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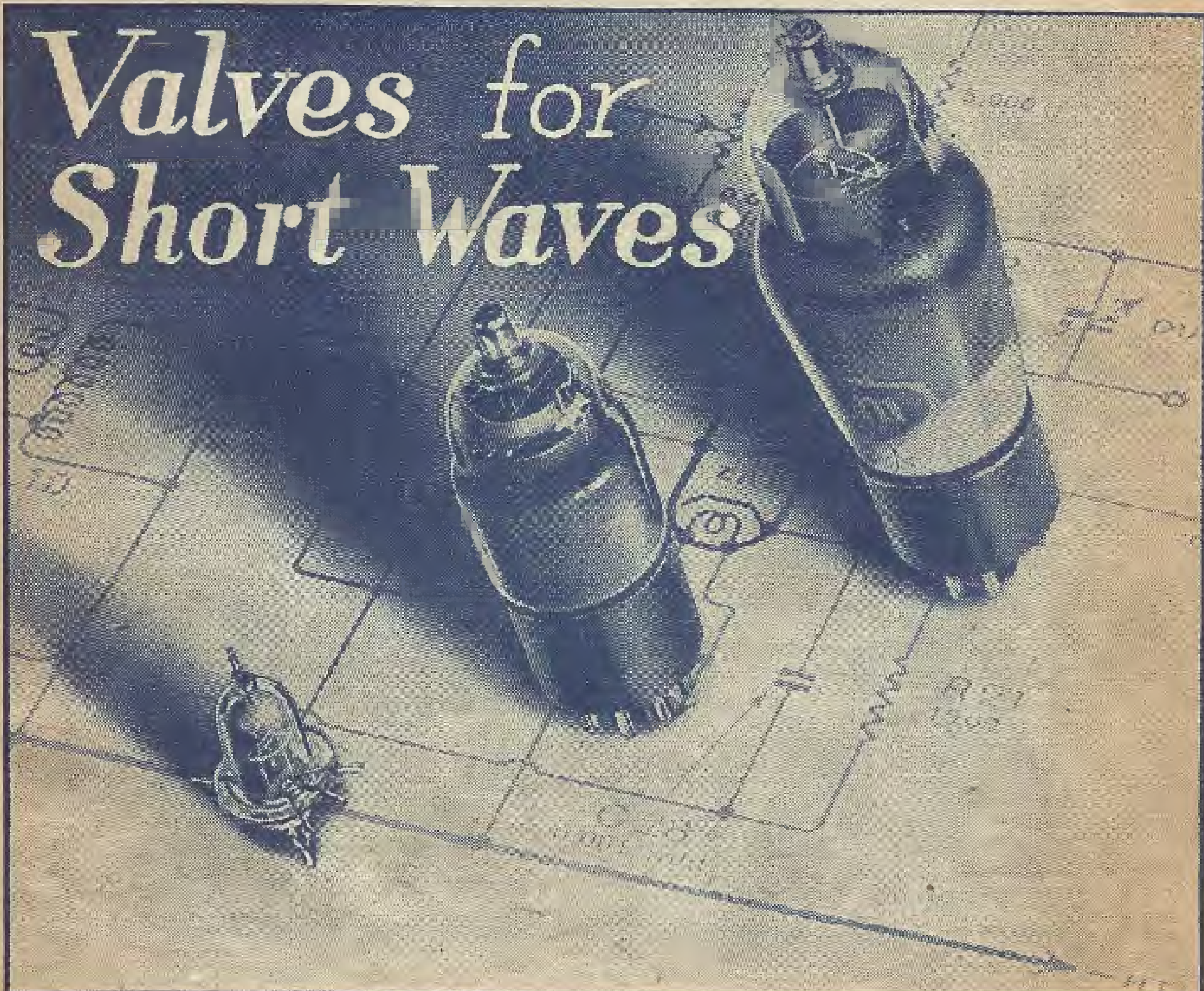
COVERING EVERY WIRELESS INTEREST

FEBRUARY, 1940



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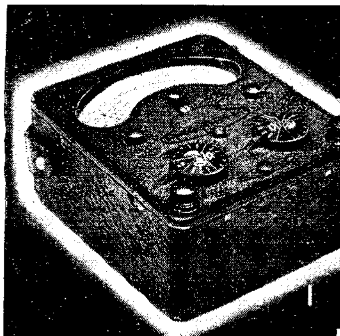
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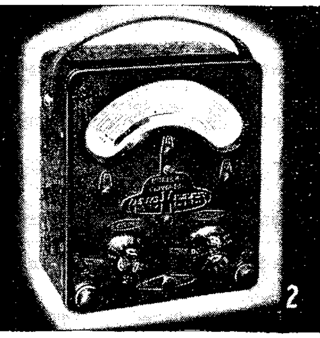
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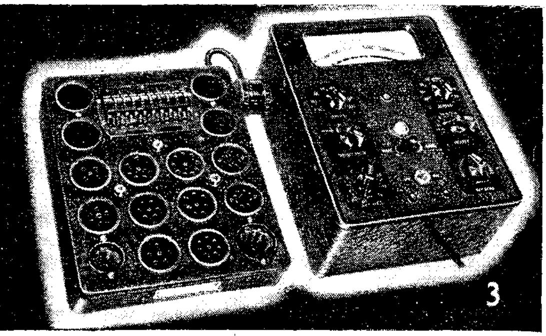
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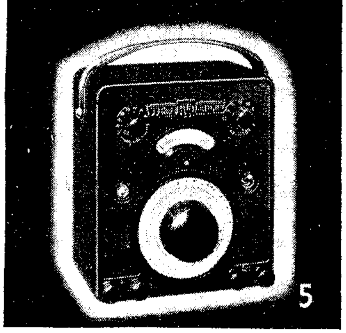
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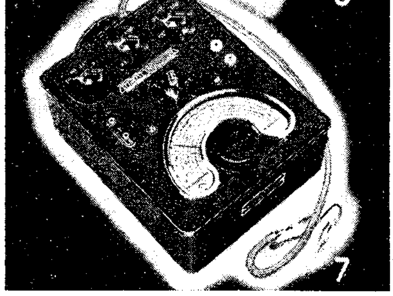
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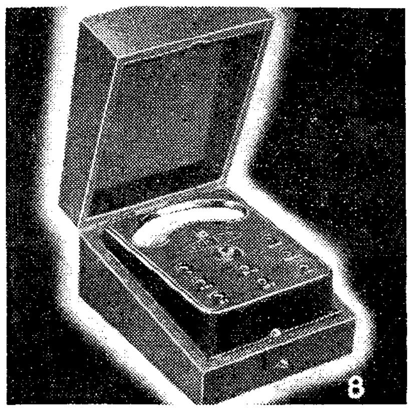
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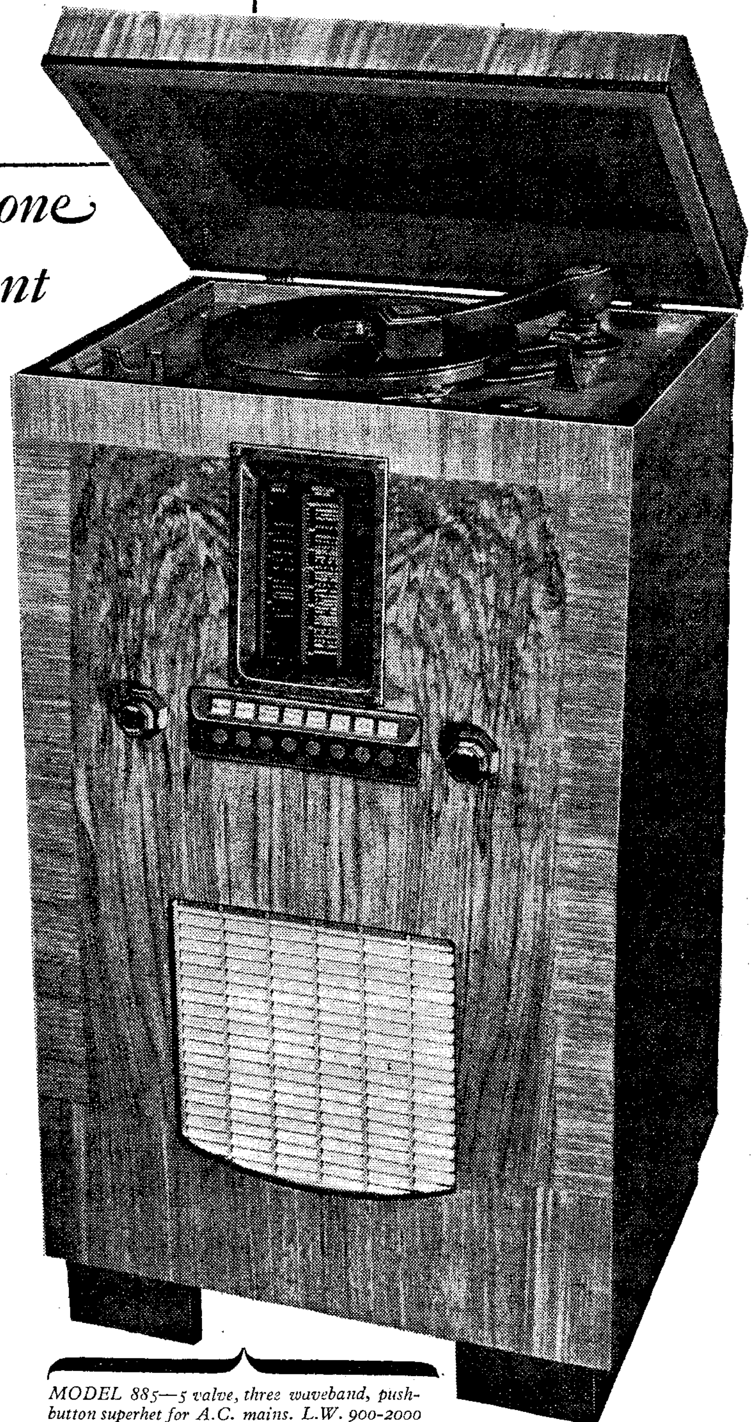

The
Wireless World

COVERING EVERY WIRELESS INTEREST

29th Year of Publication

Proprietors : ILIFFE & SONS LTD.

Editor :
HUGH S. POCOCK.

Editorial,
Advertising and Publishing Offices :
DORSET HOUSE, STAMFORD STREET,
LONDON, S.E.1.

Telephone : Waterloo 3333 (50 lines).
Telegrams : "Ethaworld, Sedist, London."

COVENTRY : 8-10, Corporation Street.
Telegrams : "Autocar, Coventry." Telephone : 5210 Coventry.

BIRMINGHAM :
Guildhall Buildings, Navigation Street, 2.
Telegrams : "Autopress, Birmingham." Telephone : 2971 Midland (5 lines).

MANCHESTER : 260, Deansgate, 3.
Telegrams : "Iliffe, Manchester." Telephone : Blackfriars 4412 (4 lines).

GLASGOW : 26B, Renfield Street, C.2.
Telegrams : "Iliffe, Glasgow." Telephone : Central 4857.

PUBLISHED MONTHLY.
Price : One Shilling
(Publication date 20th of preceding month.)

Subscription Rates :
Home and Abroad, 14/- per annum.

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

No. 1052 VOL. XLVI No. 4

FEBRUARY 1940

Contents

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COVERING EVERY WIRELESS INTEREST

ESTABLISHED 1911

No. 1052. Vol. XLVI. No. 4 FEBRUARY 1940 Price One Shilling

Editorial Comment

Broadcasting and the Press

DURING the early days of the war it became evident that the Press of this country resented competition from the B.B.C. in the dissemination of news. In commenting on this matter at the time, we expressed the hope that competition would give way to collaboration and, by modifying their methods to suit changed conditions, each party would use its own channel of news presentation to serve the best interests of the public.

Wireless people might be expected to hold the view that an unlimited increase in the power and influence of broadcasting, at the expense of the Press, would be no bad thing. But to do so would be short-sighted; the two services should be complementary, and a strong and virile Press is just as vital as it was before the days of broadcasting. A public that absorbed all its topical information through the ear would lose some of its powers of critical judgment, and would be easily lead along wrong paths by any smooth-tongued demagogue who managed to gain access to the microphone. An important difference between the spoken and the printed word is that one can absorb the meaning of the latter at one's own pace, going back to check facts or to ponder at will over suspected contradictions.

One of the most important tasks that awaits Sir John Reith, the newly appointed Minister of Information, is to smooth away differences that have arisen between the Press and broadcasting, and to help both of them to keep this country—and indeed the whole world—well informed. Veiled suggestions have been put forward that a handicap should be imposed on the B.B.C. by occasionally withholding "scoops" from the Corporation for long enough to allow prior publication in the newspapers. We do not think that Sir John will for one moment lend an ear to these proposals; such artificial and Canute-like attempts to offset the natural advantages enjoyed by broadcasting in the rapid dissemination of news can only result in failure, and, more important, cause a decline in confidence in our National information service.

Sir John Reith has been associated with broadcasting long enough to be attuned to the speed of modern communication, and, in particular, to have a knowledge of the all-pervading influence of short-wave wireless. We have long felt that the wireless man's outlook, which must in the nature of things be a wide one, has not been sufficiently in evidence at the Ministry of Information, and Sir John's appointment is therefore a matter for satisfaction and congratulation.

So far there are few signs of collaboration between Press and broadcasting, and still fewer indications of those changes in technique on both sides for which we have pleaded. To suggest ways and means is beyond our province; that is a matter for specialists. Some of the possibilities of collaboration are examined in Mr. Wickham Steed's book "The Press." The author, a former editor of *The Times*, contends that the B.B.C. news service does not necessarily conflict with the function of the newspapers, and that the two channels of news distribution should be supplementary. It is interesting, though perhaps not strictly pertinent to our present subject, to see that Mr. Steed considers the broadcasting of news and views as a "wholesome influence" that may be helpful to the Press.

The world is sorely in need not merely of news but of guidance; it would be a tragedy if the two main channels failed through mutual jealousy or bickering to give of their best.

Short-wave Valves

ADVANTAGES OF SPECIALISED TYPES

By F. E. HENDERSON, A.M.I.E.E. (Osram Valve Dept., The General Electric Co., Ltd.)

Certain effects that are quite innocuous on medium or long wavelengths are liable to give trouble when dealing with short waves. It is shown how these troubles may be minimised by the use of valves specially designed for short-wave working

THE study of short-wave radio communication goes back very many years, but it is only comparatively recently that ordinary broadcasting sets have been produced for operation over the bands of frequencies corresponding to what are commonly described as "short waves," and generally understood to represent wavelengths below 100 metres. Actually, in commercial practice 100 metres is now considered to be almost "long waves," and the fun really starts when the operating wavelength is extended to below the 15-metre mark. Difficulties in apparatus design and operation go up by leaps and bounds as we descend the wavelength scale still farther, and to obtain a true idea of what we have to deal with it becomes essential to cease talking in wavelengths and become accustomed to think in terms of frequency—millions of cycles, or *megacycles,* per second.

As an example, how many readers realise that the difference between, say, 2 and 2½ metres—only half a metre in terms of wavelength, represents a *frequency* difference of no fewer than 30 megacycles or 30 million cycles per sec.!

Admittedly, few readers will find it necessary to operate at wavelengths as low as this, but many may have begun to experience the difficulties and unusual precautions associated with ultra-high frequency working when television was launched upon us with all its attendant interests and problems.

To obtain an appreciation of the reasons why short waves bring problems of increasing difficulty in their train, these difficulties going up more and more steeply as the wavelength goes down, some knowledge of the effect of very high frequencies both on circuit values, designs and materials must be available.

There are many aspects from which the complete picture can be viewed, and each component part requires a separate study in itself as to how it is affected by being required to operate at HF voltages, or to carry currents with minimum loss at very high frequencies.

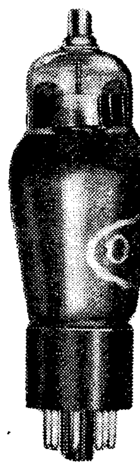
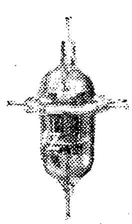
In this article we intend to look at the problem from the point of view of one component—the *Short-wave Valve*. Further, as the average reader's interest in the valve is necessarily restricted at the present time to receiving conditions, the scope can without disadvantage be narrowed down to exclude all the additional problems involved in transmitting conditions, but even so, the demands for reasonable efficiency in the receiving valve and circuit involve no little care in design and application.

Let us ignore for the purpose of this discussion the "ultra-highs" or "micro-waves" as being of small practical interest to the normal reader and consider for our present purpose the realm of short waves lying between, say, 40 metres (7.5 megacycles) and 5 metres (60 megacycles).

What are the principal points to watch in the design of a receiving valve to function satisfactorily at such frequencies, and what are the effects of different designs on the associated circuits?

