has been said about quality of output, but it may be said here that the quality from all the pick-ups was reasonably good, but from none was it what could be called really good. In general, a pick-up which brought out the bass notes well seemed to be deficient on the high frequencies and *vice versa*. In two or three of the pick-ups a definite rattle was noticed on low frequencies, especially on organ notes, pointing to resonance effects at these low frequencies, but probably not wholly or mainly in the reed.

In conclusion, it seems that there is considerable work yet to be done on the mechanical side of the pick-up, quite apart from the electrical, and it also seems more than likely that the large gramophone companies, with their great facilities and experience, will be the first to bring out a really good pick-up.

HOW TO ASCERTAIN WHETHER THE MAINS ARE A.C. OR D.C.

BEFORE installing a battery eliminator it is necessary to know the mains voltage and whether the current is alternating or direct. The mains voltage can generally be found by examining the markings on the meter, but not every meter is marked to show the nature of the current, certain types being suitable for either A.C. or D.C.

There are, of course, innumerable methods of differentiating between A.C. and D.C., but nearly all require meters or special apparatus which may not be available, say, when viewing a new house or premises. In these circumstances the simplest method is to wave the hand, with index finger extended, rapidly to and fro underneath the electric light. D.C. gives a continuous blur, but A.C. produces a series of images giving a striated appearance, as shown in the accompanying photographs. A similar effect is to be observed in a cinema theatre and is here more marked as the frequency is about 16 per second.

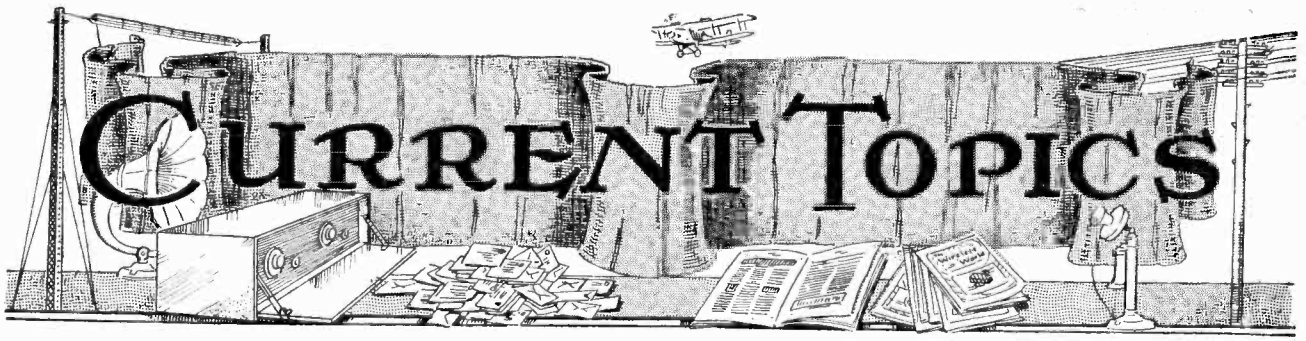


D.C. A.C.

Appearance of the hand when moved rapidly backwards and forwards under a metal filament lamp illuminated (left) with direct current and (right) with alternating current.

The success of this test depends to some extent on the type of lamp used as a source of illumination. A metal filament lamp is best, as the filament cools rapidly between each half-cycle of current. Half-watt lamps, on the other hand, cool comparatively slowly, as may be observed on switching off; the effect is consequently less marked, and in some cases may be absent, so that a metal filament lamp should be used wherever possible.

F. L. D.



Events of the Week in Brief Review.

A BOOM IN BATH.

A wireless boom is reported from Bath. During February last nearly three times as many receiving licences were taken out as in February, 1927.

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COMING HOME.

Mr. Eric Dunstan, who is general manager of the Indian Broadcasting Company, is *en route* for England with the object of persuading wireless manufacturers to provide further capital for broadcasting in India. The Government of India has refused a State subsidy.

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THE WAY OF TRANSGRESSORS.

The Postmaster-General, in a written reply to Mr. Day, M.P., states that the number of persons prosecuted during the 12 months ended January 31st for the use of wireless receiving apparatus without a licence was 1,046. Convictions were obtained in 1,043 cases and the remaining three cases were dismissed.

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SOS FROM AN ISLAND.

In response to a wireless SOS for medical assistance, Dr. Shearer and a nurse sailed from Oban to the island of St. Kilda on Friday, March 2nd, in the Lighthouse Commissioner's steamer *Hesperus*. The resident nurse on the island was ill, besides two of the natives. Medical treatment was given and the sick people were brought to the mainland.

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BEWARE OF POWER WIRES.

An unusual tragedy in the annals of amateur reception occurred on February 29th, when one man was killed and four of his friends were injured in the village of Dreghorn (Ayrshire) while a steel wireless mast was being erected. The accident was caused by the fouling of an overhead electric power line with which the mast came in contact. James Nairn was killed instantly, and three of his companions were badly injured. A woman who attempted to pull one of the men clear also received a severe shock.

Most power lines in this country are well guarded, but it is obvious that no special provision is made to screen them from such objects as metal wireless masts.

AN OLD FAVOURITE.

The oldest known excuse in the repertoire of the wireless "pirate" was revived at Linslade, Bucks, last week, when an offender under the Wireless Act pleaded that he did not think a licence was required until the set was working properly.

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AWARD FOR WIRELESS INVENTIONS.

The Royal Commission on Awards to Inventors has awarded £4,000 plus royalties to the Metropolitan Vickers Electrical Co., Ltd., respecting wireless reception apparatus.

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TELEPHONE SERVICE TO CANADA.

On Thursday last, March 8th, the Transatlantic telephone service to Canada was extended to include the cities of St. John (New Brunswick), Halifax (Nova Scotia), Winnipeg, Calgary and Vancouver. The minimum charge (for a three minutes' conversation) ranges from £9 12s. for communication with St. John to £11 8s. for Vancouver. The service to Ottawa, Quebec, Montreal, Toronto and Hamilton (Ontario) was opened last month.

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EUROPEAN RECEPTION IN WEST AFRICA.

Mr. H. A. Dade, of the Gold Coast Agricultural Department, reports that excellent reception of European and American short-wave transmissions can be obtained in the Gold Coast with a three-valve set. Little skill, he says, is required in tuning.

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AERIALS ON LIFEBOATS.

Difficulties in handling multi-wire aerials on lifeboats, due to their tendency to become fouled during hoisting, have led to further experiments with single-wire aerials by the Mercantile Marine Department of the Board of Trade. Hitherto it has been found necessary to provide multi-wire aerials in order to obtain the "metre ampere" figure of 15 laid down in Board of Trade instructions. The latest tests, says the official report, have shown that, while the single-wire aerial reduces the "metre ampere" figure of a standard lifeboat installation, the strength of the signals emitted is very little less than when the same installation is used in conjunction with a four-wire aerial. The Board, therefore, have decided to make the single-wire aerial the standard and to reduce the "metre ampere" figure to 10.

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"THE AUTOCAR" IN NEW FORM.

Commencing with the issue of Friday next, March 16th, our well-known sister journal, *The Autocar*, will appear in a new and improved form. While the regular popular features are being retained a number of novel elements, entirely new to a publication of this class, are being introduced, among these being a section in photogravure. In its new form *The Autocar* should appeal strongly to all car users, and particularly to owner-drivers.

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WIRELESS SHOW IN BATAVIA.

A wireless exhibition is to be a feature of the Bandoeng Fair, to be held next June. According to a *Times* correspondent, the annual Fair at Bandoeng receives visitors from all over the Netherlands East Indies, Malaya and other adjacent countries.

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A "RADIO PRESIDENT" FOR AMERICA?

Political interest in America is centreing on the fact that Mr. Secretary Hoover, who is likely to be one of the candidates for the Presidency, is a "radio man" to a greater extent, perhaps, than any other man in the United States. Many brilliant public speakers are timid before the microphone; Mr. Hoover reverses the usual order of things by being an indifferent orator on the platform and a compelling speaker before the microphone.

In the forthcoming campaign it is expected that the utmost use will be made of Mr. Hoover's vote-winning powers in this direction. His association with wireless will be no novelty, for it was Mr. Hoover who was primarily responsible, as head of the Department of Commerce, for the formation of the Federal Radio Commission. The Commission's work in securing at least a partial clearance in the chaotic American ether will not be forgotten.

SCHENECTADY SHORT-WAVE TRANSMISSIONS.

Short-wave enthusiasts will be interested in the following schedule of the present short-wave transmissions from the G.E.C. at Schenectady :—

Station.	Wavelength.	Day.	(G.M.T.).
2 XAD	21.96 metres	Sunday	2330-0400
2 XAD	21.96 ,,	Monday	1900-2100
2 XAF	31.4 ,,	Monday	2300-0400
2 XAF	31.4 ,,	Tuesday	2300-0500
2 XAD	21.96 ,,	Wednesday	2300-0400
2 XAD	21.96 ,,	Thursday	1900-2100
2 XAF	31.4 ,,	Thursday	2300-0500
2 XAD	21.96 ,,	Friday	2300-0400
2 XAF	31.4 ,,	Saturday	2330-0500

Special features and events not occurring within the normal periods of transmission given above, such as speeches by internationally known men, portions of important conventions, boxing matches, world series baseball games, etc., that are deemed of national and international interest are usually transmitted through either 2XAD or 2XAF, or both.

In addition to the foregoing, 2XAF is also relaying the regular "evening" programmes of WGY on Mondays, Tuesdays, Thursdays and Saturdays, and 2XAD is relaying WGY on Wednesdays, Fridays and Saturdays. These relays commence about 11 p.m. G.M.T.

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P.M.G. ON THE BEAM SYSTEM.

The impetus given to wireless and cable services by the introduction of the beam system was referred to by the Postmaster-General in the House of Commons last week. Replying to Mr. Ammon, Sir William Mitchell-Thomson said :—"The number of messages sent or received by the Post Office beam services during the week ended February 26 was : Australia, 7,130; Canada, 4,686; India, 15,122; and South Africa, 8,516. There is evidence that the total traffic with the Dominions by cable and wireless is now considerably greater than it was before the beam services were established."

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NO PARLIAMENTARY BROADCASTING.

The lifting of the ban on controversial broadcasting does not entail the likelihood of broadcasts from the Houses of Parliament. Replying to a suggestion in the House that a Select Committee should be set up to consider whether Parliamentary proceedings should be broadcast, Mr. Baldwin said that a previous enquiry showed a greatly preponderating body of opinion against such a project and he did not think there had been any substantial change of opinion since then.

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BROADCASTING KILLS HOSPITAL CONCERTS.

The value of wireless in hospitals was forcibly brought home to members of the Middlesex Hospital Ladies' Association on Wednesday last when Sybil Countess Brassey, the chairman, confessed that the entertainment branch of the association had been killed by wireless. It had been found that the patients much preferred broadcasting to any concert or entertainment that might be arranged for them.

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WHERE SUNDAY IS WIRELESS DAY.

Criminals in the prison at Rheinbach, Prussia, are coming to look forward to Sundays and holidays with a peculiar zest. These are not days of freedom, but they offer the nearest possible approach to the outside world, for they are "wireless days." Broadcast receivers have been installed. On week-days the apparatus is used for the instruction of schoolchildren.

NEWS FROM THE CLUBS.

Cinema Equipment for Club Use.

The lantern and cinema projection equipment which Mr. S. G. Williams is placing at the disposal of the Tottenham Wireless Society, was demonstrated at the last meeting. After a number of short films had been shown, a collection of slides dealing with the Society's past activities and with the progress made in radio during the last few years were described by Mr. F. E. R. Neale. Several photographs had been taken on Society field days; others depicted the Marconi wireless stations at Ongar and Croydon.

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

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Developments in Components.

Mr. B. Haywood, of the Dubilier Condenser Co., spoke on "Recent Developments in Components for Radio Receivers" at a meeting on February 29 of the South Croydon and District Radio Society. Describing the "Toroid" coil the lecturer explained that owing to the special process employed in winding the electro-magnetic field of the coil was restricted to the coil's own physical limits and thus interference by near-by components was eliminated. Compactness in set construction was, therefore, made more easily attainable. The lecturer showed a number of slides illustrating the manufacture of modern condensers.

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

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Measuring Instruments.

At a recent meeting of the Radio Experimental Society of Manchester, an excellent talk on "Instruments, their Construction and Calibration" was given by Mr. A. K. Bentley, of the Manchester College of Technology. In addition to the familiar forms of meter (voltmeters, ammeters, etc.) several very sensitive pieces of apparatus were dealt with, including a mirror-galvanometer constructed by Mr. R. Kay.

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

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A Birmingham Success.

Birmingham's new wireless society, "Slade Radio," held its first whist drive and dance on February 22nd. Its success may be judged from the fact that about 160 ladies and gentlemen were present. Music was provided by a broadcast receiver and a gramophone pick-up used with a moving coil loud-speaker provided by Mr. A. E. Wood.

There is every prospect of an influx of new members. A good programme of lectures and demonstrations has been arranged until Midsummer, and all interested in the Society are asked to apply for membership to the Hon. Secretary, Mr. H. Clews, 8, Victoria Road, Erdington, Birmingham.

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Selectivity and the Regional Scheme.

Mr. H. F. Smith, the well-known contributor to *The Wireless World*, lectured at a recent meeting of the Golders Green and Hendon Radio Society, taking as his subject "H.F. Amplification—The Unit System." Mr. Smith preferred the unit system as being the most suitable for keeping the set up to date and for the tracing of faults. Each H.F. unit of the demonstration set was enclosed in a metal box. Dealing with the advent of the regional scheme, the lecturer said that at least one stage of H.F. would be necessary to obtain selectivity. He favoured the neutralised transformer method of coupling.

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

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Valve Manufacture Explained.

An interesting lantern lecture on the manufacture of valves was given by Mr. Parr of Messrs. Edison Swan, Ltd. at the last meeting of the Holloway Literary Institute Wireless Society. The lecture was followed by a demonstration of the R.C. Threesome receiver operating a Rice Kellog loud-speaker.

Meetings are held weekly on Mondays at 7.30 p.m., Holloway School, Hilldrop Road, Camden Road, N.7.

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The Story of the Beam.

"Beam Wireless" was the subject of a lecture given by Prof. E. W. Marchant at a largely attended meeting of the Wigan and District Technical College Radio Society on March 2nd. The wireless beam, said Dr. Marchant, was very similar to the light beam, both being electro-magnetic by nature and differing only in wavelength. Just as a beam of light concentrated in one direction by reflectors was able to penetrate further, so beam wireless, concentrated by suitable means, could travel farther in the direction of propagation. Tracing the historical development of the beam system, the lecturer referred to the early experiments of Hertz, and went on to explain the special value of short waves, which were once regarded as of little value. When Franklin and Marconi took up the question of short waves they discovered that they were able to send signals over relatively enormous distances; the possibility of using reflectors was then explored and the outcome was beam wireless. The lecture was admirably illustrated by slides.

Hon. Secretary: Mr. M. M. Das, B.Sc.

FORTHCOMING EVENTS.

WEDNESDAY, MARCH 14th.

Royal Society of Arts. At 8 p.m. At Headquarters, John St., Adelphi, W.C.2. "The Lead Acid Cell: Its Place in Modern Industry," by Mr. Harold G. Brown, A.M.I.E.E. (of the D.P. Battery Co., Ltd.).

Muswell Hill and District Radio Society.—At 8 p.m. At Tollington School, Tetherdown, N.10. Lecture: "Rectifiers," by Mr. J. C. Bird, B.Sc., President of the Golders Green and Hendon Radio Society.

Tottenham Wireless Society.—At 8 p.m. At 10, Bruce Grove, N.17. Lecture: "Modern Methods of H.F. Amplification," by Mr. R. F. G. Holness.

South Croydon and District Radio Society. At the "Surrey Drovers" Hotel. Demonstration by Messrs. A. C. Cossor, Ltd.

THURSDAY, MARCH 15th.

Stretford and District Radio Society. At 6a, Derbyshire Lane. Demonstration by the Celestion Radio Co. Slade Radio (Birmingham) lecture by Mr. Derek Shannon.

Leyton and Leytonstone Radio Society.—Talk on the Mullard "Master Three."

FRIDAY, MARCH 16th.

Leeds Radio Society. At the University. Lecture by Mr. S. R. Wright.

South Manchester Radio Society. At the Co-operative Hall, Wilbraham Road, Didsbury. Crystal set competition.

MONDAY, MARCH 19th.

Croydon Wireless and Physical Society. At 8 p.m. At 5, Altyre Road, East Croydon. Lecture: "Sources of H.T. and L.T. Supply for Modern Receivers," by Mr. B. J. Axten.

Hornsey and District Wireless Society.—Lecture: "The Long Distance Five," by Mr. McConnochie.

Holloway Literary Evening Institute Wireless Society. At 7.30 p.m. At Holloway School, Hilldrop Road, N.7. Demonstration of receiver by Messrs. McMichael.

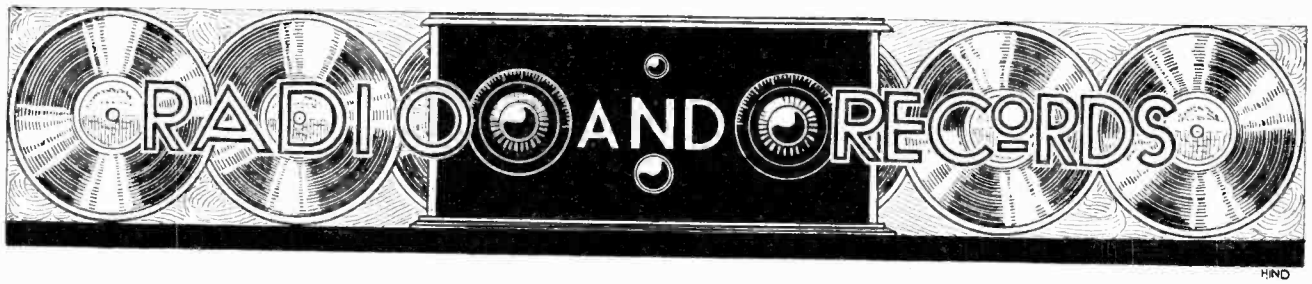
Hackney and District Radio Society. At the Electricity Showrooms, Lower Clapton Road, E.5. "Everyman Four" Night.

TUESDAY, MARCH 20th.

Wigan and District Technical College Radio Society. — Lecture: "Loud-speakers," by Mr. S. A. Matthews, of Messrs. S. G. Brown, Ltd.

WEDNESDAY, MARCH 21st.

Radio Society of Great Britain. At 6 p.m. At the Institution of Electrical Engineers, Savoy Place, W.C.2. Lecture: "Amplification and Reproduction at Audio Frequencies in conjunction with Electrical Pick-ups."

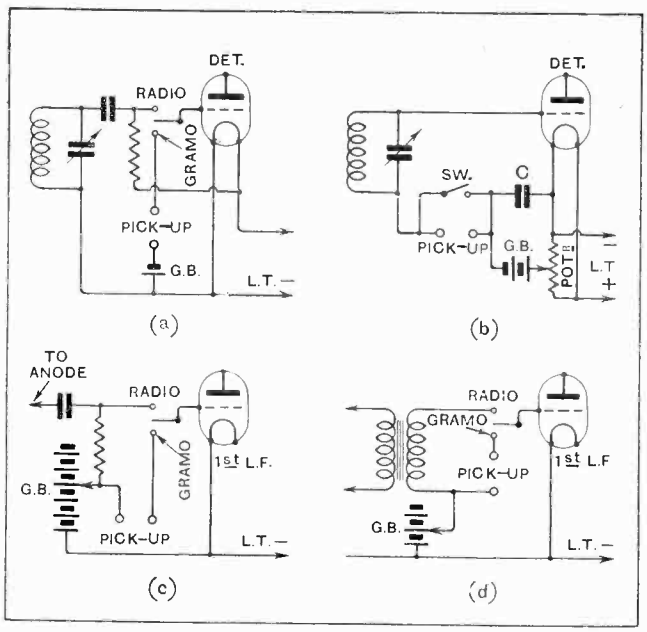


How to Adapt Existing Sets for Gramophone Reproduction.

By "RADIOPHARE."

THERE is little need for anyone possessing a receiver to deny himself the pleasures of gramophone reproduction as an adjunct to the wireless programme. The necessary modifications are neither difficult nor costly, and any set, from the simple detector-1 L.F. combination upwards may be modified in a very simple manner. It should be made clear that at least two L.F. stages are required; this statement may appear to contradict that made in the previous sentence, but there is no reason why the detector valve should not be made to function as an amplifier.

The problem, briefly, is to arrange means whereby the pick-up (or the secondary of its transformer, if one be used) may be connected between grid and filament of either detector or first stage L.F. amplifier, interposing a source of negative bias voltage. If the set has but one low-frequency amplifier, it may be definitely assumed that the pick-up should be connected in the detector grid circuit: if there are two amplifiers, its best position will depend on the overall magnification, the sensitivity of the pick-up device, and the power-handling capacity of the output valve. It is quite a good idea to try experimental connections in the grid circuits of both first-stage amplifier and detector valves.



Various methods of connecting a gramophone pick-up to a receiver.

Arrangements applicable to various typical receivers are shown in the accompanying diagram. The first (*a*) is a convenient form of conversion for a grid detector, in which the change-over is effected by joining the arm of a single-pole two-way switch to the grid, in the "radio" position, the normal wireless circuit is completed, while movement of the switch to the second contact joins the pick-up, in series with its bias battery, G.B., across grid and filament. The alterations necessary for an anode rectifier fitted with potentiometer grid control are given at (*b*), and are even simpler. Here the pick-up is inserted in the grid return circuit, with a parallel switch which short-circuits it for wireless reception. C is the usual by-pass condenser, and G.B. is a two-cell bias battery normally used in such circuits (with a potentiometer) for obtaining the negative bias required by the usual high-magnification detector valve; when the pick-up is in use, this negative bias is reduced to about half its previous value by rotating the potentiometer contact arm slightly towards that end of its winding which is joined to L.T.+.

The method of applying the pick-up to an L.F. valve which follows resistance coupling is shown at (*c*); observe that change of bias is unnecessary. This applies also to the alteration suggested for a transformer-coupled L.F. amplifier in diagram (*d*). As in circuits (*a*) and (*c*), the switch is at high signal potential, and special pains should be taken to choose a well-insulated component without an excessive mass of metal; moreover, it should be mounted in such a position that its connecting leads are short and direct.

In all four arrangements it is intended that the pick-up should be permanently connected to the receiver by means of a length of twin flexible wire: occasionally, however, it will be found more convenient to fit a pair of terminals, plug sockets, or a jack.

The question of volume control is important, particularly when three stages of amplification are in use; modern pick-ups are very sensitive, and means of reducing volume must generally be provided. Suitable methods are discussed elsewhere in this number.

Radio and Records.—

Several receivers recently described in this journal lend themselves to gramophone use without modification, or at any rate with no more alteration than the addition of a volume control. For example, the " All-Wave Four," the " Regional," and " Standard Four " receivers may be converted by fitting the pick-up leads with plugs for insertion into " G " and " F " sockets of the H.F. transformer mounting; at the same time, a slight adjustment of the detector potentiometer must be made, as explained before. The B.B.C. " Quality Four " is another receiver which lends itself particularly easily to conversion, as it is necessary merely to join the pick-up by means of a length of " twin flex " to a standard coil plug, which is inserted in the detector valve grid coil socket; as usual, the negative bias applied to this valve is reduced—in this case by moving the position of the wander plug G.B.1. The alterations necessary in the case of the " Everyman-Four " have been dealt with from time to time in this journal; when it is desired to insert the pick-up in the detector grid circuit, the arrangement shown in diagram (*b*) is applicable, assuming that potentiometer control is added to the original design. If it is not, some other means of reducing grid bias must be adopted. The method shown in diagram (*c*) may be followed when the two L.F. valves only are to be used; generally speaking, this form of connection will provide sufficient magnification. If the alternative position is adopted, a volume control may be regarded as essential.

In cases where the number of valves in use for gramophone reproduction is less than the total, it will be convenient to add an extra arm to the switch shown, and to connect it in such a manner that the filaments of unwanted valves are automatically switched off when changing over. When these valves are fitted with accessible rheostats, this addition may be regarded as a refinement.

In place of the switches shown, some amateurs will prefer to use jacks. They are most easily applied in cases where the pick-up is placed in the low-potential end of the detector grid circuit; at the expense of some complication, a scheme of connections can be devised for reducing bias and also switching off unwanted filaments when the plug (to which the pick-up is connected) is inserted in the jack.

GRID BIAS.

Precautions Necessary when Filaments are Heated from A.C. Mains.

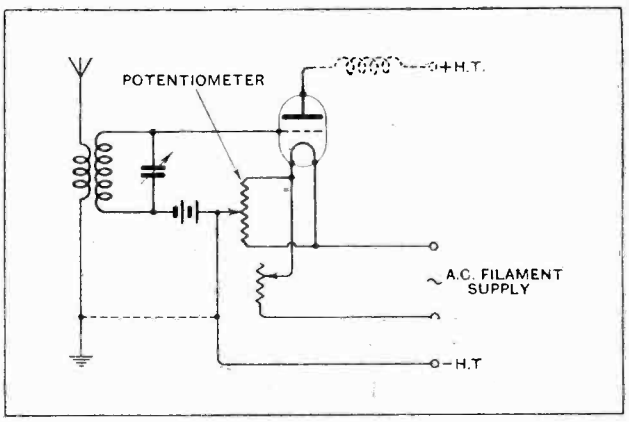
THERE are just a few circumstances under which it is possible to heat the filaments of normal valves (as distinct from the indirectly heated cathode) within a receiving set by alternating current. In passing, we will only mention one important requirement of the actual filament—that it shall be of a fairly heavy current type in order that sufficient heat is maintained between the peaks of the current waves to ensure a continued emission.

Grid bias, however, does require consideration if success is to be obtained with A.C. heating. When operated on D.C., the negative end of the filament is considered as zero voltage as far as the grid and anode are concerned. If connected to the negative end of the filament, we may say that the grid is positive to no part of the filament. In these circumstances grid current does not flow in a normal valve. Should we connect the grid to the positive end of the filament, current will show up in the grid circuit, as is to be expected, since the grid is now positive in respect to the filament.

If, however, A.C. be applied to the filament, that end of the filament to which the grid is connected will be alternately positive and negative in relation to the remainder. Thus grid current alternating in step with filament voltage is produced and an exceedingly powerful hum is heard in the receiver output.

In order to overcome this defect, it is necessary to make available a point equivalent to the centre of the filament. This is done by placing a potentiometer across the filament terminals and connecting the grid and anode return leads to the slider.

There is an important point which is often overlooked in this matter, namely, that even after means have been adopted to tap the grid return lead on to the equivalent to the centre of the filament, during each half cycle one end of the filament or the other is negative in respect to the grid by a voltage equal to half the peak value of the A.C. voltage applied to the filament. (Peak volts = 1.414 × R.M.S. or nominal volts.) It is therefore necessary to provide bias batteries of sufficient voltage to ensure that half the filament peak volts plus the signal will at no time make the grid positive. For a valve with a 5 to 6 volts filament, 4½ volts grid bias should be provided in addition to the usual bias voltage that would be used if the valve were being worked on D.C. It follows from the above that a valve taking, say, 0.6 amp. at 2 volts, is a very much better one for A.C. filament heating than one taking 0.2 amp. at 6 volts, as the former valve would have a thicker filament.



When heating ordinary valve filaments from A.C. mains additional grid bias is necessary to prevent grid current. The electrical centre of the filament is found by means of a potentiometer.

HIGH-NOTE LOSS IN RESISTANCE AMPLIFIERS.

Part III.—Practical Applications to Amplifier Design.

By A. L. M. SOWERBY, M.Sc.

(*Concluded from page 253 of previous issue.*)

IN the first instalment of this article a formula was developed which would enable the loss of high notes in any resistance amplifier to be determined exactly, given certain working values of the circuit. In the second instalment it was shown that *accurate* figures of these working values could only be obtained by rather laborious measurements on the individual valves to be used, but information was given to enable *approximate* values to be estimated. The present instalment will show the application of the calculations and data of Parts 1 and 2 to practical problems. The writer would therefore request any reader who wishes to follow him in detail to provide himself with the appropriate back numbers of this journal before reading further, as it will be necessary to make frequent reference to the curves already given. Readers who only desire to obtain a general idea of the magnitude of high-note loss may, of course, spare themselves this trouble.

Let us begin by examining one of the most popular R.C. circuits of the day, consisting of an anode rectifier and a high-amplification valve as L.F. amplifier, both having a magnification factor of 30, and a small power valve in the output stage. The circuit, together with typical values for the components, is given in Fig. 8, from which it will be seen that the amplifier is of the high-impedance variety, in which high-note loss may be expected to be serious.

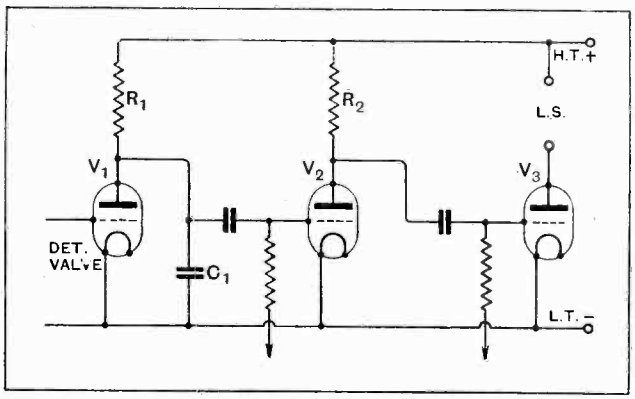


Fig. 8.—An anode bend detector followed by two stages of resistance coupling. If R_1 and R_2 are of the order of 2 megohms, and if V_1 and V_2 have high magnification factors, practically all notes at about 5,000 cycles will be lost.

It will be necessary to calculate successively the loss in the two inter-stage couplings shown, and then to combine these two results for an overall estimate of the reproduction of the receiver as a whole.

In the first inter-stage coupling, that beween V_1 and V_2, we have an anode resistance of 2 megohms following a valve of nominal impedance 150,000 ohms. Reference to Fig. 7 shows no curve for so high an anode resistance; the highest for which a curve is provided is 1 megohm. With this resistance, the working impedance of this valve on 120 volts is given as 0.43 megohm, with the grid bias adjusted for amplification; 0.6 megohm would be a very moderate estimate of the working impedance with a 2-megohm anode resistance. We will assume that the adjustment of the grid bias for rectification does not increase this figure; this assumption is reasonable only so long as the station being received is not at any great distance, or if adequate high-frequency amplification is being employed, so that a good strong signal reaches the grid of the valve.

The Working Capacity of the Valve.

Now for the stray capacity; we have seen that this is given by adding 25 to 7 times the amplification factor of V_2, *i.e.*, it is in this case $210+25$, or 235 $\mu\mu$F. In addition, we have the fixed condenser C_1, which is essential to enable the valve V_1 to rectify satisfactorily; this adds another 100 $\mu\mu$F, making, say, 350 $\mu\mu$F in all.

We are now ready to work out the value of the fraction $\frac{3RR_aC}{100\ (R+R_a)}$, for we know that $R=2$, $R_a=0.6$, and $C=350$. Substituting these values, we find that the fraction equals $\frac{3\times 2\times 0.6\times 350}{100\times 2.6}$, or 4.9. Looking up, on the curve of Fig. 4, the high-note loss corresponding to this value of the fraction, we find it is practically 80 per cent. In this one inter-stage coupling, then, we lose all but 20 per cent. of high notes of frequency 5,000 cycles.

Next, the coupling between V_2 and V_3. Here R has the same value as before, and, since V_1 and V_2 are identical, R_a also has its previous value. C, however, will be different.

The amplification factor of V_3 is 6, so that this time C has the value $25+7\times 6$, or, say, 70 $\mu\mu$F—very considerably less than before. Working out our fraction again, we arrive at the value $\frac{3\times 2\times 0.6\times 70}{100\times 2.6}$, or 0.98. Fig. 4 tells us that the high-note loss corresponding to this is 28½ per cent., so that 71½ per cent. of the high notes are retained during the passage of the signals from the plate of V_2 to the grid of V_3.

But our investigation of the first inter-stage coupling led us to the conclusion that only 20 per cent. of the high notes get to V_2 at all, the rest being lost between V_1 and V_2, and we now find that of this reduced amount only 71½ per cent. finally reach the output valve. The *overall* amplification of high notes is then only 71½ per cent. of 20 per cent., or $\frac{71\frac{1}{2}}{100}\times 20$ per cent., which works

High-note Loss in Resistance Amplifiers.—

out to a little under 14½ per cent. In other words, the high notes have about one-seventh of their proper strength as compared with the low and middle notes.

Since there are in use many hundreds of receivers built to a specification very close to that of Fig. 8, there is given in Fig. 9, as a matter of interest, a curve (Curve 1) showing the complete amplification-frequency response of this amplifier. Perfect reproduction of low notes has been assumed, as low-note loss is outside the scope of the present article. The amplification on each of a number of frequencies has been calculated in just the same way as already described, but using a more general form[1] of the fraction $\frac{3RR_aC}{100\ (R+R_a)}$.

Fig. 9 is plotted with a logarithmic frequency scale, by the use of which each musical octave is given equal space on the diagram. Each "C" of the piano, together with the highest and lowest notes of that instrument, is indicated. This mode of plotting is generally agreed to give the best impression of the aural effect corresponding to the curve, but it is perhaps worth pointing out that if the frequencies had been plotted on a normal scale, then practically the whole of the diagram would have been taken up by that part of the curve to the right of "Middle C," and the loss of high notes would have appeared enormously greater than it does with the correct logarithmic scale.

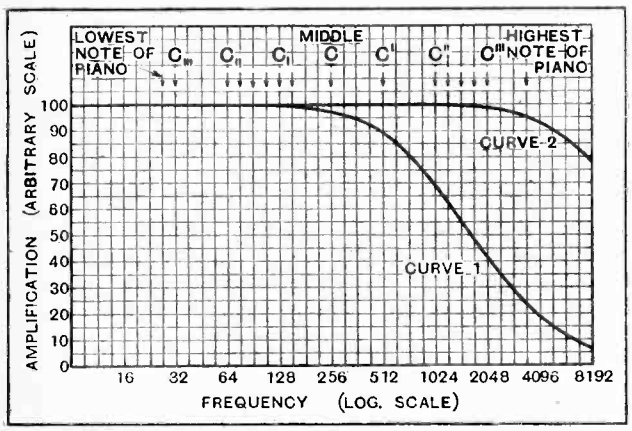


Fig. 9.—Curve 1 is the frequency response curve for the amplifier shown in Fig. 8. Note that the cut-off starts at about 200 cycles. Curve 2 shows the response curve to be expected from a 3-valve amplifier conforming to the conditions as stated in this article.

It is quite clear that the curve in question represents a thoroughly bad receiver, which will give "woolly" and low-toned reproduction of music unless the low notes are also missing, and must in any case give very indistinct consonants in speech.

Let us have a look at another and more difficult problem, which is the converse of the analysis of a receiver already designed. Let us imagine that we propose to use a valve of amplification factor 25 to 30 as an anode rectifier, and intend to follow it by L.F. amplifiers that amplify the signals given by the detector some 70 to 80 times before delivering them to the grid of the output valve, which is to be of the "super-power" class with an amplification factor of 5. We are to design an amplifier to do this, with an *overall* loss of high notes not exceeding 10 or 15 per cent. at 5,000 cycles, this loss being too small to be noticed by the ear.

More Valves and Less Amplification per Stage.

This looks, at first sight, as though the calculations involved would be both long and difficult. Apart from the fact that an easy case has been chosen, problems such as this are quite easily solved by the method of trial and error, patience and a slide rule being all the equipment required.

Obviously, there is no hope of getting an actual amplification of 70 times from a single stage, because no valve of high enough amplification factor exists; moreover, our analysis of the circuit of Fig. 8 has taught us that we must avoid valves of the high amplification type if we want to keep our high notes. It will therefore be necessary to employ two valves between detector and output stage, which makes the task extremely easy.

If we can get an amplification per stage of nine times only we have done what we want, for the total amplification then becomes 9×9, or 81 times. Just to make sure of nine times amplification, we will choose valves of amplification factor 12, which will have an impedance round about 15,000 ohms, and will therefore require anode resistances of some 100,000 ohms.

It is hardly necessary to give the full analysis of this amplifier; the circuit is shown in Fig. 10, and the values of R, R_a, and C are given in the table below, together with the percentage amplification for high notes for each inter-stage coupling.

Coupling.	R (megs.)	R_a (megs.)	C $\mu\mu$F.	Per cent. of 5,000 cycle notes retained.
V_1—V_2 ..	0.25	0.15	210	90.5
V_2—V_3 ..	0.10	0.03	110	99.6
V_3—V_4 ..	0.10	0.03	60	100

Overall high notes: retained, 90.2%
lost, 9.8%

As for the preceding design, the complete amplification-frequency curve for this amplifier, which conforms to the conditions laid down, has been worked out, and is plotted on the same diagram (Fig. 9, Curve 2). It is at once obvious that by replacing the one intermediate L.F. valve of the three-valve receiver by two valves, chosen to give a much smaller amplification per stage, we have converted a thoroughly bad amplifier into one giving really first-class quality, and, incidentally, have increased the overall amplification by about three times. In the writer's opinion, the cost of an additional valve is a small price to pay for so great an improvement, especially as the extra anode current consumption is negligible. These curves are commended to the notice of any who may possess, or think of constructing, receivers built on the lines of Fig. 8.

[1] The general form is $\frac{\omega CRR_a}{R+R_a}$, where $\omega = 2\pi \times$ frequency, and R, R_a and C are in ohms and farads. The curve of Figure 4 is used as before.

High-note Loss in Resistance Amplifiers.—

It is interesting to note that owing to the high values of plate resistance and valve impedance associated with the anode rectifier, and to the presence of the 0.0001 μF. condenser, practically the whole of the high-note loss in the circuit of Fig. 10 occurs at this point. The only way of minimising the loss here while retaining high sensitivity in the rectifier is by making V_2 a valve of very low amplification factor—a "super-power" valve, for example. To provide the necessary L.F. amplification, valves of higher impedance would then have to *follow* the "super-power" valve, making a very odd arrangement quite at variance with all one's prejudices as to the correct order of valves. The case is not likely to arise, but it is conceivable that it might be necessary to design such a receiver if sensitiveness to faint signals was required, and only one stage of H.F. amplification, on a small aerial, could be provided. The difficulty is, however, usually dodged in practice by the use of a grid rectifier, when both R and R_a can be very considerably lowered.

Building a Nearly Perfect Amplifier.

In view of the fact that the bulk of the high-note loss occurs, in any reasonably well-designed receiver, at the coupling immediately following the rectifier, the following table has been prepared showing the high-note loss incurred by using valves of various amplification factors immediately after the anode rectifier. A shunting condenser of 0.0001 μF. in the plate circuit of the latter is assumed, together with the values of plate resistance named.

R_a (nominal) of detector valve. (Ohms.)	"μ" of next valve.	Per cent. high notes lost.
20,000, with anode resistance 100,000 ohms.	10	2.3
	15	3.0
	20	4.2
	30	6.5
50,000, with anode resistance 250,000 ohms.	10	8.6
	15	11.3
	20	14.4
	30	20.5
100,000, with anode resistance 500,000 ohms.	10	27.5
	15	33.5
	20	39.2
	30	47.8

Unfortunately, it is utterly impossible to predict with any real accuracy the high-note loss taking place immediately following an anode rectifier, because the working impedance of the rectifier is entirely dependent upon the magnitude of the H.F. signal applied to its grid. The figures just given must therefore be accepted in the spirit in which they are offered—that is, as a rough approximation to the true value, which is liable to be doubled or halved at any moment by a touch on the tuning knob of the receiver.

Even the most casual reader, if he has survived so far, will by now have gathered that the calculation of high-note loss is an extraordinarily intricate one, involving to a minor extent even such unexpected variables as the size

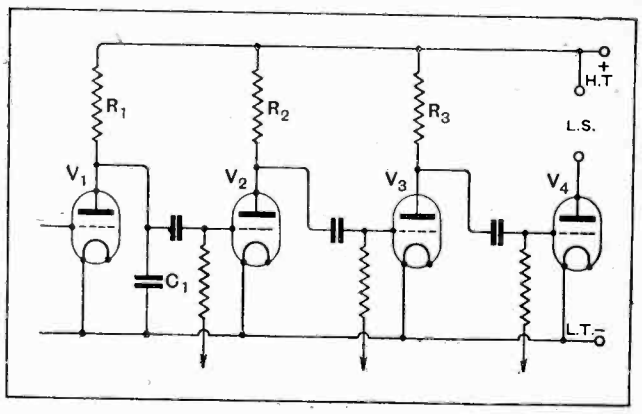


Fig. 10.—To avoid serious loss of high notes in a resistance amplifier and still retain good overall amplification it is necessary to employ three stages using low magnification valves and comparatively small anode resistances. R_1, 250,000 ohms; R_2, R_3, 100,000 ohms; C_1, 0.0001 mfd.; coupling condensers 0.01 mfd.; leaks 5 megs. V_1 (Det.) 50,000 ohms (makers' rating); V_2, V_3, 15,000 ohms with mag. factor of 12; V_4, mag. factor 5.

of the aerial and the length of the loud-speaker leads. The writer has done his best to present a readable account of the subject, simplifying it down in the process so that calculations of sufficient accuracy for practical purposes may be made from an approximate value of the three chief factors without the need for undertaking any measurements whatever.

In order to check the reliability of the results obtained in this way, a number of measurements of the high-note loss in actual amplifiers have been carried out, employing valves of which the individual characteristics had been accurately determined. Neither the time nor the apparatus at the disposal of the writer was such as to permit the making of real laboratory measurements, but nevertheless it was found that the bulk of the results obtained agreed within a very few units per cent. with the values of high-note loss obtained by calculation. Those who are inclined to mistrust pure "theory" may therefore make use of the methods and data that have been discussed without feeling that the results of their calculations are lacking in practical value.

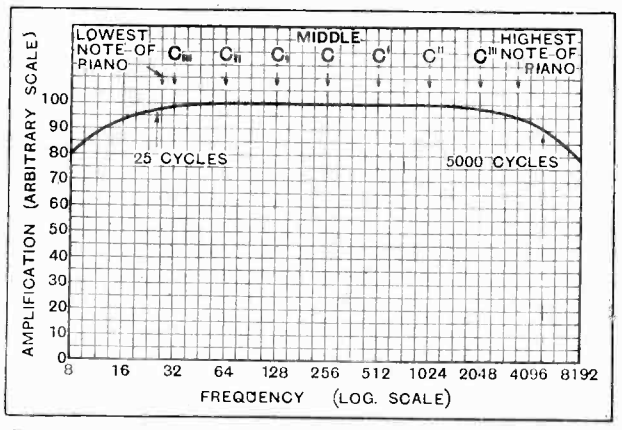


Fig. 11.—The frequency response curve of the amplifier shown in Fig. 10.

Since all that has been written in these three articles is directed to the one end of making it possible to design with certainty a distortionless resistance amplifier, the

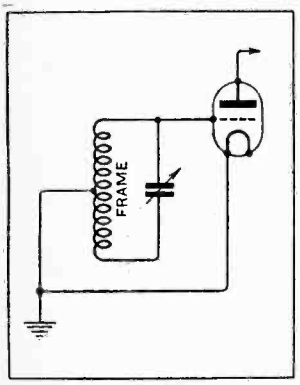
High-note Loss in Resistance Amplifiers.—
writer feels that it would be a fitting conclusion to give practical details of a circuit that can be relied upon to give an output in which notes of all frequencies are fully present. Such an amplifier has already been given in Fig. 10, together with the necessary figures which determine the loss of high notes; while if coupling condensers of 0.01 μF. and grid leaks of 5 megohms are used between each pair of valves, the overall frequency response curve will be as given in Fig. 11. This curve is, to all intents and purposes, a straight line from 12 cycles up to 5,000, the amplification falling off at these limits to 90 per cent. of its value over the intermediate part of the range.

Provided that the amplifier is *never* overloaded, and that the necessary input to the detector is made up, if required, by high-frequency amplification embodying circuits that are not too sharply tuned (and not on any account by reaction), any receiver built to this specification can be relied upon to provide signals of a quality to which no loud-speaker yet built can do full justice.

EARTH NOISES AND THE FRAME AERIAL.

The Importance of Balancing Out Electrostatic Pick-up.

AN article in *The Wireless World* (September 14th, page 333) pointed out that the directional effect of a frame aerial could be considerably improved by centre-tapping the frame and connecting this tap to earth and to the valve filaments, as shown in the figure. The idea underlying this mode of connection is that the electrostatic pick-up, being more or less evenly distributed over the frame, should be balanced out, leaving an approximation to pure electromagnetic pick-up. The degree of success attained in eliminating the static pick-up can be gauged by the extent to which the local station can be eliminated by turning the frame into the position of minimum signals.



Frame aerial circuit giving comparative freedom from earth noises.

Those who live in large towns are very frequently annoyed by finding that all reception, save from the local station, is impossible, owing to the noises due to the electrical machinery which is now found everywhere. All moving electrically driven machinery, from a vacuum cleaner up to an electric train, seems to generate disturbances which are carried along the electric light mains ("wired wireless") for very considerable distances from their point of origin. These disturbances, which are usually classed together under the vague but inclusive title of "earth noises," make themselves known to the user of wireless receivers in the form of a wide variety of scratches, cracks, bangs, buzzings, and indeterminate uproar of all kinds whenever he ventures to tune in a station at any distance. In bad cases even the local station may have its programme punctuated by the louder of the noises, while every other station may be completely blotted out by a continuous roar. Since these noises are completely untuned, it is not possible to eliminate them by making the receiver ultra-selective.

Apparently, however, the majority of the noises are introduced into the receiver through electrostatic rather than electromagnetic pick-up, for if the frame aerial connections shown in the figure are employed, the ratio of noises to signals can be very considerably reduced. It is found that a frame, connected in the usual manner to the receiver, does not offer any very great relief from noise, but that if the connections shown in the figure are adopted, a very considerable improvement results. In bad cases it becomes necessary to extend the precautions beyond that of the simple centre tap by making the tapping on the frame, which must for this purpose be wound with bare wire, by means of a spring clip, adjusting its position carefully to give the minimum of interference.

Avoid Static Pick-up.

The lead from tuning condenser to grid, having no counterpart at the other end of the tuned circuit, must be shielded, which implies, in practice, that the tuning condenser must be within the set, and the whole enclosed in an earthed metal screen.

It is also essential to look very carefully after the leads connecting the two ends of the frame to the tuning condenser and to take every precaution to ensure that the static pick-up by them is identical. This could be achieved by using twin flex for the connections, but the high capacity between the wires makes it unsuitable.

A good method is to make a kind of rope-ladder, the two wires forming the uprights, while the rungs consist of ebonite or wood spacing strips. Alternatively, the two wires may be sewn into opposite edges of a piece of webbing, with the connection for the centre tap, if desired, down the centre.

These precautions may seem very elaborate, but it must be emphasised that half measures give but little relief from the earth noises, while a whole-hearted attack on them, on the lines laid down in the present note, will at the least make it possible to obtain some sort of entertainment from any station which, on an open aerial, is not so entirely blotted out by noise that its transmissions are unintelligible.

TEACHING BROADCAST TECHNIQUE

A German Experiment with the Gramophone.

By FRANK WARSCHAUER (Wireless Critic of the "Vossische Zeitung").

THAT prejudice dies hard where a new artistic medium is concerned was abundantly shown until quite recently by the opposition among musical and dramatic artists to the steady development of broadcasting. When, three years ago, in the pages of a Berlin newspaper, the present writer declared that the new method of presentation could equal, and even rival, its predecessors, the assertion was received with incredulity. (Among the opposition was a well-known Berlin music critic who has since completely altered his views.) In general there was an outcry against what was termed the "mechanisation" of musical art.

Many inferior performances before the microphone are simply due to the fact that the artist has no means of judging his own efforts as heard on the receiving instrument. In this article the writer, a well-known German wireless critic, deals with a novel method of broadcast instruction now being tried out in the Berlin Academy of Music.

This phase did not last. Gradually the musical profession began to succumb to the spell of the microphone, not only to express its soul but to fill its pockets. The circle of broadcasting celebrities widened; persons of rank and renown joined the throng; and a point was at length arrived at when even the "die-hards" found it expedient to examine the position more closely. They found that broadcasting had arrived!

Exploring Fresh Possibilities.

But even to-day broadcasting has only half won its battle. An artist's willingness to broadcast does not imply an ability to do so. At the present time contact between the artist and the listener is not all it should be. Special preparation and much thought are necessary before an adequate broadcast performance is possible. It is not enough to repeat before the microphone what has already been received with acclamation in the concert hall or theatre. The artist must explore the possibilities of the new medium, and if he succeeds in tapping new sources of expression, he should turn his experience to the benefit of other artists. He should assist in the general quest for a new technique.

Herein lies the prime difficulty. In Berlin and the rest of Germany conditions are highly unfavourable. As might be expected, the leading broadcast artists are not altogether willing to communicate their secrets to their lesser brethren; and so long as the quality of performance has maintained a tolerable standard, the administrative and technical departments have not interfered.

At such a juncture when the technique of broadcasting appears to have settled into the well-worn groove of mediocrity, a new hope is kindled by the latest move on the part of the Berlin Academy of Music. The Academy has diagnosed the malady and has initiated a scheme of remedy. The credit belongs to Professor Schuenemann, Director of the Academy, who has already given close study to the possibilities of broadcast art.

The Academy founds its new enterprise on the doctrine that the broadcast artist should hear himself as others hear him—a pungent and sometimes unpalatable medicine, extraordinarily potent in its effects.

The Use of the Gramophone.

In association with the Academy, an Institute of Broadcast Research is being formed which will afford artists an opportunity for unique experiments on the lines indicated. A central studio has been constructed to the acoustic designs of Professor Leithäuser; one of its advan-

Teaching Broadcast Technique.—

tages is that it can be enlarged or made smaller as required. Here the pupils will find themselves in the atmosphere of the broadcast studio. More important still, they will be able to listen to their own performances with the same critical ear as the broadcast listener. For this purpose gramophone recording and reproducing apparatus has been installed, by the use of which the teacher will be in a position not merely to explain mistakes to the pupil but to demonstrate them in a compelling fashion.

Part of the work at the Academy will consist of a systematic study of the relative sound values of the various instruments in relation to the microphone. A critical examination will be made of that side of a musical transmission which is controlled by the technical staff. The task of the control engineer will be studied afresh, for it is realised that technical proficiency alone is inadequate in the proper handling of musical output. A musical education is a necessity. In the musical training of control engineers, loud-speakers will be employed, and eventually a short-wave transmitter will be installed.