When a valve is used to amplify a voltage

TABLE 1

	NORMAL RF PENTODE (KTW 63) Mutual conductance ... ... 1.5 mA/volt Input capacity ... ... 4.5 $\mu\mu$F Input impedance at 40 Mc/s ... 13,000 ohms
(To same scale) 	"ACORN" PENTODE (ZA 1) Mutual conductance ... ... 1.4 mA/volt Input capacity ... ... 3.0 $\mu\mu$F Input impedance at 40 Mc/s ... 50,000 ohms

Comparison of input impedance between R.F. pentode of normal design and pentode of comparable mutual conductance but "scaled down" electrodes and short leads.

Short-wave Valves—

developed across a tuned circuit, as in an RF amplifier, the valve itself may introduce several different effects, all of which tend to have an effect on the voltage existing across the tuned circuit in some way or other.

First, there is the purely shunting effect of the valve resistance, which is in parallel with the input circuit and causes damping, with resultant loss in efficiency. The valve characteristic which introduces this damping is called *input impedance,* and becomes of great importance on short waves. This is because the effective value of the shunt resistance decreases in proportion to the square of the frequency.

The input impedance of a valve may be affected by two features:—

(a) The "transit time" of the electrons.

(b) The inductance in the cathode lead.

It would be obviously absurd to spoil a high efficiency tuned circuit by shunting it by a resistance unless a wide band of frequency coverage were required at the expense of selective amplification.

Therefore, two of the aims in design of modern short-wave valves are to reduce the effect of electron transit time and to minimise the cathode lead inductance.

First, then, *transit time.* This may be taken as the relative time taken for an electron to travel across its controlled path, and for the potentials affecting it in this path to change in magnitude or direction. If this time period of changing potentials is very small, it is conceivable that a given potential may completely reverse in phase while the electron is in transit. It is necessary, therefore, to design a short-wave valve such that the electrons are made to traverse the cathode-to-anode distance in as short a time as possible.

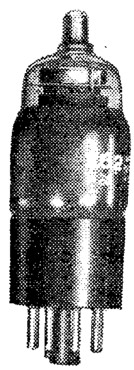
This may be done:—

(1) By reduction in the clearances between the electrodes.

(2) By increasing the accelerating voltage; this raises difficult problems of insulation and in the necessary supply of high voltages in the receiver HT circuits.

A reduction of electrode clearances naturally introduces mechanical difficulties into the manufacture of the valve, but results in an increase in its mutual conductance. Improvements in manufacturing technique have enabled such reduction in clearances to be achieved, and in short-wave valves this may be utilised by employing a shortened electrode system with the advantages of reduced electrode capacities and, at the same time, entailing no sacrifice of mutual conductance.

TABLE 2

 KTZ41	NORMAL RF PENTODE (Low Slope Type) (KTW 63)	NORMAL RF PENTODE (High Slope Type) (KTZ 41)
	Mutual conductance, 1.5 mA/volt... Input impedance, at 40 Mc/s ... 13,000 ohms	... ... 7.5 mA/volt ... ... 1,800 ohms
 Z62	RF PENTODE WITH SHORT SEAL (Low Slope Type) (KTW 73)	RF PENTODE WITH SHORT SEAL (High Slope Type) (Z 62)
	Mutual conductance, 1.7 mA/volt... Input impedance, at 40 Mc/s ... 20,000 ohms	... ... 7.5 mA/volt ... ... 4,000 ohms

Comparison of input impedance in RF pentodes of comparable mutual conductance, normal and short seal designs. (For the same values of input capacity and lead inductance, the input impedance is inversely proportional to the mutual conductance.)

The table (No. 1) shows a comparison between two typical RF pentode valves of comparable mutual conductance, and indicates how the "scaled-down" electrode system of the specialised short-wave valve effectively increases the input impedance at high frequencies. It will be noticed that in spite of the reduced clearances the inter-electrode capacity of the "Acorn" is not increased.

Secondly, we come to the effect of the cathode lead. This lead wire has an inductance which, small though

Short-wave Valves—

it may be; represents a very appreciable impedance at high frequencies.

The cathode lead is, therefore, in effect, an inductance common to both grid and anode circuits; thus a component of the anode current produced by the grid voltage results in a voltage being developed across the cathode lead inductance which is out-of-phase with the grid voltage.

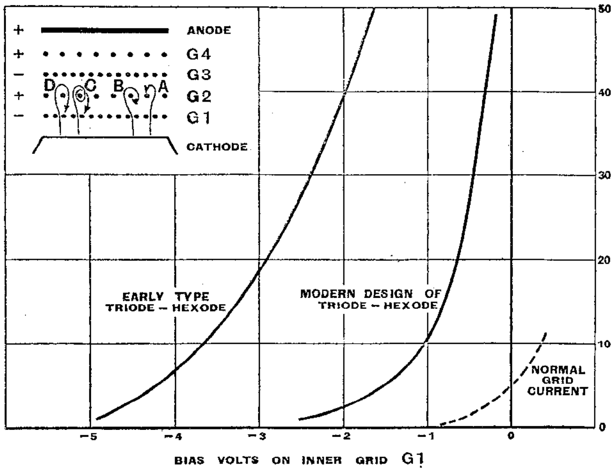


Fig. 1.—"Transit time" grid current in a triode-hexode operating at 20 Mc/s. The majority of the electrons follow paths such as A and B in the inset diagram, but a small proportion follow paths C and D, thus giving rise to a current in the circuit of the grid G1.

If the impedence of the grid-cathode path were low, such out-of-phase voltage would introduce serious damping across the input tuned circuit, and, unfortunately, it is not possible to ignore such an impedance between the grid and cathode, due to the interelectrode capacity of the valve called the *input capacity*.

Development of short-wave valves, therefore, must also take into account reduction in the grid-cathode capacity if the out-of-phase voltage developed in the cathode circuit is not to be reflected back to the grid circuit with resultant damping. This effect is *in addition* to any effect resulting from the grid-cathode capacity in itself.

The relative effects of the grid-anode and the grid-cathode capacities depend upon the voltages produced; at long waves, or as we approach audio-frequencies, the effect of the cathode impedance normally becomes negligible, and then the grid-anode capacity becomes of prior importance, particularly as the voltage developed across the load circuit can be increased due to higher efficiency tuned circuits, and "feedback" through the grid-anode capacity is a limiting factor.

Table No. 2 shows the relative effects on input impedance by a considerable reduction in cathode lead inductance, resulting from a shortened electrode system. A comparison is given both in the case of the low-slope and in that of the high-slope classes of RF valve, two well-known types being used as examples.

A type of valve which requires special care in design for efficient short-wave operation is the frequency changer. The type of frequency changer most favoured for this purpose is the triode-hexode multiple valve, or variations of this principle.

In this form of frequency changer the signal is applied to the inner grid in proximity to the cathode, and the oscillator voltage injected by means of a further grid which is joined to that of the local oscillator. It is not, of course, necessary for the oscillator and mixing sections of the valve to be contained in the one envelope, but from the points of view of economy in space and cost, and of facilitating set design, this is commonly done. Sometimes it is desirable for the oscillator to be separate—that is, to operate on a separate cathode system—as will be seen later.

In the triode-hexode class of valve, the coupling between signal and oscillator circuits may be made very small, and "interaction" between them be reduced to a minimum. This effect, often referred to as "pulling," is well known with certain designs of frequency changers unsuitable for use at short wavelengths.

Having minimised this by suitable design, however, there remains the important effect of electron transit time.

The nature of this transit time effect in short-wave operation is indicated by Fig. 1.

In short-wave frequency changers it is important that the time taken by the electrons in transit between screen and oscillator grid should be as short as possible. This time may be minimised by reducing the oscillator grid-to-screen clearance.

If the oscillator frequency—that is, the time taken for one complete reversal in potential in this space—is comparable with the time taken by an electron in traversing this space, the electron will be driven back to the control grid, the accumulative effect of which is to increase the control grid bias and reduce the effective gain in the valve.

Reduction in oscillator grid-to-screen clearance to overcome this effect naturally increases manufacturing difficulties. With such precautions in design, however, the gain of the valve may be made the same at 30 Mc/s as at 1 Mc/s.

TABLE 3

TRIODE-HEXODE VALVES. HEATER WATTAGE	CHANGE IN OSCILLATOR GRID-EARTH CAPACITY
4.8 (Type X 41)	0.25 μμF
2.0 (Type X 65)	0.1 μμF

Effect of heater wattage on "drift."

One more aspect of the problem is *frequency drift*. This may become important, and is due to a change in the capacity of the valve due to changes in the mechanical dimensions and in the dielectric constant of the base, both of which are caused by changes in temperature.

Short-wave Valves—

The two ways of counteracting this effect are:—

(*a*) Reduction in the inherent electrode capacities.

(*b*) Operation at the minimum temperature.

When a receiver is switched on, the cathode of the valve may reach a steady temperature in less than half a minute, but it may take half an hour or more for the whole electrode system to do likewise. This effect becomes more troublesome with an increase in frequency.

Table No. 3 shows a comparison of the change in the oscillator grid-to-earth capacity of typical valves of different heater wattages, so that, in general, the lower the heater voltage the smaller are the capacity changes, and, therefore, the frequency drift of the oscillator with time. This drift may sometimes be reduced by the use of a separate oscillator (referred to above), as in such a case the oscillator grid may be tapped down on the oscillator circuit, and so the effect of drift minimised.

As the development of short-wave valves proceeds apace, the reader will be able to follow from the arguments given in this article the reasons underlying various fundamental features in the design of new-type short-wave valves as they appear.

Henry Farrad's Problem Corner

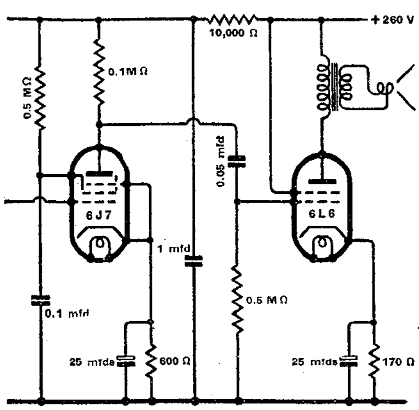
No. 43.—The Obduracy of an Amplifier

An extract from Henry Farrad's correspondence, published to give readers an opportunity of testing their own powers of deduction:—

100, Quality Street,
Raisley.

Dear Mr. Farrad,

Thank you for helping me with the tone corrector in my amplifier.* I have shifted it to an earlier stage, as you suggested, so that there is a high-gain stage between it and the output valve. The latter is now quite conventional, as shown in the diagram herewith. But when I had finished it, there was a complete absence of results.



Checking things over with the Avometer, I found zero voltage between anode and cathode of the valve; and working from this clue I traced a dud connection to the output transformer. Repeating the voltage test to make sure that I had cleared the fault, I was surprised to get a reading of only 110 volts on the 600-volt range. Leaving the meter connected I poked about for some considerable time, but found no further fault, until I spotted that the meter had been connected to the wrong tag on the valve-holder—I have never been able to remember valve base connections since the octals came in—and when I corrected this matter the reading was fully up; in fact, rather more than usual. But even now the thing won't work properly, although I have been over every connection and component about half-a-dozen times, and am fed up. It is noisy and gives practically no output. Have you any further helpful suggestions to offer? If so, I would be grateful.

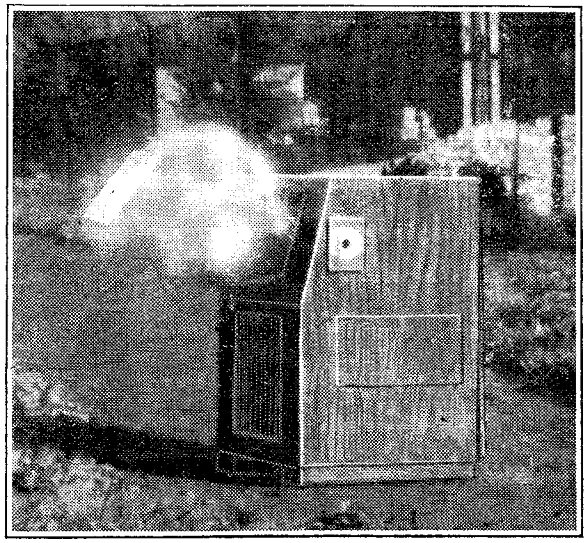
Yours sincerely,
Mark Linyer.

What is wrong? *Turn to page 132 for Henry Farrad's solution.*

**The Wireless World, August 3rd, 1939.*

CR Tubes and Implosion

IT is generally known that in the case of large cathode-ray tubes such as are used in television sets there is some slight risk of the costly tube shattering, due to an inherent



In the tests, tubes were shattered by a rifle bullet fired through a hole coinciding with the bull's-eye of the target which can be seen on the side of the cabinet. In this case, the glass screen was obviously of inadequate strength.

mechanical defect, or to its receiving a severe blow on the front, which is the weakest part of it. The reason for this is, of course, that the tubes are pumped to a high degree of vacuum, with the result that there is a considerable pressure on the glass walls, more especially the front wall, tending to cause them to collapse inwards, or "implode," as it is usually termed. Great care is taken in the manufacture of the tubes, and there is a sufficient degree of curvature of the front wall to minimise this risk of implosion. It is considered desirable, however, in order to make assurance doubly sure to mount the tube behind a protective glass screen, since if implosion does occur fragments of glass collapsing inwards attain sufficient velocity to overshoot the mark and scatter in all directions.

Experiments in the Kolster-Brandes laboratories have, according to a recent article in *Electrical Communication*, shown that for absolute safety, "armour-plate" glass having a thickness of not less than a quarter of an inch should be used. In the case of experiments in which several tubes were deliberately imploded it was found that ordinary plate glass and other materials afforded insufficient protection.

Loud Speaker Design

FREQUENCY CHARACTERISTIC TO COUNTERACT ROOM EFFECT

A recent paper addressed to the Wireless Section of the Institution of Electrical Engineers makes an important contribution to our knowledge of the acoustics of small living-rooms, and the data given in the following abstract should prove of value to all interested in quality reception in the home

THE sound from a loud speaker working in a small room does not disperse freely into space like the energy from, say, a public-address loud speaker in the open air. Some of it is rapidly absorbed in the walls and furnishings, especially that which is contained in the high-frequency components of the sound. The low frequencies, on the other hand, may be reflected from the walls, floor and ceiling many times before they disappear, and at each reflection will reinforce the direct sound heard by a listener. In fact, the room should be regarded as an essential part of the sound-reproducing system.

It follows that a different type of frequency characteristic will be required for correct tonal balance in a room than for listening at a point on the axis of the loud speaker in the open air. Just what that difference should be will depend not only on the absorption characteristic of the room and its furnishings, but also on the position of the listener and the ratio of direct to reflected sound at that point. The best that can be done is to strike an average for a typical living room and take this as the basis for the specification of the loud speaker characteristic.

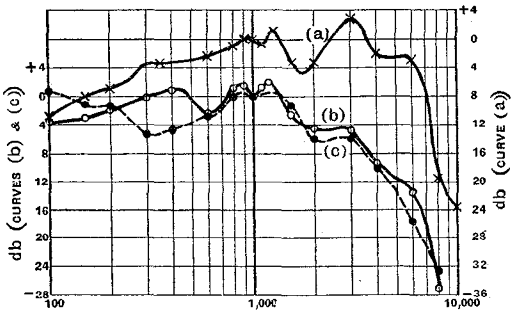


Fig. 1.—Response of typical loud speaker with enclosed back (a) on axis in free space, (b) mean spherical response in free space, (c) average sound pressure in typical furnished living-room measuring 24ft. × 12ft. × 11ft. 6in.

Loud Speakers with Enclosed Backs

The formidable task of making a statistical survey of the sound pressure at different points in a room for different positions of the loud speaker has been undertaken by W. West, B.A., and D. McMillan, B.Sc., of the Post Office Engineering Department, and their findings are given in a recent paper.[1]

The type of loud speaker selected for study was that in which the back of the cabinet is totally enclosed to suppress radiation from the back of the diaphragm (the so-called "infinite baffle"). Apart from the improved bass response obtainable with this type of baffle, the investigations were simplified by the elimination of the second source of sound. It was found that for a given size of baffle and diameter of diaphragm a simple relationship existed between the axial response and the mean spherical response in free space.

The latter curve was obtained by calculation from the combined curves taken at 0, 30, 60, 90, 120, 150 and 180 degrees off the axis of the diaphragm.

Average Sound Pressure in Room

Next the loud speaker was set up in a "typical living-room," the acoustical characteristics of which were adjusted so that they were judged to be similar to those commonly found in the rooms of dwelling-houses. The loud speaker was fed with a "warble tone" with a frequency variation of ±20 c/s, five times per second. Measurements of sound pressure were then made, using a 4ft. wire cube to locate the positions of the calibrated microphone. Readings were taken at the eight corners, and the centre of the cube, and measurements, expressed in decibels, were averaged arithmetically. After lengthy investigations it was found that three different positions of the locating frame for each of two positions of the loud speaker gave a stable average which could be repeated within 2 db at any individual frequency. Each point on the curves of frequency response in the room thus represented at least 54 microphone readings.

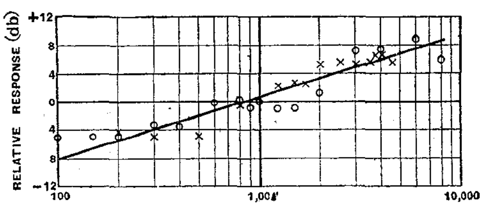


Fig. 2.—Results of analysis of two loud speakers with enclosed backs showing axial response relative to constant mean spherical response. An average rise of output of 2.5 db per octave, measured on the axis, is required to give constant mean spherical response, and hence constant average sound pressure in a typical room.

[1] "The Design of a Loud Speaker," allocated for reading before the Wireless Section of the Institution of Electrical Engineers on 6th December, 1939.

Loud Speaker Design—

The group of curves in Fig. 1 represent a complete investigation for one loud speaker. It will be seen that the average sound pressure in the room is related not to the axial sound pressure but to the mean spherical pressure in free space. The same experiment repeated for other loud speakers and rooms produced similar results.

The next step was to establish the relationship between the axial response and the mean spherical response in order that a single curve might be used as a criterion of the performance to be expected in a room. Accordingly, a number of sets of curves were analysed, and a mean curve drawn through the points obtained. These showed (Fig. 2) that for the type of loud speaker under discussion the axial response curve rises approximately 2.5 db per octave relative to the curve of mean spherical sound output, and that a single curve taken in the axis and showing a progressive rise of output with frequency of this amount may be taken as evidence that the loud speaker will produce constant average sound pressure when used in the average living-room.

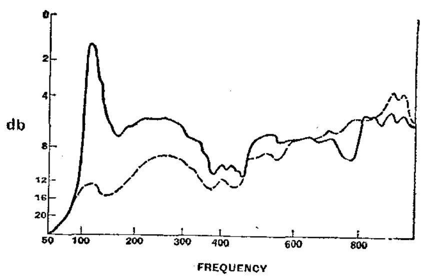


Fig. 3.—Response curves of loud speaker with closed case, full line without damping, dotted line with cotton wool 1 inch thick wrapped round the back of the loud speaker unit.

It is emphasised that this relationship holds only for loud speakers with totally enclosed backs and a diaphragm diameter of about 7 inches, and the design of this type is dealt with in some detail. It is pointed out that the diaphragm resonance will be determined principally by the volume of the air enclosed in the space behind the diaphragm, and a useful formula is given for calculating the resonant frequency on the assumption that the stiffness of the diaphragm centring devices is small relative to that due to the enclosed air. The formula is:—

$$f_0^2 = \frac{A^2\rho c^2}{4\pi^2 m v}$$

Where f_0 = resonant frequency, A = effective area of diaphragm, ρ = density of air, c = velocity of sound in air, m = mass of diaphragm with coil attached, v = volume of enclosed air.

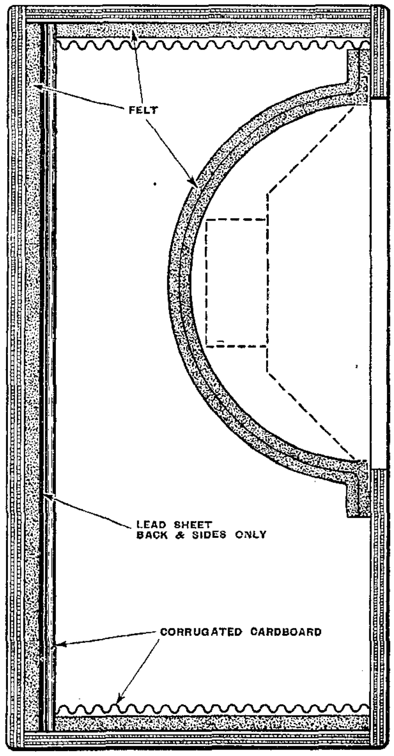
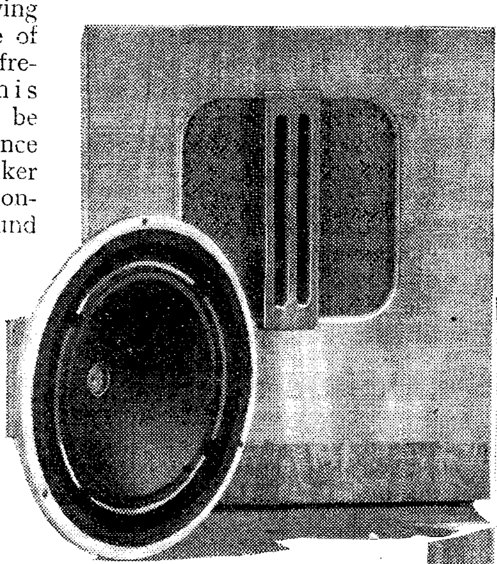
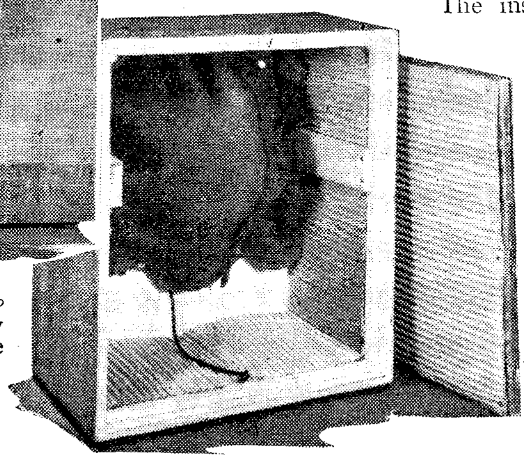


Fig. 4.—Section of loud speaker casing suggested as the result of experiments. The lead sheet is used on the back and sides only, while the felt and corrugated packing paper are applied to back, sides, top and base. The outer case is made from ⅜in. plywood and measures 16in. high × 14in. wide, 8½in. deep, and has an aperture 8in. in diameter centred 6in. from the top of the case.

Wireless World Photo

Specimen loud speaker submitted by a contractor to the Post Office specification.

Without adequate damping the amplitude developed at the main resonance may be considerable. In the specification put forward by the authors (for mass production at reasonable cost) the damping is mechanical and is provided by layers of felt near the back of the diaphragm, where the air displacement is greatest. The curves of Fig. 3 show the effectiveness of this method in practice.

The inside of the case is lined with felt and lead sheet (8oz. per sq. ft.) to ensure complete absorption at low frequencies, and the inner surface is composed of corrugated paper, presumably to scatter and break up internal reflections at high frequencies.

Detailed dimensions are given in the original paper but as they relate to a diaphragm, the origin of which is not disclosed, they are not of direct interest to the general reader. It is to be noted, however, that the diaphragm is of the "free-edged" type.

Inductive Deaf Aid

DESIGN OF A PRACTICAL ELECTRO-MAGNETIC SYSTEM

By G. A. V. SOWTER, B.Sc. (Eng.) LOND., A.M.I.E.E.

The principles of electro-magnetic induction as applied to audio-frequency distribution were described in last month's issue. The author now goes on to show how induction may be used for deaf-aid purposes; the method is particularly suitable for theatres or cinemas, where it has been applied by Multitone

THE first step towards investigating induction by audio-frequency currents was to run a single loop of wire around the floor of a room as closely as possible to the walls in order to cover the largest area. The ends of the loop were then connected to the radio set output so that the AF currents passed through this loop. The first tests, which can be repeated by any interested reader, were conducted with some early plug-in, long-wave coils extracted from the author's junk box. A pair of telephones were connected to the ends of one of these coils (Fig. 1) in a manner similar to that described in the Willoughby Smith experiments, and it was found that the broadcast programme could be heard comfortably in the 'phones whatever might be the position of the operator in the room. As a variant on the usual microphone tricks at Christmas parties this scheme is to be recommended, although several turns of wire round the room may be necessary with less sensitive telephones.

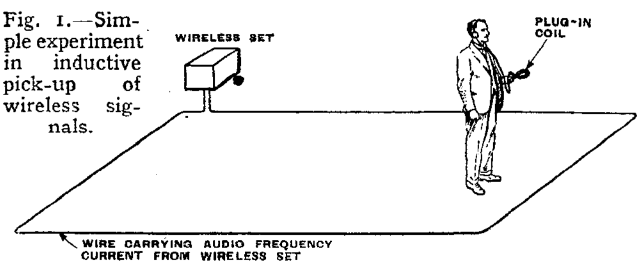


Fig. 1.—Simple experiment in inductive pick-up of wireless signals.

It was noticed that the picked-up programmes varied in strength with different coils, and were susceptible to strength variation with the orientation of the search coil.

Now, bearing in mind the ease with which it is possible to construct transformers which will pick up unwanted hum, it was decided to improve the efficiency of the air-cored pick-up coil in the room experiment by winding a coil with a similar number of turns on a core of soft iron wire. This showed such a distinct improvement over the air-cored coil that an experiment was conducted with the easily magnetised nickel-alloy Mumetal in place of the plain iron.

As is well known, Mumetal has a magnetic permeability of the order of 20,000 for feeble fields, and 80,000 to 100,000 under optimum conditions. When a length of this alloy in the form of an annealed rod is merely placed in the earth's magnetic field, as in Fig. 2, it tends to absorb flux, so to speak, but is never magnetically saturated, as was explained in a previous article.[1] The length, and to some extent the diameter, of the Mumetal rod controls the amount of flux which is picked up, as is indicated by the curve of Fig. 3, which gives the results of a simple experiment.

For this experiment a search coil was placed on a rod 50in. long and $\frac{1}{8}$in. diameter and the deflections measured on a simple ballistic galvanometer when the rod was completely reversed in the earth's magnetic field. A few inches were then cut off the length of the rod and the procedure repeated. Successive reductions in rod length were made, and the galvanometer deflections measured. The results are plotted in the form shown. It is seen that when the rod is a few inches long, the picked-up field is very small, as indicated by the bend at the bottom of the curve. It is very obvious that the longer the rod the greater the pick-up, and this will apply for alternating fields such as those evolved in the room experiment or by the induction deliberately set up on a larger scale, say, in a cinema.

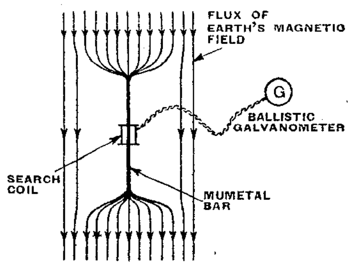


Fig. 2.—Flux distribution of earth's magnetic field in the neighbourhood of a long Mumetal rod. The flux carried by the rod is measured by means of the search coil and ballistic galvanometer, of which the deflection is observed when the rod is reversed.

Now, the prospect of assisting the deaf by providing them with long Mumetal rods with search coils and earpieces did not seem very practical, but, in spite of this, a serious suggestion

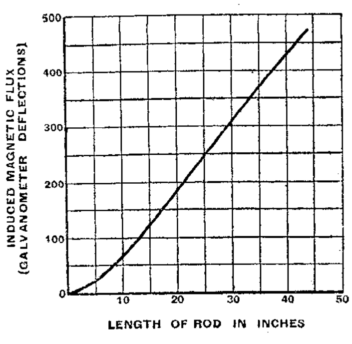


Fig. 3.—Relationship between length of Mumetal rod and induced magnetic flux from earth's field. Rod diameter is 0.125in.

[1] *The Wireless World* August 14th, 1936.

Inductive Deaf Aid—

was made of camouflaging the Mumetal rod for ladies into the form of a lorgnette, and that of the gentlemen into a walking-stick. The idea of a Mumetal walking-stick is by no means new, as the British Society of Dowsers has during recent years employed quite a number of such sticks for the divination of water, and it has been suggested that there is some connection between induction and "dowsing."

To return to the domestic induction experiments, it is assumed that the single loop of wire round the room will compare with the loop that might be installed for deaf-aid purposes in a cinema or theatre except that it is not known accurately what strength of magnetic field is being created therein. If the cinema scheme is to be successful it is assumed that eventually some agreed minimum field will be established such as that created by an RMS speech current of 2, 5 or more amperes passing through a single turn.

A number of transformer bobbins of the dimensions indicated in Fig. 4 were obtained. This was considered a practical size for a portable device, and each bobbin was wound with wire of a different gauge, so that the winding space was completely filled. This meant that there became available a number of pick-up coils having different turns up to 16,000 and with widely divergent resistance values. Two Mumetal rods 18in. long were available for insertion in the coils, and these rods were labelled X and Y respectively. X was approximately $\frac{1}{10}$in. in diameter, whilst Y had a section of $\frac{3}{16}$in. × $\frac{1}{8}$in.

Since it was anticipated that the performance might depend upon the type of earpiece employed, it was decided to carry out tests with the conventional lightweight deaf-aid earpieces in general use, such as a crystal type of high impedance and a conventional magnetic type of low impedance.

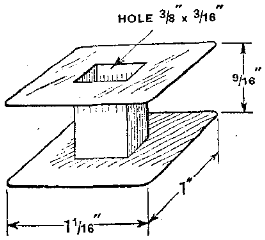


Fig. 4.—Type of bobbin used for search coils.

The method of carrying out the tests was not of a precision nature, but gave some very useful information. The loop round the room was energised from the radio set with its volume control fixed. Any variation in the B.B.C. modulation and character of the programme should not affect results, as a large number of tests were carried out. Listening tests were made with each available search coil, both with and without the Mumetal rods inserted, and the results for both earpieces are best expressed in the form of the curves in Fig. 5. The ordinate scale is of an unusual nature, but is allied to the "R" code of signal strength.

A summary of useful deductions which can be made from these curves is as follows:—

(*a*) The search coil must be matched in impedance with that of the earpiece being used. This is not unexpected, since the inductor system has the equivalent electrical circuit of Fig. 6, which brings to mind the well-known fact that "maximum power is obtained when the external resistance is equal to the internal resistance. (*b*) The low-impedance earpiece is more suitable than the crystal type. (*c*) Considerable improvement in picked-up energy is effected by utilising a Mumetal rod even as short as 18in. in length. Little difference was noticed whether X or Y rod was used, although longer rods effected an improvement. (*d*) A

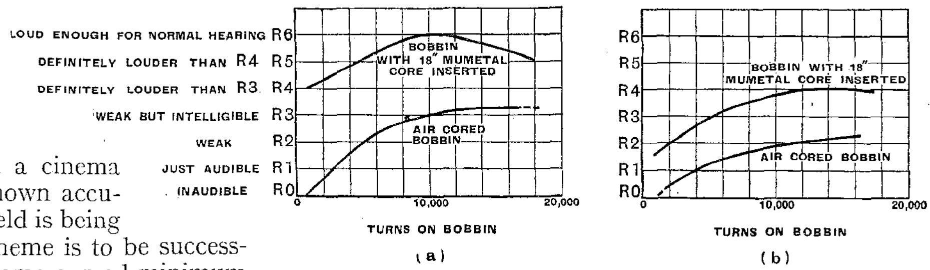


Fig. 5.—Measurements of induced signal strength, made with low-impedance magnetic earpiece (diagram (a)) and with high-impedance crystal earpiece (diagram (b)).

midget air-cored inductor alone of the dimensions specified is not practicable.

To verify this last conclusion, a pancake coil approximately 4in. in diameter and weighing 1 lb. was wound and tried out under the same conditions. The signal obtained was practically inaudible, and it was not considered worth while continuing this experiment to improve the impedance matching.

Interference with Other Services

By increasing the number of inducing turns round the room the received signal was considerably strengthened and led to the conclusion that if the magnetic field strength in a theatre or cinema is adequate, a correctly designed inductor *per se* with limited physical dimensions could give adequate volume for deaf-aid purposes.

The distribution of magnetic field from a single turn of wire carrying current is given in Fig. 7, so that there is a reasonable possibility that a system carrying *heavy* audio-frequency current may lead to undesired interference with other services. This may limit the permissible intensity of the inducing field in the auditorium, and it was therefore decided to carry out further measurements with a *weak* field, utilising an amplifier which was actually a standard deaf-aid apparatus. In this instance more precise measurements were conducted by the use of a cathode-ray oscillograph for measuring the pick-up and a variable low-frequency

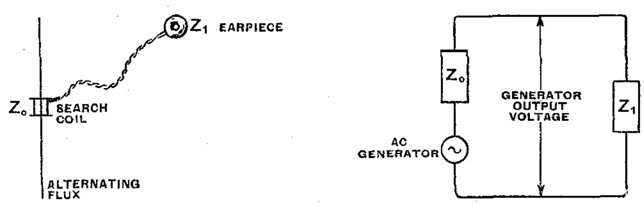


Fig. 6.—Equivalent circuit of inductor connected to earpiece in alternating magnetic field.