Not least among the aims of the Academy is the influence which it seeks to exert over the younger generation of composers. If, it is felt, the composer can study at first hand the peculiar problems associated with the broadcasting of music, he will approach the new art medium with a fuller appreciation of its scope and limitations. This is an ambitious and promising programme which may result in broadcasting helping to create a new musical art form.

TRANSMITTERS' NOTES AND QUERIES

Codes and Abbreviations.

We have to correct an error in one of the four-letter "Q" codes as printed on page 230 of our issue of February 29th, QSTI should read QSYI. The last two of these codes as given in our list are, of course, merely extensions of the International QSY—"Transmit on a wavelength of . . . metres"—the final letter "I" and "U" signifying which station is proposing or requested to change its wavelength.

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Short-wave Reception.

A correspondent in Thames Ditton sends us some interesting results of observations taken of the audibility of various distant short-wave stations since January 1st. He has tabulated these according to the percentage of "dependability," or the proportionate number of observations of the various stations which have been rewarded by clear speech. On many occasions the carrier wave was very strong, but unless speech was also good it was not counted among the "clear" observations The receiver used throughout was the "Empire Two," described in our issue of June 29th, 1927, and the "dependability percentage" is given thus: 2XAD, 86 per cent.; 2XAF, 81 per cent.; 2XG, 80 per cent. (Friday evening only); 2XAL, 10 per cent.; 3LO (Melbourne), 40 per cent.; ANH, 22.5 per cent.; KDKA, 80 per cent.

In his covering letter our correspondent states that out of ten attempts to receive 3LO he was only able to follow the whole programme on four occasions. He suggests that the station is not using a completely rectified supply and suffers from a form of "high-speed fading." He also finds that speech from 3LO is infinitely clearer than music, and that reception is generally at its best about 2½ hours after sunset.

Bandoeng, ANH, was coming through very well on 17 metres from 1 to 3 p.m. on Sunday, February 26th, with no distortion but slight fading, and 2XG which, in addition to its usual Friday transmission seems to be testing every Saturday afternoon, is reported as amazingly reliable and clear.

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Irish Transmitters.

Messrs. D. M. and D. F. O'Dwyer (GW 18B), 9, Upper Leeson Street, Dublin, were in touch with OA 3KS, Mr. J. Sims, East Malvern, Victoria, on February 6th. This is stated to be the first two-way communication between Australia and the Irish Free State. The power input to GW 18B was four watts, derived from 200-volt accumulators.

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The Irish Radio Transmitters' Society, Solent Villa, Kimmage Road, Terenure, Dublin, will forward cards and communications intended for transmitters in the Irish Free State.

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Through the courtesy of the Editor we have received a copy of the first number of *Irish Radio News*, the official organ of the Wireless Society of Ireland. The greater part of this first issue is taken up with matters relating to broadcasting in the Irish Free State, including an interesting foreword by Mr. M. R. Heffernan, the Parliamentary Secretary to the Minister for Posts and Telegraphs. It is to be hoped that future issues will contain more news about the doings of the various amateur societies and transmitters in Ireland.

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Greenland Expedition.

The following stations were heard during the last week in February by NX 1XL, the station of the Michigan University Expedition to Greenland :—

EG 2CB, 2CC, 2GF, 2NM, 2RG, 2XY, 2YU, 5BD, 5BY, 5JW, 5KZ, 5ML, 5SK, 5WQ, 6BB, 6BY, 6CI, 6FR, 6JK, 6MN, 6NO, 6PP, 6TA, 6QB, 6VJ, 6VP, 6WO, 6YJ, 6YK, 6YL, GI 2IT, 6JA, GC 5XQ, 6MS, EO 11Z, 12B, 14B, 16C, 17C, 18B.

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Transatlantic Amateurs.

The following amateur transmitters in Canada and the United States are anxious to arrange schedules with British stations on 20 or 40 metres :—

NC 2BR.—Mr. A. G. Brewer, 98, Brunet Avenue, Pointe Claire, Quebec.

NU 9EFY.—Mr. F. J. Broome, Box 346, Sun Prairie, Wisconsin, U.S.A.

NU 9BIF.—Mr. G. M. Whitney, "WCFL" Municipal Pier, Chicago, Ill.

NU 6JU.—San Mateo Junior College, San Mateo, California.

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Belgian Amateurs.

With reference to the note on page 166 of our issue of February 15th, we learn that Mr. G. Regnier, EB 4WW, was received in New Zealand at strength R6 on telephony, while using only 200 watts input and combining the stations 4WW and 4ZZ. He hopes to link up the three stations, EB 4WW, 4ZZ, and 4AX, and then to work at moderately high power on wavelengths of 20, 32, and 45 metres. Reports may be sent to 4WW at his usual address, 17, Boulevard Frère Orban, Liége.

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Obituary.

We regret to record the death on December 4th of Mr. Laurence Manning, one of the original members of the Institute of Wireless Technology, whose station, 2GN, at 36, School Green Lane, Fulwood, Sheffield, was well known to North country transmitters.

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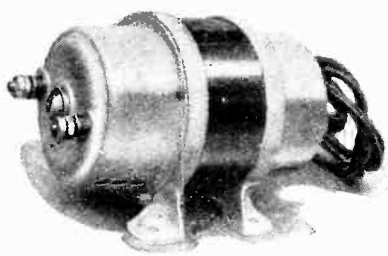
New Call-signs and Stations Identified.

2HD	(Ex 2ADC) A. Harper, Cropwell Bishop, Nottingham, transmits on 23 and 45 metres.
6RC	R. P. Cole, 55, Park Road, Chiswick, W.4, transmits on 23 and 45 metres.
2ACC	H. Bishop, 29, Birchwood Lane, Somercotes, Derby.

A Review of the Latest Products of the Manufacturers.

M.L. ROTARY TRANSFORMERS.

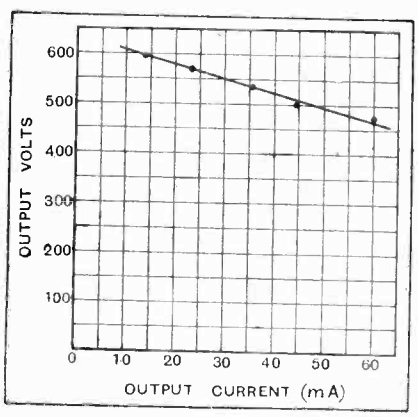
The voltage of supply mains seldom exceeds 250, and this is hardly sufficient for the power amplifiers associated with modern coil-driven cone loud-speakers. If alternating current is available it is a simple matter to step up the voltage and rectify and smooth the output. The ideal source of H.T. is, of course, the accumulator, but this is not always practicable for high voltages. The rotary transformer possibly offers the best solution of the H.T. problem for pressures of the order of 500 volts when



M.L. rotary transformer for H.T. supply.

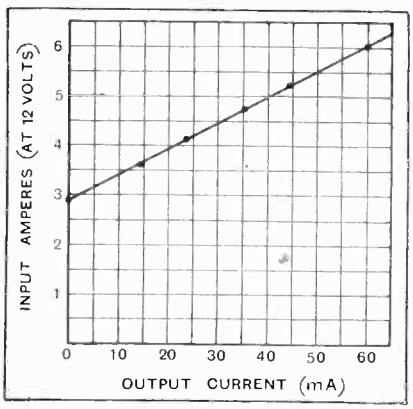
A.C. mains are not available. The M-L. Magneto Syndicate, Ltd., Victoria Works, Coventry, have specialised for many years in machines of this type, and the one illustrated is designed for D.C. input at 12 volts and delivers 60 mA. at 500 volts.

On test the machine was free from ripple, perfectly silent and free from vibration. A series of readings of output voltage and input current were taken for various output loads, and the results



Variation of output voltage with load.

appear in the accompanying curves. At the normal output rating the efficiency works out at 40 per cent., but for high ratings efficiencies as high as 55 per cent. are obtainable.



Input current for various output loads.

The machine employs permanent field magnets, and will operate both L.T. and H.T. if driven by a separate motor; a special spindle extension for this purpose can be supplied on request. The price of the machine under review is £14 10s., which compares very favourably with the cost of H.T. accumulators. Machines with inputs wound for voltages up to 250 volts are also available.

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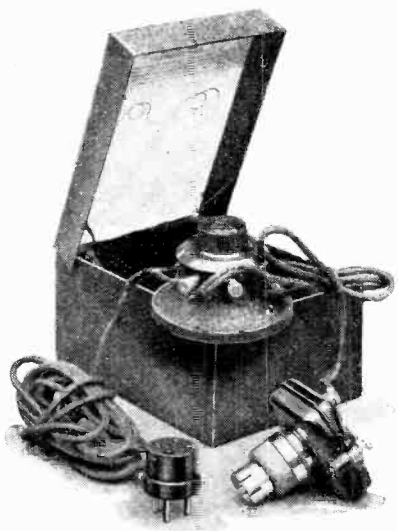
AMPLION VIVAVOX.

Electrical sound reproduction has been the speciality of Messrs. Graham Amplion, Ltd., for many years, so that the design of a successful gramophone pick-up should be to them almost a matter of routine. The results obtained with the Vivavox more than fulfilled expectations. It is highly sensitive, and one transformer-coupled stage preceding the output valve was sufficient to produce a grid amplitude of 30 volts on the last stage—more than sufficient for normal use.

The equipment tested, however, included a volume control so that the input to the amplifier could be adjusted to suit conditions. The volume control unit consists of a potentiometer mounted in a heavy cast base, and the range of control is from zero to the greatest volume of which the amplifier is capable. Each pick-up is sent out with a special valve adaptor. This is plugged in the detector valve socket of the receiver, and the detector valve is then inserted in the top of the adaptor. The function of the adaptor is to break the grid circuit of the detector and to connect the pick-up between the grid and −L.T.; no extra grid bias is used.

The pick-up itself is contained in a moulded shell, and is supplied with a universal fitting suitable for the various makes of tone arm. It is light in weight



Amplion Vivavox type G.U.I. pick-up with volume control and adaptor.

and should not cause undue record wear. Due no doubt to the thinness of the moulding, a distinct hiss is audible from the sound box during playing. This is much louder than the normal record scratch reproduced by the loud-speaker, which cannot be heard unless the lid of the gramophone is open.

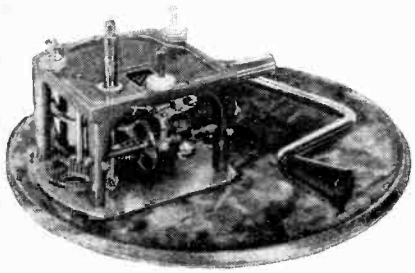
Best results are given with "loud" steel needles, and with these excellent quality with good definition and without chattering was obtained.

The price of the complete equipment, including pick-up, volume control, adaptor and 9ft. leads is £2 10s. Without the volume control the cost is £1 15s.

GARRARD MOTORS

There is a tendency among wireless enthusiasts who have taken up the electrical reproduction of gramophone records to overlook the importance of a good motor and turntable. It is of little use expending infinite pains in perfecting the pick-up, amplifier, and loud-speaker if the results are to be spoilt by uneven running of the turntable; yet too often one sees a cheap and nasty motor screwed to a rough baseboard in association with electrical equipment which must have cost upwards of £20.

A clockwork motor is probably the best with which to start work with gramophone pick-ups. Apart from its inherent simplicity there is no possibility of interference with the amplifier, which is sometimes caused by electric motors unless they are carefully screened.

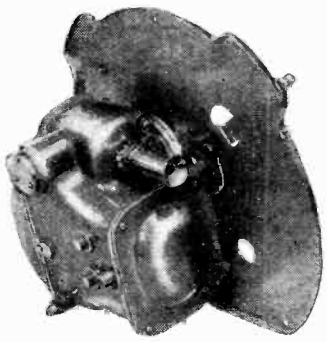


Garrard Model 11a which plays two 12in. records.

The "Garrard" motors, made by the Garrard Engineering and Manufacturing Co., Ltd., 17, Grafton Street, London, W.1, are of exceptionally high quality and in every way worthy of the best electrical reproducing equipment. All gears are machined from the solid, and helical teeth are used in all the important gears and pinions. As a result it is impossible to hear the motor running even when screwed to a baseboard. The winding gear is equally silent—an important point if artistic continuity between records is to be maintained.

For general experimental purposes the Model No. 11a is recommended. This is of the open type built into a grey cast-iron and stove-enamelled frame, and will play two 12in. records at one winding. All important bearings are of phosphor bronze. The double spring is enclosed in a case which can be easily removed from the frame for inspection or replacements by releasing a simple spring clip. This model costs £2 2s., and the price includes 12in. baize-covered turntable, inside or outside brake, speed indicator, and regulating lever, winding crank, and escutcheon fixing screws, etc.

The "Super" Garrard motor is something quite out of the ordinary and should appeal to those who wish to build a really first-class outfit. It is totally enclosed in a cast-iron case, and lubrication is by means of an automatic pump. This is actuated by the winding mechanism and works in a sump at the bottom of the case. Oil is pumped through a delivery pipe on to the top of the spring case unit and floods the entire mechanism. Ball thrust bearings are fitted to several important parts in addition to the phosphor bronze bearings. The springs are 16ft. long, and



"Super" Garrard motor, totally enclosed and fitted with automatic oil pump.

will play three 12in. records with perfect regularity without rewinding.

Each motor is sent out assembled on a plated metal base and a template is supplied for cutting and drilling the motor board of the cabinet. The usual accessories are included and the price is £5 15s.

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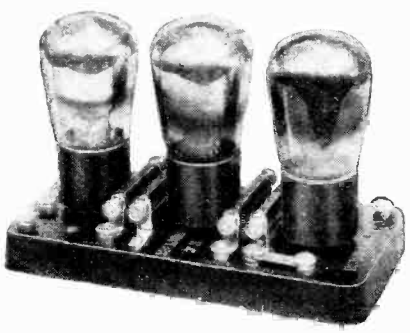
GRAHAM-FARISH THREE-VALVE COUPLER.

The dimensions of this unit are only 6¾in. × 3¼in., yet it comprises a complete three-valve amplifier with coupling condensers incorporated in the base. It is particularly well suited for amplifying the output from a gramophone pick-up, and with a "super-power" valve in the last stage gives results equal to far more expensive equipments. The only possible criticism is that the distance between the pairs of grid leaks is rather too small, and with at least one make of valve there is only just enough room to insert the middle valve.



For gramophone pick-ups; Graham-Farish resistance-capacity coupler.

The unit can be used for many other purposes, including broadcast reception, and a comprehensive series of circuit diagrams is included in the instructions. The price is 12s. 6d., and the anode resistances and grid leaks cost 2s. 3d. and 2s. each respectively. The former are available in values from 10,000 to 500,000 ohms, and the latter from 1 to 5 megohms.

GECOPHONE MODEL B.C. 1694 CONE SPEAKER.

The performance of this loud-speaker is distinctly above the average both as regards sensitivity and tone quality. There is a full-throated bass, yet the sibilants of speech are quite distinct and the sensitivity is extraordinary. The only adjustment provided is a clamping screw to allow for expansion and contraction of the cone, which is made from a composite fabric containing muslin. The cone angle is rather more acute than usual, and the diameter is about ten inches.

The cabinet appearance may be judged from the photograph; the back is perforated with large holes which allow free circulation of air and prevent resonance. Ready access to the interior is obtained by the removal of a single knurled screw which permits the complete removal of the back panel.

Gecophone Model B.C. 1694 loud-speaker.

The volume of sound obtainable without overloading and rattle is quite unbearable in an ordinary room, and the full undistorted output from a D.E.5A valve is easily accommodated. It is an instrument that would do justice to any high quality receiver or amplifier, and is quite one of the best cone loud-speakers we have tested. The price is £8 8s.

CATALOGUES RECEIVED.

Grafton Electric Company, 54, Grafton Street, Tottenham Court Road, London, W.1.—Complete catalogue of wireless and electrical components, fully illustrated, with comprehensive list of present-day valves.

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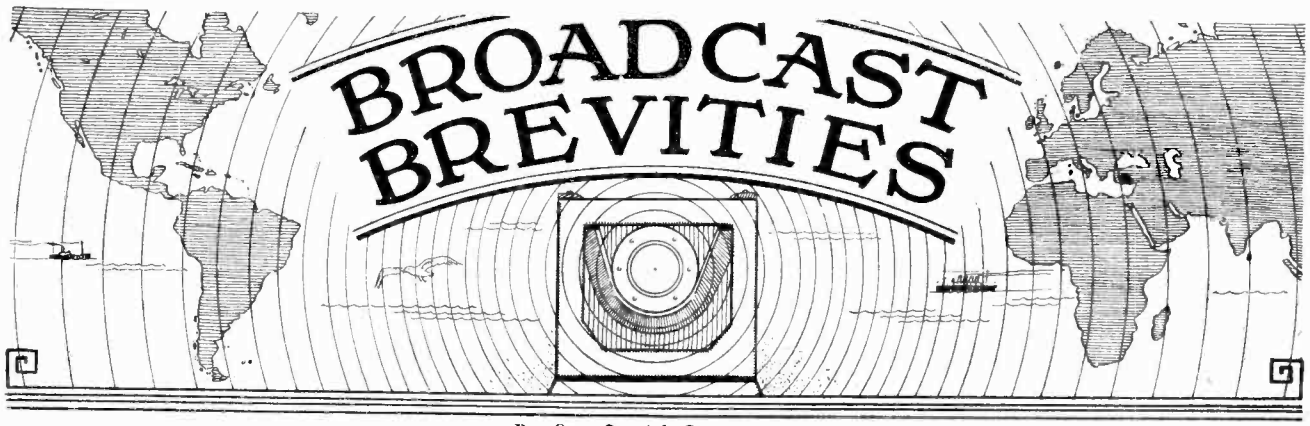
Fuller Accumulator Company (1926), Ltd., Woodland Works, Chadwell Heath, Essex.—List 260. Radio Accumulators; Types SW and SWD. List 266A. Radio Accumulators in Glass Containers, types SWDG, SDG, LDG and RHG, for low and high tension. List 91E. Inert Cells and Dry Cells. List 130a. Sac Elements and associated materials.



By Our Special Correspondent.

Controversy: New Problems.—Captain Eckersley's Scotch Tour.—Sandler in London.—The New Radio Drama.—New Ideas for Broadcast Music.—Talk about Talks.

The Lifting of the Ban.

There are no formidable changes at Savoy Hill in consequence of the Cabinet decision to allow controversial broadcasting. I am told that when the announcement was first made there was a deluge of enquiries from people who imagined that new departments would be opened forthwith, complete with official censors, and all the paraphernalia of a newspaper office.

The world has stood the shock quite creditably, and is still awaiting the first "controversial broadcast."

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A New Problem.

The new emancipation will first be evident in the choice of speakers and subjects for the "Topical Talks." Outside debates on vexed questions of the hour will follow, and a number of studio debates will also be arranged.

Very great caution will have to be exercised, and no one appreciates this more than the Programme Department, to whom falls the queer task of staging debates for a mixed audience of men, women and children. The problem is quite a serious one, and nothing quite like it has occurred before.

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Wanted: A Thick Skin.

No such problem ever faces the editor of a newspaper, whose views are, more often than not, professionally partisan. In his case there is no moral obligation to give both sides an equal hearing; he can trust his rivals. In broadcasting, the scales will be held by a single body of arbiters, and woe betide that body if its skin is not thick!

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Controversy on the Prayer Book.

One of the first subjects of argument before the microphone will be the revision of the Prayer Book.

The lifting of the ban on controversy will not, I learn, involve any extension of the time allotted to talks. This suggests that many of the "educational" talks may be abandoned with the conclusion of the present series.

FUTURE FEATURES.

London and Daventry (5XX).

MARCH 18TH.—Moszkowski Programme.

MARCH 19TH.—Civil Service Choir.

MARCH 20TH.—"The Master Builder," a play in three acts by Henrik Ibsen.

MARCH 21ST.—Speeches following the second annual banquet of the Company of Master Mariners, including H.R.H. the Prince of Wales.

MARCH 22ND.—Charlot's Hour.

MARCH 23RD.—National Symphony Concert relayed from the Queen's Hall, conducted by Sir Hamilton Harty.

MARCH 24TH.—Eye-witness Account of the Oxford v. Cambridge Sports.

Daventry Exp. (5GB).

MARCH 18TH.—Military Band Concert.

MARCH 19TH.—"The Master Builder," a play in three acts by Henrik Ibsen.

MARCH 22ND.—Hallé Pension Fund Concert, relayed from Manchester.

MARCH 23RD.—Vaudeville Programme.

MARCH 24TH.—"The Night Fighters," a play by Cecil Lewis.

Manchester.

MARCH 23RD.—A Dickens Recital by Arthur Hayes.

Newcastle.

MARCH 22ND.—Berlioz's "Faust" relayed from the Town Hall.

Glasgow.

MARCH 24TH.—Glasgow City Police Military Band Concert.

Aberdeen.

MARCH 19TH.—A Scottish Programme.

Belfast.

MARCH 19TH.—"The Voice of the Sea," choruses, stories and songs of the sea.

A Triumph of Talk.

How many people listening to Captain Eckersley's recent hour talk from 5GB realised that it was being delivered extempore? To achieve the feat of the world's longest broadcast talk, the Chief Engineer sat alone. His equipment consisted of a piece of paper bearing a few notes, and a glass of water.

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"P.P." in Scotland.

Captain Eckersley is now in Scotland busily engaged on a lecture tour. Tomorrow evening (Thursday) he will speak at the big concert which the Aberdeen station is giving in the Music Hall.

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Sandler's First London Broadcast.

Last week it was hinted in these columns that we should soon hear Albert Sandler and his orchestra broadcasting from the Park Lane Hotel, London. It is now definitely arranged that Sandler will broadcast from that hotel on Sunday, April 15th.

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A Question of Acoustics.

Some uncertainty had existed as to whether the Park Lane Hotel would be acoustically suitable, but an interesting test carried out by the B.B.C. Balance and Control Department on Wednesday last removed all doubts. It cannot truthfully be said that Sandler's new surroundings offer him quite the same opportunities as he enjoyed at Eastbourne. Listening to the special reception test in the Savoy Hill "drawing-room," I noticed the absence of the echo effect which has always added brilliance to the Eastbourne transmission. The test took place in the empty restaurant, and an hour elapsed before the control people were fully satisfied with the placing of the different instruments

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Further Tests Possible.

If, as has been suggested, the presence of a large audience in the restaurant is found to spoil the quality of the transmissions, it is possible that tests may be made with the orchestra playing in the large ball-room.

Week-day Concerts from Eastbourne.

Concerts are still to be given from the Grand Hotel, Eastbourne, under the direction of Thomas Jones, the well-known Birmingham conductor, but I understand that these will be broadcast on week-days only.

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The New Technique.

A few more whispers have reached me regarding "Speed," the radio play in a new form to be broadcast on April 2nd. As mentioned last week, "Speed" treats of the eternal conflict between mere man and the gods of Olympus, but it will not be hazy and abstract on that account. Aeroplanes, motor cars, and other modern contrivances will add swiftness to the drama, and will no doubt assist towards the final extinction of the mortals.

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Appealing to the Imagination.

It is significant that "Speed" employs the same artifice which made such a success of "Shadows" a few weeks ago, namely, sudden and poignant appeals to the imagination. In "Shadows" we heard a pistol shot; our imaginations did the rest. So it will be in "Speed." We shall hear the swift approach of the motor car, the country yokel's exclamation as it begins to take the curve, and then . . . but it would be a pity to say too much.

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Beating the Film.

It will probably be found that the broadcast drama of the future will derive its main appeal from its grip upon the imagination. A sound can stir the emotions just as surely as a spectacle; in fact, an illusion is often shattered when the ear is aided by the eye. Because of this there is every probability that in certain departments of drama, broadcasting may soon supplant the film. In plays of the Grand Guignol type the film generally fails miserably. It behoves the Dramatic Department at Savoy Hill to prove conclusively that broadcasting does not. Big strides have been made already.

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New Ideas for Broadcast Music.

The waltz "Destiny" which has been played, whistled and hummed all over the world, was the work of a composer who proposes to show listeners some new ideas in broadcast music on April 1st. He is Mr. Sydney Bayes, at present appearing with his band of twelve in "Clowns in Clover" at the Adelphi Theatre. His use of the saxophone and muted brass for light music, as distinct from dance music, will indicate his belief that these instrumental effects must have their place in all light orchestration of the future, more especially, perhaps for broadcasting.

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Bach's Cantatas: An Easter Innovation.

That great master of church music, Bach, wrote not merely one Cantata for each Sunday of the year, but almost enough to permit of a different one being given for every Sunday during three or four years. Most of these cantatas still exist, and the B.B.C. proposes to broadcast a number of them, starting on Easter Sunday. They will run fortnightly, and alternately from 2LO and 5GB, *i.e.*, the first from London on April 8th will be "Thou Wilt not leave my Soul in Hell," and the first from 5GB on April 22nd will be "Thou Guide of Israel."

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The Pied Piper.

"The Piper," an opera founded on Robert Browning's "The Pied Piper of Hamelin," will be broadcast from 5GB on March 20th. The composer is Herbert Ferrers, whose "Penelope" was given a first performance by the B.B.C. a few weeks ago. "The Piper" has also been broadcast on one or two occasions. For the 5GB broadcast Dale Smith will take the part of the Piper, Doris Vane that of a Lame Boy, Stuart Robertson is the Mayor of Hamelin, Frederick Hayes the Town Clerk, and Dorothy Burton is the Boy's mother. Mr. Ferrers will himself conduct the Wireless Symphony Orchestra.

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We've Heard Them Here.

A new broadcasting combination in America is known as the "Automatic Agitators Male Quartet."

America seems to bag all the most appropriate titles!

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Interference by Electrical Machinery.

A mysterious form of interference upset listeners in Blackpool a few nights ago. It was described as a "wireless roar." On the next evening it had disappeared and has not been heard since. The strange visitor—it may have been some form of high frequency machine—does not appear to have transferred its attentions elsewhere.

At the present time the broadcast wavebands are comparatively free from disturbance, judging by the lack of reports at Savoy Hill. Electrical machinery is a pretty constant source of interference in some districts, but there do not appear to be any new offenders.

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Are "Snippety" Programmes a Mistake?

When in trouble most of us derive a sneaking satisfaction from the thought that others are also "getting it in the neck." It may, therefore, cheer the B.B.C. (who have, it is true, come through their major troubles) to know that the South African Broadcasting Company is being asked to improve the programmes.

South Africa, it seems, has grown tired of the "snippety" programme. It now demands the "group" scheme of presentation, after the fashion of the programmes in this country. A writer in the *South African Wireless Weekly*, voicing the opinion of readers, says that programmes made up of odd items "lead nowhere, do nobody any good, and generally just result in a heterogeneous collection of nothing."

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Drawbacks to the "Group" Scheme.

Surely this is putting it a little too strong. Many people can only listen at odd moments, and cannot be expected to extract much enjoyment from ten minutes of a radio play or other type of performance which requires attention from start to finish.

There will always be a demand for odd items, and the S.A. Broadcasting Company would be well advised not to make overwhelming changes in their present programme policy. They could do worse than follow the lines of our own B.B.C. programmes.

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New Irish Broadcasting Journal.

A "New Programme Paper" for listeners in the Irish Free State makes its bow under the title of "The Irish Radio News" (No. 1, New Series). The forthcoming programmes from the Dublin station 2RN form the main contents of the journal, which also includes interesting paragraphs and news items concerning broadcasting events and celebrities. The first number receives the benison of the Parliamentary Secretary to the Minister for Posts and Telegraphs, Mr. M. R. Hefferman, who contributes an article in which he maintains that broadcasting should aim to be, in the words of the late Kevin O'Higgins, "consistently good rather than occasionally excellent."

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Talks.

A courteous correspondent rebukes me for discouraging broadcast talks. The fact emerges, however, that he resides in Birmingham and his letter implies that he listen chiefly to 5 GB, a station which has only just abandoned the principle of "all music, no talk." Programmes of this kind must be rather satiating and one can readily sympathise with the listener who yearns for a little talk, be it ever so humble, to break the monotony.

But what so many listeners quarrel with is the arrangement whereby talk is unnecessarily prolonged with insufficient intervals of music. In the past week, however, the situation has changed immensely with the lifting of the ban on controversy. Talks of the future will gain in vitality and it is not impossible that a demand may arise for more and more talk. There has been no such demand up to the present.

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Broadcasting in Iceland.

Broadcasting interest in Iceland is decidedly on the increase and the number of listeners has grown appreciably during the last two or three months. Plans are now under consideration for the erection of a more powerful station at Reykjavik which will work on a power of 5 kw. and will replace the present station operating on 1 kw.

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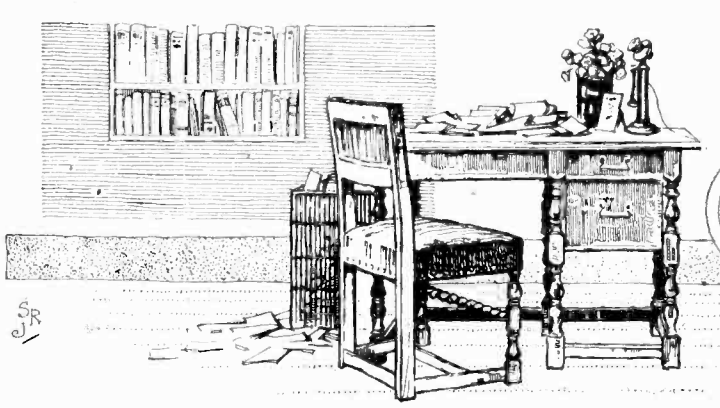
New Station at Oslo?

There are rumours that a new high power station is to be erected in Oslo as it is thought that this is badly needed and that it would lead to a rapid increase in the number of licensed listeners.

The preference for the English language shown by the inhabitants of Scandinavia is well known, so that it is not surprising to hear that the Copenhagen station has arranged for a series of English talks on famous British authors.



The Week's Postbag

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.

CONTOURS OF 2LO.

Sir,—I have read with interest Mr. Barfield's article, "Contours of 2LO," in the issue of January 4th, just to hand. I must dispute his contention that trees are the principal cause of the irregularity of the contours. If this were so, the two inner contours on the map would be two perfect circles with their centres at Oxford Street, for they enclose a completely urban area over which the very few trees are evenly distributed. As it is, we see that these contours are roughly the same shape as the outer ones. It is, therefore, obvious that the principal cause of the irregularity is to be found in London and not in the surrounding country.

Mr. Barfield has totally ignored the hundreds of thousands of receiving aerials which surround 2LO. A large proportion of these will at any moment be tuned to 2LO's wave-length. The aggregate absorption by these must be an appreciable proportion of the energy radiated, probably quite sufficient to account for the difference between the calculated and the observed signal strengths.

Now 2LO is not situated at the centre of London, but to the N.W. of it, so that the number of aerials to the N.W. will be less than in other directions. The contour map shows that reception is best in a north-westerly direction. The other irregularities can be explained by the irregular outline of London.

Besides the numberless aerials, the area is covered by a network of railway lines, overhead wires, buried pipes, etc., which must introduce a very serious error into any formula for calculating absorption or signal strength. G. E. C. WEDLAKE.

East Barnet, Herts.
February 26th, 1928.

RECEPTION OF 5SW.

Sir,—In your "Broadcast Brevities" columns I notice you say that Australia seems to be the only Dominion that takes an active interest in 5SW. You also say that that Dominion appears to be the only one that can get it.

We, here, can always pick up 5SW. It varies considerably in signal strength: sometimes loud-speaker and sometimes poor on phones. It is certainly not up to 2XAF or the old P.C.J.J. The majority of programmes are not worth listening to. Here's one for Wednesday, February 15th: 19.00, Ministry of Agriculture "Talk"; 19.15, Piano, J. Pauer; 19.25, "Talk," Eastern Art and Literature; 19.45, Variety; 19.55, Salvation Army Corps Concert; 20.25, Variety; 21.00 to 21.15, Interval (we don't get the news!); 21.15, "Talk"; 21.35 to 23.00, Concert, "Merry England"; 23.00, Kettner's Restaurant.

Well, I suppose some people do want three talks in the evening, but I have yet to meet them.

Some ten days or so ago I had the same programme for 5SW and 2XAF, the latter being much more powerful.

Lagos, Nigeria. L. A. B. TONKS.
February 16th, 1923.

EXPONENTIAL HORN.

Sir,—I have made the exponential horn described in your issues November 16th and 23rd, and am much obliged to you for the design. I constructed it of 3-ply wood in the square form and finished with a length of 4 ft. 7 in.

It is put together with glue and screws, and though it was a tough job to make the four edges meet where the curve is greatest, it came together with the aid of a piece of rope and a tourniquet.

It hangs in the corner of my room quite unobtrusively, and gives a quality of reproduction I have not heard equalled by any other type of horn.

There is not a trace of horn resonance, and the music from it is evenly distributed throughout the room. Although the wood available obliged me to make it shorter than your design, I have rigidly adhered to the measurements in your diagram; the open end is 18 in. square. ALAN CARTWRIGHT.

West Norwood.
February 26th, 1928.

OUTSIDE BROADCASTS.

Sir,—I have read with much interest the letter from Mr. Kyrle Leng in this week's *Wireless World*, because it expresses exactly my views on the matter.

The B.B.C. should give us more consistently good quality transmissions. That the great majority of sets and loud-speakers introduce so much distortion as to make the question of quality a matter of secondary importance, is not a sufficiently valid reason to justify the B.B.C.'s apparent attitude to the question of purity of transmission. Practically all S.B. stuff is bad, and the outside broadcasts are certainly not improving in quality. The greatest improvement of late has been in the quality of the transmissions from the Birmingham studio through 5GB, although there is still a lot of extraneous noise. A very considerable percentage of the 5XX transmissions are definitely bad.

It is no flight of fancy to say that Hilversum is often received at infinitely better quality than 5XX. F. G. SACKETT.

Birmingham.
February 23rd, 1928.

Sir,—With reference to the correspondence in your columns regarding the above, I should like to draw attention to an instance which appears to be opposite to the general contention, namely, that in the case of certain outside broadcasts from the Manchester station the quality of the outside broadcasts is definitely superior to the normal studio transmissions.

Anyone who wishes to confirm this should listen to the Tuesday mid-day concerts which are usually broadcast from the Houldsworth Hall, Manchester, the superior reproduction

then provided being very noticeably better than the usual direct broadcasts from the Manchester station of similar nature. The Manchester station is, I believe, notoriously weak in its transmissions of the lower register, and Manchester listeners are now in the unfortunate position of having a local station which is frequently not worth listening to, whilst 5GB, which is considerably better on the bass register, fades so badly as to be out of the question. J. BAGGS.

New Moston, Manchester.
March 7th, 1928.

PROGRAMMES.

Sir,—In your issue of February 22nd there is a letter signed "Cee Gee," Surrey, and in my opinion your correspondent, to use a well-known expression, "has hit the nail right bang on the head." I must say that I thoroughly agree with his contention, i.e., that taken all round our B.B.C. programmes are of too serious a nature. Speaking generally they go to the two extremes, either music of the "Trio in F Minor" style or dance music. Now there is, as most people know, a happy medium between these two. Such tunes as "Zampa," "William Tell," some of Greig's compositions, music from operas such as "Faust," "Mignon," etc., etc., are neither highbrow nor lowbrow, yet same are tuneful and exhilarating. Some time ago I was unfortunately confined home for two or three days, and was agreeably surprised to hear the nice light music from some of the tea houses and picture palaces. The B.B.C would do well to have on their advisory staff someone of the calibre of, say, "Frank Westfield," whose broadcasts are just what we "Medium Brows" want. True enough, Mr. Cee Gee, after a hard day's mental or manual work we want cheering up, not educating. We must, however, not lose sight of the fact that different people have different tastes, but where the B.B.C. are in error is in trying to please everyone in the same evening. What they should try to do is to attempt to please one class of listener one evening and the other class on another evening. Thus a person, according to the programme and his taste, could either settle down for the evening or not trouble to tune in at all.* "Cee Gee" talks of foreign programmes being more cheerful. Correct! They are, and I am indeed thankful, especially on a Sunday evening, to be able to get "Zeesen's" tuneful music, or the dance programme from "Radio Paris." I enclose my name and address as I would very much like to get into touch with "Cee Gee."

Bournemouth. CEE TEE EFF.

* [We entirely endorse our reader's views. We have on many occasions urged such a system in the compilation of programmes. —ED.]

THE EVERYMAN FOUR AGAIN.

Sir,—In November last I constructed the Everyman Four, and since that date I have tuned in and identified at least 63 stations, including seven American, one of which was in North Mexico, the distance being over 5,000 miles away.

I should like to add, too, that all these stations were received on the loud-speaker (Brown Universal); in fact, a pair of headphones have not yet been used with the receiver.

The above bears testimony to the wonderful results to be obtained with this receiver, and speaks highly for the contribution that *The Wireless World* is making towards bringing into being the ideal receiver. L. W. MASCALL.

Upper Edmonton, N.18.

STATION IDENTIFICATION.

Sir,—I have followed the question of identifying stations with great interest. It is only natural that so many of your correspondents are anxious for recommending identifying signals on behalf of the local listener when it is remembered that about all of you can understand your own language only. What interest do you then have of long-distance hunting? Please remember that you is not the only people in Europe, and that the listening to foreign stations is of much more interest to the Scandinave, the German, and the Dutchman than to you, as we, with regard to knowledge of foreign languages, are the most well-educated people in the world. Every man in the three Scandinavian countries does understand very well the languages of the two others, and in that way he can enjoy all the programmes from *three countries*. If he has got only a little bit of education he understands English and German. There you have *five countries*, or, more correct, *six countries*, as Austria transmits in German. If he has got a little more education he also understands French. Well, now, count the stations available to the Scandinave, and in the following lands: Norway, Sweden, Denmark, Germany, Austria, Switzerland, Belgium, France and England. Please remember that we enjoy all the transmission, from jazz to a scientific talk, and want to make use of our knowledge. I am of the opinion that the tie-tie of some German stations in the pauses is very good, as we can time in the receiver and await the transmissions' comment. When the announcer then makes use of every opportunity to mention the station's name: Hallo, Oslo, Hallo, Praha, West Deutsche Rundfunksender, so and so—I think it is sufficient, and the crystal listener should not be offended in any way, he can keep on dreaming with his headphones. My receiver has given me on one night, with loud-speaker strength, 56 *identified* stations on a 50 feet indoor aerial. Under good conditions it is picking up 3 or 4 American stations after 2 o'clock. As to your programmes, such things as the Albert Hall and York Cathedral transmissions on November 9th and December 21st are, of course, enjoyed to the fullest extent, but your ordinary programme I think is ranging behind those of Germany and Sweden. As to your stations, 5XX is coming with good volume the day over, 5GB has a mighty volume after darkness, and 2LO medium. The 1½ k.w. stations is not always so good S. W. FLOOD.

Oslo, Lilleaker
February 10th, 1928.

Sir,—As a regular reader of our paper may I express my entire agreement as to having a uniform system of station identification.

Having with me a powerful receiver and travelling a good deal on the Continent, the present system of some Continental stations interval notes makes identification almost impossible.

Monte Carlo. H. L. WENNBERG.

SALVAGE.

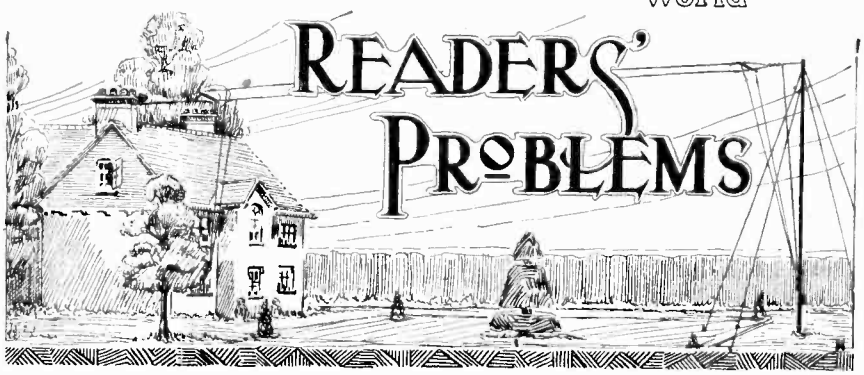
Sir,—During the first two weeks of February newspaper readers were thrilled by the records of the efforts of the Dutch tug "Zwarte Zee" to bring home to safety the British oil-tanker "Varand." It is rather a chastening fact for a maritime nation like ours to acknowledge that of the five tugs mentioned in this episode four are Dutch and one is German, and it would appear that Britain does not possess such a thing as a fleet of tugs capable of proceeding at very short notice to the assistance of distressed vessels hundreds of miles away.

Queenstown, in the south of Ireland, is made the base of these Continental tugs, and there are always several lying there ready to slip their moorings immediately information is received regarding a stricken vessel.

Their wireless equipment is very extensive. Morse signals from the transmitter of the "Zwarte Zee" have been read in Glasgow on a two-valve receiver when the vessel was over 400 miles off the south-west coast of Ireland, and last winter her signals were copied regularly each evening for about a week as she thrashed her way from Queenstown to the north of Cape Wrath to the help of a vessel requiring assistance and brought it safely to the Clyde.

Doubtless the receiving apparatus in use is equally elaborate, and the speed at which these vessels leave harbour makes it obvious that a continuous watch is maintained in the wireless cabin, and the very earliest information acted upon. Indeed, the first reception of an S.O.S. is enough to send them to sea, and the writer still remembers the thrill which followed as he copied the following message sent to a helpless steamer by a Witte Zee: "What is your exact position? We are coming to your assistance at full speed!" P. M. N.

Glasgow.



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

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

Volume Control in a Gramophone Amplifier.

I have a 1-V-2 receiver, with resistance-coupled low-frequency amplifier. When my gramophone pick-up is inserted in the grid circuit of the first L.F. valve, signals are barely loud enough, and certainly not sufficiently strong fully to load the output valve. On transferring the pick-up to the detector grid, however, volume is excessive, and overloading is continuous. It seems obvious that I must use the detector valve as an amplifier, and add some form of volume control. A few suggestions as to recommended devices would be welcomed. H V.

A continuously variable resistance of from 0-500,000 ohms, shunted across the pick-up windings, affords a simple and effective method of reducing volume, as does the use of a high-resistance potentiometer (of about 1 megohm) connected in the manner shown in the skeleton diagram, Fig. 1(b).

Alternatively, we suggest that your present first stage anode resistance might be replaced by a tapped resistor (of the same value as at present) and a selector switch connected as shown in Fig. 1(a).

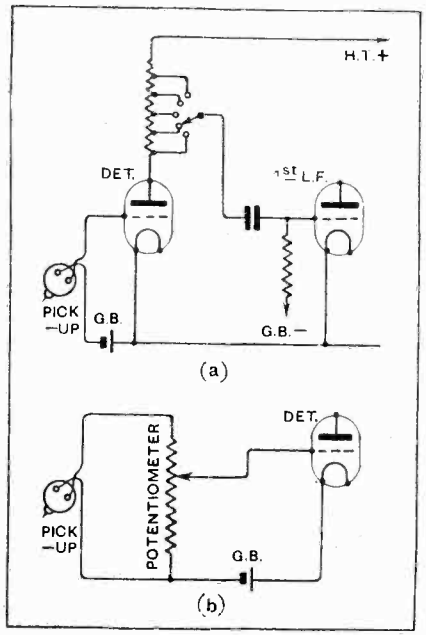


Fig. 1.—Methods of reducing volume of gramophone reproduction.

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No Reaction Effect.

My set, built to the circuit diagram enclosed, gives good results on the local station, but fails to receive any other transmission. It is impossible to obtain reaction effects. Can you tell me what is wrong? S. A.

The circuit diagram shows a conventional leaky grid detector, resistance-coupled to the first L.F. valve, which is in turn coupled to the output by means of a transformer. The resistance in the anode circuit of the detector is of 250,000 ohms, and there is no by-pass condenser. Assuming the reaction coil to be correctly connected, it will be found that reaction is obtainable if a by-pass condenser of from 0.0001 mfd. upwards is joined between the low-potential end of the reaction coil (the end which is joined to the coupling resistance) and L.T.—; or alternatively, directly across the resistance. It may be added that better control will be obtainable if the anode resistance is reduced very considerably.

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Free Grid Bias and the "Everyman Four."

Is it possible to insert a pick-up in the detector grid circuit of my "Everyman Four" and at the same time to retain the "free" grid bias arrangement for operation on both wireless and gramophone reproduction? If so, please give me the necessary connection. P. T. N.

Yes, it is by no means difficult to arrange for alternative gramophone working in the manner you desire. A careful consideration of the circuit diagram of this receiver will show you that the voltage "dropped" across detector filament resistor R_3 is applied to the grid of this valve; the relationship between the values of R_3 and R_2 is so chosen that this voltage is suitable for rectification. When the detector is converted into an amplifier about half the present voltage will be required; this is obtainable by substituting R_3, by two resistors in series, each of half the original value. These are shown at R_3A and R_3B in Fig. 2, which indicates the necessary modifications. To put the pick-up into operation it should be connected to a length of twin flexible wire, the ends of which are joined to a standard coil plug for insertion into the long-wave loading coil socket. At the same time the original wave-change switch is opened, and the new switch is set so that the grid return circuit is joined to the junction between R_3A and R_3B. For wireless reception

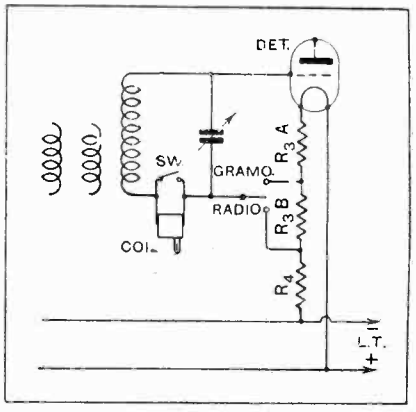

Fig. 2.—"Free" grid bias for alternative detection or gramophone amplification.

RULES.

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

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

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

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

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

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

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

the original circuit is restored by connecting (through the switch) to the junction between R_2B and R_4.

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Gramophone on the Standard Four.

I have a "Standard Four" receiver and desire to make use of the L.F. amplifier for gramophone reproduction. I believe this can be achieved in a simple manner by fitting a jack, and I should be obliged if you would provide me with a diagram showing the method of incorporating this.

J. L.

As you suggest, a jack can be used for this purpose and the method of connecting this in the circuit is shown in the diagram, Fig. 3. J1 will require to be a single closed circuit jack, and with the plug inserted valves V3 and V4 will function as amplifiers for gramophone reproduction. On removing the plug to

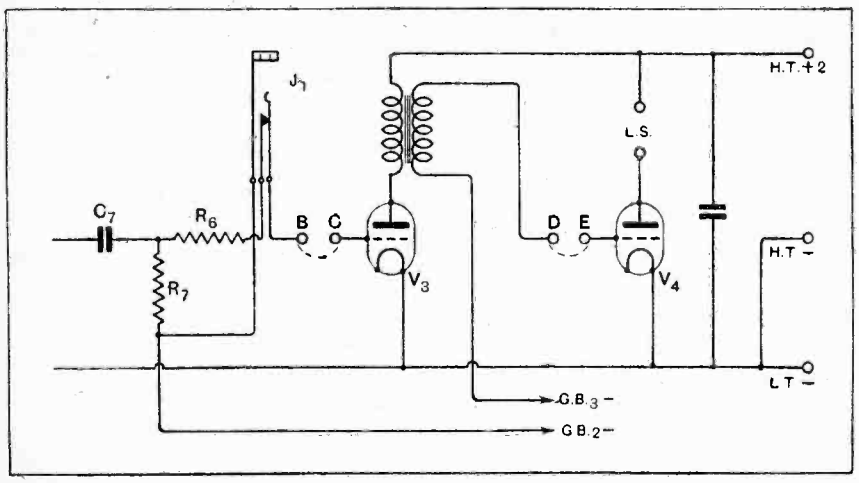

Fig. 3.—Modifying the "Standard Four" for gramophone reproduction.

which, of course, the pick-up is connected, the amplifier will be completed to the receiving circuits and the receiver will function in the normal manner.

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A Case for Systematic Tests.

My "Selection Four" receiver is giving anything but good results, and I find that signals from the local station are almost as strong when the high tension battery is disconnected from the terminal H.T.+2 *(which feeds the detector valve). Can you give me any advice as to where I should look for the fault?* A. M. L.

The symptoms you describe would indicate that there is a serious fault in the detector valve or in the circuits associated with it, although you must realise that this valve has a high resistance connected in its anode circuit, and, due to the small current passed, the charge accumulated in the by-pass condenser will feed it for quite an appreciable period. Assuming, however, that the valve is not working on the residual charge, we suggest that you remove the high frequency valve and connect the aerial to its plate socket and switch off the H.F valve. The set should now function as a plain detector—L.F. combination without reaction and it will be a comparatively easy matter to decide by trial and error whether it is working properly. It seems possible that you are not applying the correct grid bias for detection, but of course the fault may be in the H.F. transformer, the high frequency choke, the grid leak R_2 or the first stage L.F. coupling components: all these should be tested carefully.

o o o o

An Extravagant Proposal.

My set is a straightforward one with an H.F. stage, detector, and two stages of low-frequency amplification. I have recently obtained a D.C. eliminator (mains 240 volts) which gives perfectly satisfactory results. Would it be practicable and economical to heat the filaments from the same source of supply without making any alteration to the set? F. M.

We do not recommend that you should attempt to operate the filaments direct from the mains, particularly as you object to making alterations to the set. These filaments are almost certainly wired in parallel, and will consume an excessive amount of energy, with the result that the procedure will be both inefficient and costly.

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Short-wave Interference.

Although I live about 30 miles from 5GB, this station interferes with reception on the long waves, particularly on wavelengths of about 1,000 metres. My set is a fairly conventional arrangement of four valves, with neutralised H.F. amplification; surely its selectivity should be better than this? T. M. P.

You do not give details of your receiver, but we should imagine that it has an "untuned" aerial circuit, and in all probability the interference from the short-wave station when you are receiving the long waves is due to the fact that the "untuned" section of the aerial coil happens, in conjunction with the aerial and other incidental capacities, to resonate at or near to the wavelength of 5GB. This is by no means uncommon. We suggest in the first place that you should try the effect of varying the number of turns in the long-wave aerial circuit, if this is possible. Alternatively, the use of a simple absorption wavetrap similar to that included in the "Quick Change Broadcast Receiver," described in our issue of February 15th, would overcome the difficulty, as would the use of a tuned aerial circuit on the long waves.

o o o o

Lighting Circuits and Reaction.

Can you throw any light on the following phenomenon? I find that when my detector-L.F. receiver is adjusted in such a way that it is not far from the point of oscillation, the switching-off of the electric light in the room causes it to oscillate. T. S. V.