Inductive Deaf Aid—

oscillator for the source of supply to the loop which was placed round the laboratory floor (see Fig. 8).

It was realised that any successful device must eventually be incorporated in the deaf-aid gear, which weighed only $2\frac{1}{2}$ lb., and the increase in weight due to this device must be small. By reason of these limitations various bobbins of the type indicated in Fig. 4 were wound with different gauges of wire to fill completely the winding space available. The number of turns varied between 6,000 and 16,000. A number of rectangular Mumetal laminations of dimensions 2in. by $\frac{3}{8}$in. by 0.015in. were used to build up cores for these coils.

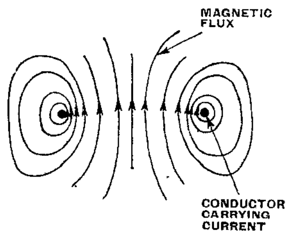


Fig. 7.—Distribution of magnetic field due to a single-turn conductor.

With the volume control on the deaf-aid amplifier fixed, a suitable resistance was substituted for the earpiece so that the output voltage due to the induction in the pick-up coil could be measured by observation on the cathode-ray oscillograph screen. Apart from this, the tests were carried out as before, but readings were taken at different frequencies and with a varying number of Mumetal laminations inserted in the bobbins. The apparatus is shown diagrammatically in Fig. 8.

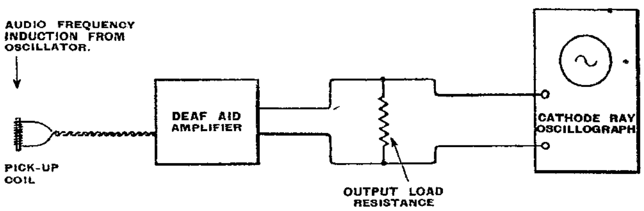


Fig. 8.—Method of testing inductive pick-up devices.

Summary of Tests

Results of the best coil, which had 10,000 turns, are given in the following table:—

Number of Mumetal laminations inserted as Core	Deflection on C.R.O. in Millimetres		
	500 Cycles	2,000 Cycles	5,000 Cycles
0	3	3.5	5.5
1	9	11	15
2	10	14	16
3	11	15	17
5	13	16	19
Full	14	17	21

It is seen that the insertion of the first lamination has the greatest effect which follows from considerations of the limited flux available, as already discussed. Also, due to the nickel-iron core, the output voltage is increased four to five times, representing a gain of approximately 14 decibels.

Little difference in the output was observable whether the search coil was on the middle or end of the laminations which follows from the fact that most of the flux enters the ends.

A large variety of tests were carried out with the individual bobbins and with bobbins inductively coupled, but the impedance match was a factor, and increasing the turns beyond 10,000 led to reduced output. As a matter of interest it should be noted that a lower permeability nickel iron was not so satisfactory as Mumetal.

Summarising, then, the best design of inductor within the limitations mentioned consists of the following:—

Bobbin: As sketch Fig. 4.

Winding: 10,000 turns of No. 45 SWG wire.

Core: 12 Mumetal laminations 2in. by $\frac{3}{8}$in. by 0.015in. thick.

Total weight: 2 ounces.

The weight is so small that it can easily be added to an existing deaf-aid equipment without serious effect.

When tried out in a cinema, a deaf-aid amplifier incorporating this design of pick-up was extremely satisfactory and also made it possible for the external magnetic field from an ordinary G.P.O. telephone to be utilised to give greatly enhanced volume, as suggested by certain deaf-aid manufacturers.

New "Raymart" Components

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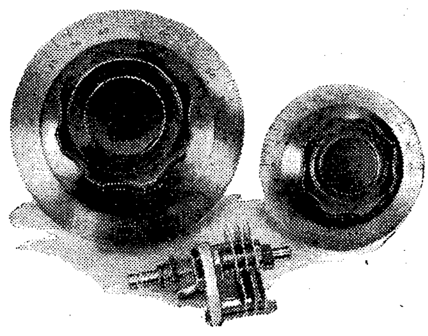

Raymart Types TXD and TXJ instrument dials and Type MC15DX micro-variable condenser.

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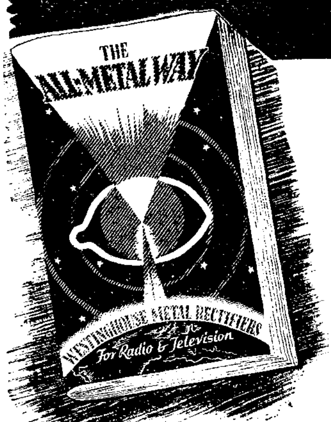

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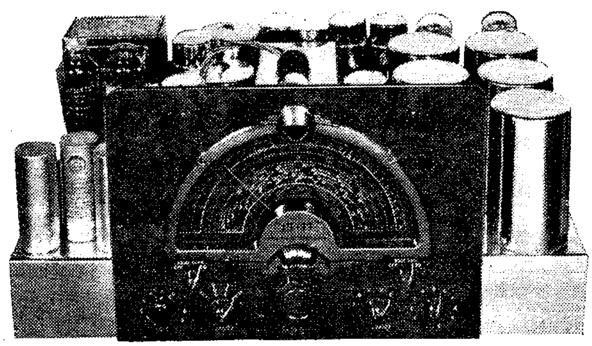

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Single-dial Band Spread

SHORT-WAVE RECEPTION SIMPLIFIED BY NEW SYSTEM OF TUNING

Short-wave reception nowadays calls for a tuning system that can be adjusted with certainty to the setting corresponding to the desired stations. Most band spread systems fall short in this respect, but the method described in this article has the advantage of allowing unambiguous "logging" of stations.

BEFORE describing the system of band spread tuning that forms the subject of this article, it might be advisable to explain what band spread is and why it is sometimes used for short-wave reception. This seems all the more necessary as it does not figure in ordinary broadcast reception, so that newcomers to the short waves may not, therefore, be familiar with it.

Briefly, it is a system for simplifying tuning, and is not used for normal broadcast reception, as on these wavelengths a good slow-motion condenser drive gives all the assistance needed.

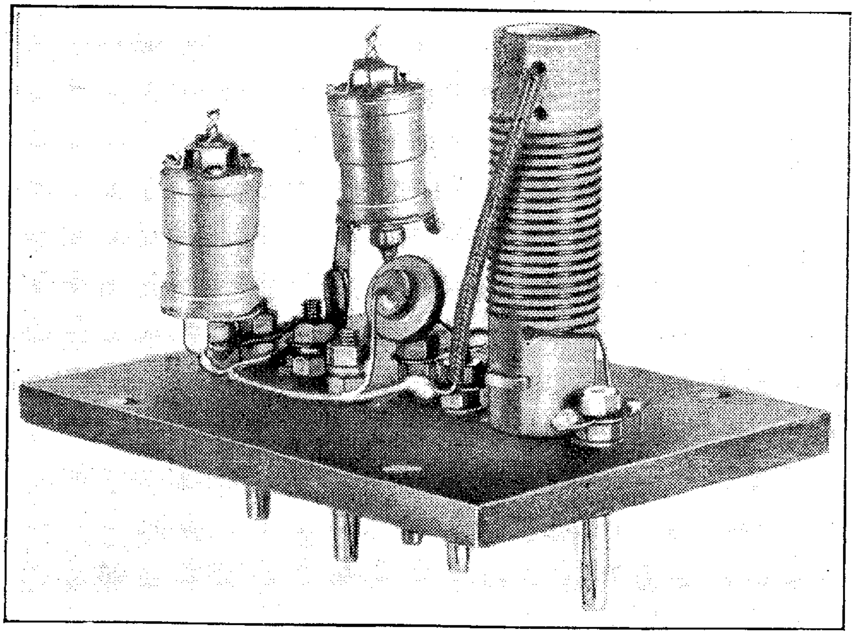
Now the medium wave band in an average broadcast receiver has a range of 200 to 550 metres approximately, while a long-wave coverage of 800 to 2,200 metres is not uncommon. Metres are awkward units in which to deal when explaining matters relating to tuning, especially when we come to band spread and short waves. Their corresponding frequencies in kilocycles or megacycles are much more convenient and lead to a better understanding of the prevailing conditions. In these units the medium wave band becomes 1,500 to 550 kc/s, while the long wave band represents 375 to 135 kc/s. The medium wave band, therefore, covers a range of 950 kc/s, but in the other extends only over a range of 240 kc/s.

As a broadcast station requires between 7,000 and 10,000 cycles (7 to 10 kc/s) in order to transmit speech and music with reasonable fidelity, there is room for 100 stations in the medium band, but space for 27 only in the long. Since the same condenser is used on both wave bands, we might expect to find a station at every gradation of an 0-100 division dial in the one case, but in the other every station spreading over three and a half to four divisions. Incidentally, this explains why tuning on the medium wave band appears to be so much more critical than on the long.

Now let us examine the short waves and, for explanatory purposes, assume that the same size of tuning condenser is used. Actually, this is not a merely hypothetical case, as in many all-wave receivers this condition does obtain. Furthermore, a single short-wave range is not uncommon, and this may cover 19 to 50 metres. Here, again, metres are deceptive, since the 31 metres in the band represents a coverage in kilocycles of 9,800, giving ether space for over a thousand broadcast stations. Actual figures are 15,800 kc/s to 6,000 kc/s. It need hardly be said that tuning on this short-wave band will be ten times more critical than on the medium wave band.

Let us now examine the case from an angle more favourable to the short-wave receiver or converter, as it was for a short-wave converter that the band-spread system to be discussed here was originally evolved. It is customary to limit the capacity of the tuning condensers to 100 m-mfd. in order to obtain a reasonable coverage on each range, and avoid having to use a multiplicity of coils.

If each short-wave range had the same frequency coverage as our medium wave band, we should need 17 ranges to tune from 13 to 50 metres, which is, of course, quite impracticable. With a 100-m-mfd. condenser this portion of the short waves can be covered in two steps. This frequency range is essential in order to take in all the short-wave broadcast bands, but coverage in two ranges means that each is over 8,000 kc/s wide. Tuning will still be far more critical than one would like.



Plug-in coil condenser unit (with cover removed) for use with the system of band-spreading described in this article.

Single-dial Band Spread—

What is the alternative to a multiplicity of bands? In the first place, we might ignore everything but the six broadcast bands which are in the vicinity of 13, 16, 19, 25, 31 and 49 metres. We could pair these and build a set with three ranges having a coverage of 13 to 17, 19 to 26, and 31 to 50 metres respectively. The first will have a frequency coverage of 23 to 17.6 Mc/s, the second one of 15.8 to 11.5 Mc/s, and the third will extend from 9.7 to 6 Mc/s. Tuning will be tolerably easy.

The alternative to this scheme is to retain the complete coverage, taking in all and sundry services, but arrange to expand just those portions of the spectrum allocated to broadcasting by using the full range of a small subsidiary tuning condenser. This is the customary system of band spreading. Note that it requires a main tuning condenser of not less than 100 m-mfds., and another variable having about one-tenth this capacity, the smaller being joined, as a rule, in parallel with the larger. A variation of this idea takes the form of connecting the band-spread condenser across a portion and not the whole of the tuning coil.

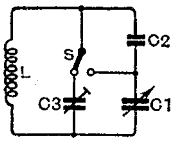


Fig. 1.—Normal tuning or band spread at will is obtained without an additional variable condenser by using this circuit.

The main drawback to either of these schemes is that if one attempts to calibrate the band-spread unit for identification of stations, *precise* accuracy of adjustment of the mains tuning condenser is imperative on all occasions. Rotating the drive to bring the pointer to a mark on the scale will rarely satisfy this condition, and one ought to use a condenser in which is embodied some form of locating device which, of course, must have a number of positions if more than one region of the range is to be expanded.

Desire to obtain the advantages of full coverage on the 13- to 50-metre band, at the same time retaining the ability to "spread" any part of that band with absolute certainty of repetition of tuning settings, led to examination of the possibilities for inclusion in a short-wave converter of the circuit shown in Fig. 1. Its great attractiveness lies in the fact that only one variable condenser is required.

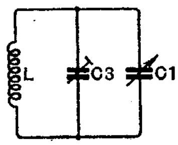


Fig. 2.—Fundamentally, the circuit of Fig. 1 under band-spread conditions of operation reduces to that shown here. C1 is now a very small variable capacity having a relatively large fixed capacity, C3, in parallel.

With switch S short-circuiting C2, the coil L1 is tuned in the usual way by condenser C1 and the full coverage is obtained. Now to band-spread any part of this range S is moved to the other position and C2 placed in series with C1. As C2 is a small condenser, the effective maximum capacity of C1 is thus reduced, for if C2 is 10 m-mfds. and C1 is 100 m-mfds., C1 and C2 in series gives a maximum of about 9 m-mfds. only. The function of C3, which is now joined in parallel with the coil, is to pre-tune the circuit to the frequency from which band spread is to commence.

In simplified form, the circuit becomes as shown in Fig. 2, where C3 is a large capacity in parallel with which is joined a very small variable condenser, here marked C1.

As C3 is a pre-set condenser, band spread will always commence at the same frequency, as it is not dependent on adjusting C3 to what one hopes will be the right capacity every time expansion is required.

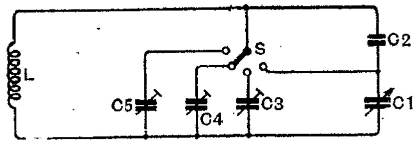


Fig. 3.—An extension of the circuit of Fig. 1 to enable band spread to be employed at three different parts of the range covered by a single coil.

This arrangement would be ideal if only one band-spread region per range is used, but as the normal circuit will cover three or four short-wave broadcast bands it hardly serves our purpose. By a simple modification the system can be arranged to make available any number of expansion areas; all that is required is to fit a multi-way switch and include the desired number of band-set condensers. This seems an appropriate description for C3 of Fig. 1; while we are coining terms, let us call C2 the band-stop condenser. These modifications produced the circuit shown in Fig. 3.

Band-stop Condenser Capacity

Where tried in a converter the system came well up to expectations, and there was only one drawback, incidentally quite a minor one. Calculations of possible coverage with band spread had shown that the amount of expansion would vary at different parts of the short-wave spectrum, and in anticipation of this a double-pole multi-way switch had been fitted so that the band-stop condenser C2 could also be changed. Not wishing to make the converter too complicated, provision was made for three changes in band-stop capacities, while three band-spread regions per range were considered sufficient for most practical purposes. With these additions the circuit becomes as shown in Fig. 4.

Small ceramic condensers are used in positions C2, C3 and C4, while air-dielectric trimmers are fitted for C5, C6 and C7; these may conveniently be mounted in a plug-in coil unit, the switch and band-stop condensers being embodied in the converter. It will thus be realised that while separate band-set condensers can be used for each expanded region on every range, the three band-stop condensers have to suffice for all the ranges to be covered.

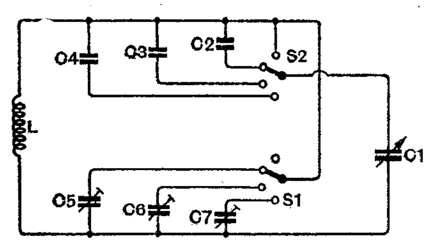


Fig. 4.—By including another switch S2 and separate series condensers, each having a different capacity, the amount of expansion can be varied for different sub-bands.

A compromise is necessary, and it is suggested that capacities be chosen to give the most convenient band spread on the lowest frequency ranges. The coverage will be greater than necessary on the higher frequencies,

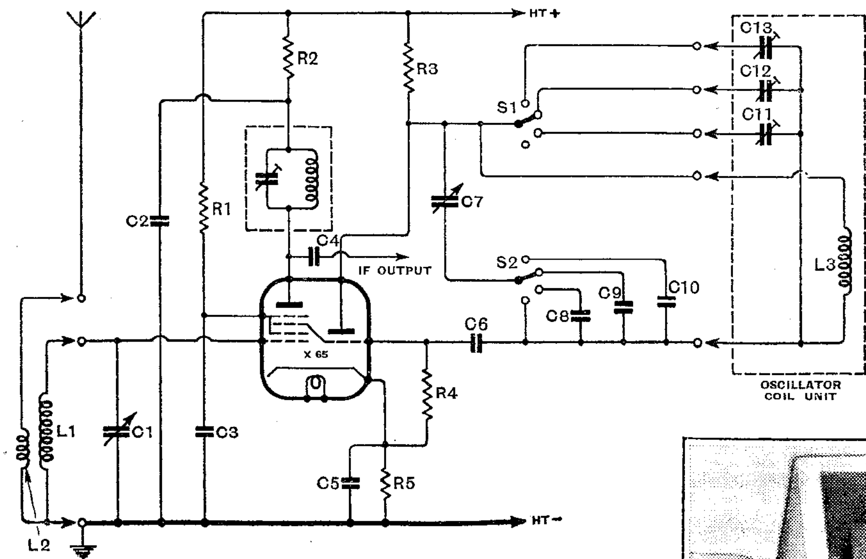


Fig. 5.—Complete circuit of a short-wave converter embodying an oscillator circuit with band spreading on the system described. Plug-in coils are employed. Values of components: C1, 100 m-mfds. variable ; C2, 0.1 mfd. tubular ; C3, 0.1 mfd. tubular ; C4, 5 m-mfds. ceramic ; C5, 0.1 mfd. tubular ; C6, 100 m-mfds. mica ; C7, 100 m-mfds. variable ; C8, 5 micro-mfds. ceramic ; C9, 10 m-mfds. ceramic ; C10, 20 m-mfds. ceramic ; C11, 3-30 m-mfds. air trimmer ; C12, 3-30 m-mfds. air trimmer ; C13, 3-30, m-mfds. air trimmer ; R1, 35,000 ohms 1 watt ; R2, 1,000 ohms ½ watt ; R3, 30,000 ohms 1 watt ; R4, 100,000 ohms ½ watt ; R5,300 ohms ½ watt.

but, even so, tuning will be child's play compared with what it would be without this simplification.