It is not unusual to find that a slight variation in absorption by local metallic bodies, such as would result were an electric light circuit to be broken, will cause a set on the point of oscillation to go into actual oscillation.

We think it probable that your aerial lead-in is taken across the room in such a way that it is parallel with the lighting wires. Possibly the same applies to the earth wire. The remedy is, in the first place, to work the set further from the oscillation point and also to rearrange aerial and earth leads so that they may be shorter and more direct.

o o o o

Calculation of Series Anode Resistances.

Having had a great deal of trouble with low-frequency oscillation, I propose to adopt the method described in your issue of January 4th, under the heading of "Low-frequency Oscillation," and to supply the detector and both low-frequency valves of my receiver from the "power" eliminator tapping, which, according to the makers, gives 180 *volts at the current taken by these three valves when the voltage applied to the first two is* 120, *and the last* 180. *Will you please tell me how to calculate the value of the voltage-reducing resistances, which I gather play an important part in reducing interstage coupling?* S. W. R.

The value of a series resistance for this purpose may be ascertained by applying the simplified formula:

$$\text{Resistance required (in ohms)} = \frac{\text{Volts to be dropped in the resistance.}}{\text{Rated current of the valve (in amps)}}$$

Your first step should be to ascertain the current passed by your valve at the desired voltage with appropriate grid bias. This information can be obtained from the manufacturer's curves with sufficient accuracy for your purpose. Assuming a current of 2 milliamps (0.002 amp.) and the "volts to be dropped" to be 60 (180-120) we get the figures:

$$\frac{60}{.002} = 30{,}000 \text{ ohms.}$$

Thus a resistance of 30,000 ohms will be required for this valve.

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CONTENTS OF THIS ISSUE.

CONTINENTAL BROADCASTS.

WE have recently been given some idea of what the B.B.C. has in mind in the direction of linking up our own broadcasting network with the studios of the principal stations of the Continent. As an engineering achievement, we think that the B.B.C. deserves full credit for the performance, but the question arises as to whether these broadcasts are of sufficient value to justify the trouble and expense involved. Even had the transmissions been free from interference and as good as reception through the studio of the local station, it is, we think, questionable whether the public attach as much importance to receiving music from abroad as to receiving it from the studio of the local station.

Misdirected Effort.

It seems to us that there is confusion in the minds of those who are responsible for this innovation, because they appear to think that by linking up in this way with the Continental studios they can meet the public demand to listen to the foreign transmissions. But this arrangement does not provide a substitute for individual searching for the Continental transmissions on a selective receiver. A sportsman who hunts some wild animal derives his satisfaction from the chase, but if, instead of having to hunt, the animal were brought to his doorstep for him to shoot, his attitude would be quite different. Probably much of the interest in distant reception is the variety of choice and the knowledge that it requires individual effort and careful adjustment of a good receiver to pick up the stations, and that good reception cannot always be guaranteed; conditions vary from night to night. It is this element of uncertainty and the satisfaction experienced when a foreign station comes in particularly well that provides the interest. If it is merely a question of providing entertainment, then we suggest that the B.B.C. can do better by putting its own music or even gramophone records of foreign music through the local transmitter.

The Question of Cost.

We would suppose, although we have no precise information available at the time of writing, that the B.B.C. is put to considerable expense in arranging for satisfactory lines between its own station and the Continental studios, and, judging by the complaints which have been received over a long period of the quality of many of the outside broadcasts provided in this country, it would seem to us well that consideration should be given to the question of whether it is not better to devote what available funds there may be to improving our own arrangements for linking up in this country before we turn our attention to anything further afield.

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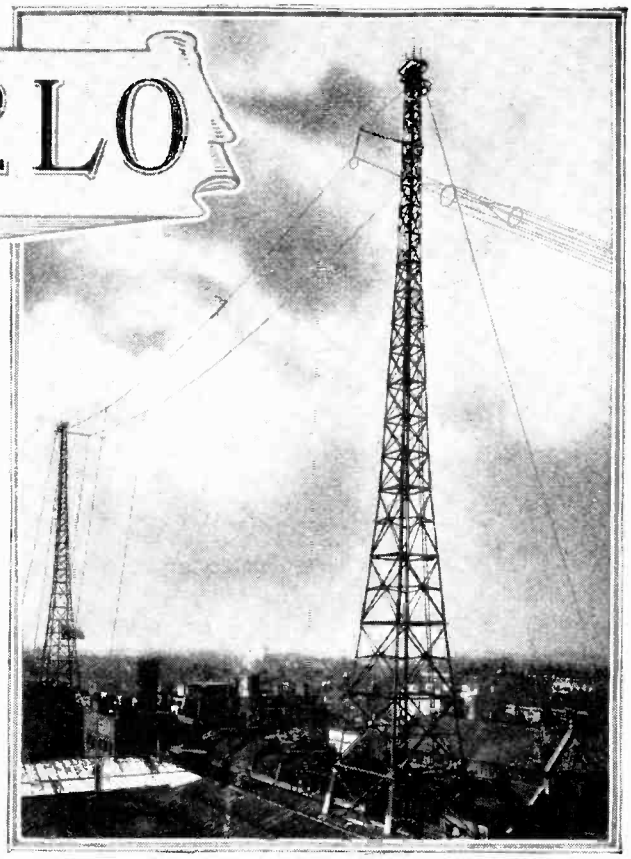
SATISFIED.

A LETTER which appears over the signature "Satisfied" in this issue will be of special interest to a very large number of our readers. Our correspondent describes the treatment received at the hands of his Electric Supply Co. when a change over from D.C. to A.C. took place.

Many readers have, we think, felt uneasy as to their position if a change of supply should come about in their district, but if this letter indicates the general attitude of the electric supply companies, then we have very little to give us concern. We understand that it is essential that there should be no delay in advising the supply company of any apparatus which may require replacement when the supply company gives notice to the consumer that the character of the supply is to be changed.

The Field of 2LO



Signal Strength Distribution Over the Home Counties.

By W. H. F. GRIFFITHS, A.M.I.E.E., Mem.I.R.E.

IN a recent article in this journal, by R. H. Barfield, an excellent contour map of 2LO was given. All kinds of maps are fascinating, especially to those possessing a bent for geography, and contour maps are, perhaps, the most fascinating of all. Who among the scientifically minded has not experienced a thrill upon being shown, for instance, the contour model or map of an ocean bottom?

The field strength contour of a popular broadcasting station should appeal equally to one's imagination inasmuch as it portrays that which can be measured, though it cannot be apprehended directly by any of the senses—a charting of the unseen.

If the field strength over the whole area served by a broadcasting station is to be shown on a single map there is no other manner in which to do so but by means of contours. Unfortunately, this method does not always give the true situation at a glance, due to the fact that the law connecting field strength with distance is non-linear. If, however, a single diagram be drawn to show the field strength at every point at a constant distance from the station, conditions at this distance are much more quickly apprehensible. In this way, using the data given in Mr. Barfield's article and in the paper read by him before the Institution of Electrical Engineers, diagrams have been drawn showing the field strength at 10, 20, 30, 50 and 82 kilometres radius from 2LO. These are given in Fig. 1, A to E respectively. The radial dimension in any direction is proportional to the field strength obtained in that direction, the diagrams being plotted to varying scales so that, whatever the distance from the station, the representation of mean field strength is constant. The thin circles represent this mean strength and help in quickly forming an idea of the reception conditions prevailing in any particular direction at a given distance from the station.

In the 50 miles radius diagram of Fig. 1, E, this is

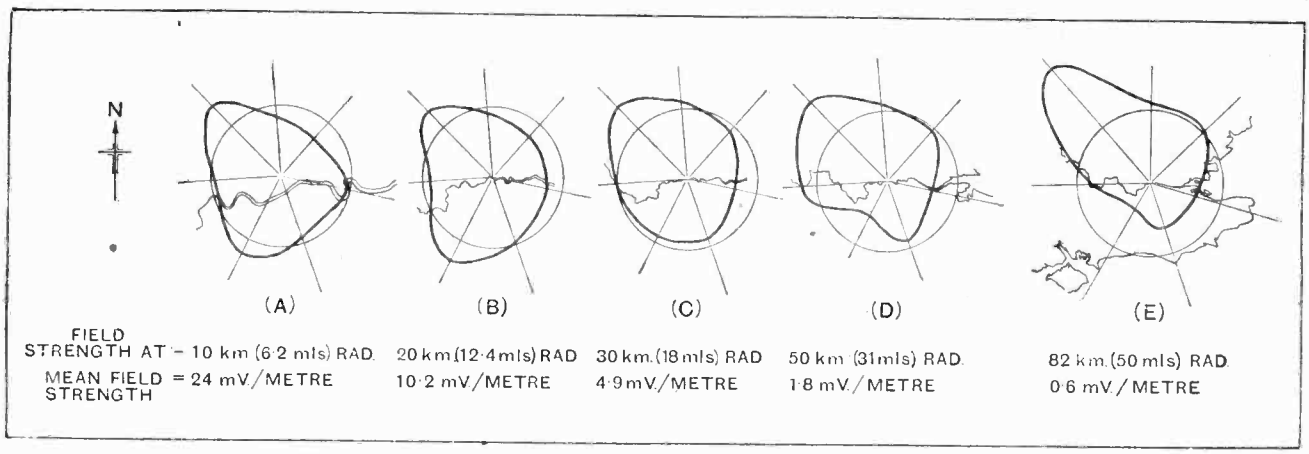


Fig. 1.—Field strength contours of 2LO for various distances up to 50 miles.

The Field of 2LO.—

particularly noticeable, the great difference, at this distance from London, between reception conditions in north-westerly and south-westerly directions not being emphasised by the corresponding contours. Whereas with a glance at Fig. 1, E, it can at once be confirmed that Hampshire and West Sussex are "dead spots" to reception from 2LO.

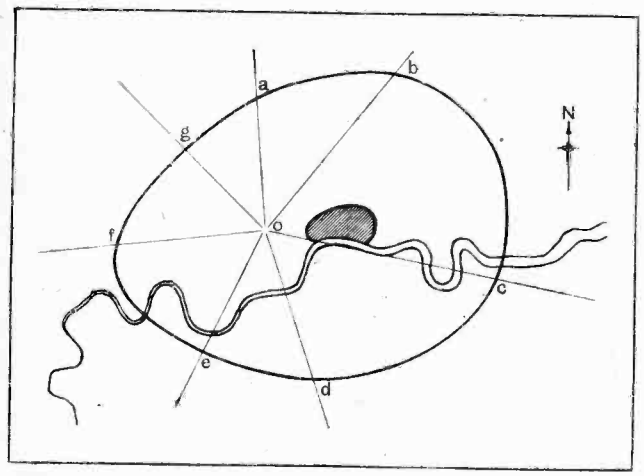


Fig. 2.—The densest part of London is here shown as an egg-shaped area to the east of 2LO.

Although the diagrams are not plotted to a distance scale, the River Thames, and in some cases a portion of the coast line, may be included, if desired, to a scale bearing some relation to the radius for which the diagram is plotted in order to simplify comprehension still further. The scale of the map drawing can, for example, be fixed conveniently by making the *mean* field strength circle correspond with the distance circle at which the field strength is being shown.

Each diagram can be made complete, quantitatively, by stating the value of mean field strength.

In any particular direction, moreover, the rate of attenuation above or below the normal value, due to local variations of the earth's surface, can be at once judged by noting the movement of the field strength curve relative to the circumference of the mean circle at that point in successive diagrams.

The Attenuation Due to a City.

In his article and paper Mr. Barfield deals very completely with the effect of well-wooded country upon attenuation, but there appears to be required some explanation for the want of uniformity of the initial attenuation at close range before reaching the really well-wooded parts.

The only explanation (except for slight directional effects of the transmitting aerial) can be that of a reduction of apparent surface conductivity due to absorption by the more or less conducting structures in the more densely constructed parts of the Metropolis. As a crude approximation, the *densest* part of London can be represented as an egg-shaped area with the City of London as its centre, as shown in Fig. 2. In this figure the position of 2LO is indicated as the centre from which the radial lines of transmission are drawn corresponding with the directions taken by Mr. Barfield. If the lengths *oa*, *ob*, *oc*, etc., of these lines be measured and their reciprocals be plotted in the same directions, a diagram (Fig. 3) somewhat like that of Fig. 1, B, is obtained. That is to say, it corresponds with the field strength actually obtained at a radius of 12.4 miles—the point where all City absorption has ceased, but before any very great vegetation absorption takes place. It is not claimed that this is sufficient proof of the initial uneven attenuation by the City, but it must, it is thought, have some bearing upon the matter.

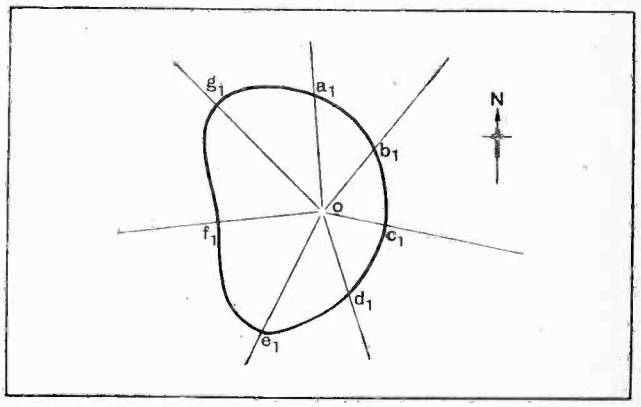


Fig. 3.—If oa, ob, oc, etc., n Fig. 2 be measured and their reciprocals plotted in the same directions, a diagram like Fig. 1, B, is obtained.

In conclusion, it should perhaps be mentioned that tests in a direction E.S.E. of London at a radius of about 10 miles, in October of last year, gave a field strength of 12 millivolts per metre. The tests were made by measuring the resonance volts across an inductance in series with an aerial of known constants, and the result apparently agrees well with the value given by Mr. Barfield for this distance.

SHORT-WAVE STATIONS.
Supplementary List.

We have received the following information, which supplements and corrects the list of short-wave transmissions given in our issue of February 8th. For the greater part of this information we are indebted to an enthusiastic short-wave listener in Sussex, and we shall welcome similar reliable data from other readers as we wish to keep our records of regular short-wave transmissions as complete and up to date as is possible.

ANE Bandœng, Java, transmits on 15.93 metres on Mondays from 1240 to 1440 G.M.T., also on 31.86 metres on Tuesdays and Thursdays from 1640 to 1840 G.M.T.

ANH Bandœng, Java, transmits on 17.00 metres (30-40 kW.) on Saturdays from 1240 to 1440 G.M.T.

NU 2XAF Schenectady, N.Y., is now transmitting telephony on 31.40 metres with 10 kW. to the aerial.

NU KGO Oakland, California (General Electric Co.), 10 to 40 metres (variable).

NU WND Ocean Township, N.J., 13.88 and 16.8 metres.

NU WLW Cincinnatti, Ohio (Crossley Radio Corporation), transmits daily on 52.02 metres from 0000 to 0500 G.M.T., power at present is only 250 watts, but this will shortly be increased to ½ kW.

KZED San Juan, Philippine Islands, on 27.5 metres, 500 watts.

KZEN San Juan, Philippine Islands, on 15 metres, working with U.S.A. and Europe during daylight.

KZET San Juan, Philippine Islands, on 30 metres, working with Europe and U.S.A. during the night.

These last three transmitters are crystal controlled and operated from the Central Office of the Radio Corporation of the Philippines at Manila.

STAGE-BY-STAGE TESTS.

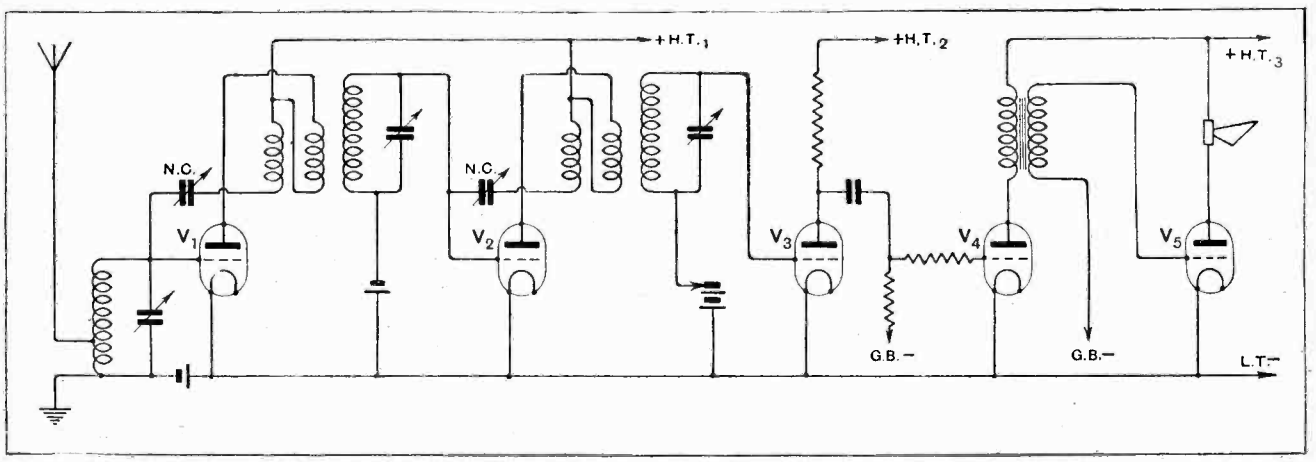
Locating Faults by the Method of Elimination.

By "RADIOPHARE."

THE fact that writers on wireless subjects devote so much space to faults and the tracing of them probably gives rise to the mistaken impression—in the mind of the beginner, at any rate—that receivers are inherently liable to suffer from a diversity of troubles. Nothing could be further from the truth; provided it is well designed, free from unnecessary complications, and properly constructed with good components, a wireless set is less likely to develop faults than the majority of other similar pieces of electrical apparatus, due in part to the small number of moving parts and the consequent immunity from mechanical breakdown. In spite of this, the "Readers' Problems" pages of this journal show that a number of constructors do experience difficulties; however, a considerable proportion of these would appear to be of the kind encountered in making initial adjustments rather than in actual maintenance. Many other failures are caused by minor errors in assembly and wiring; sometimes, let it be whispered, the novice embarks on the construction of an elaborate receiver with insufficient knowledge and experience. Failing an extensive equipment of testing apparatus, and the ability to use it, there is no better way of finding a fault in a multi-valve set than by the method of elimination. Briefly, this means that stage-by-stage tests should be carried out by removing one valve after another from the circuit until that in which the fault exists is discovered. The expression "valve" here includes associated apparatus.

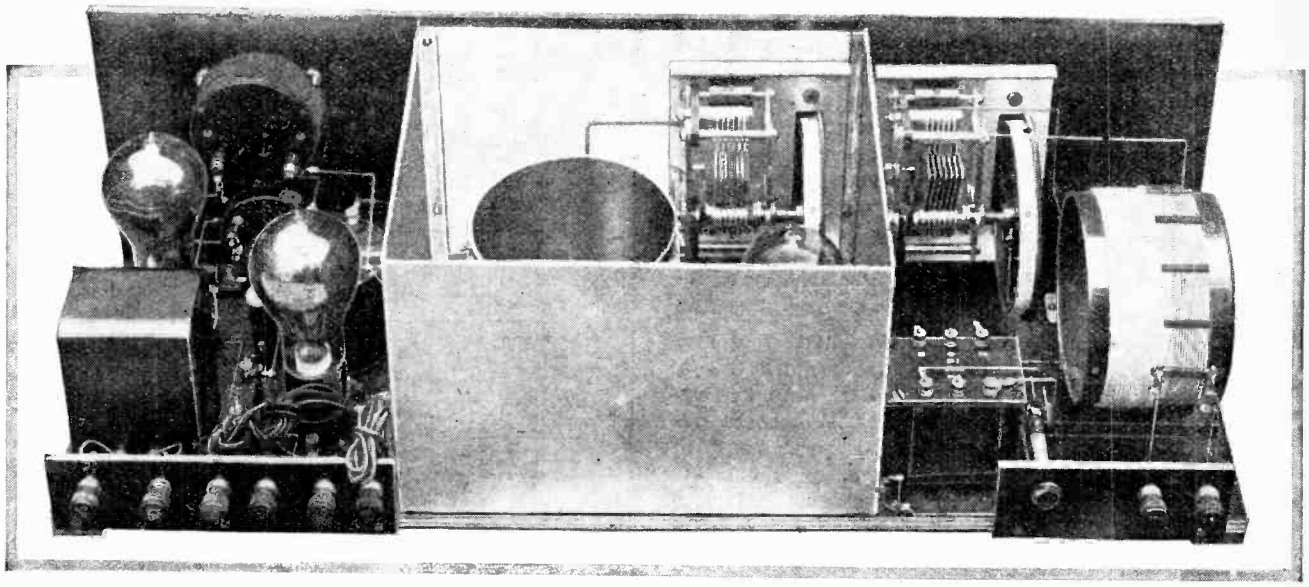
How is this to be applied in practice? Let us take as an example the simple two-valve loud-speaker receiver, with reacting detector and one transformer-coupled L.F. amplifier, and imagine that no signals whatever are heard. Now eliminate the L.F. amplifier by connecting the telephones in place of the L.F. transformer primary. If results are now those to be expected from a single valve, we know that the fault is in the coupling transformer or in the output valve, and we can assume that the batteries, aerial-earth system, and phones, which are common to the receiver as a whole, are more or less in order. At the worst, if negative results are obtained, signals still being inaudible, the field of search is narrowed down, as we are at the moment concerned only with the comparatively simple detector circuit.

The advantages of stage-by-stage testing are more obvious when we turn to the relatively complex five-valve receiver shown in the accompanying diagram. Let us again imagine a complete absence of signals, but assume that the batteries have been tested with a voltmeter, and found to be in order. The first step is to cut out the output valve V_5 by transferring phones—a loud-speaker is inconvenient for testing—to the anode circuit of the preceding valve V_4 (in place of the transformer primary). As in the case of the simpler set, good signals in this position will indicate a fault in V_5 or the transformer.



Tests of this circuit are discussed. The diagram is simplified by the omission of filament leads, screens, by-pass condenser, &c.

Negative results will indicate that the test must be carried a stage further by connecting the phones in the anode circuit of the detector V_3, in place of the coupling resistance. Obviously, the telephones cannot be moved further back than this, as they require rectified current for their operation; accordingly, if the fault is not yet found, we must turn to the other end of the set and eliminate the high-frequency amplifier. This can conveniently be done by setting the second neutralising condenser at zero, removing V_2, and connecting the aerial to its anode socket; the second intervalve transformer will now act as an aerial-grid coil, the earth circuit being completed through the H.T. battery (or its by-pass condenser). Thus V_3 should act as a plain detector; if it does not, little difficulty will be experienced in tracing the trouble, as all complications have been removed. In a similar way, the second L.F. amplifier is tested by transferring the aerial to the plate socket of V_1.



THE INDIRECTLY HEATED CATHODE VALVE RECEIVER.

Full Constructional Details of Complete Receiver.

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

(*Concluded from page 241 of March 7th issue.*)

IN the first instalment of this article the many inherent advantages of the indirectly heated cathode valve, particularly when constructed with close-spaced electrodes, were described. It now remains to give full constructional details of the three-valve set employing couplings which will do justice to the remarkably high mutual conductance of the valves.

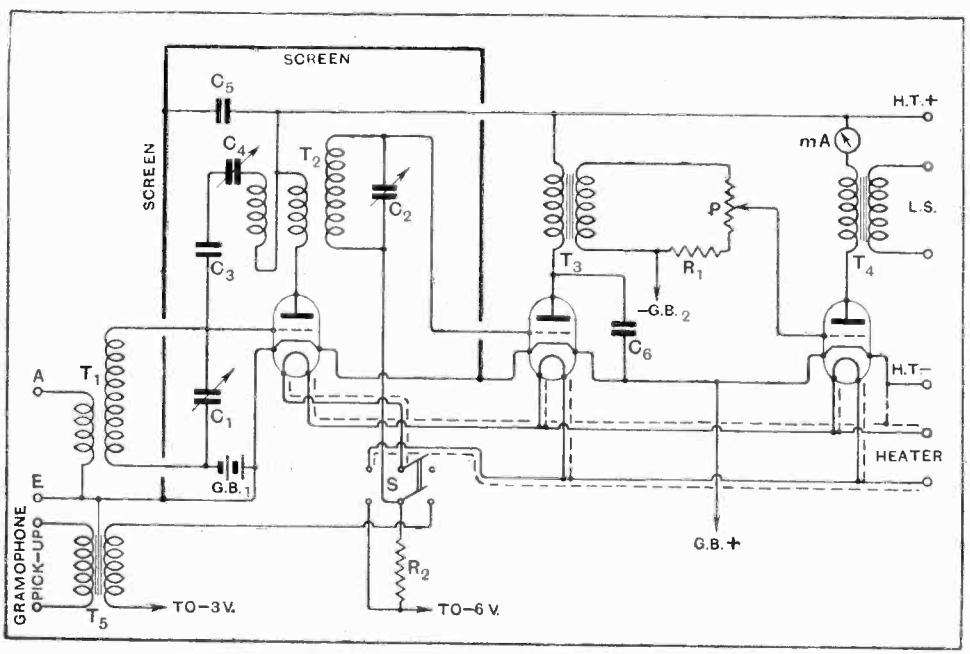


Fig. 3.—The circuit diagram. C_1 and C_2, 0.0003 mfd. variable; C_3, 0.0001 mfd.; C_4, neutralising condenser; C_5, 2 mfd.; C_6, 0.0002 mfd.; R_1, 0.25 megohm; R_2, 5 megohms; P, potentiometer, 0.5 megohm; T_3, transformer, 6 : 1 ratio; T_4, output transformer; T_5, pick-up transformer.

A high resistance R_2 of about 5 megohms is connected from the centre point of the switch to the larger value of grid bias. This ensures that the grid of the second valve is "tied down" all the time while the switch is in the process of changing over, thus making a quiet change over and preventing the plate current of the second valve from rising to excessively large values and so possibly from damaging the transformer in its plate circuit. The 5 megohm leak will be shunted across part of the grid bias battery when the switch is on the gramophone side, but this, of course, will not affect it detrimentally.

It will be noticed that transformer coupling—and a high-ratio transformer at that—is used after the anode bend detector valve. This is done deliberately to try to obtain a tone correc-

The Indirectly Heated Cathode Valve Receiver.—

tion, *i.e.*, to correct for the frequency distortion in the radio-tuned circuits. The writer has elsewhere shown the importance of having some such correction.

In brief, it may be said that the tuned circuits, when correctly tuned, as they must be for efficiency, effectively emphasise the lower modulation frequencies at the expense of those at higher frequencies. One way of improving results is to use several tuned circuits and detune each side of resonance—but this very much cuts down the H.F. efficiency besides increasing the number of controls. Another way is to make the L.F. amplifier emphasise the higher audio frequencies by some form of tone corrector.

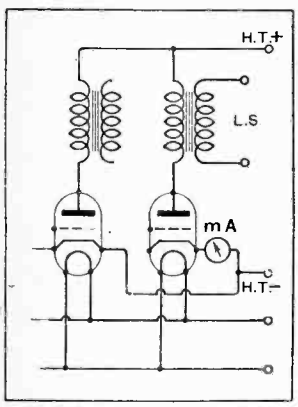


Fig. 4.—Alternative position of meter to show anode current of last valve.

In the set now being described, transformer coupling with a relatively low-inductance primary is used for this purpose. The actual transformer employed should be such that the secondary is suitable for dealing with the higher audio frequencies with the primary being fed with a valve of working resistance round about 30,000 ohms, and the primary inductance should not be high. A Marconi Ideal transformer with 6-1 ratio was found suitable, but doubtless other high-ratio transformers of reputable makes are equally suitable. A condenser of about 0.0002 mfd. capacity must be connected between plate and cathode of the detector to form a low-impedance path for the H.F. currents, and this, unfortunately, will help to cut down the higher audio frequencies.

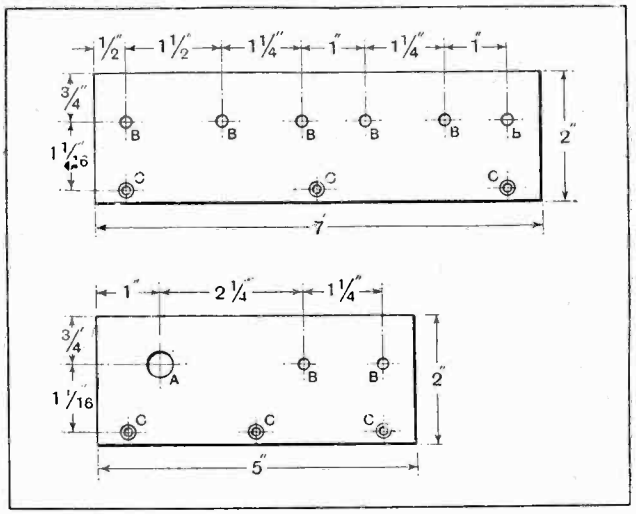


Fig. 6.—Terminal blocks. A, 3/8in. diameter; B, 5/32in.; C, 1/8in. countersunk for No. 4 wood screws.

When the second valve is used as an amplifier (with less grid bias than for an anode bend detector) the working resistance of the valve is reduced considerably, so that the reduction of amplification on the lower frequencies will not be so marked in this case. Also it is quite easy to reduce the output of the higher frequencies (if any!) from the gramophone pick-up either by using a small condenser across the pick-up, or by using a transformer of not quite suitable primary impedance between the pick-up and the amplifier, or a combination of both.

In any case, this point is hardly worth worrying about at all unless the loud-speaker to be used is of the coil-driven cone type.

An interesting detail that is made possible by the indirectly heated cathode valve is shown in Fig. 4—the milliammeter for showing the plate current of the last valve may be connected between the cathode and negative high-tension lead. If the meter were put in a similar position with an ordinary valve it would, of course, read filament current as well as some of the plate current.

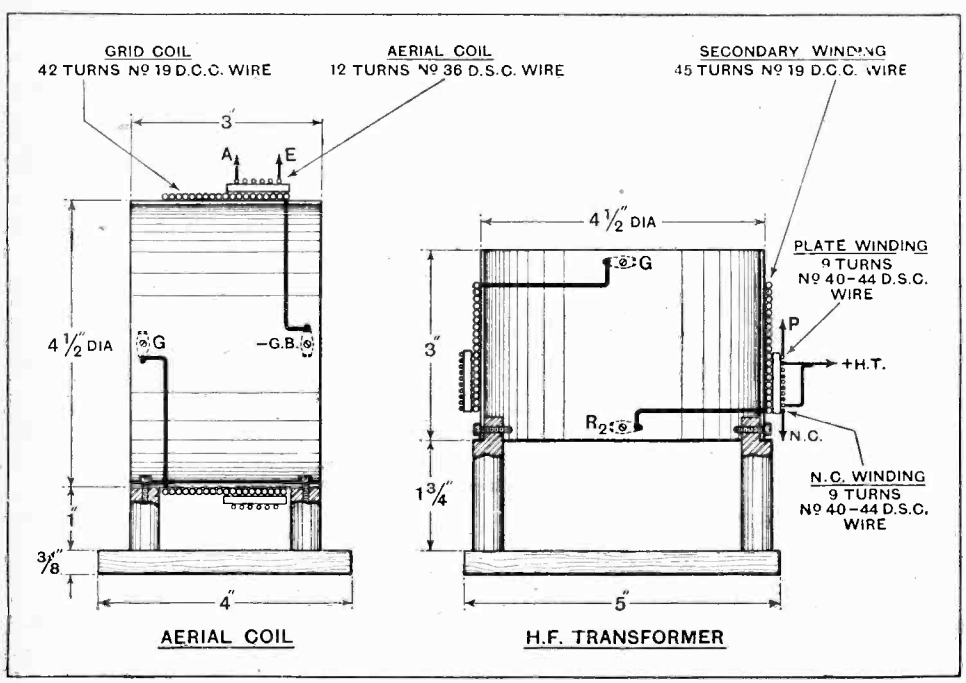


Fig. 5.—The dimensions and winding data for the aerial and H.F. transformers.

The H.F. Transformers.

The aim in designing an H.F. transformer is first to obtain as high a secondary impedance (*i.e.*, as low a resistance) as possible. For the 200-500 metre band and with 3in. diameter formers, Litz wire is necessary, and transformers with Litz wire

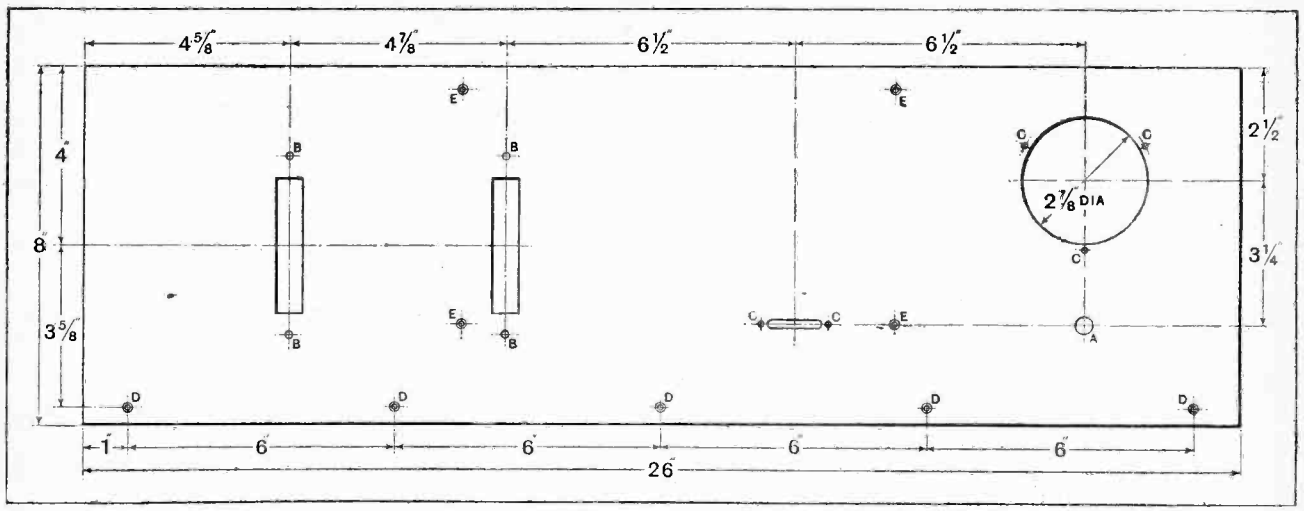


Fig. 7.—Panel dimensions. A, 3/8in. diameter; B, 5/32in.; C, 1/8in.; D, 1/8in. countersunk for No. 4 wood screws; E, 1/8in. countersunk for No. 6 B.A. screws.

secondaries as used in the Everyman Four receivers are now very familiar objects. However, Litz wire is expensive and requires rather careful handling.

Butterworth has shown that a coil of larger diameter wound with solid wire should theoretically give at least as good a secondary coil as the Everyman Four transformer using Litz wire. If the equations that he gave are worked out, it will be found that a 4½in. diameter coil wound with 19-gauge wire will give a slightly better secondary than the usual 3in. type with Litz. The number of turns required on the primary depends on the resistance of the valve to be used with it. With the AC/G valve the resistance depends slightly on the H.T. voltage used; it decreases with increase of H.T. If a high-tension voltage of 120 is going to be used, the primary should consist of 9 turns of fine wire, say, 40 s.w.g., while if up to 180 volts H.T. be used a primary of 8 turns will be found to give better selectivity.

It should, of course, be realised that the design of the primary is a compromise between the turns required for maximum amplification and the selectivity required—fewer turns than the number theoretically required giving more selectivity but less amplification.

The neutralising winding is equal in number of turns to the primary. As the method of winding H.F. transformers has been given so many times in the pages of this journal, no further reference to it will be made. The details of turns and arrangement of windings, both for the aerial and the H.F. transformers, are given in Fig. 5. The end turns of the secondary winding should be held in position by small strips of empire cloth as shown in the photographs.

The Heater Wiring.

The first item in building the set is the fixing of three Cosmos A.C. valve sockets, which should be screwed in position on the baseboard. The wiring of the heater circuits may now be done, using lead-covered single or twin cable. This cable is put *under* the baseboard and brought up close to the appropriate terminals. Provision

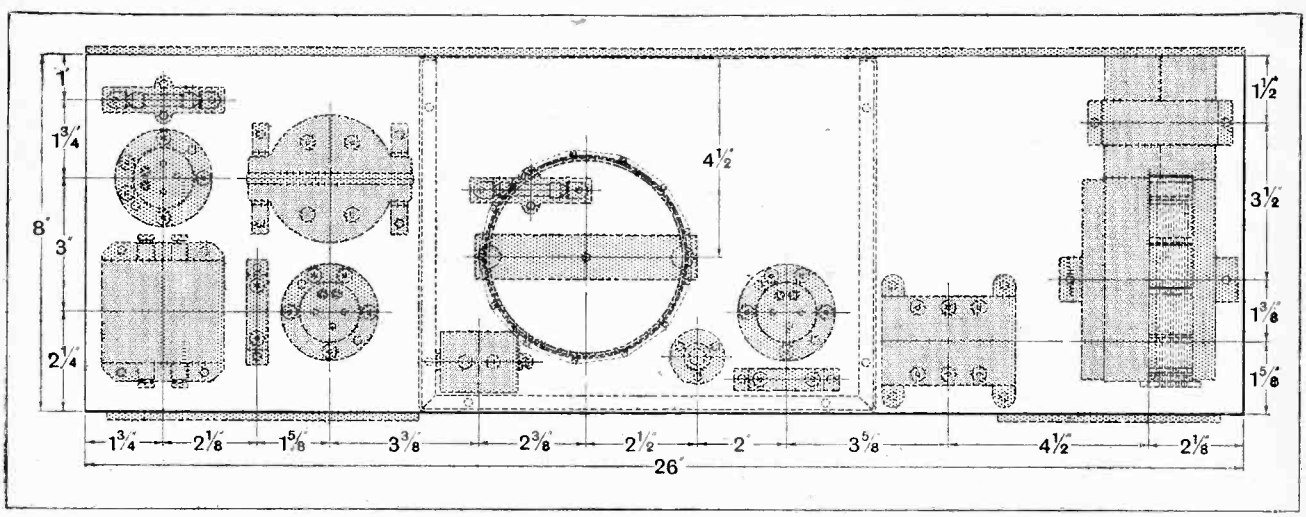


Fig. 8.—Baseboard layout.

LIST OF PARTS.

2 *Thumb control condensers, 0.0003 mfd.* (" *Cyldon,*" *Sydney S. Bird & Sons*).
1 *Neutralising condenser* (*Gambrell*).
1 *0.0001 mfd. fixed condenser* (*Type 620, Dubilier*).
1 *0.0002 mfd. fixed condenser* (*Type 620, Dubilier*).
1 *2 mfd. condenser, 500 v. D.C. test* (" *Hydra,*" *Louis Holzman, 34, Kingsway, W.C.*).
1 *Igranic-Pacent jack, P. 61* (*Igranic*).
1 *20 : 1 ratio gramophone pick-up input transformer* (*Baily, Grundy & Barrett, Ltd., 2, St. Mary's Passage, Cambridge*).
2 *Cells, 1½ v.* (" *T*" *type, Siemens*).
1 *Intervalve transformer, 6 : 1* (" *Ideal,*" *Marconi*).
1 *L.S. filter* (*Type G.R., Claude Lyons, Ltd., Liverpool*).
3 *A.C. valve-holders* (" *Cosmos,*" *type No. 955912, Metro-Vick, Ltd.*).
1 *Double pole change-over switch, lever type, panel mounting* (" *Utility,*" *Wilkins & Wright*).
1 *Milliammeter, 0 to 50 mA.* (*Ferranti*).
1 *0.25 megohm leak* } *and holders* (*Mullard*).
1 *2 megohm leak* }
1 *0.5 megohm potentiometer* (" *Centralab,*" *Rothermel*).
2 *Paxolin tubes, 4½in. dia., 3in. long.*
1 *Panel, 26×8×* $\frac{3}{16}$*in.* (" *Pertinax,*" *G. L. Scott & Co.*).
1 *Cabinet, 26×8×8in.* (*W. & T. Lock, Ltd.*).
1 *Baseboard, 26×8in.*
No. 19 S.W.G. wire.
No. 54 Armoured cable (*C. A. Vandervell*).
8 *Terminals* (" *Tapa,*" *W. J. Charlesworth, 88-89, Aston Street, Birmingham*).
Flex, screws, etc.
Aluminium for screen.

(*Approximate cost, excluding cabinet, £11.*)

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.

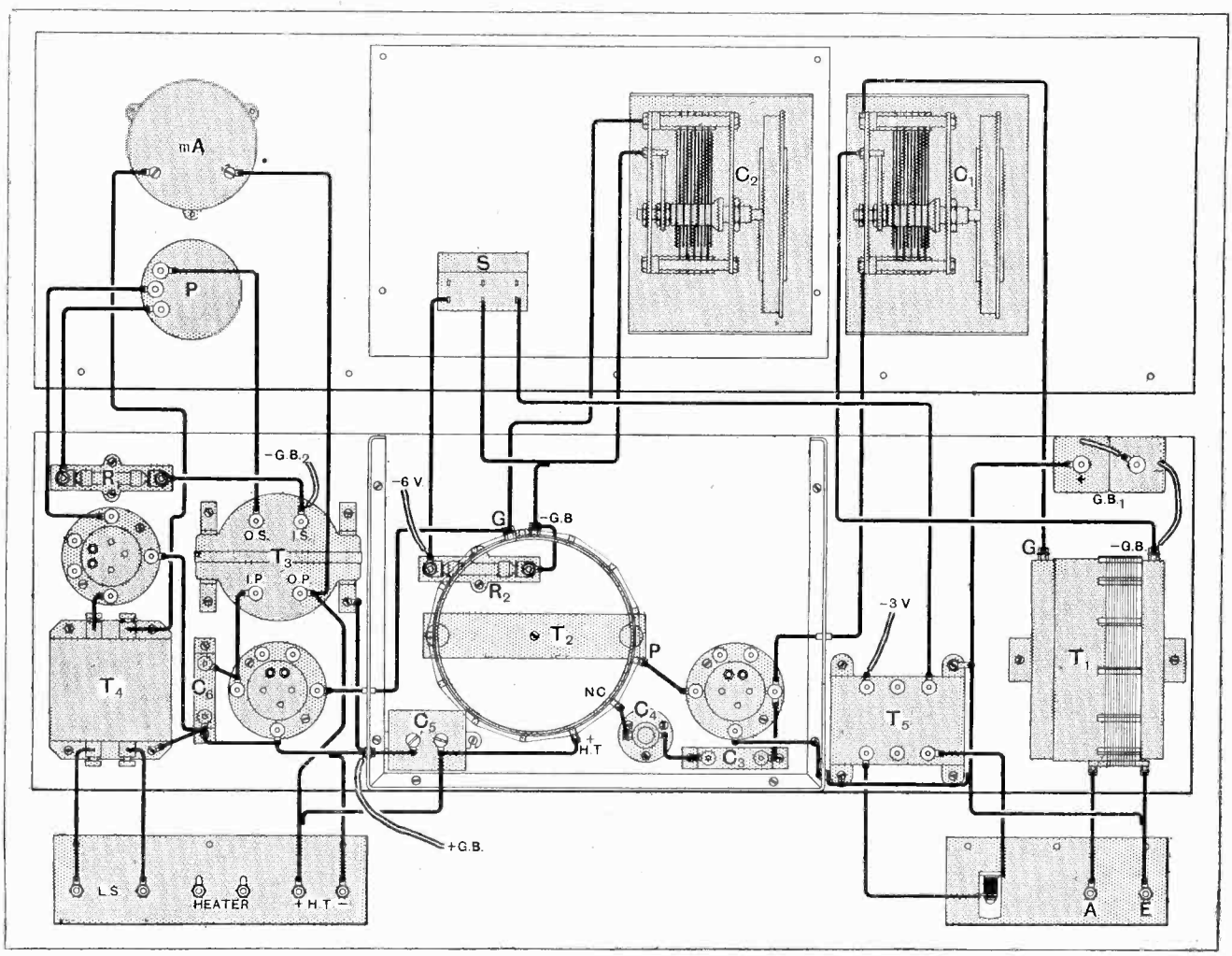


Fig. 9.—Wiring diagram. The panel and baseboard are shown in the same plane to facilitate the tracing of wires.

B 14

The Indirectly Heated Cathode Valve Receiver.—

should be made for earthing all clips (as shown in Fig. 10) used on this cable if the set is to be used with A.C. mains. The rest of the construction is quite straightforward with the aid of Figs. 6 to 11, which show the layout, panel dimensions, and wiring diagrams. A bakelite board panel is used, as its mechanical strength per given thickness is extremely high, and it is thus suitable for carrying the weight of the variable condensers.

The arrangement of components in the H.F. compartments should be strictly adhered to. An output transformer is shown in Fig. 3 for coupling to the loud-speaker; however, the more usual 30-henry choke and 2-mfd. condenser are equally suitable, the actual arrangement used being left to individual preference.

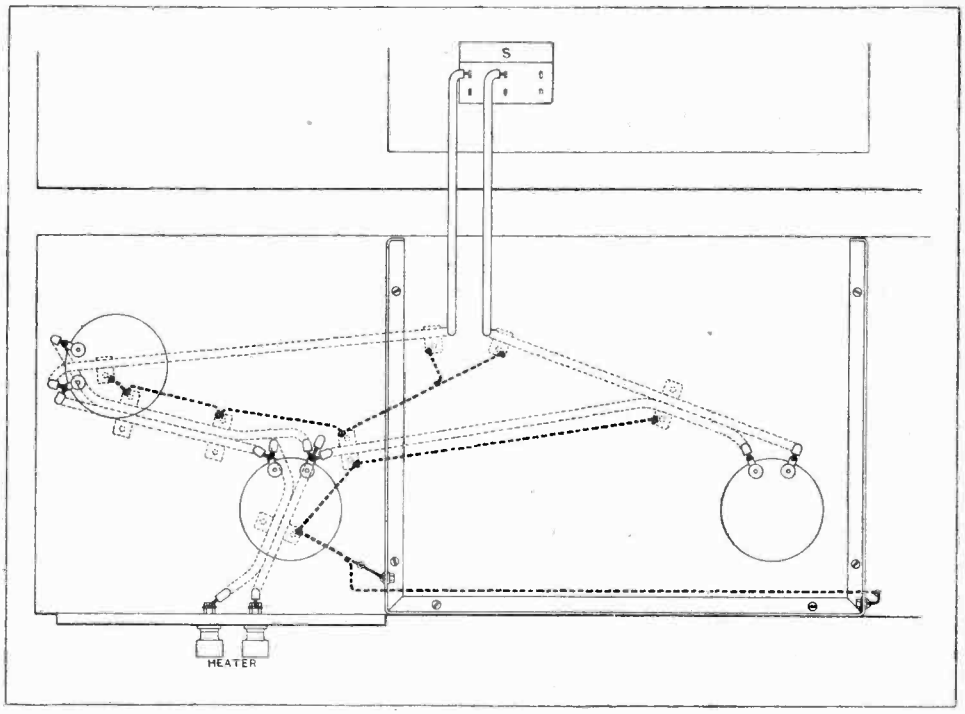


Fig. 10.—Wiring of the heater circuit. The thick dotted lines show the earthing leads to the clips holding the heater wiring.

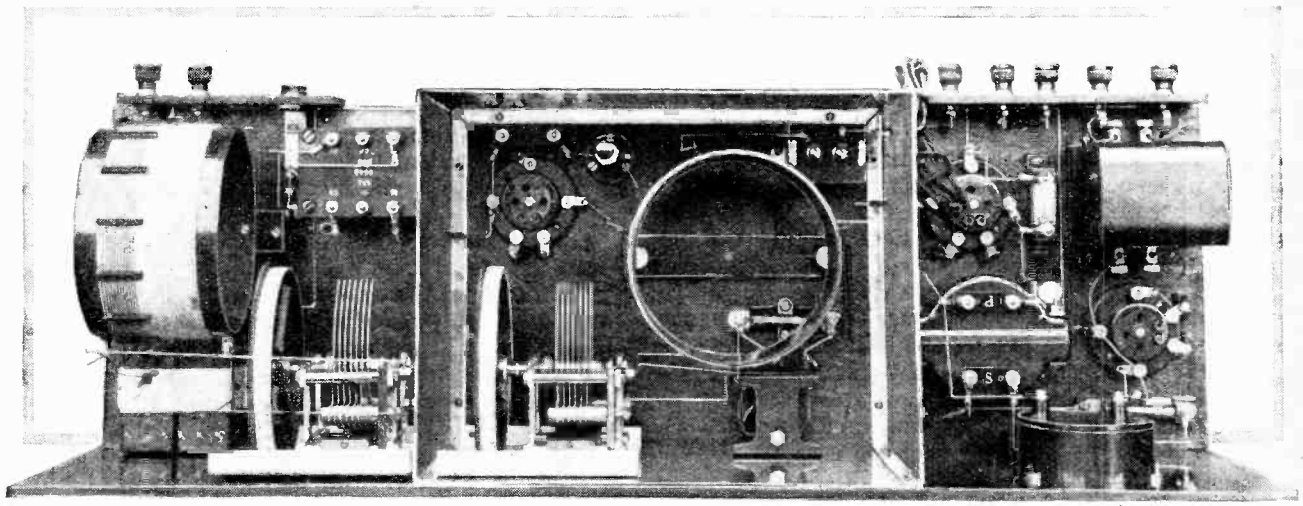
Operation.

The set will work perfectly well on as little as 120 volts H.T., but more output will be obtainable with 180 volts. A table showing the various grid bias voltages required for three values of H.T. is given below:—

H.T.	Valve No. 1.	No. 2.	No. 2a.	No. 3.
120v	1½	3	1½	6—7½
150v	1½	4½	1½—3	7½—9
180v	3	6	3	9—10½

The column *2a* refers to the second valve used as an amplifier for gramophone reproduction, and gives the grid bias required to be connected to the secondary of the pick-up transformer T_3.

It will be found perfectly easy to neutralise the set, even without switching off the H.F. valve heater. Perhaps the easiest and most convenient way of stabilising the set is to proceed as follows: First insert all the valves into their holders, and connect up the H.T. and heater supplies and the earth lead; then set the neutrovernia condenser to its minimum position by turning it in an



Plan view of the finished receiver.