Having explained the basic principles of this band-spread system, perhaps a brief description of one way of applying the idea to a practical case might be of some interest.

As already mentioned, the system was first tried out in a converter. This was designed for use with *The Wireless World* 2RF set. Plug-in coils were employed, so that an extensive wave band could be covered if required, although, so far, only the 13- to 60-metre portion has been catered for. Extra coils can easily be constructed whenever required for any waveband. In view of this, ganging was not attempted, signal and oscillator circuits being tuned separately.

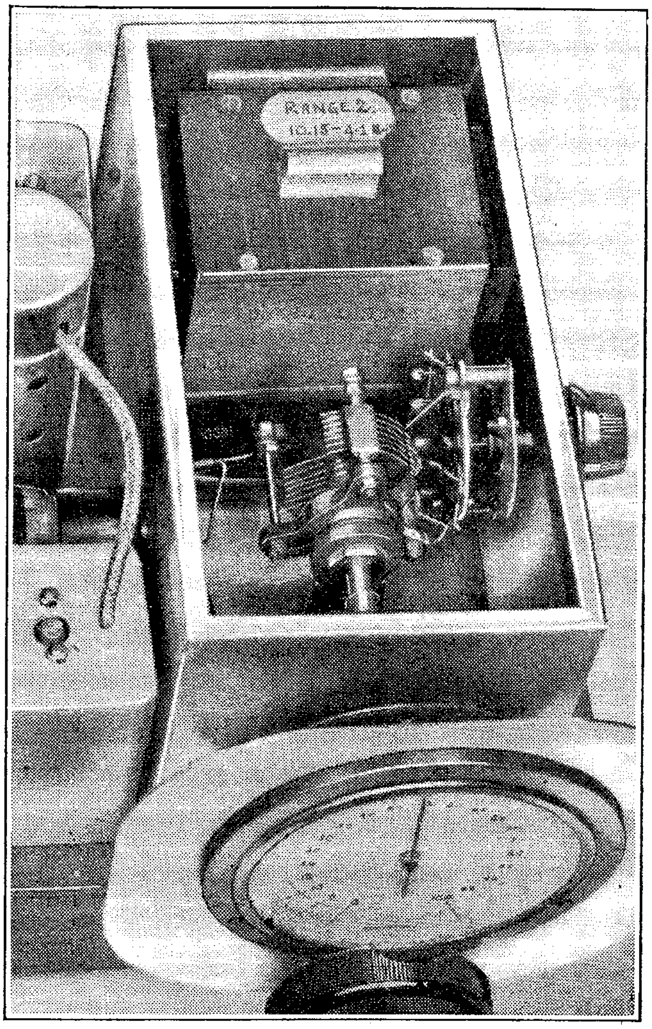
Design for a Converter

The theoretical circuit is given in Fig. 5, from which it will be seen that band spread is used in the oscillator only as the relatively flat tuning of signal circuits makes it quite unnecessary to use band spread in these cases.

The oscillator coil L3, together with three band-set condensers C11, C12 and C13, are assembled in a small coil box to which is fitted five pins. As Range 1 coil box covers 13 to 30 metres, the four short-wave broadcast bands 13-, 16-, 19- and 25-metre ones are included, one of these four will have to do without expansion. All four could be band-spread by fitting six-pin boxes and a five-way switch, but a suitable switch-plate was not available at the time, and in any case spreading is hardly necessary on the lower frequencies.

Space is saved by fitting one of the wafer-type plate switches, sometimes called the Yaxley pattern, that used being a two-pole four-way one.

Band-stop condensers of 5, 10 and 20 m-mfds. were fitted for C8, C9 and C10 respectively. With the 13- to 30-metre coil unit a band width of just over 2 Mc/s is obtained on 13, 16 and 19 metres, which are the three where band spread is used. While admittedly a wider band spread than the needs of broadcast reception dic-



This photograph shows part of a short-wave converter using the band-spread system described. Constructional details will be published in next month's issue.

Single-dial Band Spread—
tates, it served the writer's purpose, especially as the 20-metre amateur waveband is also covered when band spread is used on 19 metres.

There is no RF stage in this converter, but by using a relatively high intermediate frequency, 1,000 kc/s to be precise, very little trouble has so far been encountered from image-signal interference.

In Fig. 5, only the essential features are shown; for example, it omits the extra IF amplifier that was found desirable in order to improve the sensitivity, and incidentally the selectivity, of the 2RF set on the short waves. With this addition the whole outfit compares very favourably with many far more ambitious sets that have at different times been used for short-wave reception.

Some modifications have had to be made to the original 2RF set, as some trouble was experienced from instability with three amplifying stages tuned to 1,000 kc/s. A reasonable amount of decoupling, however, put an end to this difficulty.

Henry Farrad's Solution

(See Page 123)

MARK LINYER does not mention which valve tag he tapped in error, but assuming anything approaching normal conditions the only connection that would give a voltage of the order mentioned must have been anode (or possibly screen) to control grid. The Avometer, as is well known, takes 6 mA at full scale reading, and therefore on the 600-volt range its resistance is 0.1 megohm. This would virtually connect the control grid to + HT, causing it to take a considerable current and so to drop to a lower voltage because of the resistance of the meter. Even so, it would be positive, and the anode current would be grossly excessive, causing a considerable voltage drop in the output transformer. Altogether, the valve would be very badly treated, and as apparently it was kept in this condition for a considerable time it is not surprising that it was unfit for further use when the error was noticed. In checking the elimination of the first fault, a more serious one had been introduced. The moral is to take care when connecting meters to valve bases.

Taylor Model 45 Valve Tester

A VERSATILE AND UP-TO-DATE INSTRUMENT

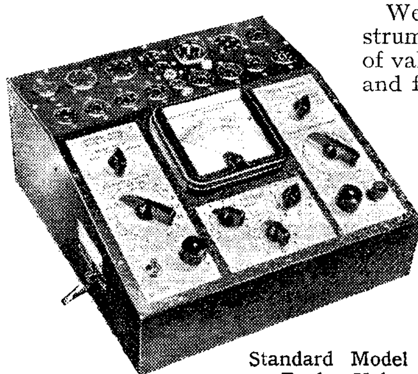
THE first essential of a valve tester is that it should be comprehensive, and in this respect the Taylor 45 answers all present and some future requirements. It is fitted with seventeen valve holders suitable for British, Continental and American receiving valves, including Mullard side contact, midget deaf aid valves. American octal, loctal and bantam bases. With an eye no doubt to the future, we find that mutual conductances up to 24 MA/volt have been provided for.

Normally, the range is up to 12 mA/volt and the meter can be used to read the mutual conductance direct or to indicate whether the emission is good or bad compared with the maker's figure.

One of the most attractive features of this instrument is the provision for initial testing of filament continuity, and electrode shorts. These can all be carried out with the valve plugged into its holder before meter readings are taken. Three selector switches are provided for adapting the circuit to the type of valve under test and with these in the zero position a pilot lamp indicates that the filament is continuous when the main selector is set to the appropriate position. With the main selector turned to "Element Shorts" each electrode can be tested in succession, and any short circuit will be indicated by the lighting of the test lamp.

Frequency changers can be tested in each of their sections and diodes and rectifiers checked for emission. There is also a test for heater-cathode insulation with a scale reading up to 10 megohms.

A clearly written instruction manual and a list of over a thousand valves with full details for setting the controls and checking mutual conductance or emission is supplied with each instrument.



Standard Model 45 Taylor Valve Tester.

We have tested the instrument with a number of valves of different types and found the readings in agreement with those taken by other methods. The controls are well arranged and clearly marked, and the switch location is positive. A press-button meter switch is a useful feature which may save the meter in case of errors in the setting of the other controls. In every way it is a thoroughly up-to-date and practical instrument which can be recommended to servicemen and dealers.

The price of the standard model illustrated is £13 2s. 6d. A portable model fitted in an attaché case measuring 18in. x 13in x 6in. with space for tools costs £13 8s. and a bench model with flush mounting panel is available at £13 13s. The makers are Taylor Electrical Instruments, Ltd., 45, Fouberts Place, London, W.1.

"The Wireless Engineer"

A REGULAR monthly feature of our sister journal, *The Wireless Engineer*, is the Abstracts and References section compiled by the Radio Research Board. In this section are given abstracts of articles on wireless and allied subjects published in the world's technical Press. An index to the year's Abstracts, which in 1939 numbered over 4,800, was included in the December issue. A summary of recently accepted wireless patent specifications is also given each month.

The January issue, published on the first of the month, includes articles on the performance of non-linear circuits, the input capacity of a triode oscillator valve and details of a power oscillator for surface hardening of steel.

The Wireless Engineer is obtainable through newsagents or from the Publishers, Dorset House, Stamford Street, London, S.E.1, price 2s. 8d., post free.

G. E. C. High Tension Batteries

The General Electric Company announce that they are reducing the number of types of high-tension batteries and have decided to concentrate, for the time being, on the "Black Label" and "Blue Label" series.

Reaction Refinements

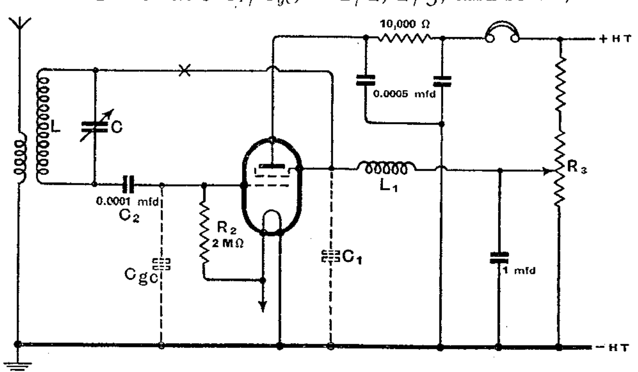
EFFECTS OF THE AERIAL, RF AMPLIFIER AND AF LOAD

This, the last of a short series of three articles, in which the problems of reaction are examined in the light of modern knowledge, deals with the problem of threshold howl as well as a number of miscellaneous matters which influence the functioning of the detector circuit.

IN last month's issue the effects of the valve and its applied voltages were discussed. It is also found that the circuit constants exercise an effect upon the smoothness of reaction, although it is normally much smaller than the valve conditions. In general, the amount of feed-back used should be small. It is often better to couple the valve loosely to the circuit and to use a normal screen or anode voltage than to couple it tightly and employ a very low voltage.

In the case of the Colpitts circuit of Fig. 3 of last month's article, the initial conditions can be controlled by C_1, C_2, C_{gc}, or by a condenser inserted at X. A small value for C_2 or a large one for C_{gc} makes for smooth reaction, but unfortunately reduces signal strength. Excessive capacity for C_1 tends to make regeneration ploppy, but is better from the point of view of the signal strength.

What happens can be seen more clearly from Fig. 1, in which C_x represents the condenser referred to above as inserted at X (see Fig. 3 of "Smooth Reaction"). First imagine C_2 and C_x so large that they can be ignored. The incoming signal is developed across C, but the whole of it is not applied to the valve between grid and cathode, but only the fraction $C_1/(C_1+C_{gc})$. Clearly, the larger C_1 is compared with C_{gc} the more nearly does the voltage applied to the valve equal that across C. The use of a large value for the ratio C_1/C_{gc}, however, does not lead to smooth reaction; the attainment of this desirable result, in fact, demands a small value for the ratio, which is bad for signal strength.



This diagram (Fig. 3 of last month's article on "Smooth Reaction") shows a Colpitts circuit for a battery valve.

When C_2 and C_x are small, the fraction of the voltage applied to the valve is approximately $1/(1 + C_{gc}/C_1 + C_{gc}/C_2 + C_{gc}/C_x)$. For a given value of C_{gc}, a reduction in the capacity of C_1, C_2 or C_x reduces the signal on the valve, but improves the smoothness of reaction. It does not matter much which capacity is varied, but as C_1 can rarely be reduced, since it consists of stray and valve capacity, it is better in practice to reduce C_2 or C_x than to increase C_{gc}. This is because it leads to a lower input capacity.

From the point of view of signal strength both the Colpitts and Hartley circuits are inferior to others, because only a part of the voltage developed across the tuned circuit is applied between grid and cathode of the valve. In spite of this the Colpitts, in particular, has much to recommend it. It has fewer possible modes of oscillation than most other circuits and is, consequently, much freer from parasitic oscillation. It demands a single untapped winding for the tuning coil, which greatly facilitates both design and waveband switching. Finally, the regeneration control can be arranged to exercise unusually little effect upon the tuning.

In all the circuits shown so far the aerial is coupled to the tuned circuit by means of a small coil. There is little doubt that this is the best method of coupling to adopt unless an RF stage is used. In common with all other methods of aerial coupling, however, it is by no means straightforward.

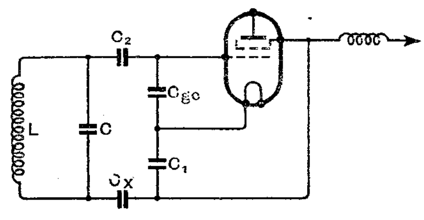


Fig. 1.—This diagram illustrates the effect of the various capacities in the Colpitts circuit.

The trouble lies in the aerial itself, for it is not a simple non-resonant structure, but is complex, with many different resonant frequencies. With a plain vertical wire aerial, series resonance occurs at wavelengths corresponding to 4, 4/3, 4/5, 4/7, 4/9, 4/11, and so on, of the length, and parallel resonance at 2, 1, 2/3, 1/2, 2/5, and so on, of the length.

A normal length of wire might be 20 metres (rather more than 60ft.) giving series resonance at about 80, 27, 16, 11.4, 9, 7.3 metres and parallel resonance at 40, 20, 13, 10, 8 metres.

If a fixed aerial coupling is used it will be found that around the parallel resonances the set oscillates unusually freely and near the series resonances much less freely than usual. The loading of the aerial on the tuned circuit depends on the coupling and the aerial impedance. When the impedance decreases near a series resonance point the loading increases and more feed-back has to be used to make the valve oscillate. Near parallel resonance the impedance is high and the loading on the tuned circuit low, so that the valve can oscillate readily.

What is needed is variable aerial coupling. This is not always easy to arrange mechanically, and greatly increases the difficulty of operation. Any change in the aerial coupling alters the tuning and reaction, so that the three controls are critically interdependent.

The usual practice is to employ fixed coupling, and arrange it so that it is slightly greater than optimum at the point of series resonance. This gives quite good results on the whole; the regeneration needed varies somewhat throughout the band, but not too badly. The greatest drawback is a loss of signal strength near parallel resonance, where the coupling is less than optimum.

The difficulty is best got over by providing another valve to act as an RF stage. This can have an aperiodic grid circuit, so that it does not complicate the tuning. A tuned grid circuit gives better signal strength, but is more complicated and expensive, and the difficulty of aerial coupling to this new circuit arises. As reaction is not applied to it, however, the difficulty is not nearly as great, but it is still sufficient to make ganging troublesome.

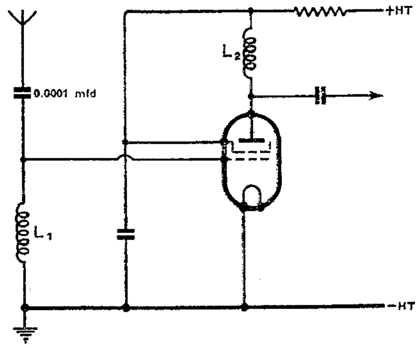


Fig. 2.—The circuit of an RF stage which can be used to precede any of the detectors shown. The aerial circuit is untuned.

The use of an RF stage has one other advantage, which is so great that it makes its use almost obligatory. It very largely prevents the possibility of radiation from the aerial. With the aerial coupled directly to the tuned circuit of the detector, serious radiation occurs whenever the valve oscillates. A short-wave set is usually used a good deal in the oscillating condition, and so very serious interference with other receivers may be caused.

The RF stage acts as a buffer between the oscillating circuit and the aerial, provided that reasonable screening is adopted, and so removes this trouble. It is probably more efficient in this respect when its grid circuit is aperiodic than when it is tuned, for RF voltages are then much less likely to be picked up on the grid.

Appreciable Gain

The valve is by no means wasted, from the point of view of signal strength, for it can usually be made to give appreciable gain. With an aperiodic grid circuit, however, precautions must be taken against cross-modulation from a powerful medium-wave local station. The arrangement shown in Fig. 2 will usually prevent this trouble. L1 and L2 are short-wave RF chokes. L2 should be a good one, since it comes in parallel with the tuned circuit of the detector. L1 is much less important, and should not be of too high an inductance. It is particularly important that it should not resonate with the aerial capacity near the medium waveband.

This arrangement may not prove adequate when the local station gives a very strong signal, and it is then necessary to include a wavetrap in the aerial lead. This will effectively prevent the trouble.

The use of a tuned circuit, however, gives a considerable improvement in sensitivity. The tuning is quite flat, so that only rough ganging to the intervalve circuit will suffice. This is not always easy, however, because with some circuits neither side of the intervalve tuning condenser can be earthed. Actually, the use of a separate tuning control for the aerial circuit complicates the operation very little, and is to be recommended.

It is usually sufficient to tune the aerial circuit to the middle of one of the broadcast bands, and leave it there while the band is explored. For example, if reception is wanted in the 19-metre band, the aerial tuning control can be set for this band and then forgotten.

So far, nothing has been said about the AF output circuit. A load impedance effective at audio-frequency is essential in the anode circuit in order to make use of the output, and it can seriously effect the operation of reaction if it is not correctly arranged. The impedance is normally an inductance or capacity in shunt with a resistance. The former occurs when the load is a pair of phones, a transformer, or a choke, and the latter with resistance coupling. In this latter case the capacitive element comes in through stray and valve capacities; there is also usually an RF by-pass condenser across the coupling resistance.

With an unsuitable load threshold howl is liable to occur. Instead of the valve sliding smoothly and quietly into oscillation, an audio-frequency howl or growl is set up when the valve is just oscillating. It is a very annoying defect, because it manifests itself just at the point of regeneration which is very frequently used, and it is consequently essential to eliminate it.

The first step towards removing it is to understand its cause. Consider a grid detector with an inductive anode circuit load impedance. When the valve begins to oscillate, a large RF voltage is developed on the grid, and through grid rectification the mean grid potential changes in a negative direction. This causes a fall in anode current, and the change in anode current through the anode circuit inductance sets up a back-EMF across it in such a direction as to oppose the change of current. The back-EMF thus acts to increase the anode voltage, and so makes the valve develop a larger amplitude of RF voltage on the grid. This makes the grid potential still more negative, giving rise to a further drop in anode current, and so on.

At length the process slows up and stops; the anode current reaches a minimum, and the back-EMF disappears. The anode voltage is then too low to maintain the RF amplitude, which accordingly falls, making the grid less negative. The anode current rises, and a back-EMF again appears across the anode inductance, but this time in the opposite sense, reducing the effective anode voltage and so still further reducing the RF ampli-

Reaction Refinements—

tude. This process continues indefinitely, and the changes of anode current occurring at an audible rate give rise to the howl.

Conditions for howling are worst with efficient detecting action in the grid circuit, a valve of high mutual conductance, and a high value of inductance for the load circuit. The trouble cannot occur with resistance-capacity coupling and grid detection. On the other hand, if the valve functions as an anode bend detector, it occurs with resistance-capacity coupling, but not with an inductive load.

With a triode as grid detector and an inductive load, the only remedy is to shunt the inductance with a resistance. As the resistance is reduced in value, conditions get better and better, and finally threshold howl ceases.

Tetrode or Pentode Valves

In the writer's experience, however, a better remedy is to use a screened tetrode or pentode valve in a suitable circuit. Over a large range of voltages the anode current with such valves is substantially independent of anode voltage. Consequently, the initial rise of anode voltage, due to the back-EMF across the inductance, does not appreciably increase the RF amplitude, and the conditions necessary for provoking threshold howl do not arise.

With a very large inductance of several hundred

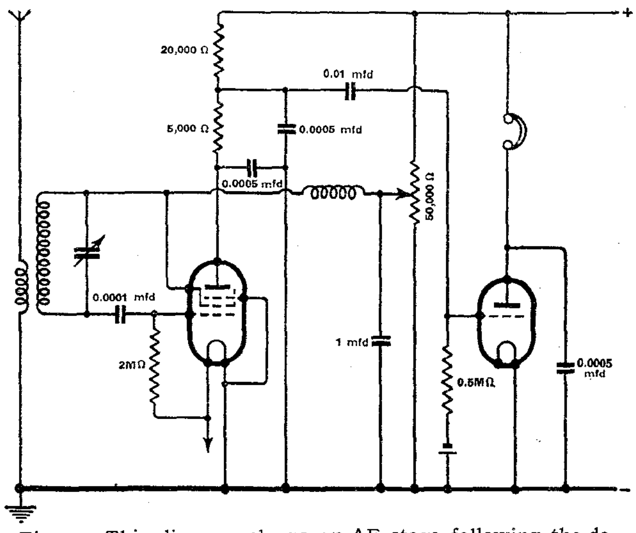


Fig. 3.—This diagram shows an AF stage following the detector and is an arrangement which is very satisfactory in practice.

henrys, such as might be used with choke coupling, trouble may still be experienced, but with phones it is normally completely absent. Even with the comparatively low inductance of phones, threshold howl is liable to occur when a triode is employed.

Resistance-capacity coupling avoids the trouble completely, but is not always easy with a screened tetrode or pentode. A high value of coupling resistance is needed for high gain, and, on account of the voltage drop in it, a low screen voltage is required. The screen voltage is fairly critical for good AF amplification, with the result that it is often inadvisable to vary it as a regeneration control. Further, with the low screen voltage, the mutual conductance is likely to be below normal, and difficulty may be experienced in obtaining oscillation.

Incidentally, when phones are used immediately after the detector, they can only be inserted directly in the anode circuit when a triode is used. With a screened tetrode or pentode a step-down transformer or auto-transformer is necessary if the full advantage of the valve is to be secured. Even ordinary high-resistance phones are of too low impedance to match a pentode, and a transformer ratio of the order of 5-1 is necessary. It is not critical, however, and a ratio of between 4-1 and 6-1 is normally satisfactory. This naturally leads to a higher value of inductive load on the valve, but in the writer's experience does not cause trouble from threshold howl.

When the detector is followed by an AF amplifier it is usually advisable to employ resistance coupling. Even with a tetrode or pentode detector it is difficult to avoid threshold howl when using a transformer. Two RC stages following the detector give more gain than one with transformer coupling, and are simpler and little more costly. As already pointed out, RC coupling has its difficulties with a pentode, but it will be found very satisfactory if the coupling resistance is kept fairly low in value, say, 20,000 ohms. Of course, if an abnormally high voltage supply is available, it can be made larger.

It is always more difficult to avoid threshold howl when an AF amplifier is used than when the phones are in the detector circuit. This is because the presence of RF currents in the AF circuits greatly accentuates any tendency to such howling. In fact, it can occur when nothing but RC coupling is used. The mechanism involved is then different from that described earlier, but the remedy is to keep RF currents out of the AF circuits as far as possible.

An arrangement which has been found very satisfactory for phones is shown in Fig. 3. For use with a loud speaker a pentode output valve RC coupled to the output of the triode is quite good, although care must be taken to avoid microphony. Among many others, a suitable detector valve is the Mazda SP210, while an HL2 can be used for the AF stage.

New Osram Valves

TWO-VOLT VALVES WITH REDUCED FILAMENT CURRENT

THREE new types have just been introduced in the range of valves designed for use with 2-volt accumulators. They are the X24, HD24 and KT24.

The X24 replaces the earlier X23 and has the same characteristics as the latter with a filament consumption of 0.2 amp. compared with the 0.3 amp. of the X23.

Type HD24 is intended to replace the three double-diode-triodes HD21, HD22 and HD23. Its filament consumption is 0.1 amp. and the triode section has an AC resistance of 28,600 ohms and a mutual conductance of 1.4 mA/volt.

Finally, the KT24 which has been introduced as an alternative to the KT21 has a filament consumption of 0.2 amp. instead of 0.3 amp. and a mutual conductance of 3.2 mA/volt compared with 5.3 mA/volt in the KT21.

Bush Model PB63

AC SUPERHETERODYNE (FIVE-VALVE + RECTIFIER) PERMEABILITY TUNED PUSH-BUTTON CIRCUITS. PRICE 12½ GUINEAS

THIS receiver occupies an intermediate position in the current range of table model receivers, and includes most of the features which characterise this season's Bush sets—a lively short-wave performance, stable push-button tuning circuits and a triode in the output stage for good quality of reproduction.

Circuit.—Three aerial sockets are provided, one for maximum sensitivity, one for maximum selectivity and the third for reception close to a powerful station. The latter brings into circuit a filter to cut down the input to the frequency changer from the local station. An adjustment is provided on the back of the chassis and the range is approximately 255 to 400 metres. A pair of tags at the back of the chassis enable a voltmeter to be connected across the feed resistance to the IF valve in order that this adjustment may be made accurately.

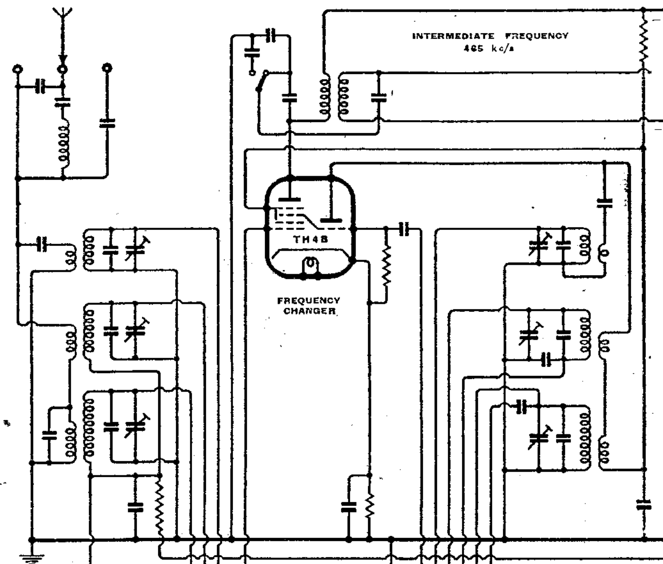
There are ten control buttons, three for waverange on manual tuning, one for gramophone and six for selected stations, two on long waves and four on the medium-wave range. Adjustment of the aerial pre-set circuits is by capacity trimmers, and of the oscillator by variable iron-cored coils connected in parallel with the long-wave tuning inductance. To give the necessary coverage on long waves additional parallel capacity is introduced when the LW waverange switch is "out."

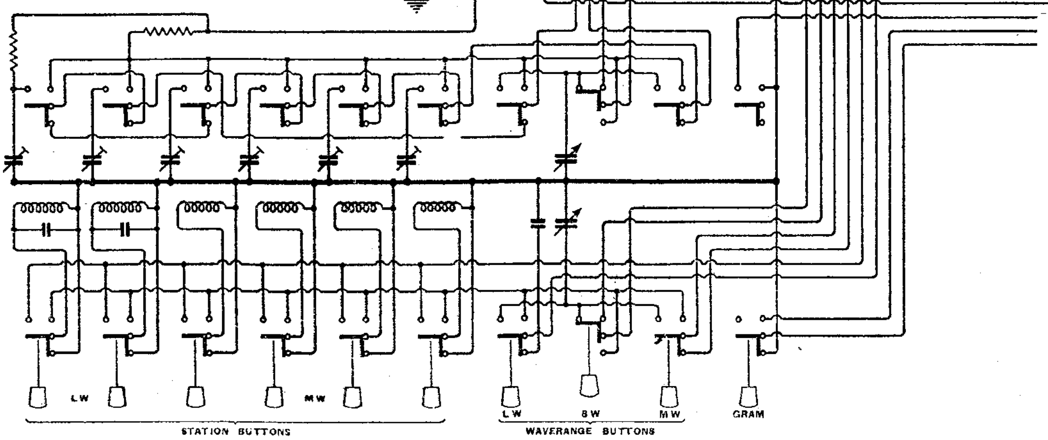
The first valve, a triode-hexode frequency changer, is controlled by AVC on medium and long waves, but not on short waves. The IF transformer in its anode circuit has two degrees of coupling controlled by a single-pole switch. In one position, a common capacity is introduced in the low potential leads from the main tuning condensers on both primary and secondary to increase the coupling and the band width of the response curve. In the other position a capacity equal to that of the coupling condenser is connected in series with the secondary tuning capacity to preserve the symmetry of the circuits. Both IF transformers make use of fixed silvered mica condensers and are permeability tuned. The output secondary is tapped down for both signal and AVC diodes.

A delay voltage is derived from the cathode bias resistance of the double-diode-triode valve and AVC is applied to the IF stage on all wavebands. When using a pick-up, the radio side is silenced by earthing the screen of the IF valve.

As the output valve is a triode, an additional stage of AF amplification has been included. Bias for the output stage is derived from a potential divider across the loud speaker field, which is connected in this receiver in the negative HT lead. The external loud speaker is connected to a switch-plug which enables any combination of internal and external loud speaker to be used.

Performance.—The maker's decision to return to the much neglected triode for the output stage



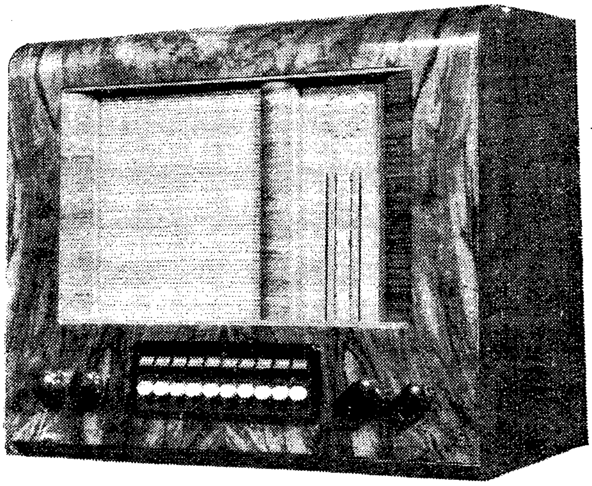


is amply rewarded by the quality of reproduction obtained. Not only is the quality at normal volume free from any trace of muzziness due to harmonic distortion, but it is also unspoilt by any tendency to over-accentuation of the high frequencies as is often the case with pentodes. That is not to say that top is lacking; quite the contrary, for with the variable selectivity control in the position of normal selectivity the trial balance is just right and does not call for any adjustment of the tune control. The bass response is clean and goes down much farther than the average table model without any resonance which affects in any way the quality of speech. The loud speaker gives excellent transient response and from every point of view this set earns bonus marks for quality of reproduction.

The short-wave performance, too, is outstandingly good, and in spite of adverse conditions over the Atlantic, reliable reception was obtained from the principal American stations. The short-wave oscillator circuits are stable and there is no noticeable frequency drift. Microphonic feed-back on strong carriers is absent and second-channel interference negligible. From the mechanical point of view, the tuning is smooth and precise and although there is no form of band spread tuning, the "Teleflic" auxiliary dial enables station settings to be repeated with accuracy.

On the medium- and long-wave ranges the sensitivity is high enough to bring in any station whose field strength is above the level of prevailing background noise, while the selectivity in the "high" position of the control is more than adequate for present reception conditions.

Constructional Features.—The "Teleflic" dial is an auxiliary tuning scale for short waves. It consists of fifteen radial slits arranged in a circle and framed to look something like the dial on an automatic telephone. Behind these fixed slits is a revolving disc with sixteen radial slits illuminated generally by a single pilot lamp and circular reflector. Only one pair of slits coincide at a time and as the moving disc makes one sixteenth of a revolution the light appears to travel right round the dial. Thus a 16 : 1 increase in the ratio of the tuning drive is obtained optically without the complication of extra gearing.