The Indirectly Heated Cathode Valve Receiver.—anti-clockwise direction as far as possible; next, after setting the H.F. and aerial tuning condensers to about 90°, connect the aerial. The set will almost certainly now be oscillating, which will be shown by a slight hiss in the loud-speaker—if it should happen that the chosen settings of the tuning condensers just bring in a station it is as well to detune, so as to cause as little interference as possible. Next turn the neutrovernia condenser slowly in a clockwise direction with the right hand, and with the left hand rotate the aerial tuning condenser about 10° on either side of the original setting. At first the set will be found to oscillate over the whole of this range, but as the neutralising capacity is increased the range of aerial condenser setting over which oscillation occurs gets less and less quite rapidly until finally oscillation ceases altogether. The cessation of oscillation (*i.e.*, stabilisation) is best proved by tuning in a weak station and thus making sure there are no heterodyne whistles due to the set.

A slight hiss which takes place in the loud-speaker when the two low-resistance circuits are in tune, does not necessarily mean that the set is not completely stabilised.

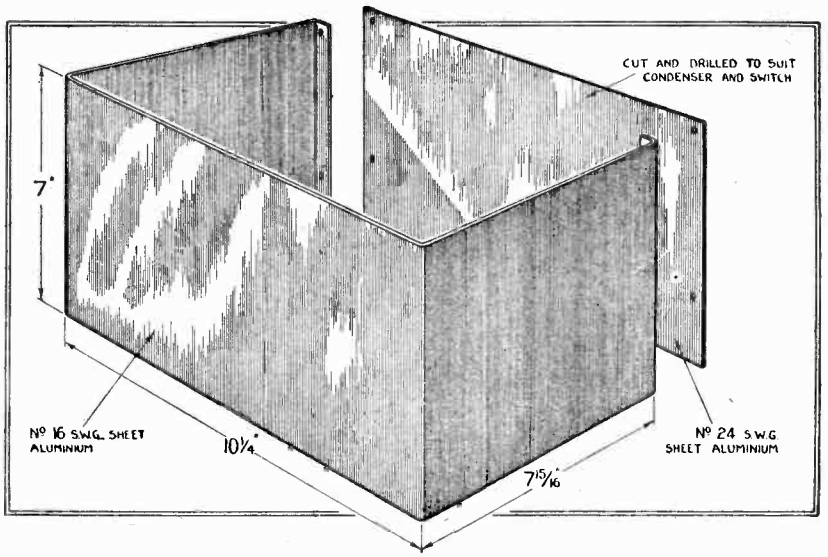


Fig. 11.—Dimensions of screen.

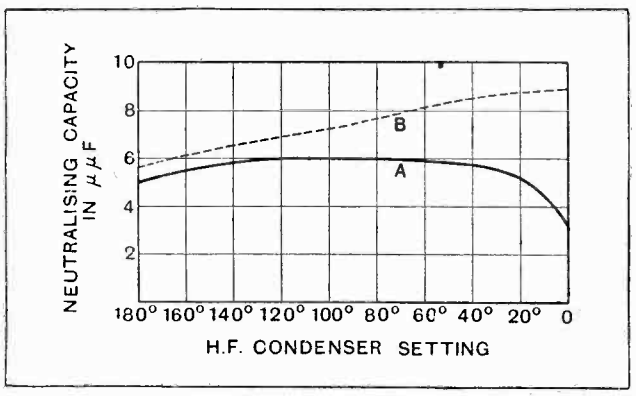


Fig. 12.—Neutralisation capacity plotted against the dial settings of the H.F. variable condenser. Curve A is for the high capacity outside aerial and curve B for the 6ft. indoor aerial. With a normal P.M.G. aerial the curve is practically a horizontal straight line.

The stabilisation is remarkably uniform over the whole range with an outside aerial of normal type. As a matter of interest the writer plotted the curves shown in Fig. 12, with the set used in adverse conditions for *uniformity* of stabilisation over the whole wavelength range. The curves show the setting of the neutrovernia condenser for oscillation just to cease over the whole range of the H.F. tuning condenser with a 6ft. indoor aerial (curve B) and with an experimental high-capacity aerial (curve A) which has a natural wavelength with the coupling coil between 200 and 300 metres, and thus a resistance which is very variable over the range of the set (250-500 metres).

With a normal P.M.G. aerial the corresponding curve for neutralising capacity over the whole range is a curve similar to curve A in Fig. 12 from 180° to 80°, but practically horizontal from 80° to 5°. With the neutrovernia set so as just to give stabilisation at the centre of the H.F. condenser scale it will be found that there is complete stabilisation over the whole scale.

It will probably take a few minutes to become accustomed to the Cyldon thumb-control condensers, but after this they will be found extremely nice to handle—one has to sit down to the set for the most comfortable operation. The valves are not microphonic at all, which is a very great advantage indeed when using efficient H.F. amplification. With normal valves it often happens that a howl builds up when the aerial and H.F. circuits are dead in tune, due to *audio* reaction between the loud-speaker and the valves. As a test of the set here described the writer tuned in a really loud station, and, using a large horn-type loud-speaker, placed the latter close to and pointing towards the H.F. and detector valves without being able to produce the least suspicion of a howl.

A volume control is provided, consisting of the now familiar half-megohm potentiometer and quater-megohm leak, giving variation from one-third to full strength. The control is conveniently situated under the milliammeter, which is in the plate circuit of the last valve. A certain amount of kicking of the milliammeter needle is allowable; the main thing to guard against is excessive kicking all in one direction, which indicates serious overloading of the last valve if grid bias and H.T. values are known to be correct.

Although this set was not designed in the first case essentially to run from A.C. mains, but in order to make the fullest use of the potentialities of the indirectly heated cathode valves, yet, owing to the screened heater wiring employed, it will be found quite suitable for both A.C. and D.C. supplies to the heaters; thus the set will run from battery supplies, from D.C. mains and low-tension battery, or from A.C. mains alone.

It is advisable in all cases to use dry battery grid bias in order to do away with the possibility of feed-back trouble which may arise when grid bias is supplied by a battery eliminator.

ANODE AND GRID RECTIFICATION.

A Comprehensive Survey Based on Practical Measurement.

By A. L. M. SOWERBY, M.Sc.

OF the two usual types of valve detector for telephony, the grid rectifier has in the past been by far the most popular, chiefly by virtue of the fact that an anode rectifier is very insensitive to really faint signals. Further, owing to the much greater plate current taken by a grid rectifier, considerably more high-frequency power is available in its plate circuit for reaction purposes, so that a single-valve receiver consisting of a grid detector will oscillate far more readily than its equivalent employing an anode detector. This point has in the past been of even greater importance than it is to-day, on account of the practice, now happily dying, of connecting the aerial direct to the grid of the valve in such a receiver, and of employing tuning coils of high resistance.

For these two reasons, then, the substitution of an anode rectifier for a grid rectifier in a single-valve set results in the immediate loss of practically all stations other than the nearest, since, even if satisfactory reaction effects are obtained by lessening the aerial damping, the resulting signals are so faint that an anode rectifier can make but little of them.

The Effect of Anode Impedance.

If a similar comparison be made while listening to the local station, the anode detector again comes off rather badly. There is a telephone load of impedance (at a mean speech frequency) of perhaps some 20,000 ohms in the plate circuit of the valve; a grid detector may have a working impedance of about 30,000 ohms, so that quite a satisfactory amount of energy, even on the lower notes, is transferred to the telephones.

But owing to the heavy negative grid bias the same valve acting as anode detector will have an impedance not far short of 200,000 ohms, so that the energy transference to the telephones is very small, and low notes practically vanish; exactly the same thing happens if the detector is coupled by a transformer to the next valve, as in the majority of receivers in use to-day. There is little to be surprised at in the fact that the grid rectifier has been, and remains, the more popular, when so simple and direct a comparison as this, which most experimentally inclined enthusiasts must have made at some time or another, shows that an anode rectifier loses many stations easily heard with a grid rectifier, and apparently offers no compensating improvement of quality on the local station.

All this merely shows that under the conditions indicated the grid rectifier is decidedly superior to its rival, but the comparison is hardly fair so far as quality is concerned, because the telephones or transformer connected to the detector have been designed for use after a grid rectifier. If the detector is followed by a resistance, adapted in value to the needs of the valve before it, a really fair comparison can be made, using a two-valve set in place of the original single-valve. It will still be found that the distant stations are much better heard with the grid detector, but the local station will now give decidedly the better quality, and possibly much greater volume as well, when the anode rectifier is used.

This tells us that if we are willing to employ sufficient high-frequency amplification the distant stations, too, can be made to give quality which, apart from interference, will be equally good, and this is, in fact, the direction in which modern receiver design is trending.

Leaky Grid Detection Flattens Tuning.

The behaviour of the tuned circuit to which the detector is connected gives us a little further information about the relative properties of the two types of detector. On tuning in the local station it will be found that when the anode detector is in use tuning is fairly sharp, the transmission becoming inaudible when detuned by more than a certain amount, while the point of exact tuning is very well marked. With a grid rectifier, on the other hand, it is impossible at short range to tell within ten degrees or so the point where the local station is at its loudest, while it can be heard, at least faintly, wherever the tuning dial may be set. There are three separate reasons for these differences; the grid detector is very sensitive to faint signals, which partly accounts for hearing the local station "all over the dial," and, in addition, there is a further cause tending to accentuate this behaviour in the damping introduced into the tuned circuit by the grid current of the detector, which naturally flattens the tuning.

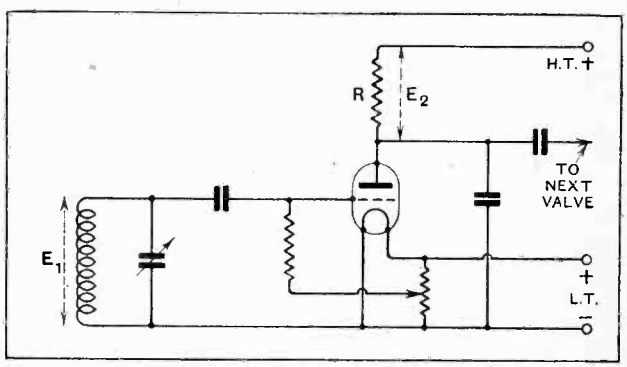


Fig. 1.—Grid rectification circuit. The D.C. volts developed across E_2 were measured for various A.C. voltages applied at E_1.

The impossibility of deciding, with a grid detector, when the local station is exactly tuned in is due to the fact that when once a certain output from this type of detector is reached, an increase in signal voltage applied to its grid results in no increase in rectified signals. The same effect is often noticed when an attempt is made to use reaction with the local station; signals become no louder,

Anode and Grid Rectification.—

but may, if enough reaction be used, become distorted through overloading, even though the point of oscillation is still not approached.

Conversely, the anode detector permits the entire suppression of the local station by detuning because it introduces no appreciable resistance into the tuned circuit, and therefore does not flatten its tuning; and, in addition, it does not respond to the very small inputs available from the detuned circuit. The sharpness of the exact tuning-point is ensured in this case by the fact that an anode rectifier, provided that the H.T. voltage is sufficient, cannot overload, so that there is no action tending to limit the output from it.

Actual Measurements.

It appears, then, that it is just as important to avoid overloading a grid rectifier as it is to avoid underloading an anode rectifier; it only remains to obtain some definite idea of the actual voltages which are required for best operation with the two types of rectifier.

For this purpose a series of measurements were made, on 50-cycle alternating current, of the relation between the input voltage to the grid of the valve and the direct voltage set up by rectification across a resistance in the plate circuit. The practical receiving circuits corresponding to the more elaborate laboratory apparatus used are shown in Figs. 1 and 2, in which E_1 and E_2 represent in each case the A.C. input voltage and the D.C. output voltage respectively. In the actual experiments the values of the condensers shown were increased so that they offered the same impedance to 50-cycle current as the condensers used in a broadcast receiver offer to frequencies corresponding to a wavelength of 300 metres, so that the figures obtained at the low frequency used may be accepted as at least approximately correct for the radio-frequencies met with in actual receiving practice.

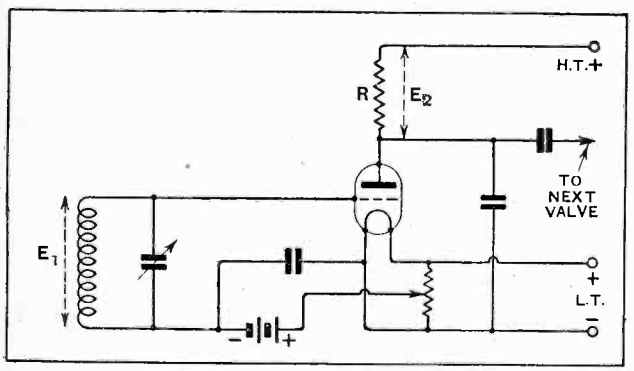


Fig. 2.—The equivalent circuit used to obtain practical data for anode bend detection.

A considerable number of measurements have been made, using in all cases a resistance in the plate circuit of the valve; valves of several types were used, and with each valve a number of different anode resistances were tried. Results are here given for one case only of anode rectification, and one of grid rectification, using the same valve for both purposes, but changing the anode resistance to suit the altered circuit conditions. The valve chosen (a Cosmos SP55 Blue Spot) has an amplification factor of 28 and an impedance of 58,000 ohms when measured in the normal way with the valve adjusted for amplification. These figures are very suitable both for anode and grid rectification; for the former purpose the impedance is low enough to ensure that with a reasonable anode resistance the high notes are not lost to too great an extent, while the sensitivity is fairly good. As a grid rectifier, the impedance is lowered by the positive grid bias to an extent which just permits of following the valve with a first-class transformer, allowing for the fact that when a grid rectifier is in use the standard of quality expected is not likely to be very high. An earnest devotee of either type of rectification would consider a valve of these characteristics as suitable as any for his purpose.

The following table gives a concise summary of the results obtained; the first column gives the R.M.S. value of the alternating potential applied to the grid, and the second and third give the resulting D.C. potential across the plate resistance for anode and grid rectification respectively. In each case the high-tension voltage applied outside the anode resistance was 120 volts; for anode detection the plate resistance had a value of 250,000 ohms, and the grid was biased 1.8 volts negatively, and for grid detection the plate resistance was 100,000 ohms, and the grid was given three volts positive bias through a 3-megohm leak.

TABLE I.

A.C. Input.	D.C. Output (Volts).	
(R.M.S. Volts.)	Anode Rect.	Grid Rect.
0.145	0.125	0.85
0.288	0.50	2.6
0.425	1.2	4.5
0.560	2.1	6.2
0.708	3.15	7.85
0.816	4.5	9.2
0.941	5.75	10.4
1.064	7.0	11.4
1.18	8.75	12.2
1.29	10.1	12.9

It will be noticed at once that for the smaller applied voltages the valve gives very much greater D.C. output voltages when adjusted for grid rectification, but that this superiority becomes less and less as the applied voltage increases. This point is brought out more clearly in the curves of Fig. 3, which are plotted from the figures of Table 1.

But the actual D.C. voltage obtained is not the true measure of the sensitivity, for this voltage was produced by a steady A.C. voltage which corresponds to an unmodulated carrier wave. For telephony, the sensitivity is measured by the response to the *modulation* of the carrier, which, being interpreted in terms of our laboratory figures, means the *change* in D.C. voltage for a *small variation* of input volts. A little consideration will show that sensitivity in this sense is greater when the curves of Fig. 3 are steeply inclined to the horizontal. We can, in fact, express this sensitivity in actual definite units by drawing a tangent to the curve at some point, so

Anode and Grid Rectification.—

as to extend the slope of the curve at that point over a greater range, and read off from this the change in output caused by a change of input of one volt. If this be done

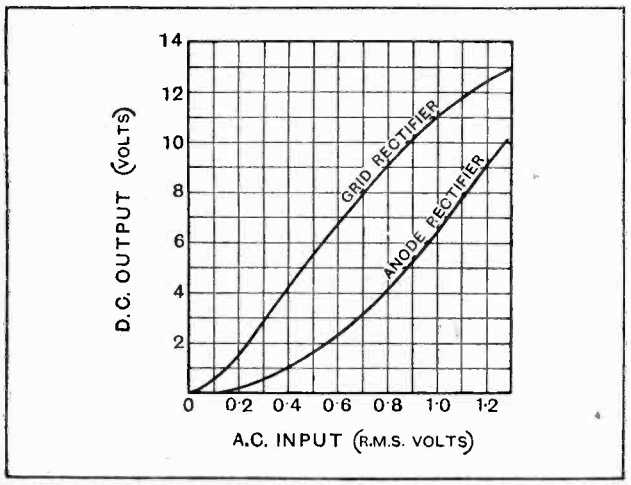


Fig. 3.—Curves showing that the superiority of D.C. voltage output from a grid rectifier diminishes as applied volts are increased.

for a number of points, covering the whole length of the curves, we obtain the following figures, which are plotted as curves in Fig. 4.

TABLE II.

A.C. Input.	Sensitivity (Slope of Curve).	
(R.M.S. Volts).	Anode Rect.	Grid Rect.
0.1	1.3	6.4
0.2	2.6	12.5
0.3	3.9	12.7
0.4	5.2	12.5
0.5	6.5	12.4
0.6	7.8	12.2
0.7	9.1	12.0
0.8	10.4	10.8
0.9	11.7	9.5
1.0	13.0	8.6
1.1	14.3	6.6
1.2	15.6	6.4

The sensitivity of the grid rectifier rapidly rises to a maximum at an input voltage of about a quarter of a volt, remains high up to an input of about three-quarters of a volt, and then falls off rapidly, while the sensitivity of the anode rectifier steadily increases with the input. At the point where the two curves cross (at an input voltage of 0.82) the sensitivity of the two types of rectifier is the same, and they will give identical signal strength from an input of this value. For larger inputs than this the anode rectifier, and for smaller inputs the grid rectifier, will give the louder signals.

It must be confessed here that the left-hand extremity of the grid rectification curve is somewhat speculative, the writer's instruments not being sensitive enough to obtain really accurate readings in this region. But in spite of any inaccuracies these curves make clear the points already mentioned, that when the available input to the detector is small a grid rectifier is to be preferred, while for larger inputs an anode rectifier should be chosen, in order to obtain the loudest signals in either case.

To determine the actual low-frequency voltages obtained in the rectification of a transmission of telephony, it is necessary to assume some definite degree of modulation, since in actual practice the modulation is greater for the louder parts of the transmission than for the softer. If we assume twenty per cent. modulation, which the writer believes to be the maximum normally used by the B.B.C. stations, we can obtain the following figures, which are shown as curves in Fig. 5.

TABLE III.

H.F. Input.	L.F. Output (Peak Volts).	
(R.M.S. Volts).	Anode Rect.	Grid Rect.
0.1	0.026	0.13
0.2	0.104	0.50
0.3	0.24	0.77
0.4	0.42	1.0
0.5	0.65	1.24
0.6	0.94	1.46
0.7	1.27	1.68
0.8	1.66	1.73
0.9	2.10	1.71
1.0	2.60	1.72
1.1	3.15	1.45
1.2	3.75	1.54

The low-frequency output of the anode rectifier mounts steadily, as did the sensitivity, but the output of the grid rectifier rises to a limiting value and there remains, any further increase of input voltage making no difference to the volume of sound obtained. In the first place, this

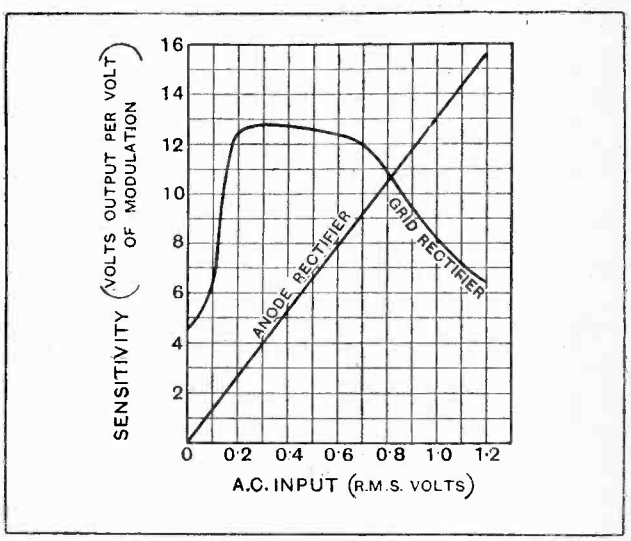


Fig. 4.—Relative sensitivities of both rectifiers measured as their response to the modulation of a carrier wave.

accounts for the refusal of a grid rectifier to respond to reaction when the local station is being received, and in the second place the peculiar shape of the curve betrays the fact that, for certain values of input at any rate, a grid

Anode and Grid Rectification.—

rectifier gives a considerable amount of amplitude distortion. In the case of an anode rectifier, appreciable distortion is only likely to occur when too much grid bias is used, though it may also arise when the valve is overloaded with signals. In this latter case the usual remedy of increasing high tension and grid bias is completely effective.

The figures given for the actual output in volts, which apply to the louder portions of the transmissions, give a good deal of guidance in the design of the low-frequency

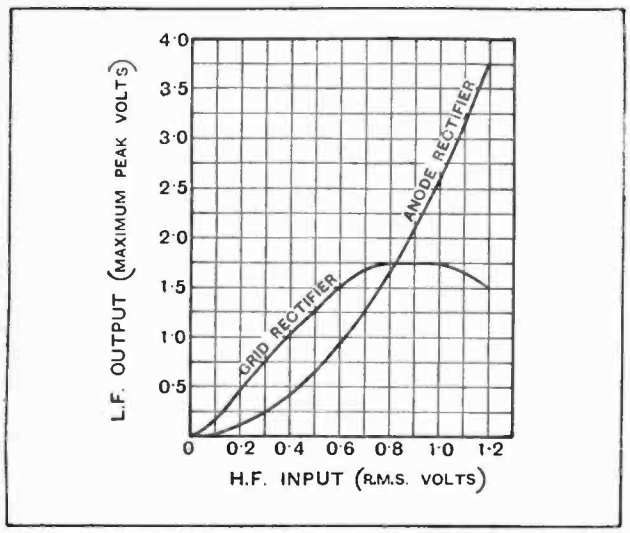


Fig. 5.—Curves showing actual L.F. peak-volts developed for various inputs of 20 per cent. modulation.

amplifier which is to follow the detector. In addition, some help is given in indicating the design of the receiver as a whole. If it is intended to employ an anode rectifier it is not good practice to cut down the high-frequency amplification to a low figure and then try to make up for this by a high degree of low-frequency amplification, for the detector will be so inefficient that the receiver as a whole will be very insensitive. The transference of a valve from the L.F. to the H.F. side of such a set will increase the signal strength of a distant station to an amazing extent. Conversely, it is not profitable to arrange several stages of high-frequency amplification in order to obtain selectivity, and then to follow them with a grid rectifier, as the detector, in such circumstances, would overload and distort on all stations. In addition, it would be detecting very inefficiently, giving a very poor return in signals for the high-frequency energy supplied to it.

Designing the Rectifier in the Receiver.

In designing a receiver an effort should be made to ensure that a grid rectifier receives an input of about a third of a volt, with which input distortion is small and efficiency high. An anode rectifier, on the other hand, should be given very nearly the greatest H.F. voltage that it can handle with the high-tension voltage available, by which means maximum sensitivity is assured. The input to the detector is most easily controlled in a practical receiver by designing the low-frequency amplifier in such a way that when the detector is working under the desired conditions the final output is just sufficient to load up fully the last valve of the set. Then, whenever the loud-speaker is working at full power, the detector must necessarily be receiving its optimum input. Where this scheme is adopted it is obviously necessary to obtain all volume control on the high-frequency side, either by adjustment of reaction, if this is used, or by control of the filaments of the H.F. valves.

In comparing the two types of rectifier while designing the high-frequency circuits, the fact that a grid rectifier damps its grid circuit must not be lost sight of. The measurements from which Table III and Fig. 5 were obtained were made under such conditions that the applied voltage was not reduced by the small load taken by the grid rectifier, but this state of affairs does not hold in a practical receiver. To this extent the comparison given is misleading, for in two otherwise identical receivers the voltage applied to a grid detector will be quite considerably less than that applied to an anode detector, and this discrepancy will be greater the smaller the resistance of the tuned circuit preceding the detector. Using coils wound with Litz wire, in fact, this damping is so large compared with the total resistance that it completely nullifies any gain in sensitivity that the change to a grid detector might otherwise confer. Of course, reaction can be introduced to eliminate the damping, the lost sensitivity being regained in this way, but only at the cost of an extra control on the receiver.

Conclusions.

Where the detector follows a high-frequency amplifier of modern design, that great sensitivity of the grid rectifier which is its only merit simply does not exist, while its employment in such a position sacrifices both selectivity and, to some extent, quality also, for the doubtful privilege of being able to employ a transformer as coupling to the next valve. But while the anode rectifier has all the advantages on its side when an adequate high-frequency amplifier precedes it, the grid detector is supreme for receivers, such as those employed for short waves, where the detector is the first valve in a set which is required to pick up distant stations. For portable receivers, too, where the use of a small frame reduces the input from the local station to such an extent that it may, for reception purposes, be classified as "distant," a grid detector is a necessity. It will always be used where considerations of cost or portability make it desirable that the number of valves should be kept at a minimum, even at the cost of selectivity, quality, and ease of operation. Both types of detector will continue to be used, for each has its own particular sphere of utility.

A "FLEX" TIP.

Frayed Insulation.

WHEN connecting an ordinary stranded wire, such as a piece of ordinary lighting "flex" to a "spade" terminal of the "claw grip" type, it usually happens that the cotton or silk insulation is not gripped by the claws, and an untidy frayed end is the result. This can be avoided by merely taking one of the strands of the wire and binding it round the frayed edges of the insulating material before inserting into the shank of the "spade-end" terminal. C. W.

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CURRENT TOPICS

Events of the Week in Brief Review.

PRAGUE WIRELESS SHOW.

A wireless show is now in progress at the Prague Spring Fair.

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BROADCASTING USURPS THE TELEGRAM.

The reduced earnings of the Post Office Telegraph Department during the past year are attributed partly to the effects of broadcasting, particularly in regard to the results of sporting events, according to the Postmaster-General's annual report.

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AN EXPENSIVE YEAR.

During its first year of activity the National Broadcasting Company of America has incurred a loss of £100,000, due to the heavy initial expenses connected with the erection of new buildings and plant. Our New York correspondent says that Mr. Merlin H. Aylesworth, the company's president, is doubtful as to whether the N.B.C. "will ever break even." Finance does not seem to be the first consideration, however, for it is stated that "the Aylesworth régime appears to have been a success."

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KING AMANULLAH STUDIES WIRELESS.

During his visit to Europe, King Amanullah of Afghanistan has been taking every opportunity of extending his knowledge of wireless. While on the voyage from Bombay he made a thorough inspection of the wireless and direction finding equipment on board ship, and on the Continent he visited several large wireless stations.

On Wednesday (the day on which our issue appears) His Majesty will be conducted over the new Croydon Air Port, and his tour of inspection will include the new Marconi station described in a recent issue of this journal. On the previous day the King of Afghanistan will have visited the Marconi beam station at Dorchester.

It is understood that the King and his Government are considering a complete scheme for the employment of wireless in Afghanistan, both for inland services and for communication with other countries.

FLEX IS SO USEFUL

A Northern newspaper writer points out that the twin flex used for loud-speaker leads makes a pretty trimming for ladies' hats.

In other words, it will suit all kinds of loud speaker.

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WIRELESS "WIDOWS."

Has anyone really met the wireless "widow"? She was much talked about two or three years ago, and an effort is now being made to restore her to the limelight in the columns of several daily newspapers. No doubt in the early days of broadcasting the "'phone fiend" made himself somewhat unsociable in the home, but nowadays nearly everyone possesses a loud-speaker, to which the whole family can listen. Many women are undoubtedly widowed by golf, which takes a man from home. On the other hand, wireless reception produces the opposite tendency; so that the woman who seeks to discourage it may have other reasons than the fear of "widowhood."

WIRELESS CELEBRATES NATIONAL ANNIVERSARY.

A wireless exhibition is to be held at Brünn, Czecho-Slovakia, from June 3rd to September 30th, as part of the celebrations marking the tenth anniversary of the Republic.

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BROADCASTING ANNEXE TO A THEATRE.

An innovation in broadcasting is being made in Denmark by the erection of an annexe to the Royal Theatre at Copenhagen, specially for broadcasting purposes. This is a sequel to the passing of a Bill in the Danish Parliament on March 9th granting facilities for co-operation between the broadcasting authorities and the management of the theatre. The annexe will contain two studios.

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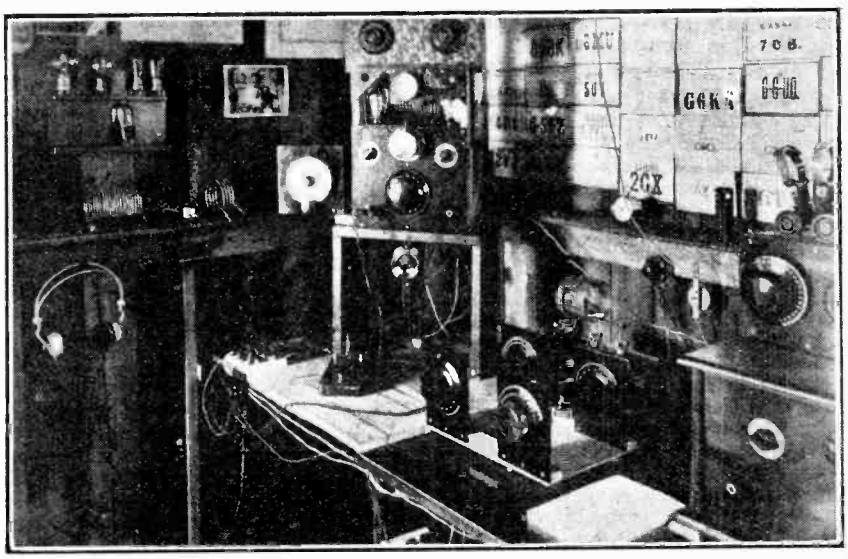
NEW DANISH SHORT-WAVE STATION

The first broadcasting station in Denmark to operate on short waves has recently been erected at Copenhagen. It is owned by the leading Danish radio



A NOTTINGHAM AMATEUR TRANSMITTER 2HD, owned and operated by Mr. Aubrey Harper at Cropwell Bishop, Nottingham, has been in touch with most European countries on wavelengths of 23 and 45 metres, and with an input of 4.5 watts. The transmitter shown is of the Hartley type. The receiver is a Reinartz.

journal, "Radioposten," and is operated by the well-known amateurs 7ZM and 7MK. At present test transmissions are carried out on 78.5 metres on Mondays, Wednesdays, and Fridays between 2300 and 0100 (G.M.T.). Reports will be warmly welcomed by "Radioposten," at 10, Snaregrade, Copenhagen, K.

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STAGE EFFECTS BY GRAMOPHONE AMPLIFIER.

A gramophone amplifier designed by Dr E. J. H. Roth and Mr. A. H. T. Robb Smith has been installed at the Gate Theatre Studio, Chelsea, for the production of stage effects in the play "From Morn to Midnight" from the German of Georg Kaiser.

The amplifier consists of three stages of L.F amplification with a power output to a loud-speaker of the coil-driven type; H.T. is obtained from the electric mains. The loud-speaker has been placed at the back of the stage with the set and associated apparatus at the side of the stalls. Special "crowd" records, supplied by the Gramophone Company, maintain a dull roar throughout two of the acts; in a cabaret scene the illusion of a distant dance band is obtained.

The whole set is fool-proof, and the "effects" are controlled by the stage manager. We understand that "From Morn to Midnight" will continue its run until the middle of April.

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NEW TRANSMITTER AT COPENHAGEN.

After some weeks of testing, which has proved satisfactory, Copenhagen is now using its new transmitter for broadcasting its regular daily programmes, writes our Danish correspondent. The wavelength remains at 337 metres, but increased power of 1.5kW. is used. This transmitter has been installed on the top floor of the Central Post Office building. The Copenhagen programmes are also simultaneously broadcast on high power by Kalundborg (1,153.8 metres).

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BROADCASTING PARLIAMENT.

The question of broadcasting Parliamentary debates came up for discussion in the House of Commons last week, writes our Parliamentary correspondent.

Capt. Ian Fraser asked the Prime Minister if, in view of the raising of the ban on the broadcasting of controversial matter, the Government would set up a Select Committee of both Houses to consider whether any parts of the proceedings of the Houses of Parliament should be broadcast.

Mr. Baldwin, in his reply, said that, in 1926, after consulting the leaders of the other parties and obtaining information through the usual channels, he had come to the conclusion that there was a greatly preponderating body of opinion against broadcasting the proceedings of the House. He did not think there had been any substantial change of opinion since then, and in those circumstances he did not propose to set up a committee such as Capt. Fraser suggested.

GOVERNMENT CONTROL OF FRENCH BROADCASTING.

Broadcasting legislation in France is still "marking time." Speaking generally, the situation has reverted to that which held sway on December 31st. Since then various proposals have been discussed for linking up the many separate broadcasting organisations which threaten to increase the present chaos, but on Tuesday of last week a determined step was taken by M. Poincaré. He secured the passage of a measure through the Chamber authorising the Minister of Posts and Telegraphs to issue permits to private broadcasting stations which were in operation prior to December 31st, at the same time ordering the suspension of all those stations which have sprung up during the present year. Approximately 150 stations are thereby permitted to continue operations under Government supervision pending the introduction of more constructive legislation.

FORTHCOMING EVENTS.

WEDNESDAY, MARCH 21st.

Radio Society of Great Britain.—At 6 p.m. At the Institution of Electrical Engineers, Savoy Place, W.C.2. Lecture: "Amplification and Reproduction at Audio Frequencies in Conjunction with Electrical Pick-ups."

South Croydon and District Radio Society.—At 8 p.m. At the Surrey Drovers Hotel. Lecture: "The Evolution of the Modern Receiving Valve," by Mr. F. E. Henderson, of the General Electric Co., Ltd.

Muswell Hill and District Radio Society.—At 8 p.m. At Tollington School, Tetherdown, London, N.10. Demonstration of "Blue Spot" loud-speakers by Messrs. F. A. Hughes and Co., Ltd.

Tottenham Wireless Society.—At 8 p.m. At 10, Bruce Grove, Tottenham, N.17. Demonstration of the Society's apparatus.

Stretford and District Radio Society. "6NA calling" (Mr. Hardingham).

THURSDAY, MARCH 22nd.

Leyton and Leytonstone Radio Society.—Discussion on Remote Control and Loud-Speaker Extension.

Slade Radio (Birmingham).—At 8.15 p.m. Lecture and Demonstration by Mr. R. Garside, of Messrs. Ferranti, Ltd.

Golders Green and Hendon Radio Society. Club Dance at 8 p.m. in the Club Ballroom, Willifield Way, N.W.11.

FRIDAY, MARCH 23rd.

Leeds Radio Society.—At the University. Lecture and Demonstration by Mr. R. Garside, of Messrs. Ferranti, Ltd.

MONDAY, MARCH 26th.

Hackney and District Radio Society.—At 8 p.m. At the Electricity Showrooms, Lower Clapton Road, E.5. Television Night.

Stepney and District Radio Society.—At 8 p.m. At Headquarters, Ocean Street, E.1. Lecture: "Valves," by the Mullard Co.

TUESDAY, MARCH 27th.

Hounslow and District Wireless Society.—At 8 p.m. At Trinity Hall, Bulstrode Road. Experiments with the "Elphi" Safety Tester.

NATIONAL FREQUENCY MEASUREMENTS.

A surprising uniformity among the standard frequency instruments of the principal countries of the world is disclosed by a report compiled by Dr. J. H. Dellinger, of the U.S. Bureau of Standards, who has recently conducted tests in Europe and America. Dr. Dellinger made measurements on the piezo oscillators at the National Physical Laboratory, Teddington, the French Military Telegraph Laboratory, the Italian Naval Laboratory, and the German National Physical and Technical Laboratory.

"So far as the United States and the four other countries are concerned," writes Dr. Dellinger, "the national standards of frequency agree sufficiently well to insure against interference." It was found that the average departure from the mean did not exceed 3/100,000.

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WIRELESS AND THE CABLES.

The provisional fusion, announced on Thursday last, between Marconi's Wireless Telegraph Co. and the Eastern and Associated Telegraph Co. marks one of the most important events in the commercial history of wireless.

It is understood that the new company resulting from the merger will acquire from the Marconi Company the whole of its Ordinary Preference and Debenture capital, and will also absorb the whole of the Ordinary share capital of the cable companies, leaving the Preference and Debenture stocks undisturbed.

The board of the new company will be nominated as to twelve members by the cable companies, and as to eight by the Marconi Company.

The agreement between the companies is, however, subject to satisfactory arrangements being made with the British Government and the Governments of the Dominions and India.

Catalogues Received.

The Abingdon Wireless Supplies, 45, Stert Street, Abingdon, Berks.—Price list of "A.W.S." resistances, condensers and permanent crystal detector.

The Edison Swan Electric Co., Ltd., 123-125, Queen Victoria Street, London, E.C.4.—Leaflets describing the Ediswan Home L.T. charger for A.C. mains and the Ediswan S.O.S. hydrometer.

The D P. Battery Co., Ltd., Bakewell, Derbyshire.—Leaflet dealing with D.P. "Kathanode" accumulators for H.T. and L.T.

The Mullard Wireless Service Co., Ltd., Nightingale Lane, Balham, London, S.W.12.—Two new pages for insertion in the Mullard catalogue file dealing with screened grid receiving valves, type P.M.12 and P.M.14. Information including circuit diagrams is given regarding their use in H.F. amplifiers.

Regent Radio Supply Co., 21, Bartlett's Buildings, Holborn Circus, London, E.C.4.—A complete catalogue of "Regentone" eliminators and components, and two leaflets dealing with new eliminators incorporating the Westinghouse metal rectifier.

Celestion Radio Co., 29, 31 and 37, High Street, Hampton Wick, Kingston-on-Thames.—A coloured illustrated folder covering the full range of Celestion loud-speakers.

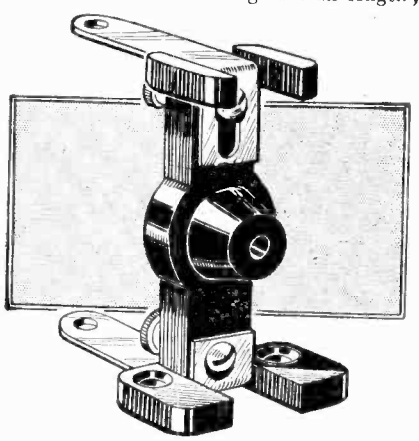
The Marconiphone Company, Ltd., 210-212, Tottenham Court Road, London, W.1.—A new publication entitled "500 Marconi Valve Combinations" showing how to choose the correct valves for any given circuit and the correct grid bias for any value of H.T.

NEW APPARATUS

A Review of the Latest Products of the Manufacturer.

AERMONIC GRID LEAK HOLDER.

Although simple and neat in design, this holder is extremely versatile; not only can it be screwed to the baseboard in either a vertical or horizontal position, but is adjustable by means of a slotted clip to take grid leaks of any length. The spring clips are long and make firm contact, and connections are taken from terminals fitted inside the grid leak length;



Aermonic dual-mounting grid leak holder.

this shortens the overall length and makes the unit neat and compact. The price is 1s., and the makers' address, Messrs. James Christie and Sons, Ltd., 246, West Street, Sheffield.

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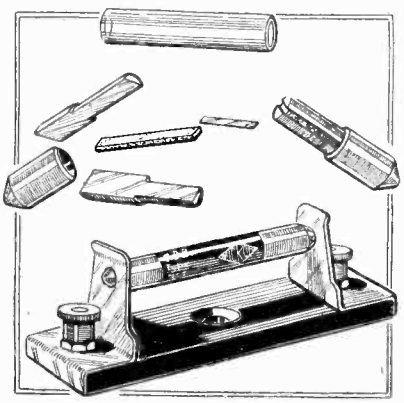
MICROFUSES.

The prevalent use of valves with 0.1 amp. filaments makes the problem of protecting them from accidental damage from the H.T. battery a formidable one. Flash-lamp bulb fuses are not always satisfactory, as most require considerably more than 0.1 amp. to break them down, and the emission of the filament may be irreparably damaged before the fuse blows. Many amateurs experiment with narrow strips of tin foil, but, apart from the difficulty of cutting the foil sufficiently thin, there is always an element of uncertainty regarding the fusing current, as it is impossible to produce the strips with any degree of uniformity.

Messrs. Microfuses, Ltd., 3, Finsbury Square, London, E.C.2, have successfully solved the problem by discovering a method of producing gold film of extraordinary thinness; the film is so thin that it actually transmits light of a characteristic greenish hue—the complementary colour to the yellow reflected light. The immediate consequence of reducing the thickness of the film is that the width may be increased for any given fusing current. Thus a strip of film $\frac{1}{16}$in. wide fuses at about 75 mA. Deposited on a suitable base, a film of this width is quite easy to handle and makes the production of H.T. fuses for 0.1 amp. valves a practicable proposition.

Great care is exercised in assembling these fuses. As will be seen from the sectional drawing the fuse element is clamped between brass jaws with rubber packing and enclosed in a glass tube with metal end-caps. All the metal parts are machined, including the flats on the metal jaws. The fuse is supplied with a spring clip holder for 1s. 6d. and refills cost 1s.



Constructional details of the Microfuse which blows at less than 100 mA.

Oscillograph tests on the Microfuse show that in the event of an overload the fuse blows 0.0002 sec. after the application of the current. This is due to the low heat content of the metal film and indicates that the fuse would blow before the excess current had time even to warm the filament.

The type C.D.B. No. 1 fuse is rated to carry 50 mA. indefinitely and to blow at about 80 mA. Three samples tested blew at 95, 65, and 78 mA. respectively. Their resistances were measured before fusing and averaged about 15 ohms.

The position of the fuse in a receiving circuit should receive careful attention. If it is connected between the source of H.T. and the reservoir condensers in the set the initial surge of current taken while the condensers are acquiring their charge will be more than sufficient to blow the fuse. The obvious remedy is to connect the fuse on the set side of the condensers, but in certain isolated cases the resistance of the fuse in this position may cause oscillation in the L.F. stages. In these circumstances the fuse must be connected between the H.T. battery and the reservoir condenser and shunted by a large condenser. The fuse will then be protected from surges, but will blow for excessive direct currents as before.

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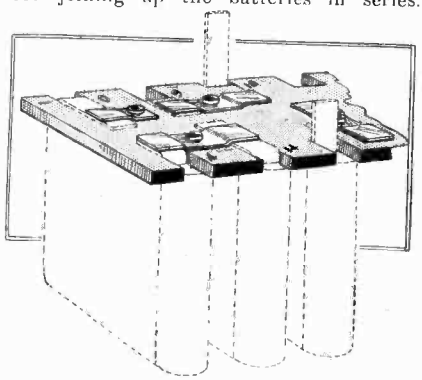
BATTERY CONNECTOR.

Those experimenters who prefer to build up their H.T. supply from flash lamp batteries will be interested in the "Simpsonic" connector panel produced by Messrs. P. W. Simpson and Co., Woodside, Horsforth, Leeds. This unit consists of a fibre panel slotted to locate the brass contact strips on the batteries and provided with swivelled connectors for joining up the batteries in series.



"Simpsonic" connector panel for flash-lamp H.T. batteries.

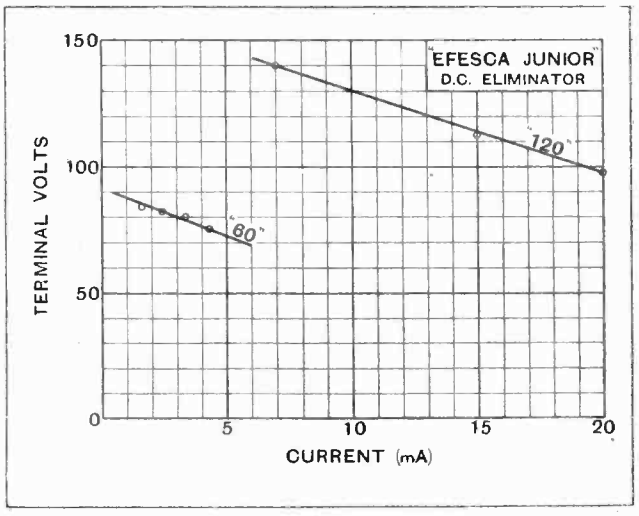
The hollow rivets with which the connectors are fixed to the panel may be used as sockets for the H.T. wander plugs, and the panel is marked to indicate the voltage at each tapping.

EFESCA JUNIOR ELIMINATOR.

This eliminator is designed for 200 to 250-volt D.C. mains and is of cylindrical form, the components being immersed in paraffin wax in a metal container with a circular ebonite top carrying the output terminals.

The type of circuit used is difficult to trace owing to the wax, but it can be inferred from the output characteristic that a potential divider of moderately high resistance is used to reduce the mains voltage. The results show that the terminal voltage is not seriously affected by variations in the load.

The complete absence of mains hum is perhaps the most remarkable feature of this unit, and in this respect it is quite one of the best we have so far tested.



H.T. output from the Efesca Junior under varying loads.

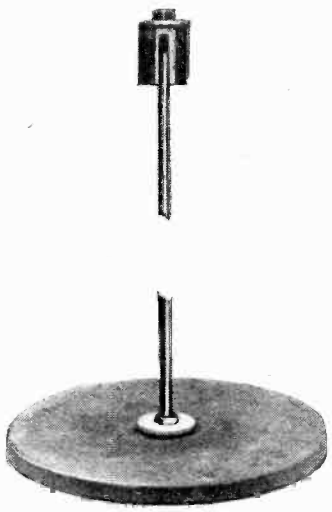
In addition to the two H.T.+ terminals there are terminals for a separate earthing condenser for connection in the earth lead from the set and also a terminal from which grid bias may be derived if desired. All these terminals, by the way, are unshrouded, so care must be taken in connecting up to avoid short circuits which may occur if the leads are bared for more than the required length.

The makers, Messrs. Falk, Stadelmann and Co., Ltd., 83-93, Farringdon Road, London, E.C.1, recommend this eliminator for sets up to three valves, and the price is 35s.

The Efesca Junior D.C. eliminator supplies H.T. and grid bias and contains a separate earthing condenser.

HOLLAND EARTHING DEVICES.

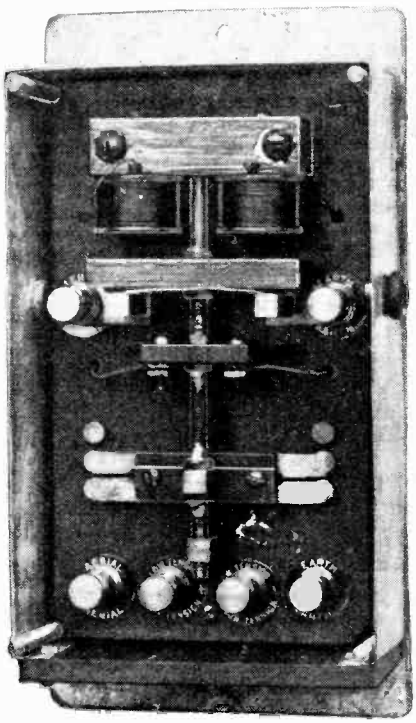
Earth Connection.—This consists of a horizontal disc of porous carbon bolted to a vertical metal rod to which the earth lead is attached at the top under a weatherproof cap. The diameter of the disc is 10 inches, so that a considerable area of contact with the earth is obtained. In addition the porous nature of the carbon serves to attract and retain moisture, while oxidation of the surface, which causes increased resistance with metal earth plates, cannot occur. The price of the complete earth plate is 7s. 6d.



Holland earth plate constructed of porous carbon.

Automatic Earthing Switch.—The low-tension current from the receiving set is made to operate this switch so that the aerial is automatically earthed when the filament current is switched off by means of the master rheostat in the set. The whole of the mechanism is enclosed in a galvanised weatherproof case, and it can be installed outside the house, the circuits being so arranged that the receiver is entirely isolated from the aerial-earth system when in the "off" position.

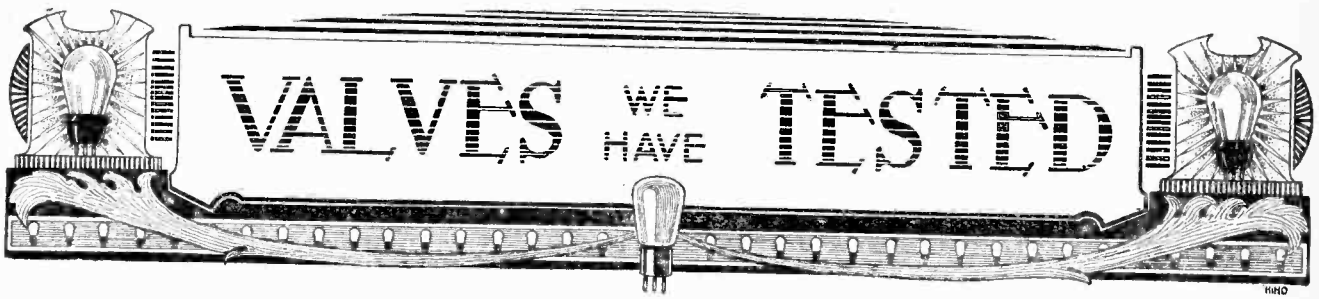
The electro-magnets carrying the L.T. current may be seen at the top of the interior photograph of the switch. They attract a horizontal soft iron armature attached to a vertical sliding shaft which carries the earthing contacts; thin phosphor bronze springs are used for this purpose and contact is made to two vertical posts of square section.



Holland automatic earthing switch with remote control.

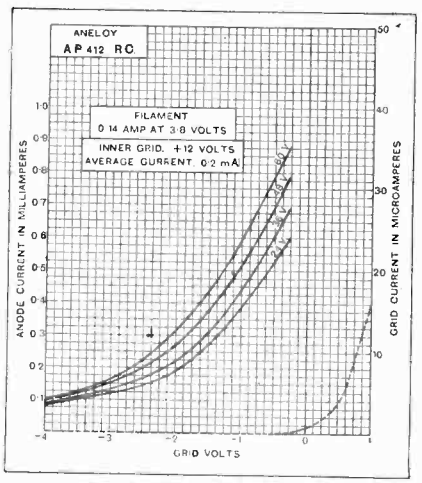
Lower down two sets of three contact studs are arranged with two phosphor bronze sliding springs for connecting pairs together. The object of this subsidiary switching device is to economise current. At the instant of switching on, the contacts are in the lower position shown in the photograph as the full L.T. current passes through both windings in parallel. When once the armature has been attracted to the magnets, much less current is required to hold it there, and the upward movement of the subsidiary switch introduces a suitable resistance for this purpose, and also connects the windings in series. The windings and resistance can be supplied for any L.T. voltage, and the current drawn is from 0.06 to 0.1 amp.

Both these components may be obtained from G. S. Holland, A.M.I.E.E., 65, Wellesley Road, Chiswick, London, W.4.



Four-electrode Valves for Low H.T. Voltages.

THE three valves under review are of the type in which the *inner* grid is connected to a positive tapping on the H.T. battery with the object of obtaining improved performance with lower values of H.T. than are normally required by three-electrode valves. Other than the extra wire from the inner grid terminal, on the side of the valve base, to the H.T. battery, no change of circuit is necessary, and the valves can be plugged into receivers designed for ordinary three-electrode valves. In this respect they differ from, and should not be confused with, the "screened grid" four-electrode valve in which the *outer* grid is joined to a point of fixed positive potential on the H.T. battery. This type of valve is not strictly analogous to the three-electrode valve, and special circuit conditions are necessary to make full use of its properties.



A.C. resistance = 172,000 ohms.
Amplification factor = 54.
Mutual conductance = 0.31 mA./volt.

The type of four-electrode valve under review owes its popularity to the enterprise shown by Messrs. Ancloy Products, Hindman's Road, East Dulwich, London, S.E.22, in developing a variety of types to correspond with existing three-electrode valves. Before this firm entered the field, the only four-electrode valves available were of the "general-purpose" type, which, although of interest to the experimenter, were hardly adequate for the specialised requirements of modern receiver design. Now, a four-electrode equivalent of every three-electrode type, from the "R.C." to the "super-power" valve is available. The three types tested are representative examples, but do not by any means exhaust the range of types available.

A.P. 412 R.C.—The filament current taken by this valve was slightly higher than the makers' rating, being 0.14 instead of 0.12 amp., but this point is hardly worth mentioning, as it is not likely to be noticed in the discharge rate of the L.T. battery. The amplification factor, on the other hand, was high, about 54 instead of 38. This increase was, however, accompanied by a corresponding increase of A.C. resistance, so that the mutual conductance was the same as the makers' rating, viz., 0.31 mA./volt.

Grid current starts at − 0.5 volt, so that the permissible input is limited as indicated by the termination of the accompanying curves. Reverse grid current is entirely absent, showing the vacuum to be dead hard. Suitable grid bias values, taking into account the early grid current, are given in the table.

A.P. 412 R.C.

H.T. (volts).	Grid bias (volts).	Anode Current (mA).
24	—1.0	0.4
60	—1.25	0.5

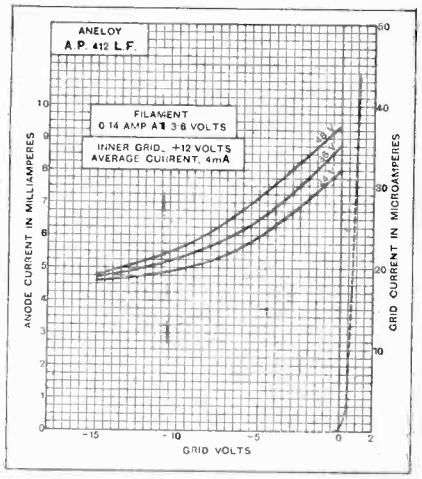
The valve can be recommended for resistance-coupled L.F. amplification or as an anode bend rectifier.

A.P. 412 L.F.—The particular specimen of this type which we tested was hardly up to the makers' standard, the mutual conductance being 0.38 instead of 0.68 mA./volt. The amplification was not very different from the stated value, but the A.C. resistance was 20,500 ohms instead of 11,000 ohms, which accounts for the fall in mutual conductance.

A.P. 412 L.F.

H.T. (volts).	Grid bias (volts).	Anode Current (mA).
24	—3.0	6.75
36	—3.0	7.3
48	—4.5	7.4

The valve should work well as a first-stage L.F. amplifier, as a detector with leaky grid, or as an output valve for a miniature loudspeaker.



A.C. resistance = 20,500 ohms.
Amplification factor = 7.7.
Mutual conductance = 0.38 mA./volt.

It will be seen from the curves that, on increasing the negative bias, the

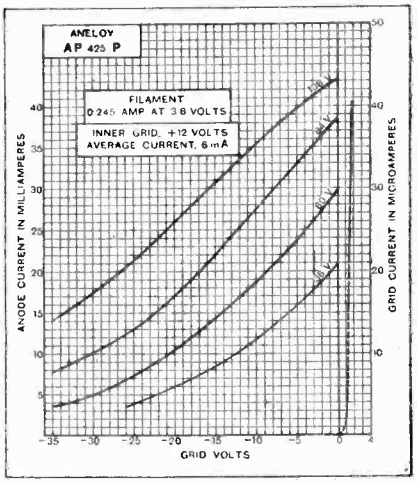
Valves We Have Tested.

anode current falls to a datum line of about 4.5 mA. instead of zero, as in three-electrode valves. To prove whether this was due to excessive inner grid potential, a fresh set of curves was taken with + 8 instead of + 12 on the inner grid. This brought the datum line down to 2.5 mA., but the 48 v. characteristic showed unmistakable signs of saturation, so the inner grid bias was returned to + 12 volts.

A.P. 425 P.—This compares very favourably with any three-electrode valve in the "super-power" class, and can be recommended for heavy duty loud-speaker work. A suitable anode potential is 80 to 85 volts with + 12 volts on the inner grid, when the outer or working grid may be biassed to − 12 volts. There is no trace of grid current, either positive or negative, on the negative side of the zero grid line, which indicates that the valve is dead hard, and that the whole of the straight part of the characteristic in the negative region may be used.

The constants of the valve are in reasonable agreement with the makers' figures, the A.C. resistance being 2,800 ohms, the amplification factor 2.8, and the mutual conductance 1.0 mA./volt.

In conclusion, we would congratulate the makers on the high degree of vacuum in these valves and on the variety of types produced. From the data given in the curves the reader can compare the four-electrode valves (not forgetting the inner grid current) with equivalent three-electrode types. It will be found that in some cases the three-electrode has the advantage, in others the four-electrode; the net result for an average set is about the same in both cases. They should appeal especially to those who prefer to work with a low plate voltage, though this does not necessarily mean that the *power* drawn from the battery is correspondingly reduced.



A.C. resistance = 2,800 ohms.
Amplification factor = 2.8.
Mutual conductance = 1.0 mA./volt.

A.P. 425 P.

H.T. (volts).	Grid bias (volts).	Anode Current (mA).
36	— 6	15
60	— 9	19.5
84	—12	25
108	—18	28

NEWS FROM THE CLUBS.

Dorset Television Club.

Residents in the county of Dorset and neighbourhood who are interested in the study of television are invited to apply for membership to the Dorset Television Club. The club was founded on March 8 last.

The hon. secretary, to whom applications should be addressed, is Mr. N. W. Wright, 13, Royal Arcade, Esplanade, Weymouth.

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Television Society in Southport.

February 22 last saw the formation of the Southport Television Society, with temporary headquarters at 10, Lancaster Road, Birkdale, Southport.

The hon. secretary is Mr. E. C. Wilson, "Lingmell," Kirklees Road, Birkdale, Southport.

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"Super-Het" for Selectivity.

A demonstration of a seven-valve super-heterodyne receiver with frame aerial was given by Mr. W. K. Alford, of the Igranic Electric Co., Ltd., at the meeting of the South Croydon and District Radio Society on March 7. Dealing with recent developments in radio reception, Mr. Alford referred to the amount of interference experienced on the ordinary type of receiver. He advocated the use of a supersonic receiver in which selectivity was improved to such an extent that stations on wave-lengths only a few metres on either side of 2LO's wavelength could be received without interference. The lecturer proved his contention in the demonstration.

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

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Gramophone and Wireless Reproduction.

A surprise demonstration was attended by members of the South Woodford and District Radio Society on March 5 at the experimental station 5AR, owned by Mr. E. Dawson Ostermeyer. The audience remained in the dining-room while announcements were made from a carbon microphone in the wireless room on the floor above. The object of the demonstration was to show the extent of developments in the reproduction of music and speech both from the gramophone and by wireless. An Igranic pick-up was selected for the gramophone work, and a moving coil loud-speaker installed in the dining-room was operated from the wireless room. A point about the loud-speaker, which had been constructed by Mr. Ostermeyer, was the incorporation of an ammeter at the bottom of the baffle to record the current impulses of the moving coil. The reproduction was excellent. After the demonstration members visited the transmitting room in parties of four and were able to inspect the apparatus. Mr. Nickless (2KT) gave a humorous demonstration of how the amateur transmitter usually addresses the "mike."

Hon. secretary, Mr. E. J. Turbyfield, 42, Alexandra Road, South Woodford, E.18.

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Measuring Instruments.

The operation of small measuring instruments was demonstrated at a recent meeting of the Leyton and Leytonstone Radio Society. The many applications of a milliammeter were shown by means of one of these instruments mounted on a special panel and used under working conditions. D.C. metres were dealt with, and the evening concluded with a discussion on A.C. and radio frequency instruments.

Visitors and prospective members are always welcome at the Society's Thursday meetings. The hon. secretary is Mr. E. Boatwright, 265, Murchison Road, E.10.

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Tests with Short-Wave Portable Transmitter.

Experiments with portable ultra short-wave equipment will be a feature of the summer programme of the Q.R.P. Transmitters' Society.

Hon. secretary, Mr. C. D. Abbott (6TA), 120, Cavendish Road, S.W.12. Headquarters, 178, Evering Road, Clapton, London, E.5.

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Valve Curves: Correct or Incorrect?

Whether the characteristic curves published by valve manufacturers are a true criterion of the capabilities of valves was the question discussed at a recent meeting of the Radio Experimental Society of Manchester. Mr. George Blake, of Messrs. Radions, Ltd., defended the published characteristics, and in support of his statement worked out mathematically the dynamic curves of several types. In a lively discussion modern fallacies in connection with valves were dealt with, but the chief fallacy, exploded by Mr. Blake, was "that a society can have too many valve lectures"!

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

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A Large Membership.

The Wigan and District Technical College Radio Society is proud to announce that the membership has now reached a total of 105, and that fresh applications are being received at each meeting. Members enrolled before April 30 are to be classed as foundation members.

An interesting syllabus has been prepared for the ensuing months, and arrangements are in hand for a number of interesting visits and social gatherings. In regard to the last mentioned, an announcement is to be made at an early date.

Hon. secretary, Mr. M. M. Das, B.Sc., Library Street, Wigan.

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High-frequency Chokes.

Mr. G. W. Hale, lecturing before the Croydon Wireless and Physical Society at a recent meeting, dealt with an ideal type of aerial inductance which combined selectivity with a uniform strength of signal over the whole range of the tuning condenser. He then dealt with high-frequency chokes, especially those required for short-wave reception, and demonstrated with a short-wave oscillator. It was shown how certain kinds of chokes could be put into a state of electrical vibration, and the positions of the nodes and loops were demonstrated by exploring the field of force around the choke by means of a neon lamp and a closed circuit containing a flashlamp bulb. The bulb lit up in the vicinity of maximum current, while the neon lamp glowed only in the position of maximum E.M.F. and minimum current.

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

BROADCAST BREVITIES

By Our Special Correspondent.

Controversial Debates.—Those Continental Relays.—Copyright Conundrums.—A Mass Meeting on Programme Selection.—Good Friday Arrangements.

A Meeting of Governors.

The B.B.C. cannot be accused of acting rashly. On the question of controversy they are treading very warily indeed, and who can blame them? Last Wednesday the Governors held a round table conference at which the matter was discussed very earnestly for several hours. I understand that no definite arrangements for future events have yet been made, but that official opinion is in favour of introducing controversy principally through the medium of debates, either outside or in the studio.

It seems to be appreciated that debates furnish the best method of presenting controversial topics because they afford listeners an opportunity of hearing both sides of a question at a single sitting.

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Continental Relays.

No violent enthusiasm has been observed among listeners over last week's attempts at relaying programmes from Liége and Cologne. The Cologne relay was the more successful of the two events—a rather remarkable fact, considering that the identical lines were used between London and Liége on both occasions, with the additional line from Liége to Cologne for the German programme.

The "motor-boating" effect noticeable during the Belgian relay is considered by the engineers to have been due to a temporary defect in the submarine cable. The land line repeaters—there were nine of them—all functioned perfectly.

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Why Enthusiasm is Lacking.

The relay in the opposite direction, permitting Cologne listeners to hear 5GB, was generally voted a success, to judge from reports which have come to hand at the time of writing.

It is just possible that German listeners may appreciate these long-distance line relays more than we do.

Three or four years ago, when we were less sophisticated, the experiments might have been more awe-inspiring. Nowadays the average man has a long-distance set of his own, and so these "relays through the pipe," as I have heard them irreverently called, are faintly suggestive of spoon-feeding.

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Why Not Relay Moscow?

It would be a different story if the B.B.C. were able to give us line relays from the really distant stations—those beyond the reach of the ordinary receiver. Unfortunately the thing can't be done under the present system of wire telephony, which suffers more than wireless over long distances.

I suggest that the B.B.C. have a shot at relaying Moscow. The "noises" would, of course, be awful, but the listener could easily be deluded into the belief that he was listening to real life in the Russian capital.

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The Complexities of Copyright.

An international conference is to take place in Rome in the middle of May to consider a problem which has been steadily growing ever since the introduction of broadcasting. This is the question of international copyright.

The more one studies the copyright question the more bewildering it appears. Imagine that a piece of copyright music is broadcast from 5GB. The composer is entitled to a royalty for its performance in Great Britain. But simultaneously the transmission is relayed to Cologne, and possibly it is tapped at Liége. Both Cologne and Liége supply programmes to relay stations, and it is quite conceivable that the piece of music in question may be picked up and broadcast by these stations as well.

How are the additional royalties due to be assessed and collected?

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Peculiarities of Broadcasting.

The size of an audience is generally a determining factor in assessing the amount of royalties due;; but how is it possible to ascertain how many Germans and how many Belgians enjoyed our composer's effort? And who is to keep a

NEW B.B.C. DANCE BAND. Jack Payne (on extreme right), the well-known dance band conductor, directing the new B.B.C. dance combination during the first performance at Savoy Hill. Mr. Payne was formerly leader of "The Cecilians" at the Hotel Cecil.

watch on what is broadcast in this manner, and how is he to do it?

The Rome conference will be up against the awkward fact that broadcasting leaves no trace after the deed is done. If a station is to be detected in the infringement of copyright it must be caught in the act.

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The Programme Director's Conscience.

It looks as if authors and composers will have to rely largely on the moral integrity of broadcasting authorities. But even supposing that these gentlemen are above reproach, the difficulties are not overcome. Very often a programme director is unaware of the existence of copyright in a particular piece that he may happen to broadcast, or alternatively he may know that royalties are due, but not know to whom. All he can do is to suffer the buffetings of conscience until the matter is mercifully forgotten or worse troubles come along.

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Copyright Sleuths Required.

The B.B.C. are fortunate in possessing an extremely efficient copyright department under the direction of a gentleman whose memory is so prodigious that he knows the copyright holder of almost everything—songs, plays, poems and even jokes.

Not all broadcasting concerns are so fortunate, and I fancy that the Society of Authors, Composers and Playwrights may find it necessary to form a Corps of Copyright Sleuths to parade Europe with portable sets.

Can anyone think of a better scheme?

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A Tremendous Idea.

I wonder whether Mr. J. E. Kemp, that popular organiser of wireless opinion in the Midlands, fully realises the immensity of the issues involved in the suggestion which he let fall a few days ago? The suggestion was that a meeting should be called in one of the large halls of Manchester in order that the whole question of the suitability of the programmes should be thrashed out!

Oh, Dante, what a meeting!

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A Rousing Meeting.

To begin with, I doubt whether Manchester has a hall sufficiently tremendous. For the sake of safety it would be wise to allow each guest a floor area of at least 16 square feet to permit of ample gesticulation without injury to his neighbours. As the meeting proceeded more space might be required to cope with the natural expansiveness of the audience. A special hall would, therefore, have to be constructed with a first aid annexe and fire hoses in strategical positions.

Bedrooms would also be a necessity, for it is inconceivable that the whole question would be thrashed out in an ordinary meeting lasting say two or three hours.

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A Basis of Agreement.

After the deliberations had proceeded for several days it is just feasible that listeners might reach some common basis of agreement on which to begin to argue. For example, it might in time be conceded by all parties that broadcasting should be permitted; and an announcement to this effect could not fail to restore confidence at Savoy Hill.

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High Brows and Low Brows.

Assuming that this stage had been reached with a minimum of bloodshed, what lines would the agenda follow? I confess I should prefer to leave it to Mr. Kemp. It is conceivable, however, that the ensuing conflict would bring about some strange reversals of front. Under the bludgeonings of their opponents many intellectual highbrows might wish that, physically speaking, they possessed lower brows, and there is no saying how many lowbrows would finish up, speaking phrenologically, with very high brows. The price of raw steak would ascend.

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Conclusions.

Finally, what conclusions would be reached? I doubt whether the meeting would reach a conclusion. It would just go on. And as the years rolled by, the guests would fade away or be carried out to a decent burial.

The truth is that no public meeting on the question of the suitability of the broadcast programmes would ever achieve anything worth talking about. The mind of a crowd is quite incapable of grasping those subtleties of compromise which go to the compilation of broadcast programmes. One might as well expect success at a public meeting for reconciling the world's religions.

The collated opinions of individuals provide a far safer guide than the blunted views of a mass audience.

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Sir Edward Elgar.

Sir Edward Elgar will conduct his own works at the B.B.C. National Concert, to be relayed from the People's Palace on March 30. The programme includes Suites Nos. 1 and 2, "Wand of Youth," the symphonic prelude "Polonia," Contrasts-Gavotte 1700-1900 and marches from "Pomp and Circumstance."

Walter Widdop (tenor) is the soloist, his items being a Scene from "King Olaf" and Meditation and Scena from "Light of Life."

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On Good Friday.

Bach's "St. Matthew Passion" will be given by the Birmingham Chorus and Orchestra, under the direction of Joseph Lewis, from 5GB on Good Friday.

The soloists, who have been specially selected, are all experts in Bach's music, and comprise Caroline Hatchard (soprano), Gladys Palmer (contralto), Eric Greene (narrator), Roy Henderson (Caiaphas, Judas and Pilate), and John Thorne (Jesus).

The edition used will be the one recently compiled by Sir Edward Elgar and Sir Ivor Atkins.

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Sullivan and Mendelssohn Evenings.

Two special feature programmes are to be given from the Birmingham studio to 5GB.

The first, a "Sullivan" programme, on April 4th, will include examples of this composer's many styles, and will range from the Finale from the Irish Symphony and a selection from "The Pirates of Penzance" to the hymn, "Onward, Christian Soldiers," and an aria from "Ivanhoe," sung by John Turner (tenor).

The second, on April 5th, is a Mendelssohn programme, with Leslie England as piano soloist. It includes the Concerto in D Minor and Saltarello from the Italian Symphony.

FUTURE FEATURES.

London and Daventry (5XX).

MARCH 25TH.—Religious Service from the Studio, conducted by the Rev. Harry Millar.

MARCH 26TH. — "The Night Fighters," a play by Cecil Lewis.

MARCH 27TH. — Musical Comedy.

MARCH 28TH.—A Chopin Recital.

MARCH 29TH. — "A Woman's Reason," a Dramatic Play by Jeffrey Farnol.

MARCH 30TH.—National Symphony Concert conducted by Sir Edward Elgar.

MARCH 31ST.—A Running Commentary on the Oxford *v.* Cambridge Boat Race, and a Running Commentary on the England *v.* Scotland Football Match.

Daventry Exp. (5GB).

MARCH 25TH.—British Composers' Programme.

MARCH 26TH. — "The Night Fighters."

MARCH 27TH.—A Symphony Concert relayed from the Colston Hall, Bristol.

MARCH 28TH.—Barclays Bank Concert.

MARCH 29TH.—Choral Concert from Birmingham.

MARCH 30TH.—"The Ballad of Black-eyed Susan."

MARCH 31ST.—Running Commentary on the Oxford *v.* Cambridge Boat Race.

Cardiff.

MARCH 31ST.—"The Stolen Rolls," a comedy in one act, by Monckton Hoffe.

Manchester.

MARCH 29TH.—"Elijah," an Oratorio by Mendelssohn.

Newcastle.

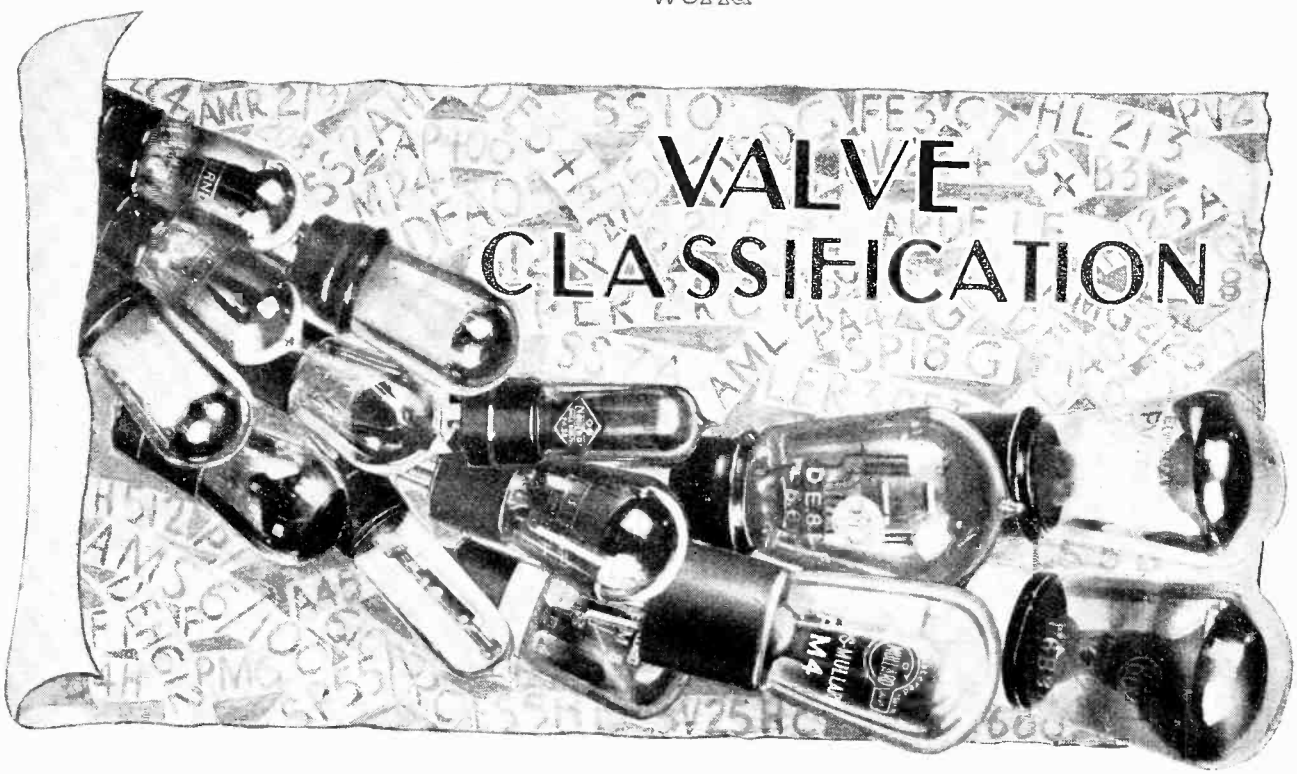
MARCH 31ST.—"All Fools Eve" Programme.

Aberdeen.

MARCH 29TH.—"A Social Evening at the Bishop's," adapted from the play "The Bishop," by A. W. Simpson.

Belfast.

MARCH 28TH.—"Cavalleria Rusticana."



VALVE CLASSIFICATION

A Suggested New Scheme Based on Impedance and Magnification Factor.

The large volume of correspondence received by this journal on the subject of valve nomenclature bears witness to the necessity for establishing some organised method of classification. The multiplicity of meaningless prefixes at present in vogue provides little help for the amateur in search of a valve for some specific purpose; the suggestion therefore here put forward that valves should be categorised according to their most important characteristics, namely, impedance and magnification factor, is worthy of serious consideration.

THERE is in existence, and gradually extending, a consistent scheme for valve nomenclature to which attention was again drawn in a recent article in these pages[1] by Prof. E. V. Appleton.

This method consists, fundamentally, in classifying valves by certain index numbers which represent the filament voltage and filament current required to operate them. A six-volt valve, consuming a quarter of an ampere, is thus designated by the figures "625" (as is, for example, the Marconi screened valve), while if the consumption is but 0.1 ampere at the same voltage the figures "61c" are employed to denote this. The first digit in such a number refers to the filament voltage, the rest of the number representing the filament current in hundredths of an ampere.

Since many valves, differing widely in their essential figures, and consequently in their suitability for the various functions that they may be called upon to fulfil, but still all having the same filament characteristics, can be made, it is obvious that some indication in addition to the figures already mentioned is essential. Those few valve makers whose products are named according to this scheme have therefore been compelled to prefix to these figures letters which are intended to denote approximately the function which the valve will fulfil most satisfactorily. The letters "H" and "L," implying suitability for high- and low-frequency amplification respectively, and "P" for the so-called "power" valve are examples of this. There is a tendency, however, for these letters, especially "H" and "L," to mean alternatively valves of high and low impedance, or high and low amplification factor, so that considerable confusion is arising. That the non-technical man should be perplexed is hardly surprising when one remembers that it is necessary, in many modern receivers, to use an "L" valve for high-frequency amplification, an "H" valve for low-frequency amplification, and an "R.C." valve as detector.

Names Based on Filament Consumption Unessential.

Despite these defects, however, this system of naming is an enormous advance on the method, still adhered to by so many makers, of allotting to a valve a name or number that tells us absolutely nothing of its characteristics, although it may convey a meaning to those responsible for its development. It must be remembered that nomenclature by filament characteristics orginated at a time when the bright emitter was still the standard valve, and when the current consumed was a very vital matter

[1] *The Wireless World*, March 7th, p. 244.

Valve Classification.—

indeed to every valve user. Now that the bright emitter is dead, and filament currents have been reduced almost to vanishing point, much of the justification for this scheme has disappeared.

Under modern conditions, the writer feels strongly that the prominence thus given to the filament characteristics is unduly great, especially as they have no relation to the performance of the valve. The present note is intended to put forward a different scheme, in which the vital figures of the valve are brought into prominence, and unessential ones are left in the background, where they belong.

Primary Importance of Impedance.

There can be no doubt, in the mind of a technical reader, that the fundamental constant of a valve, which indicates its suitability for any particular purpose, is its impedance, since this must in all cases be suited to the properties of the components in the anode circuit of the valve. Provided that a valve has an impedance suitable for the conditions under which it has to work, it may be regarded as correctly chosen from among the many types available.

It follows, therefore, that a statement of the impedance of the valve should hold the most prominent place of all in the abbreviated description.

The next most important constant is the amplification factor, which serves to indicate which individual valve, among a number whose impedance is the same, will in practical use give the greatest amplification. The figure representing the amplification factor should therefore be given a place in the abbreviated description of the valve, but this place should be secondary to that held by the impedance.

Thirdly, the user, who will be in possession of either a 2-, 4- or 6-volt accumulator, requires to know the filament *voltage* necessary to operate the valve, and this information also should be given; but, since the filament voltage has no great bearing upon the performance of the valve, it should not be given any prominent place in the description. The filament *current*, in these days of economical valves, is, by comparison, of no importance, and the valve makers can quite well be trusted to do the best they can for us in this direction. The actual figure in each case might well be relegated to the comparative obscurity of the maker's catalogue, or the outside of the containing box, positions of subordination which are now held by the really vital figures for amplification factor and impedance.

A Practical Suggestion.

Putting this scheme into practice, two figures, as before, would be needed. The first of these would indicate the impedance of the valve, expressed in thousands of ohms. Thus to a D.E.5 valve, for example, which has an impedance of 8,000 ohms, would be allotted the figure "8." To this would be added another figure, giving the amplification factor of the valve, so that the complete description would, in the case mentioned, be expressed by the figures 87. It would probably be advisable to include a bar separating these figures (thus: 8/7), which would make impossible any conceivable confusion that might arise owing to the fact that both impedance and amplification factor can run into two figures. The companion valves to that mentioned, the D.E.5b and the D.E.5a, would be known by the figures 30/20 and 3/3 respectively. All three are, on the filament-rating system, described as 625 type valves; this information is therefore of no use to us in selecting from among them. With the descriptions that are here suggested, on the other hand, there is no difficulty in making a choice for any particular purpose.

It will be necessary, of course, for the user to select valves that are suitable for his filament battery; all that is required for this purpose is to use the voltage as a prefix to the description just given, much in the same way as "D.E.H." and other prefixes are now used. The three valves mentioned would therefore be called in full "6-volt 8/7," "6-volt 30/20" and "6-volt 3/3" respectively. A screened valve could be indicated by the suffix "S" after the figures, and a valve with a separate heater is very simply provided for by using the letters "A.C." in place of the voltage specification, so that the Cosmos A.C./G. would be rechristened "A.C. 14/35." All the information that matters is here packed into the smallest possible space, and in a form which allows of no ambiguity.

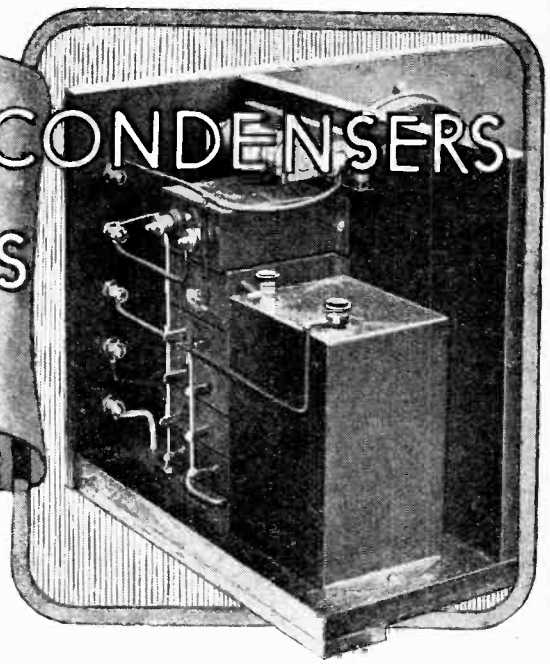
Conclusions.

The chief objection, so far as the writer can see, to this system is that it is so highly technical that many valve users, to whom the rating by filament characteristics is an open book, would be completely in the dark as to the significance of the figures employed. This disadvantage is perhaps set off by the fact that such a user generally relies, in any case, upon a dealer or a technical friend, and the latter's instructions can be made much clearer and less ambiguous if the suggested rating is adopted, so that the chance of misunderstanding and mistake is greatly lessened.

Finally, it may be an inducement to valve makers that the system here suggested is not at present in use, so that if it were adopted no one maker could claim priority, or make any form of advertising capital out of it to the detriment of his competitors.

A. L. M. S.

SMOOTHING CONDENSERS IN ELIMINATORS



The Effect of Voltage Rises Due to Inductive Surges.

WE are often advised by designers of battery eliminators to make sure that the smoothing condensers used are so designed that the full voltage of the mains in the case of D.C. or of the secondary of the power transformer in the case of A.C. will not cause a breakdown in the dielectric when it is applied across it; moreover, we are adjured to use condensers in which the dielectric is guaranteed to withstand a considerably greater voltage than that with which it is to be associated. In the case of a mains voltage of 200, we are very wisely counselled to obtain condensers which have been tested to 400 volts. This is very sound advice which is followed in all other practical applications of science. A boiler, for instance, is always designed to withstand a much greater steam pressure than its normal working pressure. This gives a large and highly desirable margin of safety.

Large Margin of Safety Necessary.

Before we can allow for this margin of safety in designing our condenser or boiler, however, we must make quite sure of the maximum working voltage or pressure which will be applied to the device. In the case of a smoothing condenser used in a D.C. eliminator, it seems fairly obvious on the face of it that the full voltage of the mains can be taken as the maximum voltage which will be applied across the condenser terminals. It seems absurd to suppose that the voltage across the condenser can ever be greater than the mains voltage, and yet it must be confessed that, like a great many other apparent truisms, this is only a trap for the unwary, and it is not to be surprised that a great many people have fallen into it. The fact that the number of accidents with eliminators due to condenser breakdown is so relatively small speaks well for the sound design and workmanship of these components.

The fact of the matter is, of course, that under certain circumstances, and more especially when used with multi-valve receivers or L.F. amplifiers using more than one "super" power valve in the output position, the voltage across the smoothing condenser may actually rise to a value three or four times that of the mains; in other words, the voltage may rise, not only far above the normal working voltage for which the set is designed, but above the maximum "test" voltage of the condensers. The risks run, therefore, are very great, and it would appear that we must purchase condensers having a very high "test" voltage, far greater than that which we have come to regard as a sufficiently high value to ensure safety.

We will now proceed to investigate and see whence this extra voltage emanates. It is well known that if a steady current be passed through an ordinary inductance, such as the iron-cored choke used in a smoothing circuit, then the inductance is surrounded by a steady, unvarying magnetic field illustrated by dotted lines in Fig. 1. This diagram shows us a conventional D.C. eliminator, which we will suppose is connected to the ordinary 110-volt D.C. mains. At the output end of it is shown the ordinary output valve circuit of a typical set. It must be remembered that the other valves of the receiver will also, in practice, be taking their H.T. supply from this eliminator, and we may, if we like, use paralleled valves in the output stage. Now, obviously, the condenser C_1 and C_2 will be charged up, their voltage in both cases being equal to the mains voltage. Any voltage drop due to the small D.C. resistance of the choke L_1 will be ignored.

Now it is equally well known that, provided the current is steady, the magnetic field will be stationary, and will have no effect whatever on the circuit. If, however, we suddenly cut off the current by means of the switch S the lines of force will collapse almost instantaneously, *and will cut through all the turns of wire* in the choke. What results will this apparently harmless phenomenon produce? It will cause a big difference of potential to

Smoothing Condensers in Eliminators.—

be set up across the ends of the choke, and this will be in such a direction that it will tend to force a current through the choke in the same direction as the current which we have just cut off. This effect will be to force an extra charge into C_1 and C_2; but surely these condensers will already be holding a charge due to the mains supply which we have just cut off, the voltage across them being equal to the mains voltage? If this extra charge be suddenly forced into them by the collapse of the lines of force around the choke, the voltage across them will rise very considerably over the mains voltage because this "surge" from the choke will be added on to the charge already held by the condensers. It will at once be seen, therefore, that the condensers have to stand up to a much bigger voltage than that of the mains; but, someone may say, this will not be so, because the condensers will have got rid of the "mains" charge by discharging through the valves in the set, or if we use one, through the potential divider. This is not so, however, because, as we know from experience, in an ordinary eliminator using the ordinary values of smoothing condensers, the receiving set will go on working two or three seconds, or even longer in some cases after the mains are switched off, the H.T. energy being derived from the charge held in the condensers. The collapse of the lines of force, however, takes place in about 0.01 of a second. This has been repeatedly proved both mathematically and theoretically. Therefore, the collapse of the lines of force and consequent charging up of the condensers will take place two or three hundred times as quick as the condenser takes to get rid of its original charge. The "surge" voltage, therefore, *will* be added to the "mains" voltage.

However, we have not even yet come to the end of the tale of woe, for, even before switching off the mains, the voltage of the condensers will be greater than the mains voltage. Why? Because the mains voltage is not steady; it is constantly fluctuating slightly. If it were not so, we should not need smoothing devices. If the current fluctuates, so does the magnetic field surrounding the choke, and, if the magnetic field fluctuates, the resultant voltage will increase the standing charge in the condensers, and on top of this comes the big, overwhelming surge when we switch off.

The Use of Safety Resistances.

Earlier in this article it was stated that it looked as though we should have to buy condensers having an exceptionally high voltage test. Is there no way, however, whereby we can avoid this! Supposing instead of switch S we put a variable resistance R_2 in one of our mains, and slowly turn off the current instead of cutting it off instantaneously with a switch. The current will then no longer cease suddenly but will decline slowly as we manipulate the resistance, and if the current declines slowly, then the magnetic field will decline slowly, and will, on the face of it, give us the advantage of permitting the "mains" voltage of the condensers to be dissipated through the valves of the set, or through any potential divider we might employ, before the "surge" charge gets into the condensers if we may be permitted to put it in such a loose and untechnical manner; but the voltage set up by lines of force cutting through conductors does not only depend on the number of lines cutting the conductors, but also *on the rate of cutting*. This is known as Faraday's Law. If we slowly turn off the current the *rate* of cutting will be very low and not comparable with the instantaneous collapse of the field already referred to. Therefore, we shall get hardly any surge voltage if we use the variable resistance R_2 instead of the switch S. The same thing applies to output chokes and transformer primaries in receiving sets. It is not the passage of the steady D.C. current which causes them to break down; it is the surge voltage caused by switching off the filaments suddenly. If we slowly turned off the filaments with a master rheostat we should not have these troubles in our set.

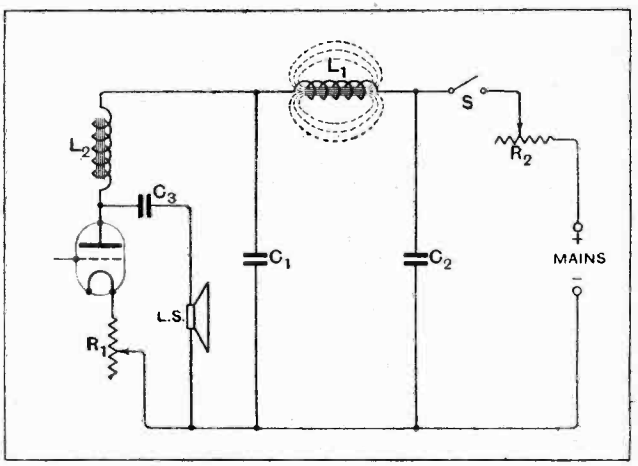


Fig. 1.—The maximum voltage produced across C_1 or C_2 is dependent on the rate of collapse of the lines of force around L_1.

The remote control switch is now firmly established, and until some enterprising firm can produce such a control which will gradually cut the current off instead of suddenly, we must, in the case of eliminators, be prepared to purchase condensers which will stand up to this "surge" voltage, and, in the case of receivers, be prepared to purchase transformers, etc., which will do likewise. With regard to receiving sets, so far as the writer is aware, the only remote control device of this description in existence is a home-made one, full constructional details of which were given in *The Wireless World* some weeks ago.

The enquiring reader who has read thus far will at once demand exactly what is the value of the "surge" voltage set up across a choke in an eliminator. It has already been pointed out that this depends on the rate of cutting of the lines of force through the conductors; but this "rate of cutting" itself depends on various factors, such as the value of the current flowing through the windings of the choke and upon various physical characteristics of the choke, such as the cross-sectional area of the iron core, the magnetic properties of the iron used when under the influence of a given magnetising force, the number of turns of wire, the average coil diameter, etc., and also, of course, upon the time taken for the magnetic lines of force to collapse from

Smoothing Condensers in Eliminators.—

their normal value when the mains are switched on to zero value when the mains have been switched off. This latter factor we have already taken as 0.01 second. The value of the "surge" voltage can be ascertained by using the formula:

$$V = \frac{N\phi}{T \times 10^8}.$$

Here V is, of course, the voltage which we require to know, N is the number of turns in the coil, ϕ is the number of lines of force present when the normal current is passing through the choke windings, and T the time taken for the total collapse of the lines of force on switching off. Now T, we know, equals 0.01 second; N we know if we have made the choke ourselves, or alternatively must obtain this information from the manufacturers of it. The stumbling block, however, is ϕ, which represents the number of lines of force which is sometimes referred to as the "total magnetic flux" or the "total field density." It is sometimes written as F, and must not be confused with B, which is the flux density per unit area of the iron core. Now the value of ϕ depends on the current flowing through the coil and upon the magnetic properties of the iron used when under the influence of a given magnetising force, etc., and it becomes necessary to delve further and find another formula for finding the value of ϕ. Unfortunately, this will lead us rather more deeply into the mire of formulæ than it is the purpose of this article to go. It will be better if we branch off here and give some actual facts and figures concerning a definite case of a smoothing circuit such as is represented in Fig. 2, these figures being arrived at both mathematically and experimentally.

Taking the case of Fig. 2, a well-designed choke of 50-henries inductance was used, and the D.C. current passing through it to the valves of the receiving set was 25 milliamperes, the choke being so designed that at this value of current it did not approach the saturation point. The inductance value is quite an ordinary one for an eliminator choke, whilst the current value is much as would be expected in the case of a modern long-distance high-quality set using paralleled valves in the last stage. Under these conditions the choke was found to have a flux value of 87,000 lines. The value of N was 12,000. As we know the value of T we can now use the formula already given.

By substitution we now get:

$$V = \frac{12{,}000 \times 87{,}000}{.01 \times 100{,}000{,}000} = 1{,}044.$$

Therefore the "surge" voltage across L_1 in Fig. 1 is well over a thousand volts, a figure which makes us fear for the safety of C_1 and C_2. However, the total voltage drop across L_1 means that the individual voltage drop across C_1 and C_2 is only 522 volts, which is not so bad, but it must be remembered that this voltage must not only be added to the mains voltage, but also to the additional voltage due to the extra charge in the condensers produced by the fluctuating magnetic field of L_1, which is in its turn brought about by the fact that the D.C.

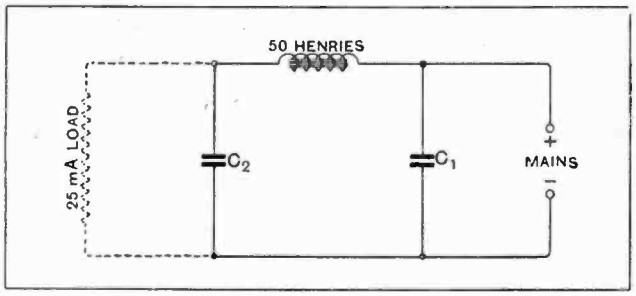


Fig. 2.—A practical smoothing circuit, C_1 and C_2 having the usual values. The load is that imposed by the valves in the set, and by any potential divider that may be used.

supply is not absolutely steady. If, therefore, we have 250-volt mains it will be seen that the voltage which our condensers will have to withstand at times will exceed 772 volts, which represents mains voltage *plus* surge voltage without reckoning the extra voltage due to the fluctuating supply. Therefore the test voltage of our condensers ought to have a value much greater than this. The moral is obvious.

The mathematical data used in this article was abstracted from a paper prepared by Dr. A. Eckel, of the Hydra Condenser Works, Berlin.

TRANSMITTERS' NOTES

Belgian Amateurs.

Mr. Louis Era (EB 4BC) has been active on 45 metres, and would like reports from British listeners and transmitters. He has arranged a regular schedule every Monday and Thursday with Miss B. Dunn (6YL), of Stock, Essex, of whose clear Morse transmissions he speaks in the highest praise, while incidentally mentioning the difficulty of understanding many foreign transmitters when sending at speed.

He also reports "duplex" communication with G 6YQ, Mr. G. A. Massey, Prestatyn, North Wales, each using two aerials, one for transmission and the other for reception, and thus avoiding the necessity for changing over.

EB 4BC has also been in communication with stations in Australia, New Zealand and U.S.A. He keeps up a regular schedule on Thursdays and Sundays with OZ 4AO, Mr. H. H. Shrimpton, Coney Hill Road, Dunedin, and, as he has been asked by several British amateurs to get them into touch with OZ or OA transmitters, he will specially listen every Tuesday between 0830 and 0900 G.M.T. on 45 metres for messages from Great Britain.

° ° ° °

Calibration Waves.

The QRP Transmitters' Society has amended their schedule of calibration waves which we published on page 72 of our issue of January 18th. On and after Sunday, March 25th, the schedule will consist of three wavelengths only of approximately 46, 45 and 44 metres. These will be transmitted at 1400, 1405 and 1410 G.M.T. on the fourth Sunday, and at 1000, 1005 and 1010 G.M.T. on the second Sunday of each month. The alteration is due to the fact that the calibration signals sent out from G 5YK will be under the auspices of the R.S.G.B., and its committee consider the amended schedule more generally suitable.

° ° ° °

General Note.

Mr. C. K. Attwater (NU 2JN), 161, Bellevue Avenue, Upper Montclair, New Jersey, transmits every Sunday from 14.15 to 14.30 on 9.8 metres, and will welcome reports, which may be sent, if preferred, *via* Mr. E. A. Dedman (G 2NH), 65, Kingston Road, New Malden, who tells us that he has several times heard U 2JN in communication with EF 8CT at excellent strength.

LETTERS TO THE EDITOR.

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

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

ELECTRIC SUPPLY.

Sir,—In connection with "A Sufferer's" letter on this subject in to-day's issue, may I relate my own experience in connection with a recent change-over from D.C. to A.C. mains?

I was charging my L.T. accumulators in series with the mains in the usual way, and using for H.T. a simple but fairly efficient home-made smoothing arrangement. Just before Christmas the supply company's representative called while I was out, explained to my wife a coming change to A.C., asked to be shown any apparatus we were using, and mentioned that this would all be altered or exchanged at the company's expense.

My wife forgot to show him the H.T. smoother, but my immediate letter drawing attention to it was accepted without question, and at my request the company's man called again to discuss the replacement.

On the day of the change-over (nearly a month later) a "trickle" charger (bearing an honoured electrical name) was delivered to me, and on the following day an excellent H.T. battery eliminator *of my own choosing* arrived—in all about ten guineas' worth of apparatus at retail prices, in exchange for which I was merely asked (not unreasonably) to surrender my home-made smoother.

May I say in conclusion that this letter is prompted solely by one's natural desire to see fair credit given to at least one company which has *not* misused its powers, and that I have no interest whatever (beyond that of a small private consumer) in the company concerned, nor in any other.

SATISFIED.

Barnet, Herts.
March 7th, 1928.

ARE THERE TOO MANY TYPES OF VALVES?

Sir,—The article appearing in your issue of March 7th, and bearing the above title, touches briefly on the subject of valve nomenclature, and the following sentence appears: "The scheme . . . . which is gradually winning its way . . . . is that originally suggested by the makers of Burndept valves." Although the Burndept Company were the first manufacturers to adopt it, the three figure system of denoting filament voltage and current was originally devised and offered to the Valve Makers' Association as long ago as the first weeks of 1925, by Mr. P. K. Turner, then editor of *The Wireless Trader*. Descriptions of the scheme were published in this journal in February, 1925, and in an article in *Experimental Wireless*, in March, of the same year, and since then the designations have been consistently in use in test reports and similar matter, at any rate, in *The Wireless Trader*.

Burndept Wireless, Ltd., modified the original scheme to include the initial letters H. and L. instead of "a" and "b," as suggested by us, which, we agree, is an improvement.

As to the main theme of the article, we should like to lend our support to the tentative proposal to abolish four-volt valves, believing, as we do, that such a step would be in the best interests of the trade and the user.

W. E. MILLER.
The Wireless Trader.

Sir,—In the article by Prof. Appleton, "Are there too many types of valves?" the last paragraph appears to be very condensed and not quite so clear as the body of the article. In col. 2, line 22, should not "these" read "three (3)?"

So far as my recollection serves this scheme of lettering valves was not originally suggested by the makers of Burndept valves, but by either your good selves or your companion journal, *Experimental Wireless*. I think I remember reading of this scheme before Burndept's put valves on the market, but I am not sufficiently energetic to verify the point by searching.

The scheme is excellent and should be universally adopted. The abolition of the 4-volt series would be almost unnoticed, the number of 4-volt accumulators consigned to me for charging being in a hopeless minority. Nevertheless the 6-volt series might be improved judging from the 2-volt types now available. We have now a D.E.P.240 with a filament consumption of 0.8 watt, whilst its 6-volt equivalent, the D.E.5A, takes 1.5 watt, or twice as much. Alternatively one might expect a D.E.L.610 to be three times as good, or at any rate distinctly better than a D.E.L.210, as the filament wattage is three times as large. This point of view does not seem to commend itself to Professor Appleton, however (p. 244, col. 1, lines 16-19), and I must confess I myself use 6-volt impregnated filaments (D.E.5 type).

May I put forward a plea for better valve advertisements? It is very nice to know that one maker's valves have "wonderful . . . . filaments," another maker's valves "are by virtue of their special construction inherently more efficient than any valves built on stereotyped lines," yet another's "do everything that good valves should do," etc., etc., but I cannot compare valves on this basis. Could we not have a statement, even if only in a little corner out of the way, of fil. volts, fil. amps, impedance, and amplification factor? These *could* be compared, and I am forced to the conclusion that makers would rather have us buy on the reputation of their name than on a comparison of their products with those of other makers. The advertisements could keep the facts before us always. This complaint does not apply to valves alone—What is the cut-off frequency of any speaker, the impedance and capacity of a transformer or choke, the life of a H.T. battery at a given rate of discharge, and the current a rheostat will pass without overheating?

Your assistance to get this data given in advertisements would be invaluable, and now that one aspect has been raised I hope others will follow.

D. ORMEROD.

Stockport.
March 8th, 1928.

Sir,—I read with interest the article by Professor Appleton in your issue of March 7th, in which, among many other excellent suggestions, he recommends the use of a standard method of naming valves. In this part of his article he views with approval the nomenclature of which he gives as an example "H.510" for a high-magnification valve taking 5 volts on the filament and a current of .1 amp. My only quarrel with him is that he states that this was originally suggested by the makers of Burndept valves.

As a matter of personal vanity, I should like to make it clear that this method of naming valves, which seems at last to show signs of coming into use, was devised by myself, and published about three years ago, both in the *Wireless Trader* and in *Experimental Wireless*. Messrs. Burndept's have long ago expressed to me their appreciation of the scheme, which they adopted immediately.

P. K. TURNER.

Crofton Park,
March 8th, 1928.

TALKS.

Sir,—May I express the strongest endorsement of the letter signed "F." in your issue to-day?

I have long looked in vain for some evidence of anything beyond the inane and frivolous mentality which seems to be the normal state of those who air their opinions on this subject. As a matter of fact, however, there is a very large body of listeners who highly appreciate the very admirable matter broadcast during the all-too-brief "talks" periods, and who regard with scorn the worthless sneers so industriously ground out in some quarters.

"F's" last sentence I particularly approve, and hope you will take to heart. "Don't do it!"

G. E. H. RAWLINS.

Bembridge, I.O.W.
March 7th, 1928.

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

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

Super Seven Transformer Bobbins.

I propose building "The Wireless World Super Seven," but as I have no facilities for turning the I.F. transformer bobbins, I propose to build them up from ebonite discs held together by a rod through their centres. I should be pleased to receive your comments on this suggestion, and whether you consider the presence of the brass rod through the centres will lower the efficiency of the transformers? W. H. G.

We see no reason why you should not construct the intermediate frequency transformer bobbins in the manner suggested; however, it would be advisable to use a rod of small diameter for the purpose of holding the discs together, and we suggest that No. 4 B.A. rod would be suitable for this purpose.

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Worse Results with Better Valves.