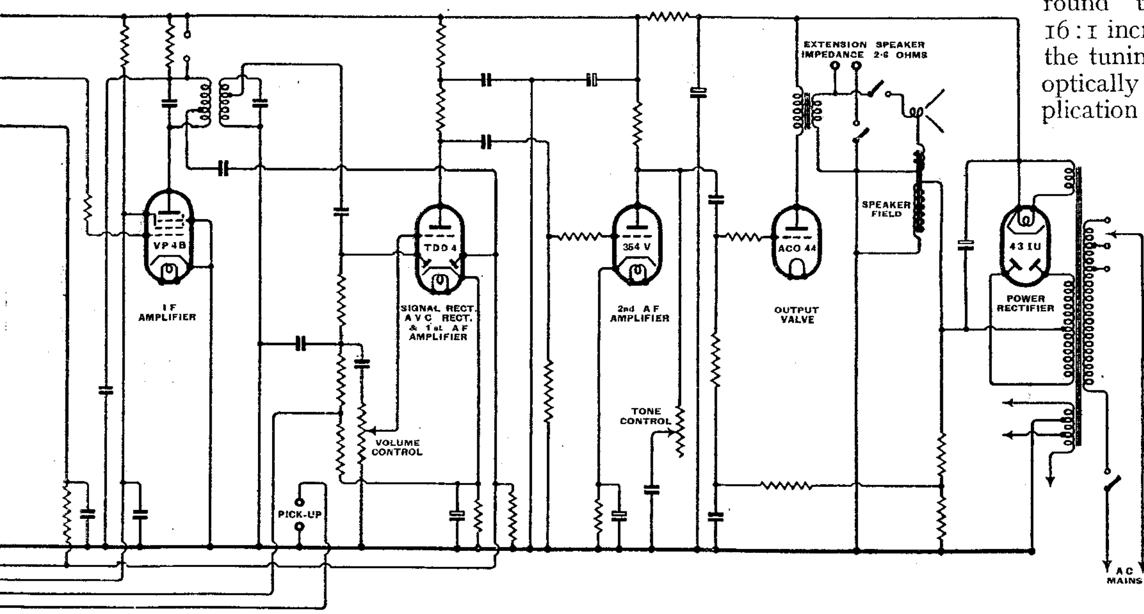
WAVERANGES

Short	*16.5* -	*51 metres*
Medium ..	*198* -	*565 metres*
Long	*850* -	*2000 metres*

The pre-tuned circuits may be adjusted from the front of the set after removing the moulded escutcheon plate, and a noteworthy refinement here is the provision of miniature wavelength scales alongside the adjusting screws for the cores of the oscillator coils.

From every point of view the PB63 is a well thought out design and both its appearance and performance entitle it to a high place among good quality receivers. The controls are positive and smooth in action and there is no requirement of modern reception—short-wave performance, quality, range and selectivity—which it does not fulfil in ample measure.

Makers.—Bush Radio, Ltd., Power Rd., Chiswick, London, W.4.



Circuit diagram of the Bush PB63. The inductances in the pre-set oscillator circuits and the IF transformers have adjustable iron dust cores. Terminals are provided for a voltmeter in the anode circuit of the IF valve for adjusting the aerial filter.

Current Topics

RECENT EVENTS IN THE WORLD OF WIRELESS

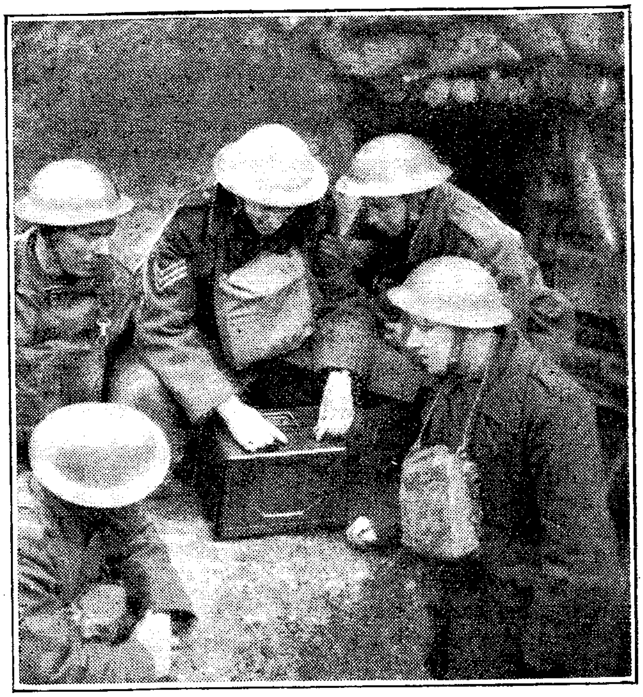
AMERICAN TELEVISION

F.C.C. Report

THE Television Committee of the Federal Communications Commission has recommended that television stations should be permitted to broadcast a limited proportion of commercial programmes. Whilst the Committee hold that television is still highly experimental, the members feel that it has reached a crucial stage, but "extensive developments are yet to be accomplished before television receivers can be bought with the same assurances that go with the sale of an ordinary receiving set." Fewer than 1,000 receivers have been sold since May, 1939, when the N.B.C.'s New York station started regular transmissions.

It is announced in *Broadcasting* that the Committee has recommended the allocation of three channels to metropolitan districts with a population of over 1,000,000; two channels to those with a population between 500,000 and 1,000,000, and one channel to districts with fewer than 500,000 inhabitants. With this assignment of frequencies a maximum power of 10 kW is stipulated.

Referring to the cessation of television development abroad, the report states: "An opportunity exists for American industry to construct foundations for a position in the world television market of the future by undertaking active steps at this time to further the technical and operating development of television in this country. This opportunity should not be lost."



FOR THE B.E.F. One of the portable receivers provided by Lord Nuffield's gift of £50,000 from the Nuffield Fund for the Fighting Forces in use in a trench on the Western Front. These battery operated portables, which are made by several well-known manufacturers, are purchased by the N.A.A.F.I.

FREQUENCY MODULATION

Success of Triple Relay Experiment

HAVING heard a demonstation programme that had been relayed three times by frequency-modulation stations, Mr. K. B. Warner, managing secretary of the American Radio Relay League, and editor of *QST*, said: "I thought it was just technically unbelievable with three relays, yet the programme was still better by far than the present conventional system at its best. In ten years there won't be any orthodox brand of broadcasting remaining except for the lowest grade of local service."

The demonstration programme, which included sounds requiring a high degree of fidelity to reproduce them, was broadcast by W2XCR at Yonkers, New York. It was received and rebroadcast by Major Armstrong's station W2XMN at Alpine, New Jersey. The transmission from W2XMN was received at Meriden, Conn., and again broadcast by W1XPW, which transmission was received in the studio of WDRC, Hartford, Conn., before those invited to hear the demonstration.

It was in order to prove the practicability of a chain of F-M stations that the demonstration was staged, for it is not possible to use cable links between F-M stations as they will not transmit a 15 kc/s band.

About 25 frequency-modulation transmitters, it is stated, will be in use by midsummer.

PLUG IN AND VIEW

Proposed Television Scheme

WHILST television in England is at a standstill, there are signs that it will go ahead with leaps and bounds in the United States. Whereas England had a two-year lead in the television field there is every reason to believe that if the war lasts for two or three years America would gain absolute supremacy both commercially and technically.

As is already known, transmissions from the London television station ceased on September 1st, for reasons of national defence. Mr. Sagall, managing director of Scophony, Ltd., has submitted a memorandum to the Postmaster-General and the Television Advisory Committee urging them to consider the question of restarting television transmissions. He says: "If the objections of the Defence Authorities to the transmissions of television by radio are incontrovertible, the possibility of introducing television over wires, i.e., over telephone lines or their equivalent, should now be carefully considered by the Government Departments in conjunction with representative television interests."

Mr. Sagall points out that a wired television system would be the ideal method of making television accessible to the bulk of the population, for in its wake would come a rental system of television sets, and a charge of 5s. a week is suggested. The suggestion is that the rent should include a contribution towards the provision of programmes. Transmission by wire would not, of course, be subject to atmospheric and electrical interference.

Apart from the home service, the plan also provides for the linking up of cinemas.

B.B.C. HOME SERVICE

Criticisms and a Compromise

THE B.B.C. Home Service was severely criticised at a recent meeting of the Radio Industry Luncheon Club, the members of which unanimously passed a resolution that: "While the meeting realises that certain shortcomings in the B.B.C. Home Service are due to measures taken to preserve the national security, it is felt that both the Ministry of Information and the B.B.C. should make clear to the public the fact that poor reception of the English programme is more often due to such emergency measures at the transmitting end than to the fact that listeners' receiving sets have broken down."

Criticisms of the poor and indifferent reception in many areas have also been voiced in the lay Press by dissatisfied listeners. In defence of the B.B.C. engineers, it must be said that it was known before the single-programme Home Service was put into operation that there would be many districts in which reception would be unsatisfactory, but the engineers were powerless to do anything with the system they were called upon to use.

It will be remembered that in November many listeners heard unannounced musical items on the 342-metre wavelength, which until the war was used by London Regional. These transmissions proved to be from a B.B.C. transmitter, and a few days before Christmas the B.B.C. made the following announcement: "Listeners who find difficulty in receiving the Home programme on either of the two wavelengths, 391 or 449 metres, are advised to try after 6 p.m. any evening the 342-metre wavelength." Since January 7th this wavelength has been used each evening for the special B.E.F. programme.

There are, however, still districts in which reception of B.B.C. programmes is far from satisfactory, and listeners in these areas must have been gratified to hear Sir Adrian Boult say during his recent talk on music: "Our engineers are doing everything possible to devise some means of improvement within the drastic limits of power that are imposed on us by the necessity of wartime. I believe the new wavelength begun a fortnight ago has improved things already, and I want to assure you that tireless efforts are being made to get things better still."

RADIO RELAYS

Conditions of the New Licence

RADIO relay companies have now received the new agreement from the Postmaster-General authorising their operation for a period of ten years from December 31st, 1939. With this is introduced a new scale of fees payable to the Post Office calculated according to the number of subscribers served. Stations with fewer than 300 subscribers will pay £3 annually, those with more than 300 but fewer than 500 £5, while those with over 500 subscribers will pay £10. A separate licence of £1 per annum is still required for each stand-by receiver.

Although the general scheme for the connection of relay exchanges by line to B.B.C. studios, which the Postmaster-General mentioned in the House of Commons last March, has had to be postponed in view of the present heavy demand on Post Office lines, the reception of B.B.C. transmissions by wire is permitted under the terms of the new licence. No provision has been made for the compulsory linking of exchanges to B.B.C. studios, but the P.M.G. reserves the right to impose such a condition.

The distribution of programmes at carrier frequencies and the use of an earth lead as a part of any circuit for programme transmission are prohibited. To avoid interference with Post Office communication services a minimum clearance of two feet from a Post Office line is specified for the distributing plant.

STANDARD I.F.

WITH a view to facilitating the standardisation of an intermediate frequency for superheterodyne receivers, the Australian Postmaster-General has circularised radio manufacturers in the Commonwealth with a proposal that the frequency of 455 kc/s be adopted. In the memorandum it is stated that unless the majority of manufacturers consider 455 kc/s as unfavourable, it is proposed to protect the band of frequencies between 450 and 460 kc/s by keeping important transmitters out of this band.

In 1937 the Federal Communications Commission of America adopted 455 kc/s as being most suitable for the intermediate frequency.

AUSTRALIA'S WORLD TRANSMISSIONS

Inauguration of International Service

A DAILY short-wave world news service broadcast by the Australian Broadcasting Commission was inaugurated by the Prime Minister of the Commonwealth on December 20th.

Transmission No. 1A, which is directed to central and northern Europe, is radiated from 7 to 9 a.m. (G.M.T.) on 9.615 Mc/s (31.2 metres), the call sign being VLQ. This transmission is at present given in English. French and German, but will later include Dutch, Russian and Norwegian. The principal English transmission is at 8.15 a.m. Transmissions for north and south America and India are radiated on the same frequency at various times between 11.30 a.m. and 4.30 p.m.

The transmission directed to southern Europe and the Balkan States, which at present is given in English and Spanish, but will later include Italian, Arabic and Turkish, is radiated from 7.30 to 8.30 a.m. from VLQ2 on 11.87 Mc/s (25 metres).

A new transmitter, VLW3, at Perth, was used on January 15th for the introduction of transmissions in English and Afrikaans to Africa on 11.83 Mc/s (25.36 metres).

Transmissions to the Dutch East Indies and Japan are radiated from VLR on 9.85 Mc/s (31.3 metres) and VLR3 on 11.88 Mc/s (25.25 metres).

"SENDER BREMEN"

THE German transmitter, working on 395.8 metres, which uses this identification, is situated at Oldenburg, close to the German-Dutch frontier, and about 30 miles from the North Sea. It will be remembered that this station suddenly made its appearance in July, 1939, no mention of it having been made by the German delegation at the Montreux wavelength conference.

In July, our Berlin correspondent reported that there seemed no reason for building this transmitter in a corner of Germany already well served by the local station Bremen unless its transmissions were intended for countries outside Germany. That this was the case has been amply borne out by recent events.

The station's published programmes are very interesting, for they entirely ignore German listeners. They are intended for England and Holland.

Although the power of Bremen has

Current Topics—

not been published, it is thought to be between 100 and 150 kW. Its aerial is directional on Great Britain. The original 2-kW Bremen transmitter continues to transmit on its wavelength of 225.6 metres under the name of Unterweser.

ECHOES OF RADIOLYMPIA

LT.-COL. G. D. OZANNE was given a gold cigarette case together with a piece of jewellery for his wife by members of the Radio Manufacturers' Association as a token of their appreciation of his untiring work in organising Radiolympia, 1939. The presentation was made at a recent luncheon during which the chairman, Mr. W. W. Burnham, revealed that the loss on Radiolympia, which it will be remembered closed prematurely, was between £12,000 and £13,000.

A.I.R.'S FOURTEENTH STATION

THE 5-kW transmitter of All-India Radio at Dacca, which was opened by His Excellency the Governor of Bengal on December 16th, is designed to give a first-rate, direct-ray service to cities within a radius of 50-100 miles of the station, as well as serving Eastern Bengal as a whole.

Working on 257.1 metres, the transmitter, which was erected by Marconi engineers six miles from the studios in Dacca, employs a mast-radiator aerial. Dacca is the ninth centre and the fourteenth transmitter to be erected under the present development scheme of A.I.R. It is proposed to establish a receiving station at Dacca for the purpose of relaying the news broadcast by the central news organisation at Delhi.

I.E.E. MEETINGS RESUMED

THE Council of the Institution of Electrical Engineers having reviewed the position regarding the activities of the Institution in the light of the present conditions, have, in response to the requests of members, announced that its activities will again be resumed. Meetings of the Institution in London will, therefore, be held during the second half of the present session. Activities in the provinces will be resumed when thought advisable by the various committees. All London meetings will be held from 6 to 8 p.m.

GERMANY'S RADIO INDUSTRY

A WELL-KNOWN German radio journal reports that the German radio industry has not only fulfilled its obligations for supplies to the war departments, but has increased its exports to nineteen neutral countries. No fewer than eleven types of AC and AC/DC receivers have been produced for export. The increased demand on the home market for sets at Christmas was also easily met. The previously reported rationalisation of sets, which will come into operation later in the year, will not affect the receivers built for export.

It would appear from the number of sets for home construction recently described in the German technical Press that this side of the industry is also flourishing.

ON THE WESTERN FRONT. A French soldier operating one of the many portable transmitter-receivers which are being used by the allied armies.

FROM ALL QUARTERS

Television Radio Link

GENERAL ELECTRIC engineers are experimenting with a television relay receiver near the Company's television transmitter W2XB on the Helderberg mountain, which is about twelve miles from Schenectady. It is proposed to pick up transmissions from the N.B.C.'s New York transmitter W2XBS, which is approximately 130 miles away, and then to rebroadcast them from W2XB.

Long Distance Broadcasting

SIR NOEL ASHBRIDGE, B.B.C. controller of engineering, will deliver a lecture on "Long Distance Broadcasting" at the Royal Institution, 21, Albemarle Street, London, W.1, on Friday, January 26th, at 5 p.m.

Germany's Jamming Station—Official

IT is reported by *The Nottingham Evening Post* that the announcer from Deutschlandsender when reading a list of gifts to German troops recently read "two hundred marks from the jamming station at Stralsund."

American Radio Census

THE introduction of the question "Is there a radio in this dwelling unit?" on the schedule for the United States sixteenth Decennial Population Census, will provide the first accurate survey of receivers in the country.

Little Lawlessness

M. RAYMOND BRAILLARD, director of the U.I.R.'s Control Centre in Brussels, recently stated that with few exceptions countries are keeping to their allocated wavelengths.

Another N.Y. Television Station

APPLICATIONS to operate television transmitters continue to reach the Federal Communications Commission, and one of the most recent is for a 1-kW station in the centre of the Metropolitan area of New York City. It will operate in the 84—90-Mc/s band, a rather higher frequency than those already in use.

Byrd Antarctic Expedition

THREE call signs have been allocated to the Byrd Antarctic Expedition for use in the amateur bands. They are KC4USA, KC4USB and KC4USC.