I have recently replaced the bright emitter valves in my four-valve receiver with modern dull emitters, expecting to obtain much better results. Unfortunately, these have not materialised, as violent oscillation is produced. As far as the local station is concerned, however, this can be got over by detuning, but if the rated H.T. voltage is applied to the L.F. valves, another difficulty arises, as L.F. oscillation sets in. What can I do to put matters right? W. J. K.

We presume that your set is of an obsolete type, with an unneutralised H.F. coupling and a directly-connected aerial. With inefficient valves the loading of the aerial is sufficient to ensure stability, but with those now available, which have improved characteristics, it is not at all surprising that violent oscillation is produced as the two circuits come into tune. It is a difficult matter to give really helpful advice; you can use palliatives, such as the application of a positive voltage to the H.F. grid, or the insertion of damping resistances in the tuned circuits, but these arrangements are neither satisfactory nor in keeping with modern technique. We strongly advise you to rebuild the set to a more up-to-date circuit with a neutralised H.F. coupling.

Regarding the L.F. side, the production of oscillation is due to the vastly greater magnification obtainable through the use of modern valves, and it will be necessary for you to apply the various preventatives which have been discussed from time to time in this journal.

RULES.

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

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

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

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

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

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

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

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An Efficient Tuned Anode Coil.

I wish to construct an efficient neutralised tuned anode coil for a high frequency stage before my present detector valve, and should be obliged if you could supply me with particulars of the coil. W. A. T.

An anode coil for a neutralised tuned anode circuit can be constructed by winding 70 turns of No. 26 D.C.C. wire on a former 3in., in diameter; this winding will be tuned by the variable condenser. The neutralising winding should consist of half this number of turns wound over the first-mentioned coil, but spaced from it by $\frac{1}{16}$in. spacers. The turns on the neutralising coil should be spaced so that they occupy the same winding length as the tuned coil, but the wire should be of much smaller gauge, so as to keep the capacity between the coils as low as possible. The theoretical circuit diagram of this arrangement was given in Fig. 1 on page 804 in *The Wireless World* for December 14th, 1927.

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Effect of the Anode Load.

A puzzling effect in my receiver has recently been observed. There is a super-power valve in the output stage, with ample high-tension voltage, and good results are obtainable with an ordinary loud-speaker connected in the plate circuit through a choke filter. I notice, however, that with a sensitivity adjustment which does not produce overloading when this loud-speaker is in use, the substitution of a moving coil instrument (with high resistance coil) results in almost continuous fluctuations of the milliammeter needle. Moreover, reproduction with the moving coil instrument is not as good as I should wish. Is there any explanation for the fact that the output valve appears to be overloaded much more readily when the latter is used? C. D. A.

Yes, there is a simple explanation for the effect you have observed. In all probability the moving coil has a much lower inductance than have the windings of the ordinary loud-speaker, with the result that the effective impedance in the anode circuit at average audio-frequencies is much lower than when the comparatively high-inductance magnet winding is in circuit. The result is that the "flattening" effect on the valve characteristic is much more marked when the latter instrument is connected. We may add that there are indications that your moving coil resistance is rather too low, and that your amplifier is not passing on the lower frequencies without considerable attenuation.

A House-wiring Problem.

Is it possible to adopt the general idea of the "Remote Control Relay" ("The "Wireless World," July 27th, 1927) for the operation of a receiver installed in an upstairs room, which is required to work three loud-speakers in different rooms downstairs? My H.F.-Det.-1-L.F. receiver does not provide excessively loud signals, so the volume control could be omitted. In any case, its retention would probably complicate matters unduly, as far as I can see. Can you supply me with a circuit diagram showing the connections of the relay, and also the extension leads for the loud-speakers? I use a choke-filter output.

M. F. B.

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We take it that independent control is required at each distant point. This is not difficult, but obviously it would be an impossible matter to arrange a satisfactory volume control unless those listening to the three separate loud-speakers were all of the same mind.

The circuit diagram is given in Fig. 1, from which you will see that the volume control rheostat has been replaced by switches at each of the distant points. These are wired in parallel. The closing of any one of them will pass current through the H.F. valve filament, and also energise the relay, the contacts of which will close, and thus complete the circuit of the detector and L.F. valves. At each point it will be necessary to provide a 2-pole change-over switch, which, in the "off" position will break the relay circuit and short-circuit the loud-speaker, so that it will not be in operation when the relay is energised by the closing of a switch in another room.

It will be obvious that the H.F. valve must have a lower filament voltage rating than the others (this point was dealt with in the article mentioned). Furthermore, consideration will show that the total resistance of the extension circuit will be very slightly less when all three switches are closed as compared with the conditions existing when the set is switched on from one point only. However, this difference will only amount to an ohm or two at most, which has no effect on modern valves consuming about 0.1 amp. You should set the rheostat controlling the H.F. valve to such a value that full normal voltage is applied when all three distant switches are closed.

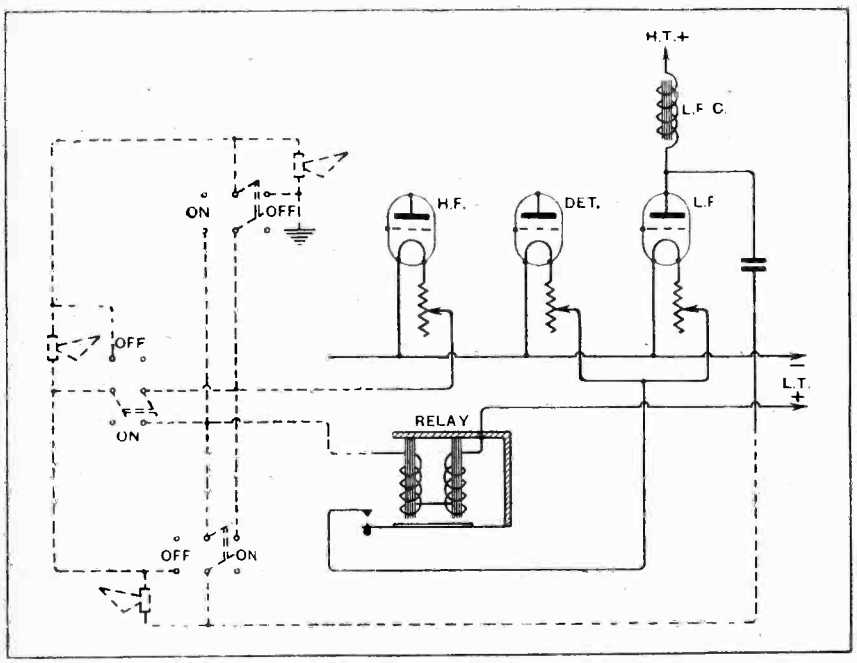

Fig. 1.—Control of a receiver from three distant points. Extension leads are shown in dotted lines. Note the earth return for loud-speaker circuit.

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Output Choke as an Auto-Transformer.

In discussing the output stage of the "Alternative Programme Quality Receiver," the author explains the method of obtaining a step-down ratio between output valves and loud-speaker by utilising a tapped choke, and states that a step-up ratio can also be obtained, but omits to explain how this is achieved. Can you indicate how this is done, please?

H. C. R.

For the purpose of stepping-up the output, the loud-speaker should be connected across the ends of the choke, and the anodes of the two push-pull valves connected to appropriate tappings on the choke; thus the number of turns in the anode circuit of the valves is less than that across the loud-speaker. The output choke is an auto-transformer working normally with a 1 : 1 ratio, but when tappings are provided the ratio can be adjusted to meet the requirements of the valves and loud-speaker.

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Parallel Anode Rectification.

I should be obliged if you could explain the parallel anode method of rectification and what advantages it possesses over those normally used? F. W.

In the parallel anode method of amplification the signal is applied between the plate and negative filament of the valve and a small positive bias is given to the grid for the purpose of neutralising the space charge. This arrangement is used in special receivers, where superlative quality is desired, as a valve used in this manner has a practically linear characteristic. However, the arrangement is very inefficient, and possesses no advantage apart from the above.

The method of applying this in practice was shown diagramatically on page 232 in *The Wireless World* of August 24th, 1927, under the heading of "A Diode Rectifier."

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Mains Interference.

I am troubled by an intermittent "crackling" noise in my loud-speaker. This is not continuous, and the intensity varies from time to time. I have discovered that it can be stopped entirely by switching off the electric supply at the main switch. The house wiring has been tested, and I am assured that there is no leakage to earth. Can you tell me how the difficulty may be overcome? The set is an "Everyman Four," built exactly in accordance with your specifications. F. T. C.

The fact that the "crackling" is completely eliminated when you take out the main switch would certainly indicate that there is a fault, which probably takes the form of an intermittent contact in your electrical fittings or wiring, and we advise a careful overhaul. It is quite possible that such a fault should exist without there being any leakage to earth.

If a careful search fails to reveal any likely source of the trouble, we suggest that you should join two 4 mfd. condensers in series across your mains input, connecting the junction point of these two capacities to earth.

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A Difficult Modification.

My commercial five-valve receiver (with two H.F. stages) covers both broadcast wavebands. Can it be easily converted for reception of the very short waves of from 20 to 70 metres?

P. N.

Practically speaking, it is not possible to adapt a receiver such as that you describe for reception of the very short waves, particularly as it has high-frequency amplification. You might find it possible to omit the H.F side and to insert a short-wave aerial-grid coil in the detector grid circuit, but to do this you would probably have to make radical alterations, and we hardly recommend you to pursue the matter.

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CONTENTS OF THIS ISSUE.

THE WIRELESS AND CABLE AMALGAMATION.

THE recent announcement that an agreement had been reached between the Marconi Company and the Eastern Group of cable companies with a view to amalgamation does not appear to have attracted much attention at first, except from speculators in the shares of the respective concerns; but there is, nevertheless, ample evidence that this proposed amalgamation is, in point of fact, a matter of national concern.

There is little doubt but that the cable companies have, from the earliest days of wireless telegraphy, watched the progress of development of the new means of long-distance communication with keen interest, but, so long as the cost of erection of high-power wireless stations and their maintenance remained high and comparable with the equivalent costs of the cable routes, the cables had really little to fear from the competition. An effort was made soon after the War to compete with the Marconi Company, when certain of the cable companies backed the Radio Communication Company. Recently, however, control of this company has been obtained by the Marconi group, thus eliminating competition from that quarter. Almost simultaneously with the loss of control of the only competitor of the Marconi wireless monopoly came the advent of the short-wave era, and the remarkable record of efficiency of the beam stations erected by the Marconi Company for the Post Office. The possibilities of the short wave as a cable competitor now assumed a more important aspect.

It must be remembered that Empire cables and Empire wireless are Government controlled, whilst communication with foreign countries is left to private enterprise. To meet future beam competition a war of rates appears impracticable, for the cable companies, with certain outstanding exceptions, are already working pretty close to the margin of profit necessary to cover the maintenance costs of the cable routes, and it would hardly be possible for the Government to permit its own alternative means of communication to compete with one another on rates.

Fortunately, perhaps, for the cable companies, the present state of affairs affecting their interests has coincided with an upheaval in the Marconi Company necessitating a financial readjustment. If the Marconi Company had been in a more settled state it is doubtful whether the overtures of the cable interests would have resulted in the present amalgamation.

A move which appears definitely to be in the best interests of the rival concerns may not necessarily be in the best interests of the public. A war of rates was tending to reduce the costs of long-distance communication to the public, but if this had eventually resulted in the working of any of the cable routes becoming an impracticable proposition, the effect might well have been more serious than if the higher rates had remained, for the Government in this country could never permit that the cable routes should be closed, and would undoubtedly have subsidised them, when, of course, the taxpayer would find the necessary funds.

One aspect of the matter calls for special consideration. The door should always be left open for a licence to be granted to any new undertaking which can show itself competent to embark on a competitive enterprise; if there is to be any monopoly, that monopoly should be in the hands of the Government, and should not be ceded to a private undertaking. The patents in connection with beam wireless are patents of detail rather than principle, and some of the fundamental wireless patents which have hitherto given to the Marconi Company a virtual monopoly will, before long, run out, thus leaving a clearer field than has hitherto existed for competitive effort. It is in the public interest that such effort should be stimulated rather than suppressed.

By H. B. DENT.

THE wireless listener desirous of utilising the electric supply mains as a source of high tension for the receiver can refer to many useful designs in *The Wireless World*, but he who wishes to go a step further and replace all batteries by a mains unit will find himself floundering in a mire of uncertainty. These remarks may be said to apply equally to all sources of electric supply, whether they come within the category of alternating or direct current systems. By the time this appears in print, the case for the A.C. supply will have been discussed in an article describing a receiver embodying the indirectly heated cathode valves, but only the most meagre of information seems to have been put on record concerning the mode of procedure when a D.C. supply is available.

The Filament Supply from D.C. Mains.

In this article it is proposed to limit the discussion to the ways and means whereby the direct current supply mains can be used as a substitute for all batteries in a broadcast receiver. The design of an A.C. unit to undertake these duties is a fairly straightforward proposition, and the characteristics of the mains will have negligible effect on the performance of the receiver. With a D.C. supply, however, the problem cannot be solved in quite such a simple manner, and experiments show that a special design of receiver is essential if satisfactory results are to be obtained under all conditions. Slight ripple or other inequalities in the supply produce an objectionable hum in the loud-speaker, and the necessity arises for complicated smoothing circuits in the filament supply before a background of reasonable silence can be assured. Even with these precautions a residue of hum is often present, and this can be traced, in most cases, to the sensitiveness of the detector valve to slight ripple in the filament circuit.

Under average conditions, the background can be reduced to negligible proportions by the adoption of crystal rectification in place of the more orthodox thermionic detector, and this can be achieved with minimum smoothing of the filament supply. Now, when D.C. mains are employed, these will be in direct electrical contact with the receiver, but this will not prove harmful if the negative conductor is earthed; however, this desirable state of affairs does not exist in all cases. With the positive main earthed, certain complications are introduced, and although this condition is encountered less frequently than the negative earthed system, the "snags" are so numerous that it was considered advisable to concentrate attention into this channel and develop the receiver for use on a positive earthed system. At the same time the other aspect has not been ignored, and the slight modification required will be discussed later. It follows, therefore, that those contemplating the construction of a battery-less receiver must ascertain first which conductor is at earth potential, and then adopt the appropriate smoothing arrangement.

It would be well to mention in passing that occasionally extraordinary noisy supply systems are encountered, and although everything points to a state of normality it is impossible to obtain satisfactory results with the smoothing arrangement suggested for this particular case. Such cases will be rare, and, as each will require a special treatment depending upon the conditions prevailing locally, they cannot be given detailed consideration here, but, in general, suitable chokes in both filament and H.T. supply circuits with additional condensers on the mains side of the chokes should eliminate practically all hum. If this is found to be inadequate, then the filament and H.T. circuits should be wired with metal-sheathed cable, and the sheathing earthed to a point on the filament circuit.

The Detector Circuit.

The introduction of a crystal may be thought by some readers to be a retrograde step and bordering on a nuisance, but if the semi-permanent type, such as a carborundum or perikon combination, be adopted, its stability will not fall far short of that of a valve. To achieve selectivity and reasonable sensitivity a stage of high-

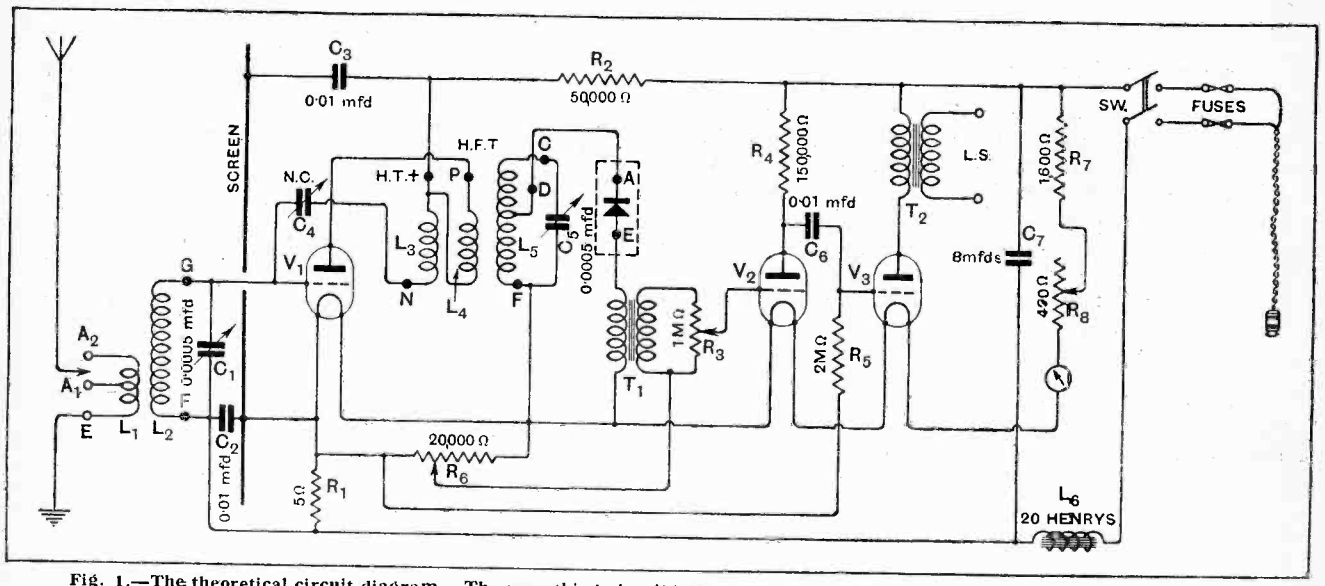

Fig. 1.—The theoretical circuit diagram. The smoothing circuit is arranged for a supply system with the positive conductor earthed.

frequency amplification is essential, but this may prove disappointing unless precautions are taken to prevent the comparatively low resistance of the detector from damping the secondary circuit of the high-frequency transformer. In this respect a crystal may be considered analogous to a leaky grid detector valve, and the expedient of connecting this across a portion only of the coil becomes an essential feature of the arrangement. Even so, the circuit will be damped to a greater extent than would be the case with an anode bend valve detector, so that little advantage will be gained by employing a secondary circuit of low decrement. That is to say, it would not be worth while winding the secondary of the transformer with Litz wire, as the slight gain in efficiency would not compensate for the difference in price between this and a solid conductor.

Turning now to the circuit diagram in Fig. 1, it will be seen that the main departure from accepted standard practice is that the filaments of all valves are connected in series, the object being to limit the current taken from the mains to the lowest value possible. With valves taking 0.1 ampere, this limits the total filament requirements to the current taken by one valve, whereas, if the filaments were in parallel, the wattage taken from the mains would be trebled, with a corresponding increase in the cost of working. Now we have at our disposal a considerably higher voltage than the requirements demand, so that advantage can be taken of this to use the most efficient type of valves, irrespective of whether they fall within the two-, four-, or six-volt range. Generally speaking, the six-volt type are more efficient than those of lower voltage in the same class, but, of course, the choice must be made from valves having the same filament characteristics. Considerable latitude can be permitted in this respect, but it would be advisable to keep the filament consumption within the 100-milliampere mark, otherwise many of the components specified here will require replacing by the more expensive types, and in certain cases special parts made up to meet the new requirements.

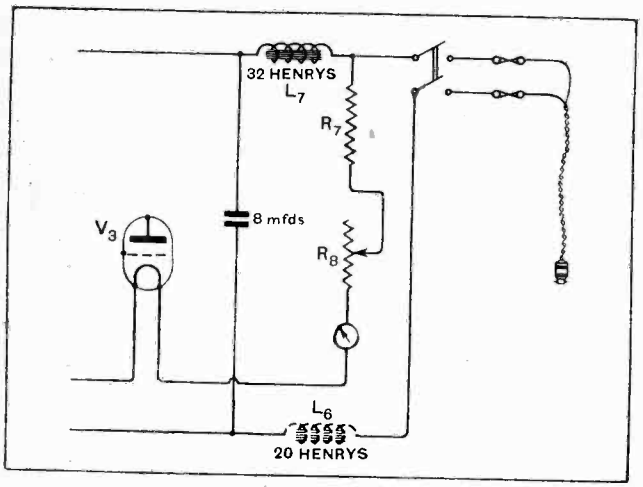

Fig. 2.—The alternative smoothing circuit to be used when the negative main is earthed.

Current Limiting Resistances.

With regard to the limiting resistances R_6 and R_7, the value of these can be determined by first calculating the total resistance required to limit the current in the circuit to 0.1 ampere, and deducting from this figure the sum of the D.C. resistances of any other components in the filament circuit. An examination of Fig. 1 will show that these comprise the valve's filaments, smoothing choke L_6, and the milliammeter. The grid bias resistance, R_6, of 20,000 ohms, is so high compared with that of the valve filament with which it is paralleled that its presence can be ignored. The biassing resistor R_1 is 5 ohms only, so that this need not be considered. Now, the total resistance across the mains is found by dividing the supply voltage by the current, *i.e.*, $\frac{220}{0.1} = 2{,}200$ ohms.

The resistance of a valve's filament is found by dividing the working voltage by the current passed, *i.e.*,

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$\frac{6}{0.1}$, or 60 ohms, and as there are three valves in series these together will amount to 60 × 3, or 180 ohms. To this must be added the resistance of the choke, L_6 which, according to the manufacturers' figures, is 300 ohms, and that of the milliammeter, in this case, 40 ohms. The total is therefore 520 ohms, which deducted from 2,200 leaves 1,680 ohms to be proportioned suitably between R_7 and R_8. Convenient values for these would be 1,600 and 100 ohms respectively, but this does not provide sufficient variation on R_8 to meet the requirements of a 240 volt supply, and a more suitable value would be 400 ohms.

A fixed resistance of 1,600 ohms could be made up by winding 287 yards of No. 30 S.W.G. Eureka wire on a suitable former, but now that special resistance units can be purchased for a few shillings it would be hardly worth while expending time on its construction. The Igranic Electric Co., Ltd., supply tubular resistances of 400 ohms, each with a current rating of 0.15 ampere, and four of these units connected in series will comply with the requirements of R_7, while R_8 can consist of an Igranic 400 ohm potentiometer used as a variable resistance.

Grid Bias Considerations.

From time to time various methods of obtaining "free" negative grid bias have been advocated, but with the exception of those deriving the bias from the difference in potential across fixed resistors in the filament leg of a valve, the anode voltage is reduced by the value of the biassing voltage. In the present case bias values up to about 12 volts negative can be obtained without a corresponding drop in plate potential, and this is brought about in the following manner. Referring to Fig. 3, and assuming that 6-volt valves are used, it will be seen that six volts are dropped between points A and B, but between points A and D the difference in potential will be twelve volts. Furthermore, point A will be the most negative part of this circuit, and any point to the right of this will have a positive sign; thus any part of the filament in valve V_2 will be six volts positive to the corresponding part of V_1, and, similarly, V_3 will be twelve volts positive with reference to V_1. Thus if the grid of V_3 was returned to point A, this would acquire a negative bias of 12 volts, and by shunting V_1 and V_2 by a high resistance R_1 any desired value of negative bias from 0 to 12 could be obtained.

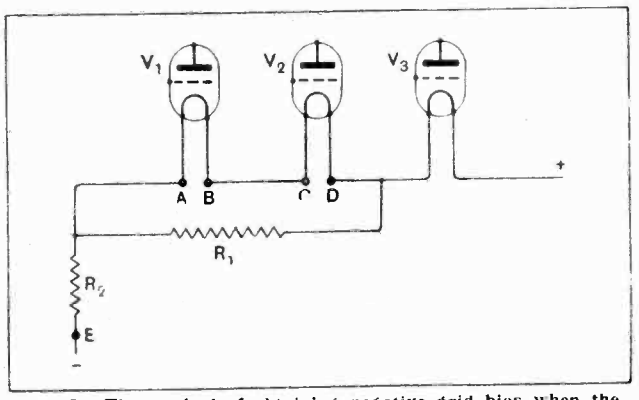
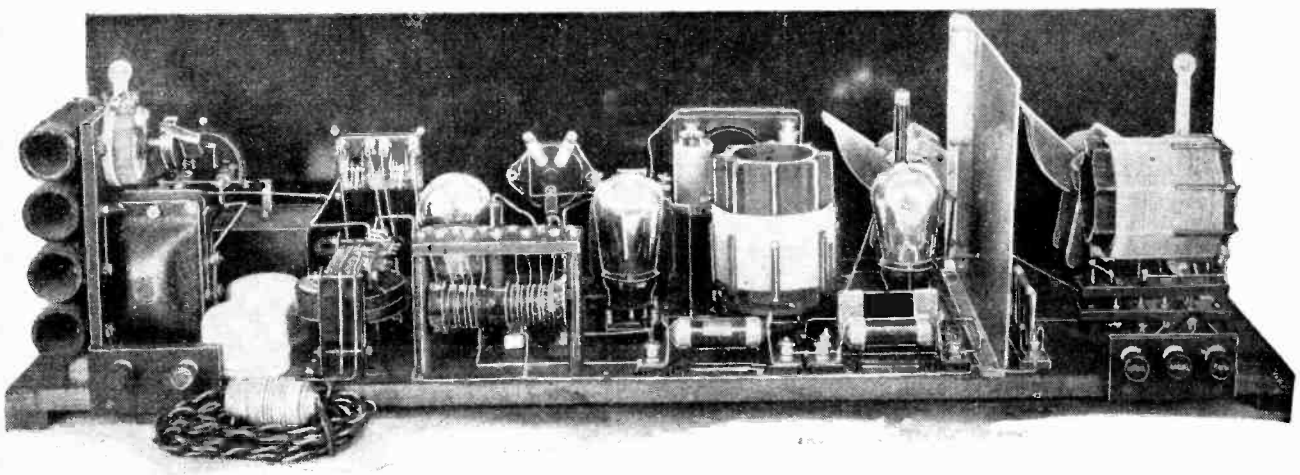


Fig. 3.—The method of obtaining negative grid bias when the filaments of the valves are connected in series.

Now, if we wish to bias negatively the value V_1 it is obvious from the foregoing that the procedure advocated for valves V_2 and V_3 cannot be adopted as this would lead to biassing the valve positively, so that it becomes necessary to include a further resistance R_2 (Fig. 3) in the negative supply lead to the filaments and return the grid circuit associated with V_1 to the point E or to some part of R_2. This resistance, being directly in the filament supply circuit, must be sufficiently robust to carry the full current without overheating, but in the present case this is limited to 0.1 ampere, so that a commercial type of fixed resistor will answer the purpose.

When a current of 0.1 ampere flows through a resistance the difference in potential across this will be one-tenth the value of the resistance, but, of course, in volts. This is shown by Ohm's law in the following manner. Taking the value of R_2 as 5 ohms, then the volts dropped across its ends will be 5 × 0.1, or 0.5 volts; or if its



The rear view of the receiver. The current limiting resistance can be seen on the left and in the centre is the 20,000 ohms tapped resistance for supplying grid bias to the first L.F. valve.

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value was raised to 10 ohms, then volts dropped equals 10 × 0.1, or 1 volt. From the above it will be seen that any desired value of grid bias can be obtained by the simple expedient of changing the value of the resistor.

The H.F. Transformer.

In every receiver embodying or using a mains attachment it is desirable that the aerial circuit should be totally isolated, as far as direct electrical connection is concerned, from the remainder of the circuit, and this feature is embodied in the receiver under discussion. Four coils in all will be required, two for the medium B.B.C. band covering the wavelengths between 230 and 600 metres, and two for the high wavelengths of from 600 to 2,000 metres. All coils can be wound on moulded formers of the eight-ribbed type; those used in the present case were supplied by Messrs. Redfern's Rubber Works, Ltd., Hyde, near Manchester; however, these can be obtained from most radio dealers. The 3-inch diameter formers must be used, and these should be cut in lengths of $4\frac{1}{2}$ inches. Two of the formers will require mounting horizontally, and the remaining pair vertically; the construction of these can be seen by referring to the dimensional drawings and illustrations.

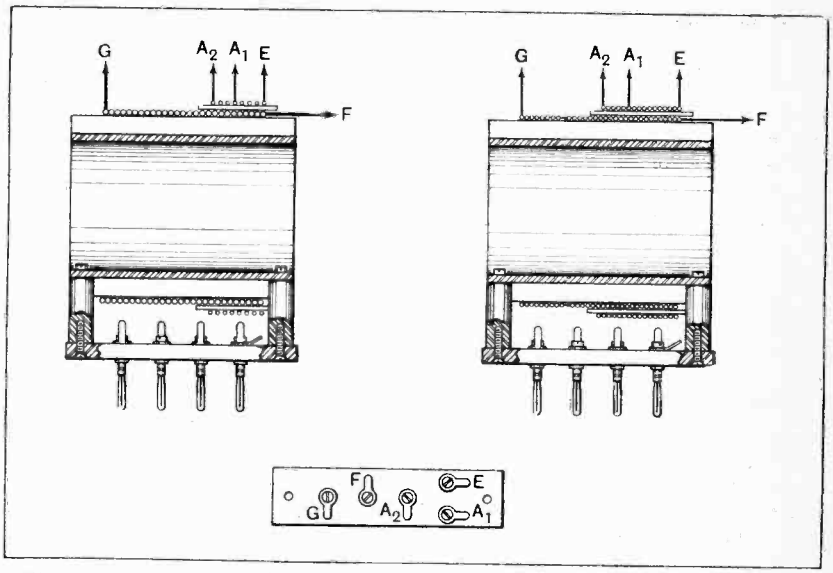

Fig. 4.—The two aerial-grid transformers. That on the left is for the 230–600 metres band of wavelengths, and the other for the long waves.

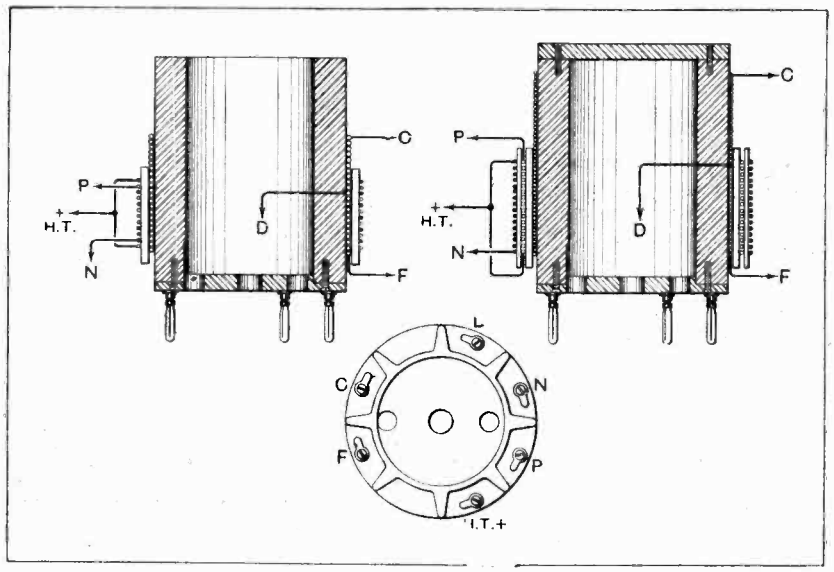

Fig. 5.—The intervalve high-frequency transformers. On the left is the transformer for the medium wavelengths, and on the right the transformer for wavelengths over 600 metres and up to 2,000 metres.

The medium wavelength aerial-grid transformer is wound with 70 turns of No. 27/42 Litz wire for the secondary, and 15 turns of No. 32 D.S.C. on $\frac{1}{16}$in. thick spacers for the aerial winding. This is provided with a tapping at the 8th turn as an alternative aerial connection where greater selectivity is desired. For the benefit of those who do not wish to use Litz wire, the secondary may be wound with a corresponding number of turns of No. 26 D.C.C. wire, the primary remaining as mentioned above. The intervalve high-frequency transformer for the corresponding waveband will require 70 turns of No. 26 S.W.G. D.C.C. for the secondary winding with a tapping at the 35th turn. The primary and neutralising windings should consist of 20 turns each of No. 36 S.W.G. D.C.C. wire wound on $\frac{1}{16}$in. spacers and accommodated over the low potential end of the secondary.

In the present case the primary winding is wound 16 turns to the inch and the neutralising portion accommodated on the same distant pieces but with the turns in the space between the primary turns. To facilitate this it would be well to cut shallow grooves in the spaces (32 to the inch), so that equal spacing between individual turns can be assured. This will militate against the chances of short circuits between primary and neutralising windings. All coils should be wound in the same sense, but it is quite immaterial whether this is clockwise or anti-clockwise; however, it would be advisable to maintain the same winding direction throughout. Constructional drawings of the medium wavelength coils are given in Figs. 4 and 5. The aerial-grid transformer to cover wavelengths over 600 metres and up to 2,000 metres should have 230 turns of No. 36 D.S.C. close wound as a secondary winding, and the aerial portion can consist of 120 turns, close wound, of the same gauge wire on $\frac{1}{16}$in. spacers, and this coil should have a tapping at the 80th turn for the alternative aerial connection. For the long waves the secondary of the intervalve high-frequency transformers should be wound with 250 turns of

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No. 36 S.W.G. D.S.C. wire and tapped mid-way; the primary and neutralising windings consisting of 50 turns each of the same gauge wire. In this case the neutralising portion is wound over the primary on $\frac{1}{16}$in. spacers, thus making a "three-deck" assembly. If the primary and neutralising windings are wound 32 turns to the inch the spacers will require to be about 2 inches in length.

The use of 36 gauge wire for the primary and neutralising coils may not be quite in keeping with the practice usually adopted in transformers of this type, but the assembly will be much more robust than would be the case if 40 gauge wire was used. However, in view of the limitations imposed by the crystal detector, the small loss arising from the use of larger gauge wire in this case can be ignored.

(To be concluded.)

TRANSMITTERS' NOTES AND QUERIES

American Amateur Regulations.

The enormous number of amateur stations in the United States has apparently caused some considerable interference with commercial and broadcasting services, as the Federal Radio Commission has established new regulations which, in addition to restricting the wavebands which may be used, decrees that if interference is caused with other radio services a silent period must be observed between the hours of 8.0 and 10.30 p.m. local time, and on Sundays during local church services. Amateur stations must not communicate with commercial or Government stations unless authorised by the licensing authority, except in an emergency or for testing purposes, or for communication with yachts or motor boats which may have difficulty in establishing communication with commercial or Government stations. Neither may an amateur station be used for broadcasting news, music, lectures, sermons, or any other form of entertainment.

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Japanese Broadcasting Stations.

The Japanese Department of Communications has, we understand, allotted the following call-signs and wavelengths to the six new 10 kW. broadcasting stations which will shortly start transmitting :—

Tokio (Central)	**JOAK**	345 metres.
Osaka (Central)	**JOBK**	400 ,,
Hiroshima	**JOFK**	353 ,,
Kumamoto	**JOGK**	380 ,,
Sendai	**JOHK**	390 ,,
Sapporo	**JOIK**	361 ,,

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A Correction.

With reference to the note on page 244 of our issue of March 7th, we understand that the Naval short-wave stations are now using the call-signs as given in the *Berne List*, and in the list of short-wave transmissions published in our issue of February 8th.

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Short-Wave Transmissions.

The Danish short-wave station ED 7RL, operated by *Populaer Radio*, is now transmitting regularly on 42.12 metres at the following times (G.M.T.): Sunday, 1100-1130 calibration and morse course, 1130-1300 telephony; Tuesday, 1600-1620 calibration and morse course, 1620-1700 telephony, 2000-2300 calibration and telephony, 2300-0000 telegraphy; Thursday, 1300-1305 calibration, morse and telephony, 2300-2320 telegraphy; Saturday, 1630-1710 calibration and telephony, 2300-2330 telephony, 2330-0030 telegraphy. Reports will be welcomed and should be addressed to Raadhusplads 55, Copenhagen.

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New Call-Signs and Stations Identified.

5CK	L. H. Pearson, "Ellesmere," Thorncliffe Road, Nottingham. (Change of address).
5HN	R. S. Holden, 29, Colinview Street, Springfield Road, Belfast. (Change of address from 25th March).
5QF	(ex 2AXL) S. Buckingham, 53, Beaconsfield Road, New Southgate, N.11. Transmits on 23 and 45 metres.
5WB	Clement A. Webb, 38, Oakhill Rd., East Putney, S.W.15. (Transmits on 90 and 150-200 metres).
6XN	(ex 2AMM), L. A. Moxon, 5, Pembroke Mansions, Confield Gardens, Hampstead, N.W.6. (Transmits on 23, 45, and 90 metres).
RIL	Radio Centre, Tiflis, Caucasus.

Correction.

6VJ	A. Cross, 337, Anlaby Rd., Hull. The number was incorrectly given as 333 in our issue of March 7th.

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QRA's Wanted.

2AFK, 2AMN, ED 7IL, AE 1IUI.

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IRISH AMATEURS.

IRISH Free State amateur transmitters have been taking active part in the international tests organised by the American Radio Relay League which concluded on Sunday, February 19th.

11B (Colonel M. J. C. Dennis, Baltinglass, Co. Wicklow), working on nine nights, using crystal control on 45 metres, worked thirteen NU stations and exchanged test messages with these stations.

12B (Wireless Society of Ireland), operated by the Hon. Secretary, Mr. H. Hodgens, on six nights worked eighteen United States and two Canadian stations, received nineteen and sent eighteen test messages. Wavelengths used were 45 and 23 metres, and special attention was paid to the most suitable periods for working.

14B (J. P. Campbell, Sutton, Co. Dublin), using a new transmitter, worked and exchanged test messages with seventeen North American stations.

11D (H. Fitzpatrick, Naas, Co. Kildare), working exclusively on 23 metres, exchanged eight test messages with NU stations. He works only on Sundays and Saturday evenings owing to business in the city.

17C (J. B. and R. D. Scott, Rathgar, Dublin) was heard working several NU stations during the test period, but 18B (Messrs. O'Dwyer, Dublin) did not take part in the tests as their transmitters were dismantled for overhaul at this time.

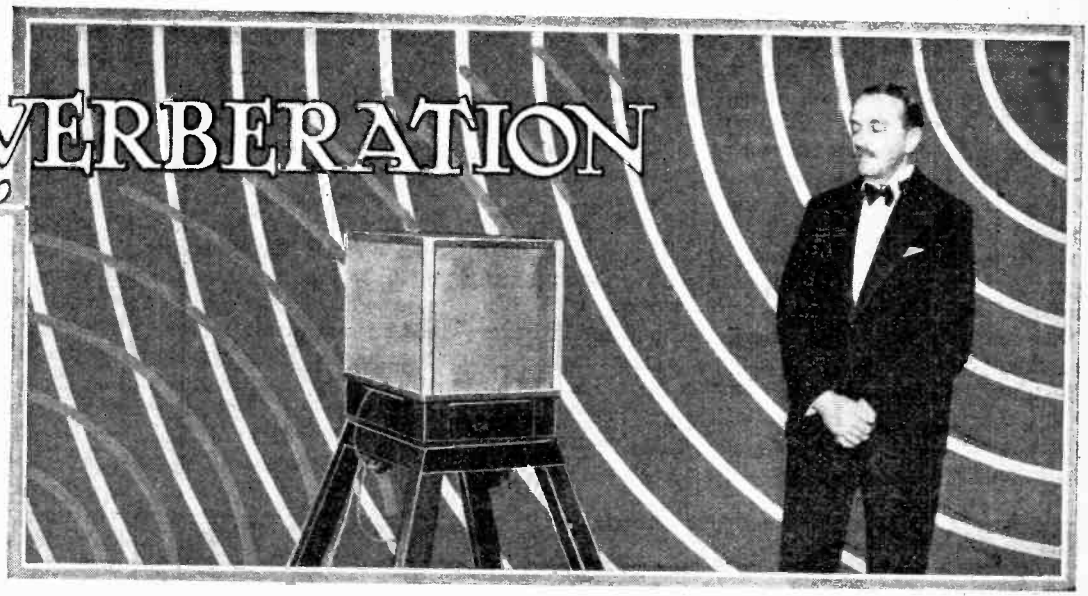
Some good records in long-distance and low-power working on short waves have been put up by Dublin amateur stations. The Wireless Society of Ireland has received a report from Sydney, Australia, saying that signals from their transmitter 12B have been often received there at strength R3 to R5, while two Florida amateurs were worked on both 45 and 23 metres during the international tests. 18B has lately worked an Australian amateur on 45 metres with power of about 4 watts, and 16C (G. Horander, Dublin) raised and worked NU 2CUQ on 45 metres with power as low as 2 watts.

Interest amongst Dublin amateurs has recently turned to telephony on 45 metres. 14B has been putting out some excellent telephony at good strength and very perfect modulation, many reports are being received from all parts of England, and tests have been carried out with amateurs in France and Australia. 13D (R. V. N. Sadleir, Rathmines, Dublin) has been getting good reports of his telephony from various parts of England. The Wireless Society's station 12B has also been using telephony, and got a report saying "Modulation good, speech very clear" from Glasgow.

BOOK RECEIVED.

Science for You.—Essays on modern scientific problems and theories, including earthquakes, geology, super-magnetic fields, Cosmic rays, atmospherics, the transmitting wave, and many other matters now under research. By J. G. Crowther. Pp. 241. Published by G. Routledge and Sons, Ltd., London. Price 5s. net.

REVERBERATION



How Distortion may be Created by Incorrect Room Conditions.

By A. H. DAVIS, D.Sc.

Reverberation is the echo effect resulting from reflection and which tends to prolong the duration of sounds. Broadcast reception or gramophone reproduction may be rendered false by room conditions tending to unduly absorb or prolong the sounds by unsuitable echo. The necessary duration of reverberation for speech and music for realistic reproduction is here discussed. The loud-speaker or gramophone is usually operated in a room too small to be sufficiently reverberant so that it becomes necessary to introduce an excessive echo effect in the studio. The bearing of reverberation on quality of reproduction is of first importance.

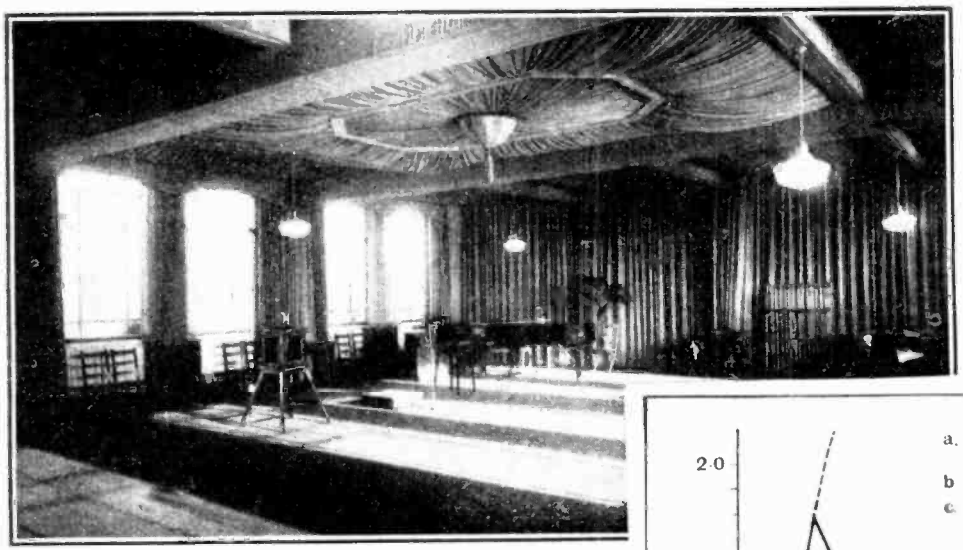
APART altogether from questions of the faithfulness of electrical microphones and loud-speakers, and apart also from questions of the uniform transmission of notes of all pitches by the elaborate amplifiers, transmitters, receivers, etc., which form the chain from the one to the other, musical taste and public preference require that the overall condition of the reproduced items shall correspond closely to those which obtain in ideal auditoriums. These facts are not always realised by the possessor of a wireless set or of a gramophone, but they present difficulties which have engaged much attention by broadcasting and gramophone organisations. They are, in fact, the difficulties which arise when any speech is made or any music played in an ordinary auditorium, and, although the problems are modified in detail by the chain of electrical and mechanical apparatus involved, the overall requirements for good hearing remain substantially the same.

In the case of an ordinary auditorium, the chief difficulty met is excessive prolongation of sounds by reverberation, that is, by being reflected to and fro within the hall without sufficient weakening. Sound may, indeed, suffer some two or three hundred reflections before it finally dies away, and hearers in such a hall would be confused in listening because each syllable of speech would be drowned in a considerable volume of miscellaneous sound. In studying the subject it is customary to express the reverberant condition of a hall by the time taken for a sustained sound of standard initial intensity to decay to one millionth of its original value after the source is stopped. This is a convenient unit, because it is not greatly different from the time taken for the sound from an ordinary organ pipe to die away to inaudibility. When duration of reverberation is measured in this manner it is generally agreed that for halls of moderate size, say up to 25,000 cubic feet, a standard period of from three-quarters of a second to just over one second represents the optimum acoustical condition with a full audience. For very large halls, periods up to two seconds or so are acceptable. If reverberation is shorter than this the conditions are generally regarded as "too dead"; if longer, confusion arises from the undue overlapping of consecutive sounds. Values permissible for music are some twenty-five per cent. higher than those for speech.

Effect of Reverberation upon Syllabic Speech.

It is possible to give some idea why the existence of a certain amount of reverberation should be desired, whilst an excess may be very objectionable. For the purpose let us consider the case of a person speaking at the rate of five syllables per second, a pause of one-twentieth of a second occurring between consecutive syllables. When a sustained note is sounded in a room the intensity of reverberant sound rises uniformly throughout the room until it finally attains a steady state in which the rate of sound emission by the source is just equal to the rate at which sound is absorbed by the surfaces of the room. The curves of Fig. 1 show the growth and decay of sound in three different halls

Reverberation.—due to the emission of a single syllable of speech. The lower curve relates to a hall with very absorbent surfaces, the period of reverberation being only one-third of a second. It is seen that the intensity rapidly rises to a maximum and then, when the source of sound ceases, the intensity rapidly dies away. The second curve relates to a hall having a period of one second. The sound rises to a greater intensity than before, but takes longer to die away. Also, from the dotted line, which shows the manner in which the sound intensity would have continued to increase if the sound had not been stopped, it is seen that the intensity was only just approaching its maximum when the syllable ceased. The upper curve relates to a hall with a very long period. In this condition the intensity attained is still higher, it is cut off long before the maximum possible intensity is reached, and the sound takes much longer to die away.



The Birmingham Studio. With windows along two of the sides and the end walls only lightly draped, combined with its larger size, this studio creates a distinctive echo effect which has been much appreciated.

It may be mentioned that the curves have been calculated for speech of ordinary loudness in a hall of about 35,000 cubic feet (say, 45ft. × 30ft. × 26ft.). The unit of sound intensity chosen is approximately the intensity at a distance of about 8 feet from a speaker in open air, or about 25 times the intensity at 40 feet in open air. These figures show how greatly the enclosing walls of a room and the consequent reverberation can increase the loudness of sounds at all distances more than a few feet from the speaker.

Fig. 2 shows the conditions in the same three halls when a long series of syllables is being spoken. In the hall with a period of one-third second it is seen that each syllable dies away to about one-tenth of its maximum, a very low intensity, even before the next syllable is uttered, and is almost completely obliterated shortly afterwards. Staccato effects are thus obtained, and it is seen that the sound intensity is low. In the hall with a period of one second, intensities are higher, and the effect of each syllable is seen to die away appreciably (*i.e.*, by about one-half), but not excessively, before the next is emitted. Further, from the dotted line which shows how the decay of previous syllables continues while the new syllable is being uttered, it is seen that at the peaks only about 7 per cent. of the energy in the room is due to reverberation set up by previous syllables. Thus each syllable at its peak is practically free from overlapping sounds, although it commenced before the previous sound had completely died away. We thus get syllables essentially distinct but linked as in a chain, apparently the condition which is desired. In the case of the upper curves, which represent an excessively reverberant hall, it is seen that, even at the peaks, about two-thirds of the sound energy present is due to previous sounds and only one-third to the syllable just uttered. This is evidenced not only by the dotted line showing decay of previous sounds, but also by the fact that the general intensity of sound revealed by the curves in Fig. 2 (between 4 and 5 units) is markedly higher than that (about 1¾ units) which a single syllable can set up (Fig. 1). Good hearing in this case is obviously impossible, although some improvement would result from a reduced rate of enunciation. Rate of speaking should, therefore, be modified to suit hall conditions.

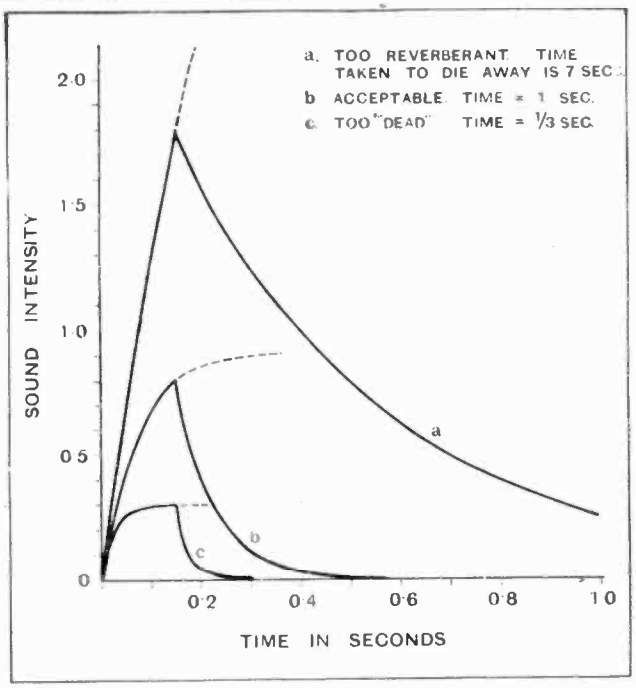


Fig. 1.—These curves represent the growth and decay in the intensity of a sound in three halls, similar in size though differently draped. In each the sound intensity is built up by the emission of a single syllable which if continued would grow in intensity as indicated by the dotted line.

B 18

Reverberation.—

Music and Reverberation.

It is not possible to state why greater reverberation should be acceptable for large halls than for small, but there are various considerations which tend to that end. It may be that increased reverberation is tolerated for the sake of increased loudness and that speakers are expected to enunciate more slowly to accommodate themselves to the conditions. But there is also another point.

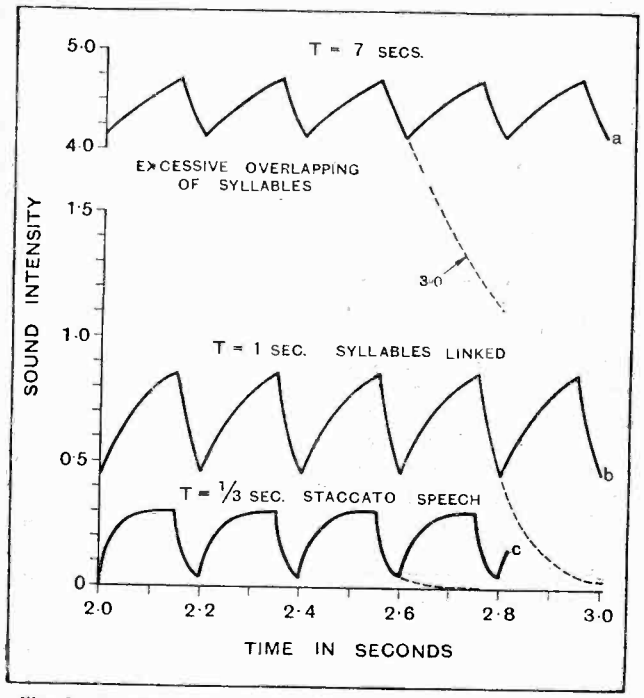


Fig. 2.—Relative rise and fall in sound intensity of single syllables issued at a rate of 5 a second under the same conditions as the curves of Fig. 1.

It is much more difficult and more costly to reduce the reverberation of a very large hall than that of a smaller one, and it may be that the type of music usually heard in large halls has been adjusted through the centuries to suit the conditions which occur in them.

Whatever the cause may be, there is no doubt that the reverberation period of 1 second preferred for music in a moderate room would not be acceptable for orchestral music in a large hall where periods up to 2 seconds or more are desired.

From a recording or broadcasting point of view there is another way of looking at the matter. The larger the hall the larger the orchestra required to " fill " it. It is not surprising to find, therefore, that for broadcasting purposes reverberation periods are specified for a type of music rather than for a size of hall. Thus the degree of reverberation required for transmitting ordinary speech or dramatic performance is about $\frac{3}{4}$ second, for a singer 1 second, for an octet or small orchestra $1\frac{1}{2}$ seconds, and for a larger orchestra 2 to $2\frac{1}{2}$ seconds or more.

Reverberation Conditions in the Studio and the Home.

From what has been said it will be realised that reverberation is one of the most important features in the acoustics of direct performances in ordinary auditoriums. With reproduced music it is equally important, and there are two rooms to be considered, either of which may introduce reverberation effects. With the microphone and artist in a " dead " room, and the loud-speaker in a properly reverberant one, fairly satisfactory results would be obtained if reverberation were the only factor. With the microphone in a properly reverberant room and the sound reproduced in a dead room, the correct amount of reverberation would also be ensured.

Fig. 3 illustrates the effect when both rooms are reverberant to the degree which would be proper for an ordinary auditorium. The upper curve shows the variation in sound intensity due to syllabic speech by an ordinary voice in a room of 1 second reverberation period. The lower curve refers to speech from a loud-speaker or gramophone, the instrument being served from or the record made in a reverberant studio in which the microphone is a few feet away from the speaker and picks up variations similar to those given in the upper curve. The curve shows the extreme effect, for matters would be improved by placing the microphone closer to the speaker so that the direct sound at the point would be louder than the reverberant. It will be noted, however, that equal reverberation in both the studio and the listening hall delays the rise and fall of sound, and the overall effect

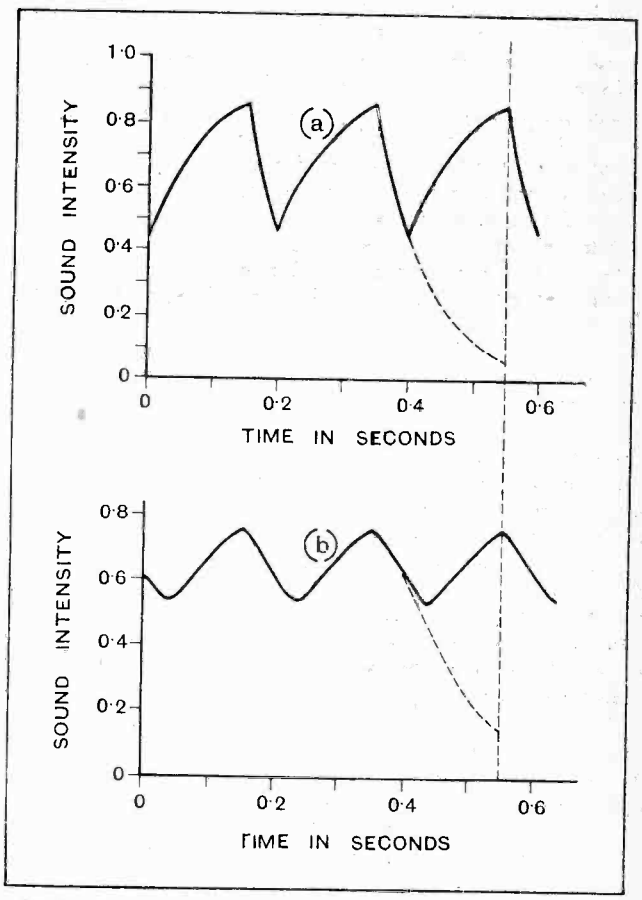


Fig. 3.—Sound intensities produced in a hall with a reverberant period of 1 second by (1) the voice (2) loud-speaker reception from a reverberant studio having a 1 second reverberant period.

Reverberation.—

is to increase reverberation, though not perhaps to a prohibitive extent. A better result would, of course, be obtained with equally reverberant rooms if both were slightly less reverberant.

It may also be shown that if *either* of the rooms is itself excessively reverberant for the type of music concerned, the overall effect would be at least as poor as—and usually rather worse than—ordinary reverberation in the defective room, and would be irremediable. The overall rate of decay of sound in such conditions is at first slower than that of either room alone, but ultimately becomes equal to that of the most reverberant room. Consequently no complete solution can be found at the studio end if the reproduction is in too reverberant a hall, and nothing done at the loud-speaker end will eradicate excessive reverberation introduced in the studio.

Additional reverberation can always be introduced into broadcast music by the use of a special echo room which is highly reverberant. The sound is introduced into the echo room electrically by means of a loud-speaker connected up through an amplifier to the microphone in the studio. From the echo room the sound is picked up again by means of a microphone, and is now more reverberant. This device is regularly used in broadcasting dramatic performances to adjust reverberation effects where differentiation may be required between, say, a small room and a cathedral. Actually the sound picked up by the microphone in the echo room is added electrically in variable amounts to the original sound from the studio, according to the effect it is desired to convey.

Binaural Listening.

It appears, therefore, that studios and recording rooms must on no account be too reverberant, but that there are means of improving matters if they are too dead. In order to meet the requirements of hearers having gramophones or loud-speakers in small non-reverberant rooms it is necessary that the recorded or broadcast music shall itself contain an approach to the optimum amount of reverberation. Conditions will then be satisfactory for all reasonable listening rooms other than those which would have been too reverberant for ordinary musical performances of the type involved. The degree of reverberation in the recording room necessary for this ensures more natural conditions for the artists during their performance, and enables them to hear their own music as it will be heard by others—an extremely important point.

There are a number of instrumental factors in the recording and reproduction of sounds which tend to prolong them. For instance, the use of two ears enables a hearer to get a sense of direction as well as loudness, and it has been said that this enables him to separate the reverberation from the direct music to some extent. The microphone in a studio corresponds to only one ear, however; any such discriminating power is consequently lost, and too much reverberation appears to be thrust upon the record. The use of two microphones representing the two ears is not a solution of the problem; for it would be necessary to convey the sound from one microphone exclusively to one ear of the listener, and the sound from the second microphone exclusively to the other ear—a prohibitive requirement. If an attempt is made to reduce the appearance of reverberation by placing the microphone nearer the performers where the direct sound is louder—as is frequently done—there is the risk of disturbing the balance between the loudness of the various instruments. Another factor is that experiments have shown that any transients or peaky frequency distortions set up by the recording or reproducing system constitute increased reverberation. The result of these effects is to require that the reverberation of the studio shall fall just short of the optimum for an ordinary auditorium. Probably the requirements of gramophone recording are more stringent than those of a broadcasting studio on account of the permanence of the record, and it may be that the mechanical apparatus involved is more likely to introduce transients than electrical. If so, gramophone recording rooms should perhaps be somewhat less reverberant than broadcasting studios. Some figures recently published state that the time for a gramophone recording room should be rather less than three-quarters of that for an ordinary auditorium used for music in the usual way.

In conclusion, therefore, reverberation is one of the essential requirements of acceptable music. Where reproduction in private houses is concerned, the loud-speaker or gramophone is usually in a room which is too small to be excessively reverberant when furnished, and it is therefore necessary that the appropriate degree of reverberation for orchestral music, for instance, be introduced into the record at the studio end. The studio thus tends to be the chief room to be considered. When, however, the reproduction takes place in larger rooms, the condition of the receiving room becomes more vital. If its reverberation period is then excessive it may be reduced by bringing into the room soft carpets, heavy curtains, draperies, upholstered furniture, etc., and is always lessened when the number of persons present is increased appreciably.

TRADE NOTES.

Change of Address.

Messrs. Langham Radio have now moved into new premises at Rosslyn House, 96, Regent Street, London, W.1; telephone, Gerrard 9676.

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Improved Rectifying Valve.

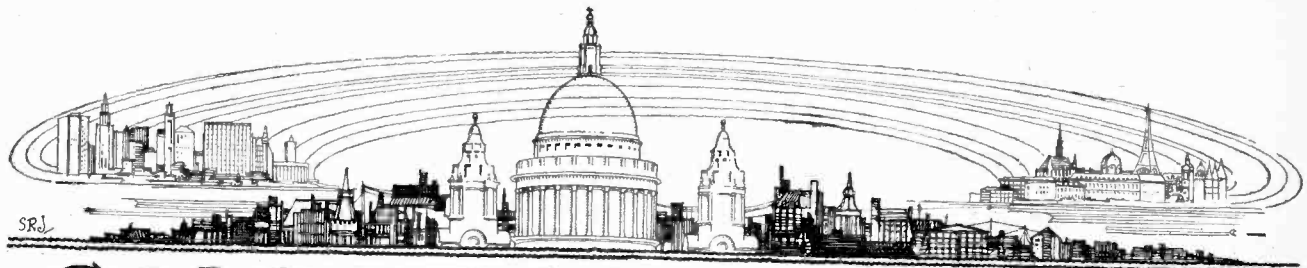
The power handling capacity of the Osram U5 rectifying valve has been increased from 50 mA. at 250+250 volts to 60 mA. at 400+400 volts. As a result a single U5 valve can now be relied upon to supply the necessary H.T. for two L.S.5 or L.S.5A valves connected in parallel or on the push-pull system. The full rating of the U5 is therefore revised as follows:—

Fil. volts	5.0
Fil. current	1.6 amps.
Anode volts (R.M.S.)	400
Impedance	300 ohms
Max. anode current (D.C.)	60 mA.

Burndept Pick-up.

The production of a gramophone pick-up is one of the recent activities of Messrs. Burndept Wireless, Ltd. It has been designed to give an even response to musical frequencies, and special attention has been directed to the reduction of record wear and the noise emitted by the pick-up.

The price of the complete outfit, including volume control, valve adaptor and leads, is 32s. 6d.; the pick-up is also supplied separately for 20s.



CURRENT TOPICS

Events of the Week in Brief Review.

"PACK UP YOUR TROUBLES . . ."

"The (wireless) licence, after all, is a very moderate amount, and if anyone is unable to afford it, the only thing for them to do is to pack their sets up."—The Mayor of St. Albans.

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£2 PER MINUTE.

Chicago broadcasting stations are selling "time on the air" the candidates in the forthcoming election campaign at the rate of £2 a minute. Our New York correspondent states that many small stations which can barely pay their way are hanging on in the hope of selling their wavelength to one or other of the political parties.

oooo

SCHOOL WIRELESS IN FRANCE.

How far wireless can be used beneficially in the public schools of France is being investigated by a committee nominated by M. Herriot, President of the French Board of Education. The Committee, says a Paris correspondent, will consider what type of transmissions are suitable for training the juvenile mind and what are the best hours.

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BIGGER MARCONI DIVIDEND.

At the annual meeting of the Marconi International Marine Communication Co., Ltd., to be held on Friday next, March 30th, the shareholders will be asked to approve the payment of a final dividend of 8½ per cent., making a total dividend for the year 1927 of 12½ per cent., as against 8¾ per cent. for the previous year.

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GOOD LUCK, I.R.S.!

An appeal for more members is being issued by the Indian Radio Society, which has headquarters at 2, Phœnix Buildings, Bullard Estate, Bombay. For an annual subscription of Rs.10 (about 15s.) the Society offers facilities which challenge comparison with the bulk of wireless clubs in this country. The attractions include a monthly journal, postal notification of special transmissions, reading room, and postal circulating library.

What wireless organisation in this country provides the same benefits?

THE CAMEL SET.

A receiver now arousing interest in America is known as the "Camel Set." Nothing in the nature of a hump is implied, however, for it is described as a "flat top tuning receiver."

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MUSIC BY THE MINUTE.

KDKA appears to have adopted a new principle, viz, "Brevity is the soul of music," by introducing "one-minute" radio singers. These high-speed artists guarantee that each selection shall not exceed a minute's duration. But the announcer is also allowed a full minute to introduce each item!

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AN AUSTRALIAN PIONEER.

An Australian visitor to this country at the present time is Mr. Charles D. Maclurcan (OA-2CM), of Sydney, well known as President of the Wireless Institute of Australia, and as one of the pioneer wireless enthusiasts in the Commonwealth. Friends of Mr. Maclurcan who would care to communicate with him during his stay may address letters c/o the offices of this journal.

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IN THE HEBRIDES.

A wireless telephone service is to be established between the Inner and Outer Hebrides.

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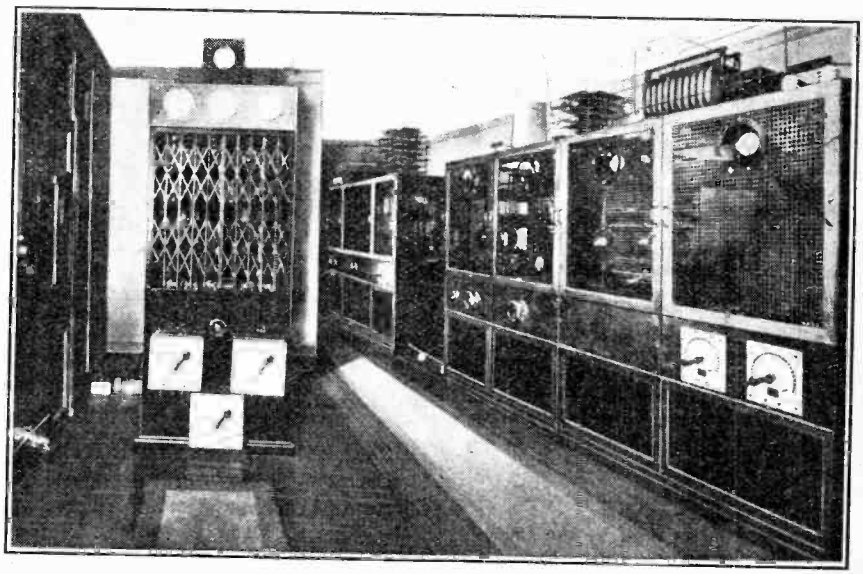
A THIRD ANNIVERSARY.

That popular French broadcasting station, Radio Toulouse, the transmitter of which is illustrated on this page, will celebrate its third anniversary on April 15th next. Since the inaugural transmission in 1925 the programmes have been carried on regularly without a day's interruption, despite the several crises which have already overtaken broadcasting in France.

Radio Toulouse is supported by eight general councils representing the neighbouring communes, by 183 agricultural societies, by the Federation of South-Western Radio clubs, and by the voluntary subscriptions of some thousands of individual listeners. The aim of the



A POPULAR FRENCH STATION. The transmitting room at Radio Toulouse, showing the 5-kilowatt transmitter which is capable of working up to an aerial power of 9 kilowatts. Radio Toulouse celebrates its third birthday on April 15th.

station directors is to make the programmes representative of all departments of art, literature and industry.

On the technical side Radio Toulouse is well equipped with a 5-kilowatt transmitter (Geneva rating) and efficient aerial system. Reports are received from listeners all over France and in many parts of Europe. The wavelength is 258 metres.

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A PRIVILEGED PERSON?

The proprietor of a Bognor wireless shop, summoned last week for operating a set without a licence, said: "I was under the impression that no licence was required of me."

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CEMENTING INTERNATIONAL FRIENDSHIPS.

A special programme for the benefit of Swiss residents in Barcelona was broadcast by Radio Catalana on Sunday last, March 25th.

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INDIRECTLY HEATED CATHODE VALVE RECEIVER.

In the several diagrams which accompanied this article (*The Wireless World*, March 7th and 21st), the output to the loud-speaker was shown as a transformer while actually the component used was the output speaker filter, a product of Claude Lyons, Ltd., Old Hall Chambers, 76, Old Hall Street, Liverpool.

Attention is drawn to this point owing to confusion which has arisen over the similarity in appearance between this output filter unit and an output transformer.

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HAVE YOU HEARD THE CARAVAN?

A Chevrolet caravan equipped with a short-wave transmitter is now making an arduous journey from Cape Town to Stockholm. The expedition left Cape Town on March 7th, and was reported to be crossing the Limpopo River, Rhodesia, *en route* for Bulawayo, on Thursday last, March 22nd.

Messages of interest concerning the trip are being transmitted almost daily at 4 a.m. (G.M.T.)) on wavelengths of 20 and 40 metres, and it is felt that many amateurs in Great Britain and elswhere would be glad to pick up these transmissions, which are sent under the call-sign A8M. To facilitate such reception a second transmission at 12 midnight (G.M.T.) is being arranged which should enable European amateurs to receive the messages at a more convenient hour. The caravan, which consists of a Chevrolet saloon and truck, carries a Hertz type aerial. The generator is driven off an engine belt from the car generator and delivers 1,500 volts to the plates. Reports on the transmissions will be welcomed by the General Motors Export Company, Holders Hill House, Holders Hill Road, London, N.W.4.

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FRENCH AND GERMAN TRANSLATIONS.

An assistant is required by the Department of Scientific and Industrial Research to make translations and abstracts of articles dealing with radio-telegraphy. Ability to translate with ease scientific French and German is essential. A scientific training and some knowledge of radio telegraphy would be an advantage. The commencing salary will be from £200 to £250 inclusive per annum according to qualifications and experience. Application forms can be obtained from the Secretary, Department of Scientific and Industrial Research, 16, Old Queen Street, Westminster, S.W.1, and should be returned not later than April 4th.

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KING AMANULLAH AT DORCHESTER BEAM STATION.

On their visit to the Marconi beam station at Dorchester last week, the King of Afghanistan and Queen Souriya inspected the main transmitting hall and saw the seven short-wave beam transmitters for communication with the United States of America, Brazil, Argentine, Egypt, Japan and the Far East. His Majesty was particularly interested in an explanation of the special characteristics of short waves and the methods adopted in designing oil-cooled valves and the beam transmitter panels. The party afterwards examined the mast, aerial and erector systems, the King showing special interest in the curtain of vertical wires peculiar to the beam type of station.

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WIRELESS STRIDES IN THE NAVY.

Wireless developments in the Navy are referred to by Mr. W. C. Bridgeman, First Lord of the Admiralty, in a statement accompanying the Navy Estimates for 1928.

All ships in distant stations are now equipped with short-wave apparatus, and there is no ship which cannot be reached from the Admiralty during some part of the twenty-four hours. The improvements carried out in naval wireless have resulted in a considerable reduction of expense since communication by cable is now rarely necessary. Wireless proved itself of special value during the troubles in China.

oooo

5SW SCORES A SUCCESS.

"The most remarkable wireless relay ever arranged in Cape Town" was the description applied to the reception of the Prince of Wales's speech on Wednesday last at the Master Mariners' dinner at the Mansion House. According to a *Times* correspondent, the speeches of the Prince and the Prime Minister were picked up by an amateur at Kenilworth, near Cape Town, and transferred by land line to the broadcasting station. Practically every word of the speeches was heard as clearly as if the speakers had been in the Cape Town studio. Atmospherics were almost entirely absent.

WIRELESS AT WESTMINSTER

(From Our Parliamentary Correspondent.)

Government and the Wireless Merger.

Replying to several questions in the House of Commons last Thursday, the Prime Minister said that His Majesty's Government at the Imperial Wireless and Cable Conference had no previous knowledge of the details of, nor any responsibility for, any financial arrangement for the merger of the Eastern Telegraph Company and the Marconi Company. "As regards the general question," continued Mr. Baldwin, "I can make no statement in advance of the reports of the Imperial Conference, which only on Monday received the proposal from the two companies. But as honourable members have specifically enquired as to the attitude of His Majesty's Government in Great Britain, I think it right to say that the Government, while it is prepared to join in discussing measures for working arrangements, does not commit itself, even in principle, and reserves freedom of action in regard to proposals for the transfer of the operation and control of the Imperial wireless services at present administered by His Majesty's Government."

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Cost of Wireless Beacons.

Sir Philip Cunliffe-Lister, President of the Board of Trade, in a written reply to Sir Robert Thomas, M.P., stated that two wireless beacons were now in operation—at Round Island, Scilly, and at Skerries off the coast of Anglesea; while three—at Caskets, Lundy and Start—were in course of erection and were expected to be in operation in a few months' time. Several more were projected. The first cost of a wireless beacon installation at an existing lighthouse was from £3,500 to £4,500, depending on local conditions, and the estimated cost of maintenance £300 a year. If a wireless beacon were installed at a place where there was not already a lighthouse the cost of establishment would be much greater, and the cost of maintenance would be increased to approximately £1,000 a year. It was not possible to make any useful comparison between these costs and the costs of the erection and maintenance of lighthouses, particularly as, owing to local conditions and requirements, there was necessarily a very great difference between the costs of different lighthouses. The cost of constructing new lighthouses since 1897 had ranged from £2,400 to £88,000, according to the situation of the lighthouse.

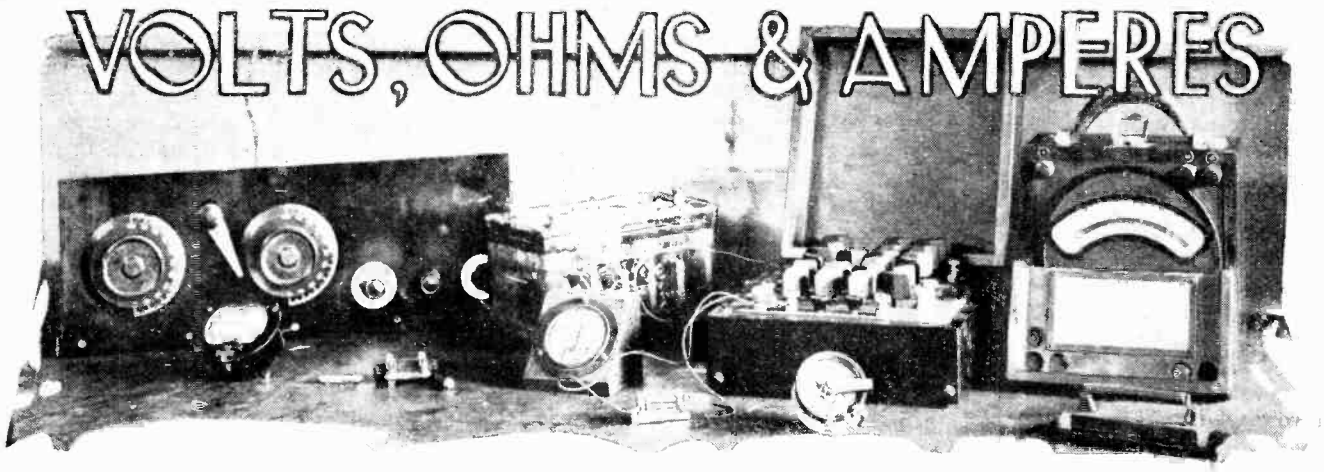
Catalogues Received.

The Wet H.T. Battery Co., 12-13, Brownlow Street, London, W.C.1. A booklet and price list dealing with the selection of a suitable H.T. battery containing full details of the "Standard" wet cells and "Unibloc" containers.

Dubilier Condenser Co. (1925), Ltd., Ducon Works, Victoria Road, Acton, London, W.3. Catalogue and price list of Dubilier components with full details, including dimensions of fixed condensers, resistances, etc., for reception purposes.

Thompson and Co., 1 and 3, Old Swan Lane, London, E.C.4. Illustrated list of L.S.A. wet and dry cell H.T. and L.T. batteries.

VOLTS, OHMS & AMPERES



How to Apply Ohm's Law to Your Wireless Set.

By N. P. VINCER-MINTER.

THE average home constructor knows naught concerning Simon Ohm and his famous law, and neither does he care. The reason why he does not care is that his sole concern is to build a receiver which will give him the utmost range and selectivity coupled with reasonably good quality, and he cannot see how this fundamental law can help him to achieve his aim, and so very wisely he does not bother about it. If, however, he could be convinced that a knowledge of this law and what is more important, a knowledge of how to apply it in a practical manner would increase the efficiency of his receiver, he would, in the writer's opinion, hasten to acquire such knowledge.

It is suggested, therefore, that those in doubt turn for a few minutes from their study of the Readers' Problems pages and learn, not merely Ohm's law, which is simple, but how to apply it to their practical, constructional, and experimental work in such a manner that they will be enabled to solve a large number of their own problems, and so be in a position in the future to view the aforesaid pages with a kindly tolerance, as being largely intended for those who have preferred to suffer the constantly recurrent vigil of awaiting the postman's tardy knock rather than to acquire a little fundamental knowledge.

Avoidance of Complicated Definitions.

We must keep before us the fact that our main object is how to apply Ohm's law in a practical manner rather than to acquire a mere academic knowledge of it. However, we must know a little about it before we can understand what we are doing when we attempt to apply it in a practical manner. The fundamental law as promulgated by Ohm, is better expressed as a simple equation than by the usual complicated definition. The equation referred to is $I = \frac{E}{R}$. Here I equals the current flowing in the circuit, E the electrical pressure tending to drive the current through the circuit, and R the resistance tending to oppose the passage of the current through the said circuit. I is measured in amperes, E in volts and R in ohms. It must be remembered that if in practice we meet with divisions or multiples of the ampere, volt, or ohm, such as the milliampere, etc., they should all be converted to their fundamental values before Ohm's law is applied. Simple equations are handy, and are easy things to juggle with, and we know, therefore, that if $I = \frac{E}{R}$ then $R = \frac{E}{I}$ and $E = I \times R$. We see also that, provided we know two of these three things we can easily find the third.

Now for some practical applications. Taking the case of Fig. 1(a), we have a valve arranged as a leaky grid detector. The first problem with which we are confronted is the value of R_1. We have, say, a valve whose filament

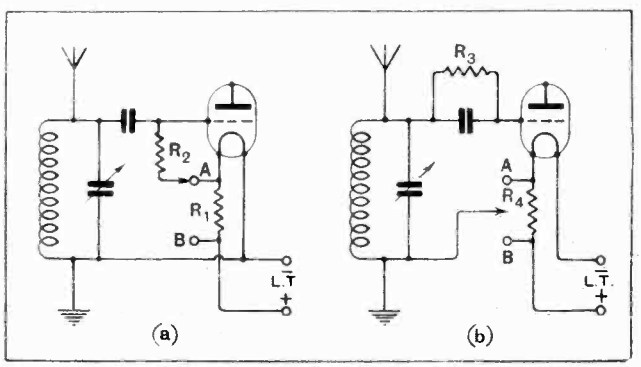


Fig. 1.—(a) Shows low potential end of grid leak connected directly to filament. (b) Shows grid bias applied through coil.

current requirements are 0.1 ampere, and this current will flow when 1.8 volts are applied across the filament pins of the valve. We will suppose that our accumulator is a 2-volt instrument. We obviously have 0.2 volt to drop across the resistance. By applying this formula $R = \frac{E}{I}$, and substituting we get $R = \frac{0.2}{0.1}$ which is 2 ohms. So much for the filament current.

Now for the grid. We require a positive bias of roughly 2 volts on the valve grid, or, in other words, we

Volts, Ohms and Amperes.—

desire to make the grid of the valve 2 volts more positive than the negative side of the valve filament, which is always the point from which we work when calculating plate or grid voltages. If we connect the grid (*via* the grid leak R_2) to A, we shall obviously obtain a bias of 1.8 volt, the voltage drop across the filament, but, if we connect it to B, we shall get also the voltage drop across the resistance, namely, 0.2 volt, which gives us the requisite 2 volts. Actually, unless the value of the grid leak is infinite, thus stopping all flow of grid current, we shall be putting a little more than 2 volts positive bias on the grid when we connect the grid leak to B, because there will be a slight current flowing through the grid leak, and if there is a slight current, then there must be a voltage drop across the grid leak. If, therefore, we can by means of a suitable microammeter measure the grid current, we shall be able to apply the formula $E=IR$, since, of course, the value R of the grid leak is known to us. This would then tell us the exact voltage drop across the grid leak. Therefore, we may conclude that variation of the grid current in any manner such as by altering the resistance of the grid leak, must alter the value of grid bias.

Biassing Through a Leak.

It is most important to note, however, that this does not apply to L.F. amplifying valves, in which grid bias is applied through the same type of grid resistance, as is used in a leaky grid detector. In the case of an L.F. amplifying valve we deliberately make the grid negative by means of a battery, so that, among other things, no grid current will flow. Since no grid current flows, therefore, we need only apply the same formula again, and we shall find that no matter how high the value of the grid resistance, no volts are lost across it, and the voltage on the grid is the same as the voltage on the battery terminal at the other end of the resistance, which may have a value of several millions of ohms; $E=IR$, therefore $E=I\times 0$, which is, of course, nil. No volts are lost, therefore, however high the resistance.

Fig. 1(b) is similar to Fig. 1(a), except that we have what is known as the series method of grid connection. The action of the two circuits is exactly the same, and one works as well as the other. In Fig. 1(a) we apply the bias directly through the grid leak, and it does not matter in the least whether we connect the bottom end of the tuning coil to L.T.+ or L.T.−. In Fig. 1(b) we apply the bias through the coil, and consequently the rules for connecting the bottom end of the tuning coil are the same as were given for the grid leak in Fig. 1(a).

Free Grid Bias.

Fig. 2(a) shows a method of obtaining "free" grid bias for an L.F. amplifying valve without the necessity of using a grid battery. It leads, however, to certain complications, and since grid batteries are very cheap no tangible advantage is conferred on us by using it. It is well to understand it, however, as we may sometimes meet receivers employing it. Suppose we require a negative bias of 4 volts on the grid of the detector valve in Fig. 2(a) we can obtain it by using a 6-volt accumulator and a 2-volt valve in the following manner.

We must first insert in the negative filament lead a resistance R_5 of such a value that when the normal filament current of the valve passes through it 4 volts will be dropped across it, this 4 volts representing the difference between battery voltage and valve voltage requirements It has already been shown how to arrive at the value of this resistance. If now we connect the grid to that end of the resistance which is remote from the negative side of the filament, it is obvious that it will be connected to a point which is 4 volts more negative than the negative side of the valve filament, and we shall have the advantage of 4 volts "free" bias on the grid. If we arrange a slider to slide up and down the resistance as shown (it is then called a potentiometer or potential divider) we can give the grid any value of negative bias between 0 and 4. Unfortunately, 4-ohm potentiometers are not readily available, but we can get over the difficulty by using two fixed resistors, as shown in Fig. 2(b), at A and B, the grid being connected to the junction between them. The values of these resistors must total to the same value as that of R_5 in Fig. 2(a). It will now be obvious that the ratio between the resistance A and the total resistance C will be equal to the ratio between the voltage drop across the resistance A and the voltage drop across the resistance C. From this we can easily evolve the necessary formula for finding resistance values of A and B when it is desired to apply a given voltage E to the grid of the valve. The formula for finding the value of A is $R_A=\frac{R_C\times E_A}{E_C}$ and for finding the value of B it is $R_B=R_C-R_A$, where R_A represents the resistance value of the resistor nearest the negative end of the filament, R_B the resistance value of the other resistor,

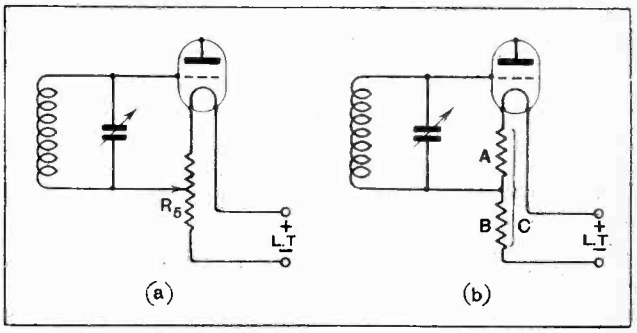


Fig. 2.—(a) Method employed in obtaining "free" grid bias from a variable resistor. (b) Use of fixed resistors in series for the same purpose.

R_C the total resistance value, E_A the potential difference across the ends of the resistor nearest the negative end of the filament, and E_B the potential difference across the ends of the remaining resistor, all measurements being taken in volts and ohms.

Fig. 3 shows us a practical receiver consisting of an anode bend detector, followed by a stage of resistance coupling and a choke filter output circuit. We have already discussed the question of filament resistance values and how to find them by Ohm's valuable formulæ, and so will not pursue them further. We have also discussed the question of why the value of the grid resistance, in the case of an amplifying valve, has no effect on grid

Volts, Ohms and Amperes.—

bias. No volts are therefore lost across the grid resistance R_{11}, and since there is no current flow through the stabilising resistance R_{12} the same thing applies here also. This applies with equal force to an anode bend detector, which not only needs more negative bias than an amplifying valve, but usually requires a more critical setting, so that the ordinary 1½-volt tappings of the grid

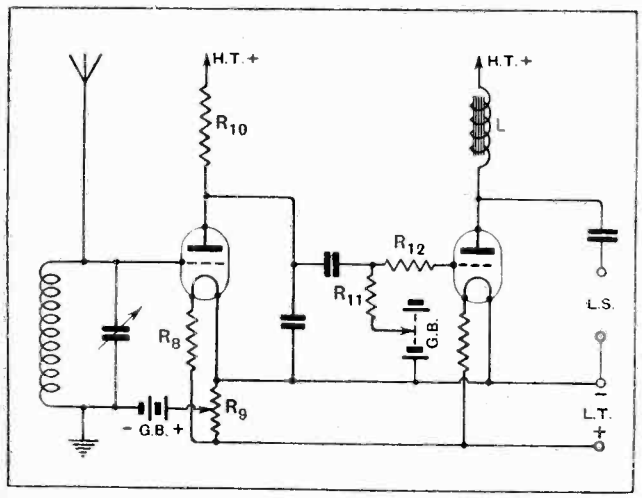


Fig. 3.—Typical circuit having resistances in which a knowledge of Ohm's law is an advantage.

battery are too "coarse." We can get over this difficulty by using a grid battery and giving a little *more* bias to the valve grid than we require, and then subtracting a little by fine adjustment of the potentiometer, R_9. It is obvious, from a glance at Fig. 3, that the potentiometer gives very small changes in the relationship of the grid voltage to the voltage of the negative side of the filament. The nearer the slider is moved to the positive side the less negative will the grid become with respect to the negative side of the filament.

With regard to the anode resistance, R_{10}, it must not be forgotten that extra H.T. voltage must be provided to compensate for the voltage drop across this resistance. We can easily calculate what the voltage drop is by Ohm's law. The valve we shall use may possibly take a plate current of ½ milliampere under working conditions. We will assume the anode resistance to have a value of 100,000 ohms. Now $E = IR$, but before substituting we must not overlook the fact that C is in milliamperes, and we have first to turn it into amperes. Therefore, we have $E = 0.0005 \times 100{,}000 = 50$ volts. If, therefore, the valve is one which normally requires 100 volts on its anode, we must use a 150-volt H.T. battery.

Volts Lost in a Choke.

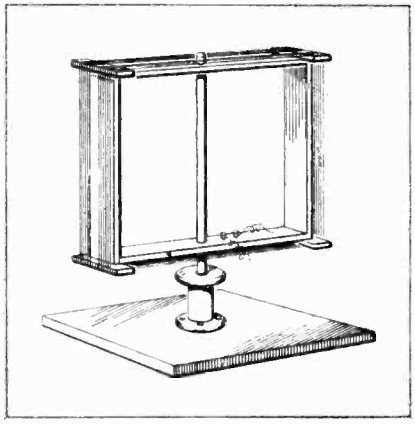
In the case of the output choke, we must consider also the voltage drop across this. The D.C. resistance may be 500 ohms, and the output valve probably has a plate current of 10 milliamperes under normal working conditions; this would be an ordinary super power valve. By Ohm's law we get $E = 0.01 \times 500 = 5$ volts. This is not serious, but if we had connected the ordinary 2,000-ohm loud-speaker directly in the plate circuit of the output valve instead of using a choke, the voltage drop would have been $E = 0.01 \times 2{,}000 = 20$. Twenty volts would be far more than we can afford to lose on the output valve, where volts are vital.

Only a very few of the possible applications of Ohm's law have been shown, but sufficient, it is hoped, to enable readers to find others, and to stimulate in them the thirst for further knowledge concerning watts, henries, microfarads, etc., the simple rules which govern them, and their straightforward but important application to the wireless set.

A SIMPLE FRAME AERIAL MOUNTING.

THE construction of a simple frame aerial of the non-portable type presents no difficulty to the amateur. He usually finds, that it is not easy to mount the frame so that it is rotatable without going to considerable complication.

A very simple and inexpensive method of making a rotatable frame aerial is shown in the accompanying illustration. The frame itself may be constructed of four pieces of light wood, with grooved ebonite pieces at each corner. It is, however, the mounting which chiefly concerns us. A large empty reel of the type upon which wire is wound should be obtained, this being screwed to a suitable wooden baseboard by means of small brass screws around the bottom flange of the reel as shown. The baseboard



A cheap frame aerial using a wire bobbin as a bearing.

should be sufficiently heavy to prevent the frame aerial easily overturning. Into the centre hole of the reel a light curtain rod should be inserted. The rod will, of course, be of greater diameter than the centre hole of the reel, and the diameter of this centre hole must first be increased until the rod rotates comfortably in it. A hole should be bored in the centre of two of the pieces of wood forming the frame, the diameter of these holes being slightly smaller than that of the frame. The frame can then be mounted on the rod as shown, and owing to the fact of the holes in the wooden sides being very slightly smaller in diameter than the rod, it will not slip unless, of course, it is subjected to considerable force. Naturally, other and better methods of firmly attaching the frame to the centre rod will occur to experienced workmen.

M. G.

MEASURING INSTRUMENTS.

Hints on Choosing and Using Meters.

By "RADIOPHARE."

IN an article which appeared in last week's *Wireless World* the present writer assumed that battery voltages would naturally be measured before conducting stage-by-stage tests of a receiver. More mature consideration has led him to the conclusion that this assumption was not completely justified; unfortunately, the amateur does not always realise that a voltmeter is a virtual necessity. Without one he is in the unenviable position of, let us say, a motorist who has no means whatsoever of ascertaining whether an involuntary stoppage is due merely to an empty petrol tank or to more obscure causes. It is sound advice to suggest that, rather than dispense with a meter, expenditure on the set itself should be curtailed. Further, the initial cost of a measuring instrument will yield good dividends in the shape of longer life of valves and batteries.

What kind of meter should we obtain? The cheap moving iron pattern has a certain field of usefulness, provided it is used with care and an appreciation of its shortcomings; it is certainly better than nothing. However, it should be emphasised that the moving coil instrument, with a resistance of some 100 ohms or more per volt, is well worth its extra cost. A two-range meter capable of measuring H.T., L.T., and grid bias voltages, is satisfactory for ordinary requirements, and is more economical than separate instruments. Care should be taken to choose one which will cover the voltage range desired, not losing sight of the fact that there is a growing tendency to increase the pressure applied to the last valve.

While discussing multi-range instruments we may consider for a moment the desirability of obtaining a meter which, in addition to indicating voltages, also has a scale calibrated in milliamperes. There can be no doubt that it is almost as desirable to be able to read anode currents as to measure voltages; as before, the combined instrument is more economical, but a multiplicity of terminals is apt to be slightly confusing to the less experienced, and where cost is not a first consideration, it is suggested that a separate milliammeter might well be obtained.

False Readings.

Simple as is the measurement of L.T. voltage, there is one precaution which must be observed unless misleading results are to be obtained. An accumulator cell will generally show about two volts, however bad its condition, when no appreciable current is taken from it. The current consumed by a reasonably good voltmeter when connected across the battery terminals is certainly negligible, so a reading will be valueless unless the battery is delivering its normal current; in other words, unless the valve filaments are lighted before the meter is applied.

Measurements of H.T. voltages are slightly more complex, particularly if current is supplied by dry cells, as the consumption of a voltmeter is rarely negligible as compared with that of the anode circuits. Assuming a resistance of 100 ohms per volt, a meter with a 0.120-volt scale will have a total resistance of 12,000 ohms, and when connected across a 120-volt battery, will pass a current of 10 milliamps. This is certainly comparable to the normal anode current, and a more accurate idea of the state of affairs will be obtained if the filaments are temporarily switched off prior to connecting the meter across the battery. If the windings have a much higher resistance, or if the normal anode consumption is considerably greater than that of the meter, it will be better to take measurements while the valves are in operation.

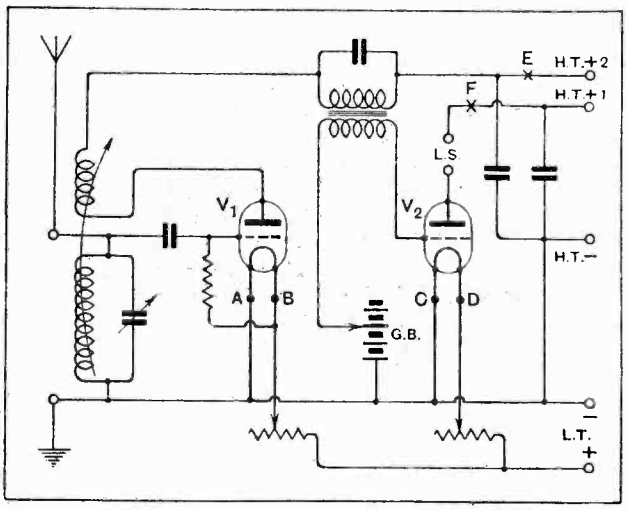


Diagram showing applications of a voltmeter and milliammeter.

A milliammeter should always be inserted at the low-potential end of the anode circuit of the valve whose current it is desired to measure. This means that it should be joined between the load (reaction coil, transformer, primary, tuned anode circuit, or resistance, etc.), and the H.T. battery connection. Referring to the accompanying diagram, which shows the circuit of the classic detector-L.F. receiver, correct positions for inserting a milliammeter are indicated at E and F.

A voltmeter is often useful as an aid to adjusting the filament voltage of a valve, particularly when its rating is considerably below that of the L.T. battery. To make this adjustment, the meter is joined directly across the filaments of each valve in turn, in the positions indicated at A, B, and C, D, in the diagram, and the rheostats are rotated till the rated voltage is shown on the dial. Here, again, it is desirable that the instrument resistance should be high in comparison with that of the filament; if it is not, the voltage will rise considerably when the testing connections are removed, and a false impression of the true operating conditions will be obtained.

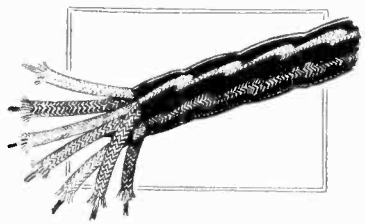
The use of measuring instruments is more complicated when the set is fed from an H.T. eliminator; the writer hopes in the near future to described a simplified method of obtaining a sufficiently accurate idea of the voltages developed.

Latest Products of the Manufacturers.

VAR-LAC BATTERY CABLE.

Too many receiving sets are sent out nowadays with battery leads on the short side so that if the receiver is placed on a fairly high table the leads will not reach the floor and the batteries must be raised on boxes to meet them. This state of affairs is easily remedied by the Var-Lac multiple cable which may be purchased by the yard in any length to suit individual requirements. There is really no excuse now for the home constructor who allows the appearance of his set to be marred by untidy battery wires.

The quality of material used in the construction of this cable is surprisingly good. Each of the seven strands is insulated first with rubber covering and then with braiding of distinctive colour. The whole is encased in a sheath of black shiny material which is not only water- and acid-proof, but will also withstand considerable heat if one should be so careless as to allow the cable to get too close to, say, a gas fire.



Var-Lac acid proof battery cable.

The manufacturers of this useful material are Messrs. Flexible Electric Cords, Ltd., Queensway, Ponders End, Middlesex, and the price per yard is 1s. 3d.

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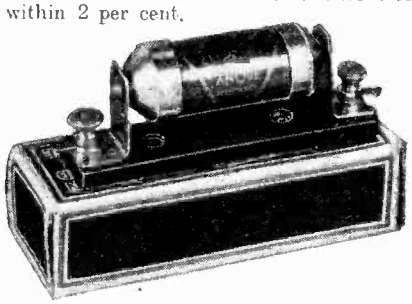
C.E. PRECISION ANODE RESISTANCES.

These resistances are wound with special nickel-chrome wire and are consequently able to withstand considerable overloads without deterioration. They are enclosed in the conventional cylindrical cartridge with metal end caps and an ebonite base with clips and terminals is supplied as an extra for 1s. 3d.

The resistance values available are as follow:—20,000 to 50,000 ohms at 3s. 9d.; 60,000 to 100,000 at 4s. 9d.; 150,000 to 200,000 at 7s.; 250,000 ohms at 8s. Other values may be obtained to order. Tests on a series of resistances showed that the values were consistent to within 2 per cent.



C.E. Precision anode resistances are wound with nickel-chrome wire.

The makers are Messrs. C. Ede and Co., Ltd., Byfleet, Surrey.

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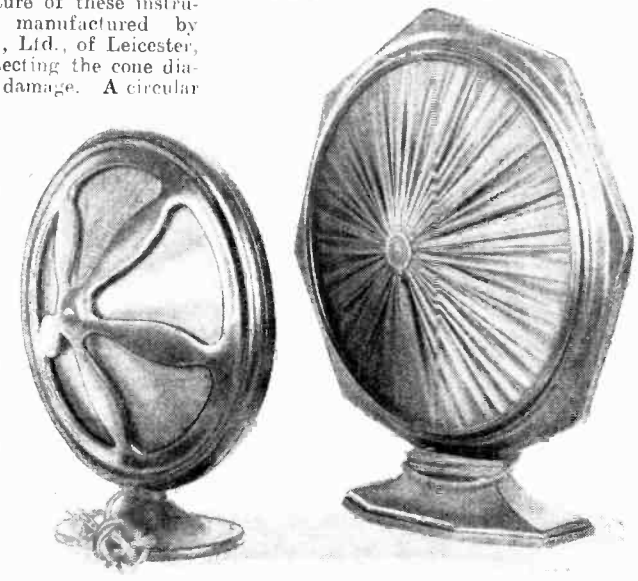
TOUCHTONE CONE LOUD-SPEAKERS.

An interesting feature of these instruments, which are manufactured by Messrs. Gent and Co., Ltd., of Leicester, is the method of protecting the cone diaphragm from possible damage. A circular metal frame consisting of a single-piece stamping with radial strengthening ribs encloses the diaphragm which could only be damaged maliciously—certainly not accidentally. A pleated cover of brown art silk adorns the front, and the base is covered with baize.

If the metal frame is tapped a distinct ring is audible; consequently, a resonance corresponding to the pitch of this note was looked for in testing the loud-speaker. No trace of this could be observed under any conditions, and no uneasiness need be felt on this score. The area of the metal ribs is small compared with the area of the spaces through which the sound passes, so that the sound waves have little purchase on the metal and are unable to excite vibrations.

The general tone is best described as brilliant, and speech and the diction of vocalists is particularly good. As in all cone loud-speakers, the bass is all these, and if any choice is possible the piano may be picked out as an excellent example of the capabilities of the loud-speaker for the reproduction of instrumental music. Naturally, the Senior Model at £5 5s. is the more efficient of the two, but pleasing results are obtainable with the Junior Model, which sells at £3 5s.; the latter should be well suited to small two- or three-valve sets. There are two other models available, the Wall Model at £5 12s. and the Pedestal Model contained in a cabinet 4ft. 6in. high at £7 5s.

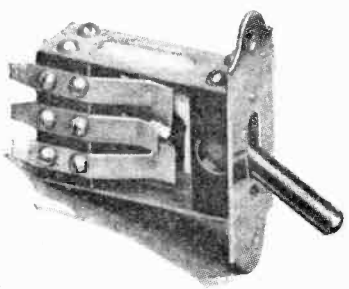
A patented movement employing four permanent magnets is a feature of the Senior Model. All movements are adjustable and are wound to 800 ohms.



Senior and Junior "Touchtone" cone loud-speakers.

A WELL-MADE CHANGE-OVER SWITCH.

Best quality ebonite is used in the construction of this component, the product of Messrs. C. A. Carter and Co., Edison Works, Edison Road, Crouch End, and the insulating blocks carrying the contact springs are milled from the solid. The metal work is also of exceptionally high quality for a component of this type. It is not surprising, therefore, that the movement of the operating key is both smooth and positive. By an ingenious arrangement and shaping of the contact springs the lever locks into each of the three alternative positions with a reassuring click.



Carter change-over switch for panel mounting.

We understand that switches of this type have been supplied for use in Air Ministry sets. The price is 5s. 6d.

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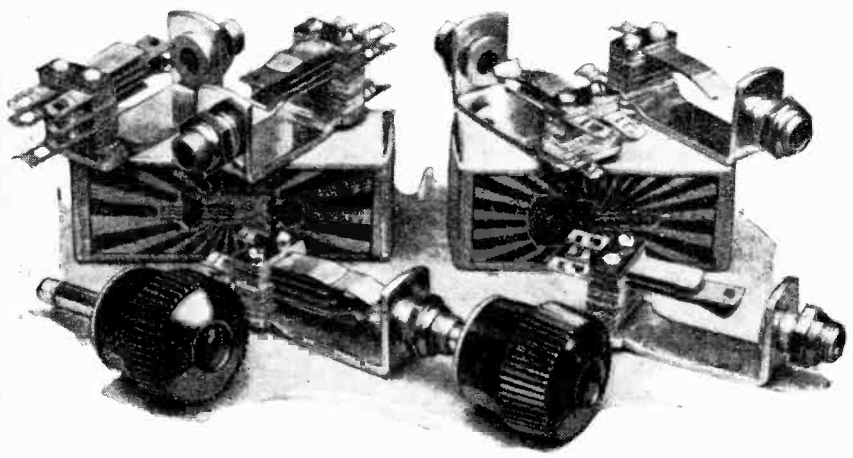
ORMOND PLUGS AND JACKS.

In some types of jacks the thickness of the panel affects the operation of the contacts. The length of the plug being fixed, it may not be long enough to lift the contact blades if the panel is too thick or may pass in too far if the panel is on the thin side. This difficulty is overcome in Ormond jacks by riveting the guide bush to the frame and using a fixing nut on the front of the panel. The front face of the bush then acts as a stop and the plug always enters the same distance whatever the thickness of the panel. The jacks are rather shorter than usual and project only 2¼in. behind the panel; a distinct advantage where space is limited. A special form of tag is used for the jack connections which enables wires to be attached without soldering; this should prove useful for experimental work, but soldered connections are recommended for permanent sets.

A feature of the Ormond plug, which will fit any standard jack, is the special type of terminal connection employed; this will accommodate bare wire, pin or spade tags and is suitable for all types of telephone or loud-speaker leads.

Six different patterns of jacks are available, the prices ranging from 1s. 9d. to 3s., and the plug is priced at 2s. 6d.



Ormond plugs and jacks.

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FOR CUTTING EBONITE SHEET.

A continuous cut in sheet ebonite of indefinite length is possible with this specially shaped saw, the product of Messrs. Fry's (London) Ltd., Knox House, Water Lane, London, E.C. 4. The blade is renewable.

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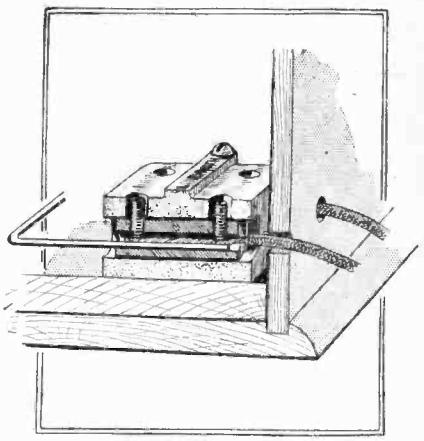
ATHOL TERMINAL BLOCKS.

Readers will be pleased to learn that the business of the Athol Engineering Company, manufacturers of the well-known Athol valve holder and other porcelain products, is to be taken over by the Athol Electrical Company, Tyson Street, Cheetham Hill, Manchester.

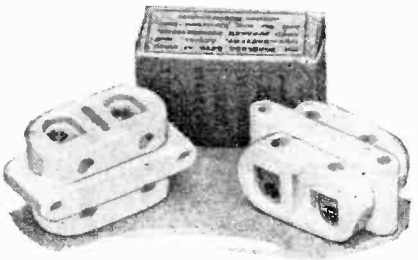
For the present the new company is concentrating on the production of a porcelain terminal block of the type shown



Sectional diagram showing method of fitting in receiver cabinet; holes are drilled for passing the battery leads through the back of the cabinet.

in the photograph. The superior insulating qualities of porcelain require no emphasis, but there are other advantages which may not be so obvious. For instance, the difficult process of cutting out the back of the cabinet to fit terminal panels is avoided, and it is only necessary to drill small holes in the cabinet opposite the brass connectors. Apart from the saving of time and trouble when building the set, the appearance is greatly improved.

No tools other than a screw-driver are needed for fitting the block or clamping the wires. It is an advantage to overlap the wires as shown in the sectional drawing; this eliminates one dry joint and ensures perfect contact. The glazing on the top ridge of the porcelain block is of such a nature that lettering for identifying the leads may be written in ordinary ink; this can be easily rubbed off and changed if desired.



Athol porcelain terminal blocks.

Many other applications will suggest themselves to the experimenter, particularly in connection with high-voltage rectifier work and moving coil loud-speakers.

The price of the 2-way terminal block is 1s., and 3- and 4-way blocks are in course of preparation which will be priced at 1s. 6d. and 2s. respectively.

A Representative Selection Specially Suitable for Electrical Reproduction.

ALL records are more or less suitable for electrical reproduction by the use of a pick-up. Those which are recorded electrically are, of course, particularly suitable, but it by no means follows that the most successful records when used with a sound-box of the normal type should necessarily be selected for use with a pick-up and its associated amplifier.

Probably the most striking records recently issued are those of the Philadelphia Symphony Orchestra, of which Hungarian Rhapsody No. 2—Liszt—D1296 (H.M.V.) is a good example. This record forms a very severe test of the efficiency of a pick-up, and it is suggested that a super-volume record such as this should only be obtained when the intending purchaser is certain that his pick-up is free from chatter. The actual needle displacement is surprisingly large, and the amplifier is required to deal with a large volume in the bass. The above requirements are more or less essential for good reproduction, but it is quite possible to obtain pleasant music, etc., from records of moderate output with apparatus that shows up badly when reproducing from a super record. The whole effect of an orchestral climax is lost if at the peak the input has to be throttled to prevent overloading in the amplifier.

Records to Suit Every Mood.

The following short list is suggested as the nucleus of a collection. Certain loud records have been included on account of the excellence of the recording, and also because musically they provide very good fare. The list is as representative as possible, and with this view in mind the collection has been grouped under the various headings. The records which give intense volume are starred.

(1.) Orchestral Works.

Marche Militaire—Schubert ..... H.M.V. C1279
Royal Opera Orchestra. Covent Garden.

Unfinished Symphony—Schubert ..... H.M.V. C1294/6
Royal Opera Orchestra. Covent Garden.

Casse-Noisette Suite—Tschaikovsky ..... H.M.V. D1214
Philadelphia Symphony Orchestra.

L'Arlesienne Suite, Nos. 1 & 2 ..... P. E10597
E10598
Grand Symphony Orchestra.

*Hungarian Rhapsody No. 2—Liszt ..... H.M.V. D1296

*Rienzi—Wagner ..... H.M.V. D1226
D1227
Philadelphia Symphony Orchestra.

*Invitation to the Waltz—Weber ..... H.M.V. D1285
Philadelphia Symphony Orchestra.

*Fire Music—The Valkyrie—Wagner ..... H.M.V. D1079
Symphony Orchestra.

(2.) Light Orchestral Works.

Blue Danube Waltz—Strauss ..... H.M.V. D1218
Philadelphia Symphony Orchestra.

Orphée Aux Enfers—Offenbach ..... H.M.V. C1262
De Groot and the Piccadilly Orchestra.

Serenata—Moskowski ..... H.M.V. B2451
Victor Olof Sextet.

Troika and a Lady ..... Z. M2976
Kirilloff's Balalaika Orchestra.

(3.) Concert and Chamber Music.

Concerto No. 5 in E Flat Major—Beethoven. H.M.V. D1198/01
Backhaus and Albert Hall Orchestra.

Concerto in D Major—Beethoven ..... H.M.V. DB990/5
Kreisler and State Opera Orchestra.

Trio No. 1 in B Flat—Schubert ..... H.M.V. DB947/50
Cortot, Thibaud and Casals.

(4.) Vocal.

(a) *Soprano.*

Batti, Batti, O Bel Masetto ..... H.M.V. DB946
Elisabeth Schumann.

Carmen—Habanera—Bizet ..... P. E10441
Emmy Bettendorf.

Shadow Song—Meyerbeer ..... H.M.V. DA817
Galli Curci.

One Fine Day—Puccini ..... H.M.V. DB981
Margaret Sheridan

(b) *Tenor.*

Vesti la Giubba—Pagliacci ..... H.M.V. DB111
Caruso.

O sole Mio ..... H.M.V. DA103
Caruso.

Opening of the Play—Pagliacci ..... Col. 4356
Heddle Nash.

No, Punchinello, No More—Pagliacci ..... Col. 4358
Frank Mullings.

I Know of Two Bright Eyes ..... H.M.V. F449
W. Widdop.

(c) *Baritone.*

Prologue—Pagliacci ..... Col. 4347
Harold Williams. 4348

Simon the Cellarer ..... H.M.V. B2324
P. Dawson.

Toreador Song—Carmen ..... H.M.V. C1440
P. Dawson.

(d) *Bass.*

The Two Grenadiers—Schumann ..... H.M.V. DB933
Theo. Chaliapine.

*Farewell and Death of Boris—Moussorgsky H.M.V. DB934
Theo. Chaliapine.

Erl King—Norman Allin ..... Col. L2038

H.M.V. = His Master's Voice.
Col. = Columbia
Z. = Zonophone.
P. = Parlophone.
* Good volume.

Records for the Gramophone Amplifier.—

(e) *Duets.*

My Fate is in Thy Hands—Pagliacci ..... Col. 4352
Dennis Noble and Miriam Licette.

Come to Arcadie—German ..... Col. L1431
Dora Labbette and Hubert Eisdell.

(f) *Choral.*

Hear My Prayer—Mendelssohn ..... H.M.V. 1329
Temple Church Choir.

Easter Hymn—Cavalleria Rusticana ..... Col. 3399

Hallelujah Chorus—B.B.C. Choir ..... Col. L2033

(g) *Vocal Gems.*

Vocal Gems—The Mikado ..... Z. A323

Vocal Gems—The Gondoliers ..... Z. A325

(5.) Instrumental.

(a) *Piano.*

Rustle of Spring—Irene Scharrer ..... H.M.V. D1303

Prelude in B Flat—Rachmaninoff ..... Col. L1997
Pouishnoff.

(b) *Organ.*

Toccata and Fugue in D Minor—Bach ... H.M.V. C1291
G. D. Cunningham.

Marche Aux Flambeaux ..... H.M.V. B2582
A. Meale.

Evening Song ..... H.M.V. C1325
H. Goss-Custard.

(c) *Violin.*

Menuet—Kreisler ..... H.M.V. DA777

Thaïs Meditation—Isolde Menges ..... H.M.V. D1223

Caprice Viennois—Kreisler ..... H.M.V. DB1091

(d) *Violoncello.*

Traumerei—Casals ..... H.M.V. DA833

Le Cygne—Casals ..... H.M.V. DA776

(6.) Miscellaneous.

Whistler and His Dog—Pryor's Band ... H.M.V. B2373

Aïda—Creatores Band ..... H.M.V. C1339

Two Black Crows—Moran and Mack ..... Col. 4441

The list by no means pretends to be exhaustive, but is simply the start of a collection to suit one's every mood. No dance records are shown in the above list, as all the new issues are reasonably good, and they drop out of fashion so rapidly that it is best to obtain the very latest consistent with particular requirements.

CLUB REPORTS AND TOPICS

Shielded Valve Explained.

The members of the Thornton Heath Radio Society spent an enjoyable evening recently when Mr. F. Youle, of the Marconiphone Co., Ltd., lectured on the shielded valve. The lecturer described the functions of the valve and its characteristics, and explained its advantages for neutralising high-frequency stages. The necessity of screening components was a point emphasised by the lecturer, who gave some useful hints on the best methods to adopt. A demonstration was afterwards given with a model '50" Marconi receiver incorporating three stages of high frequency employing the S625 shielded valve.

The Society's meetings are held every Tuesday evening at 8 o'clock in St. Paul's Hall, Norfolk Road, Thornton Heath. Hon. secretary, Mr. C. H. Piper, 77, Torridge Road, Thornton Heath.

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Association of British Radio Societies.

For their second open lecture, held on March 13 in the Albert Hall, Peter Street, Manchester, the Association of British Radio Societies were fortunate in having as lecturer Mr. P. K. Turner, of the research department of Messrs. Graham Amplion, Ltd. Dealing with "Modern Broadcast Receiving Apparatus," Mr. Turner first dealt with musical reproduction, discussing the various phenomena connected with sound production. He showed how the human ear changes with the age of the person and how some people were able to hear notes of a frequency of 15,000 and over. Various types of loud-speaker were discussed. Mr. Turner laid down the axiom that "the successful wireless receiver depends on qualitative design more than on the circuit used." The lecture concluded with a demonstration of a moving coil loud-speaker. The chairman was Dr. S. Z. de Ferranti.

Hon. secretary, Mr. L. A. Gill, Hope House, South Reddish, Stockport.

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Activities in Irish Free State.

"The Mystery of the Valve Explained" was the alluring title of a lecture recently given before the Wireless Society of Ireland by Mr. J. Ree, of the Mullard Wireless Service Co., Ltd.

Irish Free State amateur transmitters have been taking an active part in the international tests organised by the American Radio Relay League. Particulars of some of the work carried out appear under "Transmitters' Notes and Queries."

The membership of the Wireless Society of Ireland is open to all members of the public. The annual subscription is 5s. Hon. secretary, Mr. H. Hodgens, 12, Trinity Street, Dublin, C.1.

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Successful Tottenham Social.

The Tottenham Wireless Society held another highly successful radio social on Wednesday, March 14, when a large number of members and friends took part in a whist drive and dance. In addition to the Society's own dance band, music was supplied by two moving coil loud-speakers reproducing music from gramophone records and broadcasting.

At the Society's meeting on April 4 the summer programme will be discussed.

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

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Behind the Scenes in a Valve Factory.

An insight into wireless production methods was afforded members of the Woolwich Radio Society on March 7, when Mr. Henderson, of the General Electric Co., spoke on valve manufacture. Beginning with a description of early manufacturing methods, Mr. Henderson proceeded to show by means of characteristic curves the progress made during the last six years in the direction of valve perfection. The manner in which valves are pumped was described, besides the many intricate processes through which each specimen passes before it becomes a saleable product. After describing the new "indirectly heated" valves the lecturer demonstrated two interesting sets, the first equipped with KH1 and KL1 valves deriving current directly from the A.C. mains, while the other—a new five-valve receiver—incorporated two stages of H.F. with shielded valves. This receiver gave very impressive results.

Hon. secretary, Mr. R. J. South, 42, Greenvale Road, Eltham, S.E.9.

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For the "Man in the Street."

At a recent meeting of the South Croydon and District Radio Society Mr. J. Thompson, of Messrs. A. C. Cossor, Ltd., described and demonstrated the Cossor "Melody Maker." The receiver proved its capabilities as an instrument for the "man in the street."

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

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Using the Electric Mains.

During the past session members of the Southend and District Radio Society have profited by lectures covering the choice of circuits and the layout of components. They have also appreciated the value of employing the electric mains, these having been used throughout the period under review. A recent lecture and demonstration dealt with the latest developments in radio receiver design on the Continent, and the demonstration included a four-valve set in which the valves were all contained in one glass bulb. On Friday, March 16, the closing meeting for the winter session was held.

Hon. secretary, Mr. F. J. Waller, Eastwood House, Rochford, Essex.

FORTHCOMING EVENTS.

WEDNESDAY, MARCH 28th.

Muswell Hill and District Radio Society.—At 8 p.m. At Tollington School, Tetherdown, N.10. Demonstration by Mr. H. F. Smith (of "The Wireless World").

Tottenham Wireless Society.—At 8 p.m. At 10, Bruce Grove. Demonstration of the Society's apparatus, by Mr. F. Dyer (G6IY).

South Croydon and District Radio Society.—At 8 p.m. At the "Surrey Drovers" Hotel. Lecture by a representative of the Tungstone Accumulator Co., Ltd.

THURSDAY, MARCH 29th.

Stretford and District Radio Society.—At 8 p.m. At 6a, Derbyshire Lane. Review of the Season.

Leyton and Leytonstone Radio Society.—"Aerials and Associated Circuits."

Slade Radio (Birmingham).—Demonstration of Brandeset IIIa, by Mr. E. Mottershead.

FRIDAY, MARCH 30th.

Leeds Radio Society.—At the University. Lecture No. 6: "Three-Valve Set," by Mr. A. F. Carter, A.M.I.E.E.

South Manchester Radio Society.—At the Co-operative Hall, Wilmslow Road, Didsbury. Review of Wireless Progress for the Year.

MONDAY, APRIL 2nd.

Whitley and Monkseaton Radio Society.—At 8 p.m. At the Royal Hotel, Whitley Bay. Annual General Meeting.

Croydon Wireless and Physical Society.—At 8 p.m. At 5, Altyre Road, East Croydon. Lecture: "The Romance of Radio," by Capt. H. Bevan Swift.

Hornsey and District Wireless Society.—Lecture: "High Tension Eliminators," by Dr. C. W. J. Dunlop.

Hackney and District Radio Society.—At the Electricity Showrooms. Junk Sale.

BROADCAST BREVITIES

By Our Special Correspondent.

Easter Programmes.—Savoy Hill and Controversy.—How India "Heard" 5SW.—A Licence Farce.—The Growth of "S.B."—A Shaw Play by Wireless.

Programmes at Easter.

The Easter holiday programmes should attract a wide audience. On Good Friday a Glasgow performance of John Masefield's "Good Friday" play, relayed to 2LO and 5XX, will be followed by a service relayed from St. Ann's Church, Manchester. Later comes a National concert from the Queen's Hall. 5GB will give an afternoon broadcast of Bach's "St. Matthew Passion."

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From York Minster.

On Easter morning London and Daventry will broadcast the service from York Minster, with an address by the Archbishop of York. The Wireless Military Band will provide the afternoon programme, and in the evening the service in Carlisle Cathedral, with an address by the Dean of Carlisle, will be relayed to 2LO and 5XX. The Cathedral bells will also be heard. 5GB will broadcast the York Minster service, and later in the day will give Bach's Cantata for Easter Day.

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Bank Holiday.

Easter Monday's broadcasts will include vaudeville, with a burlesque by Mabel Constanduros, from 2LO and 5XX. The latter is a "rehearsal" of "Dick Whittington," as performed by an amateur theatrical party. The piece should have been performed on Boxing Day, but for reasons which will be stated on the day of broadcasting, has unavoidably been postdated. 5GB has light music by Corelli Windeatt's Band, and a psychic mystery play entitled "Out of the Shadows."

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Playing for Safety.

From a very reliable source I gather that the recent discussions between the Governors on the question of controversy have been unproductive of any marked change of policy.

The lifting of the ban is regarded as a welcome measure in that it releases the B.B.C. from the necessity of warning outside speakers to avoid certain subjects, but there is an unwillingness at Savoy Hill to use the new freedom aggressively. I learn, also, that religious and political controversy are still to be avoided as far as possible, which means, in effect, that the microphone will retain its youthful innocence for many moons to come.

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A Curious Clash.

How many readers, I wonder, noticed a curious clashing of programme items on Tuesday of last week (March 20th)? The Gladys Noon Trio, broadcasting from 2LO and 5XX between 12 and 1 o'clock, concluded with a selection from "La Tosca." They were immediately followed by Moschetto and his orchestra at the Savoy Hotel, and the first item on that programme was the identical selection from the same opera!

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India and 5SW.

Although the success of the short-wave experimental broadcasting station 5SW at Chelmsford has been mainly confined to Australia, with only minor triumphs elsewhere, it will come as a shock to many to learn that the Indian Broadcasting Company has tried repeatedly to pick up 5SW's transmissions and has "never heard a signal"!

This is the report made by Mr. Eric Dunstan, General Manager of the I.B.C., who is now in London and paid a visit to Savoy Hill last week.

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Why Not Change the Wavelength?

5SW has now been broadcasting regularly for four months, and throughout that period has stuck slavishly to the 24-metre wavelength. Experience with other short-wave stations has shown that different parts of the world can only be reached by different wavelengths. But a change at 5SW, we are told, would involve a good deal of trouble, as the special aerial itself would have to be altered.

If an amateur transmitter put forward an objection of this sort we might reasonably assume that a lady or some other object of attraction was causing him to lose interest in wireless matters

FUTURE FEATURES.

London and Daventry (5XX).

APRIL 1ST.—Pianoforte Recital by Pouishnoff.
APRIL 2ND.—"Speed," a play by Charles Croker.
APRIL 3RD.—Vaudeville.
APRIL 4TH.—"The Dream of Gerontius," by Cardinal Newman.
APRIL 5TH.—Music and Song of the Gael.
APRIL 6TH.—"Good Friday," a play in verse by John Masefield.
APRIL 7TH.—English Comic Opera.

Daventry Experimental (5GB).

APRIL 1ST.—National Union of Students' Concert.
APRIL 2ND.—Ballad Concert from Birmingham.
APRIL 3RD.—Military Band Concert.
APRIL 4TH.—A Sullivan Programme from Birmingham.
APRIL 5TH.—Variety Programme.
APRIL 6TH.—Chamber Music.

Cardiff.

APRIL 4TH.—Welsh Wynne in Character Studies.
APRIL 6TH.—The Fourth Concert of the Cardiff Musical Society, relayed from the Park Hall.

Manchester.

APRIL 2ND.—"9.45," a mystery play by Gwen Davis and Sewell Collins.
APRIL 6TH.—"The Passion," a special service relayed from St. Ann's Church, Manchester.

Newcastle.

APRIL 3RD.—"Glimpses of the Past," a series of dramatic episodes dealing with the history of Newcastle and district.

Glasgow.

APRIL 5TH.—Music and Song of the Gael.

Aberdeen.

APRIL 2ND.—A Scottish Programme.

50 Per Cent. Pirates?

Mr. Dunstan's present aim is, I understand, to raise nine lakhs of rupees (about £63,000) to put Indian Broadcasting properly on its feet. So far the income from licences has been negligible, and at least 50 per cent. of the listeners to Bombay and Calcutta belong to the great fraternity of the unlicensed. This is not altogether surprising, viewed in the light of Mr. Dunstan's disclosures concerning the methods of the Indian Post Office in collecting licence money.

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Getting the Licence: Old Style.

Until recently the listener who decided to obtain a licence had to take almost a day's holiday for the job.

First of all he had to fill in a form which required all sorts of historical data about himself, and he was lucky if he did not have to go home again to verify his answers. Having filled up the form, he was given a chair, and on it he remained until the postmaster invited him to hand over his 10 rupees. Then he had to wait, sometimes for three or four hours, until the worthy official summoned up enough energy to write out the licence.

Conditions are now changed for the better in consequence of representations made to the Government by the Indian Broadcasting Company. The prospective licensee is treated less like a sinner at the penitent form, and there seems little doubt that the result will be a gain in the number of licences.

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Heard in Afghanistan.

India is surprisingly free from atmospherics. Both Calcutta and Bombay, equipped with standard "Q" type 1½-kW. transmitters, are heard at fair strength up to 300 miles. Shortly before Mr. Dunstan's start for England a letter reached him from a listener in Kabul expressing great delight at the excellent broadcast report from Bombay of King Amanullah's arrival in that city. The distance from Bombay to Kabul is more than 1,000 miles.

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All Dialects at the Microphone.

The dialect difficulty promised to be a formidable obstacle to broadcasting in India, but Mr. Dunstan reports that experience is proving the opposite. The fact that practically all dialects have a share of the microphone is greatly appreciated by the population, and a genuine friendliness is becoming more and more noticeable.

The one obsession which still lurks in the Indian mind, and which it is the duty of the Broadcasting Company to dispel, is that broadcasting is an instrument of Government propaganda.

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Growth of S.B.

The extension of the S.B. principle has been so gradual that it is almost startling to realise that no fewer than four nights a week are now devoted to "S.B." from London to all stations except 5 GB.

This increase, which is largely due to requests from the local stations themselves for "more programmes from London," has incidentally helped to remove some bones of contention. For example, in earlier days Edinburgh not unnaturally bridled at the thought that 2ED was merely a relay station to Glasgow. Now that Glasgow, at its own request, receives the bulk of its programmes from London and passes them on to Edinburgh the scales are fairly evenly balanced and "Auld Reekie" is satisfied. Equally delicate questions of a similar sort are being smoothed over in the same way in other parts of the country.

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The Broadcasting Machine.

What an inhuman affair the broadcasting machine has become! Once upon a time not a day passed without its funny little accident. Old men knocked over microphones, cats stalked into studios, mice made their nests in transformers, and it all added to the gaiety of nations. Nowadays the broadcasting machine starts up in the morning and pursues its relentless course until late at night. Nothing extraordinary happens and the miserable journalist, hungry for "copy," is lucky if a valve burns out. And even that is becoming a rare event.

It is time that something happened. Where is Father Ronald Knox?

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Sir Landon Ronald's Reminiscences.

Sir Landon Ronald will broadcast from 2LO and 5XX on March 29th some interesting reminiscences of Sir Herbert Tree, Sir Charles Santley and Caruso.

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Adult Education Scheme.

The B.B.C. is discussing with the National Adult School Union an arrangement for a special series of talks for the benefit of study groups in different parts of the country. The idea is to assist students towards a fuller appreciation of art, music, poetry, sculpture and kindred matters.

There are, I believe, nearly 1,500 study groups conducted under the auspices of the Union, and their enthusiasm over the possibilities of broadcasting deserves to be encouraged. The scheme will probably be inaugurated with the transmission of two of Shakespeare's plays.

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Guarding the Dutch Language.

Our own broadcasting authorities are not alone in their anxiety over the preservation of the national language. A Linguistic Commission in Holland is now turning its attention to broadcasting, and is scrupulously watching the efforts of speakers before the microphone. An appeal has been issued to all people who intend to broadcast, requesting them to exert special care regarding the language they use so that listeners will not pick up "linguistic iniquities."

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Gaelic Broadcasting in Scotland.

Though final details of the scheme for extending the scope of Gaelic broadcasting in Scotland are not yet available, it is understood that it will consist of a series of concerts by the leading Gaelic choirs to be given at intervals during the year. The first of these concerts, which is to be given in the Glasgow studio on April 5th by the Oban Gaelic Choir, will be introduced by Lady Elspeth Campbell of Argyll, who is, of course, a leading figure in Gaelic circles. They are to be supported in their broadcast concert by the well-known Gaelic soprano, Jennie Currie, and by Mrs. Shand (piano) and Alec Sim (violin), who are both leading exponents of Scottish dance music. Part of the concert will be relayed by London as well as by the Scottish stations.

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A Conrad Thriller.

"Lord Jim," one of the most thrilling romances ever broadcast, will be transmitted from 2LO and 5XX on April 11th and from 5GB on April 10. This is a radio version by Cecil Lewis of the novel by Joseph Conrad; when it was broadcast once previously an enormous volume of appreciative correspondence was received from listeners.

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The Two "V's."

How many people would escape if they had to explain at the point of the revolver exactly what difference obtains between "Vaudeville" and "Variety"? The two have only recently become distinct entities in the B.B.C. programmes.

Vaudeville concerts are usually of the entertainer type and have no pretensions to seriousness. Variety, on the other hand, has a much larger scope and may include anything from Victorian ballads to violin solos. In vaudeville we see life as jovial lowbrows; variety promotes us to the status of genial middlebrows. Will no one provide a mixed entertainment for the highbrows? Something ethereal enough to be described as "Vacuity"?

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A Shavian Epoch.

To-night (Wednesday) will mark an important step in the development of the dramatic side of broadcasting, for it signals the first performance of a Shaw play before the microphone. "The Man of Destiny," which is one of Mr. Bernard Shaw's shorter plays, will be performed in the London studio by the Macdona players, the part of Napoleon being taken by Esmé Percy and that of the Lady by Margaret Macdona.

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New Welsh National Orchestra: First Concert.

Last month details appeared in these columns of a scheme for the formation of a "National Orchestra of Wales," for which the B.B.C. offered financial support in co-operation with the Welsh National Council of Music, the National Museum of Wales, and the City Corporation of Cardiff.

The scheme has borne fruit, and the new orchestra will make its *début*, under the baton of Sir Henry Wood, at the Cardiff City Hall on April 12th. The inaugural programme will be broadcast through the Cardiff, Swansea, and Daventry Experimental stations.

Warwick Braithwaite will be the permanent conductor of this "National Orchestra," which should fill an important *rôle* in the musical life of Wales.

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.

PROGRAMMES AND MEDIUM-BROW.

Sir,—"Cee Tee Eff," in your issue of March 14th, pleads for more medium-brow music, and by that he means such music as Zampa, William Tell, some of Grieg's compositions, music from operas such as Faust, Mignon, etc.

Well, if that is medium-brow music, startled minds will no doubt be wondering what is left to be called low-brow.

"Cee Tee Eff's" answer to that seems to be dance music. Now dance music is not any brow in particular; members of every division of brow both like and loathe it, and I rather resent it being described as low-brow. This description seems to me to fit quite perfectly the music which "Cee Tee Eff" describes as "nice light music—tuneful and exhilarating"—the kind of music, in fact, which calls for no effort on the part of the listener, and very little attention—good music to talk to, with tunes and rhythm so obvious and inevitable that given a few bars anywhere the gist of the rest can be all too certainly forecast. Of course, some of it has merit and suits moods, but it palls after a time.

In a second suggestion, "Cee Tee Eff" asks for complete evenings of one type of programme. Surely this would be a dismal idea. A complete evening of "Cee Tee Eff's" type of music—could "Cee Tee Eff" stand it? A complete evening of variety? A complete evening of talk? And, even worse, a complete evening of the type of music I like best—Chamber music?

Surely 1½ to 2 hours of any type of programme is enough at a stretch.

It seems to me that the B.B.C. arrange the programmes in the main admirably.

KAY ELL.

Sunningdale, Berks.
March 16th, 1928.

QUALITY OF TRANSMISSION.

Sir,—In reply to Mr. George H. Tozer, I will only say that I have frequently listened to the set he mentions, at the Kensington Science Museum, and, moreover, that my set is modelled on it.

I admit that I have never been there when one of those Bournemouth Winter Garden concerts was being broadcast, but I have no shadow of doubt that the distortion would have been plentifully evident.

The real answer to Mr. Tozer and others of the "look to your set" faction is that distorted transmissions are fortunately not a continuous feature and are obviously noticeable in contrast to undistorted transmissions.

Again and again one may turn with a twist of the dial from a distorted 2LO to an undistorted 5GB, or, what is perhaps better evidence, one may enjoy an undistorted item from one studio, only to suffer from distortion when the next item comes on from another studio—and this with the set untouched in a distant room.

Mr. Tozer has evidently misread my letter, since he reports me as having said that of "the transmissions from 5GB and London, some are poor, some bad, and some are an insult to music, wireless and the listener."

What I actually did say was "about 50 per cent. (of programmes) are fairly and satisfactorily free from distortion, and of these very very few are outside broadcasts—as for the rest, some are poor, some bad and some an insult to music, wireless and the listener."

Mr. Tozer thinks the transmissions in general are nearly perfect; I think some of them *are*, but some are hopelessly imperfect, and since it is quite possible, it is these latter which I hope to see eliminated.

Mr. E. C. Richardson's scheme for some authoritative person to issue periodical reports on the purity of transmissions seems to me excellent, and I am sure that there are many who would gladly subscribe to it.

As for the land lines, I entirely share Mr. Philip H. A. Matthews' misgivings about the proposed Continental relays, and agree with Mr. P. B. C. Beasley that the Manchester relay voice and music, coming through skeins and skeins of wool, are quite bad enough.

I have not suffered from the symptons described by Mr. W. K. Islip—transmissions changing from good to bad within a few seconds—the distortions of which I complain, generally cover complete items, but I also have satisfied myself and others that the fault is not due to silent oscillation or heterodyning.

Incidentally, I am in the country, well away from other aerials.

KYRLE LENG.

Reading.
March 7th, 1928.

Sir,—I was glad to see my old friend, Mr. D. R. Roberts, raise the question of interference between stations, which is now so bad that it has extended to 2LO, which is violently heterodyned nearly every evening. I also endorse the views of Mr. R. Leng, and I can bear out his statement that the Bournemouth transmission from 5GB on Thursday afternoon has been vile.

Not only myself but several of my friends have spent the last nine months, sparing neither time nor expense in perfecting a set and coil drive speaker, with a view to receiving the local broadcasts with the utmost possible quality, and we do not need to be told to look to our sets.

Your correspondent, Mr. G. H. Tozer, mentions the Science Museum set, but I would remind him that this set only receives 2LO, and as this station has no need for long land lines for its studio broadcasts, it is mostly good quality.

My own experiments bear this out, as 2LO always sends out good quality from its studios at any rate.

One of my friends possesses the Science Museum type of receiver, but it does not prevent the distortion from 5GB that is present with some transmissions.

Mr. P. B. C. Beasley also notices the hard metallic result from a relay from Manchester, which is good compared with the result from Newcastle, as witness the band from that station on Tuesday evening last.

It would be interesting to hear the results from 5GB and 5XX from studios situated at Daventry, and I do not think we should have much to say about bad quality.

I am quite convinced that a correctly designed set and coil drive speaker is capable of doing more than justice to even the best transmission that is now being sent out, and I trust this agitation for better quality will be carried on.

F. C. RODERICK.

Bedford.
March 8th, 1928.

THE LOSS OF BOURNEMOUTH.

Sir,—From a seafaring listener and enthusiastic point of view it seems a pity such a station as Bournemouth should be eventually done away with for a regional station in some other locality.

This station is without doubt one of our best, if not *the* best,

we have for reception abroad, not excluding 5GB, meaning on the medium wavelengths.

It is realised that a great part of its emission is dissipated over the sea and that Morse spoils its reception over the land in its vicinity, which are, of course, very good reasons why a coastal station is a wrong position for listeners in Great Britain, but cannot some lesson be learned by the B.B.C. as to its situation, or whatever makes this station such a wonderful distance reacher?

These observations have been taken all over the Mediterranean for over three years on a "Roberts Reflex," "Everyman Four," and "2H.F. Set," and have proved most consistent.

The Germans, of course, come over at strength, but it is still something to us to get the news nightly, spark permitting, and to hear Alfredo and his band, who can be relied upon to give us something new. Low-brow probably, but ship life is dreary enough without mind-uplift.

By the way, I agree with your correspondents who advocate a simple "Hallo, Hallo, London" or "Radio London," say. The Esperanto and Morse would have to be learnt in any case and be very confusing.

What is simpler than "Hallo, Hallo, Pra-ha" or "Radio Wien," and what worse than an abrupt "London calling," the first word of which is always missed? BERMIN.

Bizerta, Tunisia.
March 6th, 1928.

ARE THERE TOO MANY TYPES OF VALVES?

Sir,—Allow me, through the columns of *The Wireless World*, to express my hearty agreement with the remarks made by Prof. E. V. Appleton in his article *re* number of valves and types in March 7th issue.

Let us take the pick of the 2- and 6-volters, and drop 4-volt tubes altogether—personally, I see no need for them whatever. Doubtless the valve manufacturers will be reluctant to accept the idea, but we must hope for the best!

By *standardising* valves, a great deal of good will be done—results and tests, etc., will also be more comparative.

Leicester Road, New Barnet. F. G. APPLETON.
March 14th, 1928. (B.R.S.92).

Sir,—In a recent article Professor Appleton discussed valves, and suggested a standard nomenclature, based primarily on the *filament* characteristics (P.D. and current).

I would suggest that at the present day a nomenclature based on filament characteristics is out of date, however desirable it may have been in the early days of the "dull-emitter" *versus* "bright emitter." The more progressive valve-makers of to-day are not increasing the number of types of filament they use, but the number of different "Impedances" of valve obtainable with a given type of filament, and interest has shifted from the filament to the "Impedance" and "Amplification factor."

When we wish to select a valve for a particular job we first specify its "Impedance" [R], as the valve-makers continue to call it. (Of course, as Professor Howe has continually pointed out, "Slope or A.C. resistance" is the proper term to use.) We then glance at the "Amplification factor" [μ] obtainable with the given "R." Having settled these characteristics, we say, "I want a valve with this 'R' and a 2-, 4-, or 6-volt filament" (of reasonable current consumption be it understood). And a given maker usually has three valves of much the same "R" and "μ" suitable for 2-, 4-, or 6-volt filament supply. And, provided we can get a low enough R, with a large enough μ, we do not greatly care if the filament takes 0.10 or 0.12 or even 0.2 of an ampere!

I suggest, therefore, that the best way to specify a valve would be by two numbers separated by a "bar" [/] forming a fraction R/μ. Expressing R in kilohms (1,000 ohms), the required numbers are not inconveniently large.

Thus, for example, a "super-power" valve of the "D.E.5a" class becomes a $3\frac{1}{2}/3\frac{1}{2}$, while a "D.E.5b" becomes a 30/20. Incidentally, the fractional form is suggestive, because by performing the division of R by μ, indicated by the fractional form, we obtain the reciprocal of the "Mutual Conductance in milliamps. per volt." In modern valves this reciprocal, which might be called the "mutual resistance" in kilohms, is usually round about 1, and the lower it is the better the valve is as an amplifier.

We could, if desired, add a letter or number to indicate the filament properties. [Thus, "30/20 Six," or "85/40 Two"; or, in the case of A.C. valves with separately heated cathodes, the AC/R valve described by A. P. Castellain on p. 240 of *The Wireless World* would be "$2\frac{1}{2}$/10 A.C."]

I would suggest to the valve manufacturers that the filament of a valve is no longer the centre of interest; for my own part, I find that if I compare two valves of similar R and μ by different makers (say, by interchanging them in a receiver), I find no difference whatever, although each maker advertises that his *filament* is quite different to anybody else's (and, of course, vastly superior). And I find that filament consumption and reliability varies remarkably little between one make and another among the more recent products of reputable makers.

Is it too much to hope that valve advertisements will one day cease to tell pretty tales about filaments, and give us some *real* information about the valves? I do not wish to be able to throw valves out of an aeroplane, or hang myself with a rope made of filaments (as recent advertisements, if I believed them, would show me I could do), but I *do* want to know R and μ, which more than half the advertisements do not give, and if the advertiser is going to go to the expense of a block I shall get a much more favourable opinion of his competence and knowledge if that block were a characteristic curve drawn to a reasonably large scale, instead of a "pretty picture." Even in their pamphlets many makers give only very small-scale characteristics, and there is one make of valve at least of which I have never been able to obtain a curve at all! The Marconi-Osram valve combination do have reasonably large-scale curves, obtainable in a loose-leaf folder about the size of *The Wireless World*. It was originally sold, years and years ago, by Marconi's, for 5s., and by writing to them I can get the loose leaves for new types of valve. This is, so far as I am aware, the *only* maker who supplies his characteristic curves in a form that can be kept on a bookshelf for reference, instead of a microscopic curve in a scrubby pamphlet that is impossible to keep. As a result, if I want a valve of a particular type, I look in the Marconi-Osram list, where I generally find what I want, and the other makers only get tried as an occasional experiment. (So far as I can recall, the only valve that I cannot find a practical equivalent for in this list is the B.T.H. R.H.I. rectifier, which will stand 550 volts on the anode.)

Makers realise that the majority of their sales are to the "Broadcast listener," and they imagine he is a fool that cannot understand sufficient "technical information" to realise that the curves tell him all about the valve. In this I can assure them they are mistaken; the average "Broadcast listener" knows at least as much about it as the average assistant in the smaller wireless retailer's! And, even if he is rather ignorant, tell him about it in the advertisement (it is quite simple) instead of giving him what is obvious to the veriest idiot as a mere advertising "stunt." C. R. COSENS.

Cambridge.
March 16th, 1928.

EMPIRE BROADCASTING.

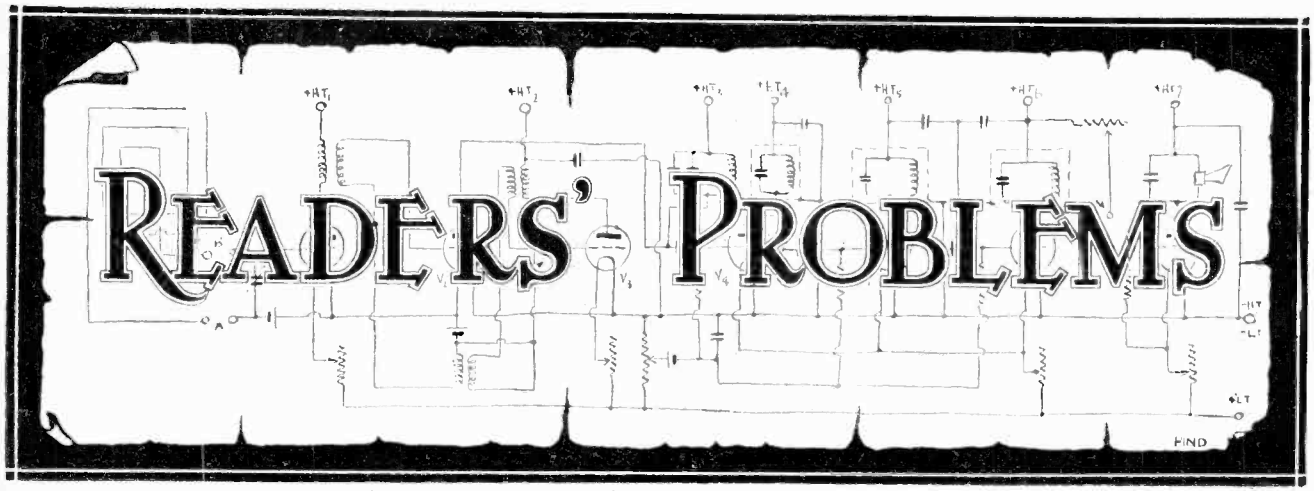
Sir,—I enclose newspaper cuttings showing that interest in the short-wave broadcasts has by no means died. The letters received by CFCA prove this, although station CFCA's attempts at relaying 5SW are very poor compared with re-broadcasts by WMAK at Buffalo, N.Y.

It is interesting to note that these relays are made possible by manufacturing concerns as an advertisement for various products.

Surely here is a solution of the problem of who shall support 5SW. Remembering some of the excellent programmes put over by some leading newspapers through 2LO a year or so back, we should get a good bill of fare.

However, before we can expect firms to pay for programmes 5SW must have more power or better radiation, so that manufacturers can be sure of their stuff getting over. My letter is mainly an appeal to let 5SW live, no matter what measures have to be taken. C. ROBINSON.

Toronto, Ontario, Canada.
February 23rd, 1928.



READERS' PROBLEMS

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

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

Incipient Oscillation?

I am troubled by "coarse" reproduction from my receiver, which is a 1-V-2 set, the circuit of which is shown on the attached sheet. This is evident on all transmissions, and I am fairly confident that it is not due to resonance in the loud-speaker, as I have been able to try several different types. Can you suggest the cause and cure of the trouble? M. T. L.

It is rather difficult to offer helpful advice in cases of this kind. We have examined your circuit diagram, which is quite in order, and we are inclined to think the trouble is in all probability caused by low-frequency reaction, brought about by inter-stage coupling due to a resistance in the high-tension battery. In cases of this kind, the various cures for low-frequency oscillation which have been suggested from time to time in the pages of this journal should be applied. In particular, we think that the addition of a choke-filter output circuit, of the type in which one side of the loud-speaker is joined to L.T. negative, should be helpful in putting matters right.

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Batteries or a Mains Unit.

I have a good three-valve set, which gives satisfactory results when dry batteries are used, but when these are worn out I propose to purchase an H.T. D.C. battery eliminator. I have not had previous experience with these units, and would hesitate before installing one if I thought that the performance of my set would be impaired by doing so. Can you, please, give me the benefit of your experience on this question? B. H.

Generally speaking, most receivers will function satisfactorily with an H.T. battery eliminator, and under certain conditions will give better results, this being due to the higher voltage available for the output stage, which enables the best results to be obtained from a super-power valve. When the supply mains are used for this purpose, it is necessary to include a condenser between the earth and the earth terminal of the receiver; however, most commercial units incorporate this condenser, and two terminals are provided, of which one should be connected to earth and the other to the terminal marked "E" on the set. In cases where facilities permit, we would recommend the use of a loosely coupled aerial circuit having no direct electrical connection to the remainder of the receiver; this isolates the earth from the supply mains, and will be an additional safeguard to meet the conditions of a supply system with the positive conductor earthed.

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Wireless and a Car.

I have a four-valve receiver (1-v-2), the high-frequency stage following closely that of the "Regional Three" receiver, and this I propose to modify so that it can be used with a frame aerial in a motor car. I propose to fix the frame under the hood of the car in a horizontal position, the space available being 6ft. × 3ft. Can you give me, please, an indication of the number of turns required to cover the medium broadcast wave band? W. H.

As you propose to fix the frame horizontally, the pick-up will be practically nil with a frame of orthodox construction, and it is our considered opinion that considerably better results could be obtained by the adoption of the following arrangement. In place of frame aerial, a number of wires should be attached to the underside of the hood, and these should be connected together at both ends. These wires should be well insulated at all points with, of course, the exception of where they are joined together, and from one end an insulated wire should be taken to the aerial terminal of the receiver, the earth terminal being connected to some convenient part of the metal work of the chassis. This arrangement will give better results than a frame with a receiver of the type you propose to use, and, moreover, it will not possess the same directional properties as that of a frame, which, we think, would be undesirable in your case. Alternatively, you could employ the arrangement discussed in the "Motorist's Portable Receiver," which was described in *The Wireless World* for May 11th, 1927.

RULES.

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

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

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

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

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

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

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

A Valve Rejector.

I should be obliged if you would give me some advice on valve rejector circuits, as I propose to add the arrangement shown on the enclosed diagram to my Reinartz receiver. Is there any method whereby the valve rejector could be more usefully employed?
T. S.

The arrangement shown by our correspondent is reproduced in Fig. 1, in which V_1 is the rejector valve and V_2 the detector. The number of turns in the rejector inductances is shown.

The arrangement would certainly function, and, although modifications could be suggested, we doubt if they would result in any very considerable improvement. It seems likely, however, as the arrangement is by no means free from complication, it would be much better to use the extra valve as a high-frequency amplifier. This would not cost appreciably more in the first place, and the upkeep would be about the same, while a higher degree of real selectivity should be obtained.

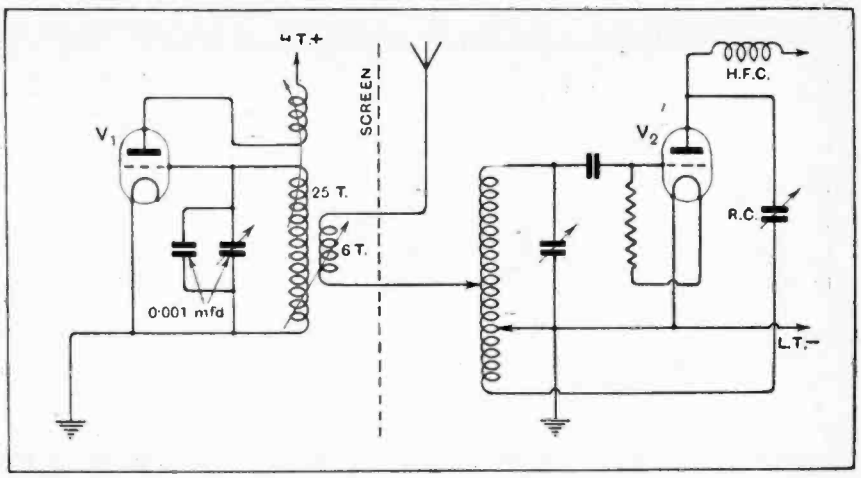

Fig. 1.—A separate valve rejector circuit.

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Detection Without H.T.

I notice when disconnecting the H.T. plug which supplies the detector valve of my "Everyman Four," that signals still come in strongly, and conclude that something must be wrong. It occurred to me that there might be a leakage between the adjacent H.T. terminal and that connected to the detector anode, so I applied a voltmeter between the end of the anode resistance and H.T. negative, still with the plug disconnected. Signals stopped at once, and there was no deflection on the meter, so I assume there is no appreciable leakage. Can you suggest what is wrong? C. D. A.

In all probability there is nothing wrong. The detector valve has a high resistance in its anode circuit, and, moreover, is of high impedance. The result is that the consumption of H.T. current is extremely small, and the valve will function for quite an appreciable period on the charge accumulated in the H.T. by-pass condenser. When you connected your voltmeter, this charge was at once dissipated, and, of course, signals disappeared immediately.

It is just possible, however, that your anode resistor has increased its resistance very considerably. This would be indicated by the fact that comparatively weak signals do *not* begin to fade away until appreciable time has elapsed.

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A Reaction "Snag."

I have a receiver embodying the Reinartz circuit, and, wishing to increase the selectivity, added a stage of H.F. amplification. The results were disappointing, in that I cannot now obtain any regeneration effect, and increasing the capacity of the reaction condensers actually weakens signals. Can you, please, tell me how to correct this? I enclose a diagram of the circuit. H. C. H.

By interposing a stage of high-frequency amplification between the aerial circuit and the detector valve, it will be no longer possible to obtain reaction by feeding back energy, via the condenser, from the detector to the aerial in the manner previously adopted. The sense of the feed back is incorrect, as the inclusion of the high-frequency valve has resulted in a phase shift of about 180°, and we are not surprised to hear that increasing the capacity of the reaction condenser leads to a weakening of signals. We notice that you are using the tuned anode method of H.F. coupling, and suggest that the most satisfactory method of applying reaction would be to adopt the arrangement shown in the diagram on page 804 in *The Wireless World* of December 14th, 1927.

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A Bad Patch.

I live near to a telephone exchange, and, in addition, there is an electric motor within a short distance of the room in which I propose to instal a receiver. I am told that some interference may be experienced from these, and should be obliged for any advice you can give to enable me to receive broadcast with the minimum of interference. T. E. M.

In view of your proximity to so much electrical apparatus, a certain amount of interference will be inevitable; however, this can be kept down to a minimum by using a receiver possessing just sufficient sensitivity for your requirements. Under these conditions, we would not recommend the use of high frequency amplification, but suggest that something on the lines of the "Quick-Change Broadcast Receiver" described in *The Wireless World* for February 15th last would be the most suitable set to instal.

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Positive or Negative Bias.

Will you please show me how a single tapped grid bias battery can be connected in order that a positive or negative bias may be applied at will to the grids of any of the valves in the set? S. T. V.

The arrangement you require is shown in Fig. 2. You will see from this that instead of joining the L.T. negative to the positive end of the grid bias battery, as is usual, this is connected to a point on the battery removed by a few tappings from the positive end. Thus the grid of any valve can be made positive or negative with respect to the negative end of its filament; in practice, of course, a positive bias is seldom applied to any valve other than a grid current detector.

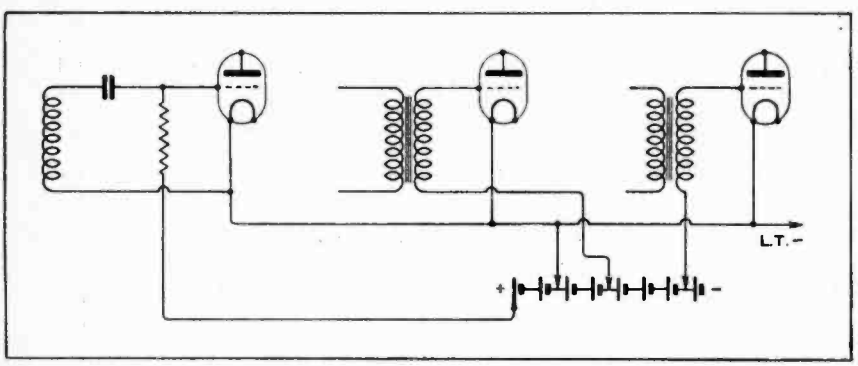

Fig. 2.—The application of positive or negative bias from a single bias battery.