Captain Plugge

AT the last general meeting of the Parliamentary and Scientific Committee at the House of Commons, Captain L. F. Plugge, M.P., was elected chairman.

Belfast Wireless College

THE Caledonian Wireless College is to open a branch college in Belfast which will specialise in the training of marine wireless operators. It will be known as the Belfast Wireless College.

Philco's Chairman

MR. L. D. BENNETT, M.Sc., has been elected chairman of the Philco Radio and Television Corporation of Great Britain in succession to Mr. C. C. Rattey, who has resigned.

Wireless for the Blind

THE National Institute for the Blind has announced that more than £10,000 had been received by the end of the year in response to the Christmas Day broadcast appeal by "an unknown blind man" for the fund which provides and maintains wireless receivers in the homes of needy blind people.

Wireless World Diary

COPIES of *The Wireless World* Diary for 1940 are still available from our publishers, Iliffe and Sons, Dorset House, Stamford Street, London, S.E.1. In addition to the usual features of a diary it contains technical data and reference sections compiled by the staff of this journal. Copies cost 1s. 6d., or, by post, 1s. 7d.

Getting the Best from Records

Part 1.—THE RECORDING CHARACTERISTIC

By P. G. A. H. VOIGT, B.Sc., A.M.I.E.E.

This is the first of a series of articles by an acknowledged authority on quality reproduction. The author developed the electrical recording system used by Edison Bell Ltd., and was responsible for the recording of over a thousand titles while he was with that company

ONLY too often, the feeling of scorn with which radio engineers regard record reproduction is due to the fact that they have never seriously tried to get the best out of records and have therefore never discovered how good modern records can be. No doubt the idea that records cut off at 5,000 c/s is largely responsible, and while this was certainly true of some of the early electric recordings, the commercial recording system which cuts off at such a low frequency is nowadays the exception rather than the rule.

The B.B.C. cannot always satisfy our requirements, so there is much to be said in favour of records, when correctly reproduced. Quite apart from the programme point of view, however, no quality enthusiast should consider his equipment complete until he is able to obtain from the best records a quality of reproduction which is only excelled by the very finest of broadcasts.

This is not merely a matter of connecting up a pick-up and enjoying a record, as most people imagine. The question of pick-up actually introduces several problems which challenge the technical ability of both the quality lover and pick-up designer.

The usual starting point in such matters is the characteristic curve, but, as Mr. Scroggie said in a recent article,* "it is difficult to get authentic information about the characteristics of records." This is a point which must be clarified before we can proceed.

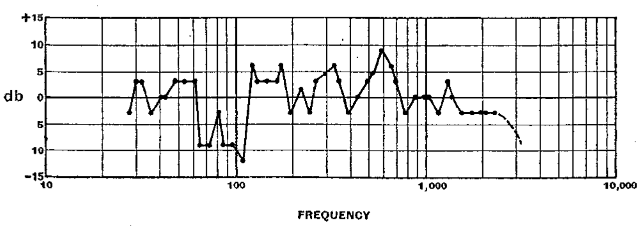


Fig. 1.—Sound output from notes of a piano when struck with equal force.

In the days of horn recording, progress was based on laborious hit-and-miss methods, so that all information about the details became the most jealously guarded secrets. This tradition of secrecy is probably responsible for the absence of information deplored by Mr. Scroggie. Readers may therefore be interested to learn the factors which determined the basic characteristics of a recording system upon the development of which I was engaged for several years from about 1923.

When the problem first arose, little was known about electro-acoustics, and the distribution of energy within the audible spectrum was largely a matter of surmise, with a strong bias in favour of the idea that there was extra energy at low frequencies. No doubt the visible motion of the diaphragm of a big drum contributed to this idea.

However, serious development could not be based on vague beliefs of this kind, no matter how widely held, and so I examined the matter from the only possible standpoint, namely, that of mechanical efficiency. It seemed, since the violin and the double bass are similar except as regards size, that their efficiency, when each is playing in its proper frequency spectrum, is also likely to be similar. The same applies to the piano, namely, if each note is hit with equal force, no great variation in sound output energy could be expected.

This latter was a fairly simple matter to check, providing a few things, particularly microphone characteristic, could be taken on trust. With regard to the microphone employed, this had a calculated response which would be level if the air cushion in it expanded and contracted adiabatically at all audible frequencies. If, however, the air worked isothermally, the response would still be level, but about 3 db higher up. At that time no information was available to show which way the air was working inside the microphone, or whether (as afterwards proved to be the case) the mode of working changed over slowly somewhere in the audible scale. At worst, therefore, unless the microphone calculations were wrong, a 3 db loss in the treble was the maximum error to be expected.

It was obviously impossible to hit the piano keys uniformly by hand, so a mechanical device was made up. This comprised a weight capable of sliding up and down a rod. A cork was attached below to hit the key, and by adjusting the height through which the weight fell the impact could be controlled. A valve voltmeter giving a reading approximately proportional to the peak value was used, and the results, when plotted out, confirmed the expectation that the general efficiency would be more or less constant throughout the scale.

My original curves seem to have been lost, but Fig. 1 gives a curve taken under the same kind of conditions and redrawn (to conform to modern practice) on a db basis. The local peaks and troughs are familiar to all

*Wireless World, November, 1939.

electro-acoustic workers, and are caused by interference effects between the direct and reflected waves which are always present in a room unless it is highly damped. To check up on this, the relative position of piano and microphone was altered, when a new curve completely different in detail would be obtained; even the opening or closing of a near-by door would affect the details of the curve. All the curves, however, had one factor in common, namely, the top octave was weak. This I attributed to the piano itself. With many pianos, the highest notes are so weak as to be lost under the mechanical noise of the hammers, action, etc. It can, therefore, safely be assumed that the piano builders have some difficulty in maintaining efficiency for those notes in which the strings are very short.

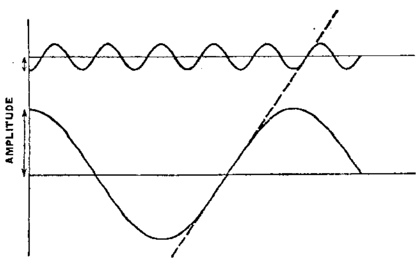


Fig. 2.—In a sine wave the slope in the region of the datum line represents the velocity of the moving point. To maintain a constant slope, the amplitude must be progressively increased as the frequency is decreased.

The assumption of a tendency to uniform efficiency over the scale was, therefore, supported by experiment, and in my subsequent experience I have confirmed that (big drums and organs excepted) a high note, particularly the soprano soloist, is just as likely to overload a level chain as a low note.

Sound energy in free air resembles electric energy in many respects. Thus Sound Power (Watts) = Sound Pressure (Volts) × Sound Velocity (Amps). So that constant output means that both Pressure and Velocity remain constant. If the velocity is kept constant, we find as we go down the scale that amplitude increases. This is quite automatic (see Fig. 2), and I must stress again that increasing amplitude in the bass does not indicate extra power, but is directly due to the fact that, as the period of a low note is long, the excursion is also large.

Constant Velocity v. Constant Amplitude

Basically, the ordinary acoustic gramophone can be considered as a diaphragm driven more or less directly from the record groove and driving into a horn. If the horn were perfect, and big enough to cover the whole musical scale, we should require for constant output that the diaphragm velocity be kept constant. If the coupling beween the diaphragm and the groove is rigid, this would call for constant velocity at the needle point.

In other words, given perfect gramophones, constant velocity recording would be ideal.

Unfortunately, constant needle-point velocity introduces two major disadvantages. The one which is generally ignored is that the amplitude of high frequencies becomes so small that they tend to be lost under the accidental surface irregularities. The other disadvantage, to which much publicity has always been given, is that for low frequencies the amplitude would be so great that the grooves might run into one another. Actually in practice this latter is not the real trouble. The real trouble is the commercial one that with some gramophones the soundbox will be thrown out of the groove by a violent excursion, and then keep repeating, while with others, even if they track satisfactorily, the note concerned will soon be worn out. (The same applies with some pick-ups.)

By recording on a basis of constant amplitude, our trouble in the bass would disappear, while in the treble the amplitude of the recorded sound would then exceed the surface irregularities so much as to drown their noise completely. Since under normal conditions constant energy at the mike is a reasonable expectation, constant amplitude recording would seem to be ideal as a means of storing the image of the sound in any medium with an amplitude limitation or a tendency to inherent noise.

With constant velocity, for each octave rise the amplitude drops to half. Constant amplitude, therefore, has, relatively, a top lift of 2 : 1, i.e., 6 db per octave. It seemed to the writer, therefore, that if something (such as a weak spring) could be included in the stylus bar so as to give a loss of 6 db per octave going upwards, then constant amplitude recordings would prove practical, and the first commercial electric recordings I made (1926) were an attempt at constant amplitude recording.

Unfortunately, these recordings, while better than

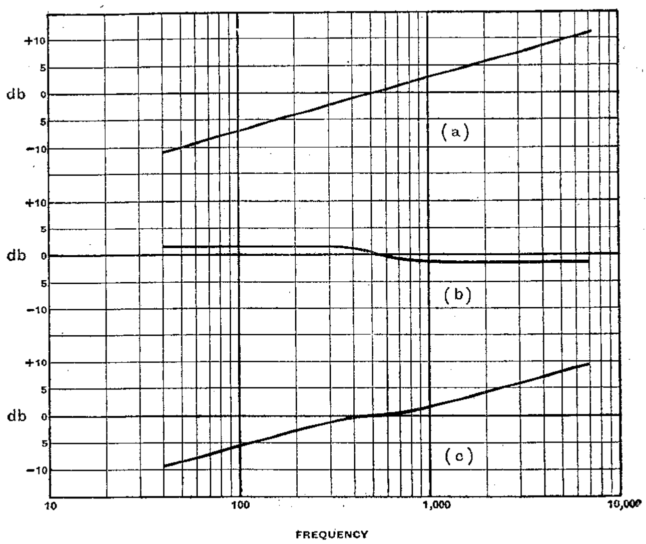


Fig. 3.—Characteristics of the Edison Bell electrical recording system. (a) Cutter characteristic; (b) microphone characteristic; (c) over-all characteristic.

horn recording, were rather "thin" when played on ordinary machines, and it was not possible to wait while the design of gramophones adapted itself to constant amplitude recording. Moreover, electric recordings were also being issued by other companies, and, as they were making no attempt to record on a constant amplitude basis, all possibility of gramophone design adapting itself vanished. Another good reason for abandoning constant amplitude recording was found later, namely, excessive record wear at high frequencies.

Getting the Best from Records—

We have now arrived at the point where we know that constant velocity recording gives us insufficient top, and constant amplitude gives us too much. In the bass, things are reversed, and constant velocity gives us too much for the ordinary gramophone, while constant amplitude does not give enough. Obviously, a characteristic somewhere in between the two is required, but just how far in between is a problem not easily settled, especially when it is remembered that the difference between them over the frequency range 32 to 8,000 cycles amounts to 250 to 1, or about 48 db.

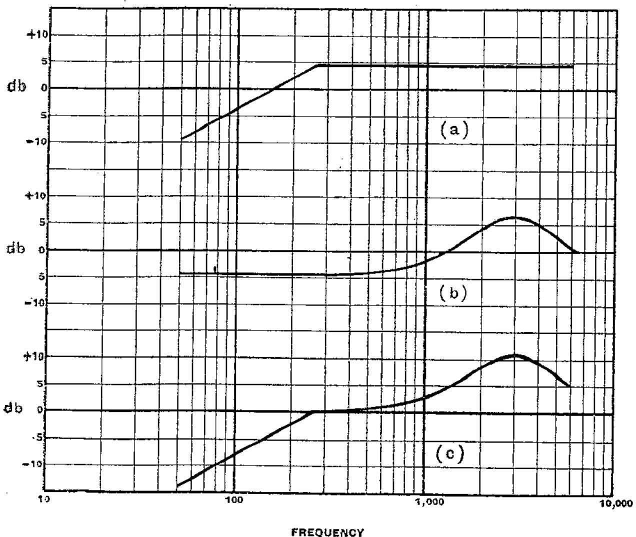


Fig. 4.—Characteristics of another early electrical recording system. The three curves correspond to those of Fig. 3.

The method of solving this problem which would have pleased the managing director best would no doubt have been to measure the characteristics of the gramophone he uses in his office and then make the recording characteristic suit that machine. This, however, did not seem very scientific, especially as I had no guarantee that it was an "average" machine, or even that it might not be altered for some experimental reason soon afterwards. Measurements of several different types of gramophones showed that, except for complete loss of bass, and numerous treble resonances, there was nothing consistent in their output on which a recording characteristic could be based. Finally, I decided to strive for a cutter characteristic which would be a scientific compromise and lie exactly in between constant amplitude and constant velocity. Except for the possible 3 db change in the mike, my over-all characteristic would thus be a rising one, rising at the rate of 3 db per octave. The mike change was found to occur slowly in a region about the middle of the scale, and, as this change was in opposition to the rising cutter characteristic, it would cause a slight flattening of the slope in the region concerned. This is shown in Fig. 3, where the desired cutter curve, the mike curve, and the combination of the two are shown.

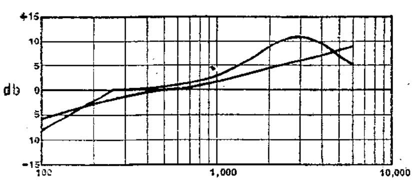


Fig. 5.—Comparison of over-all curves of the systems analysed in Figs. 3 and 4.

It had been published that the recording system used by our competitors had a constant amplitude characteristic below about 250 cycles, and a constant velocity one above. Comparison of one of my records with one of theirs, however, showed that their general balance had much too much top for the published curve to be correct.

Technical confirmation, which showed how a mistake had come to be made, was not published till much later. The mistake was due to the fact that our competitors had assumed their mike curve to be level in the treble. This assumption was based on elaborate pistonphone and thermophone measurements carried out with the microphone at one end of a tube full of hydrogen. When a microphone is used for recording, however, it is situated in free air, where it will reflect high notes but not low ones, and it certainly is not contained together with the artists in a tube full of hydrogen.

The top lift caused by the obstacle effect when a mike is used in free air, and also the added top lift due to cavity resonance, have since been investigated by W. West, of the Post Office Research Dept., and the results were published in the I.E.E. Journal for April, 1930. These showed that microphones of the type used by our competitors when operating in free air, face on to the source of sound, had a top lift amounting, at 3,000 cycles, to as much as 11 db over the rated value. This is shown together with the published recording curve and the combined curve in Fig. 4.

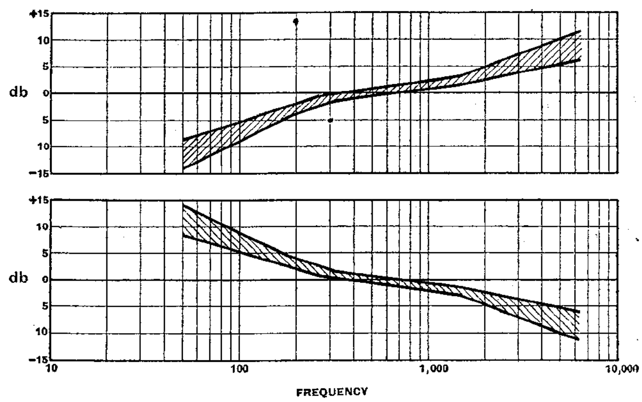


Fig. 6.—Estimated limits of characteristics of modern electrical recordings and the corresponding over-all amplifier and pick-up characteristics required for reproduction.

In our competitors' early electric recordings, frequencies above 5,000 were somewhat cut off by the cutters then in use. Since then, however, they have widened the range of recording and effected many other improvements. Comparison of early and recent electric recordings, however, shows that a substantial top lift but rather smoother than the earlier one is retained to this day. In fact, any record recorded on an overall constant velocity basis above 250 cycles, quite apart from surface noise, would sound so dull and heavy as to be unsaleable.

Getting the Best from Records—

In Fig. 5 the important frequency regions between 100 and 6,000 cycles can be compared, the two curves shown superimposed being the relevant parts of the combined curves from Figs. 3 and 4. It will be noticed how remarkably closely they fit.

How does this compare with present-day records? Here, like Mr. Scroggie, I have no official information, but I do know that it is possible to mix in my own recordings with modern records. Although the orchestrations may be antique, and the records show various other signs of old age, there is no impulse to reset treble or bass controls as would be the case if there was any major difference in the over-all characteristic Moreover, why should there be any change? The basic fundamental laws remain, and the only factor which might influence matters is that surface irregularities are now appreciably reduced. Against this, however, the public has become more critical, and improved reproducing apparatus discloses what little surface there is. These facts tend to balance one another.

All things taken together seem to prove that even if modern records are recorded on a basis which differs from that shown in Fig. 5, then the difference cannot be great, and I would estimate that the curve of the present-day average record lies somewhere between the two lines shown in Fig. 6, which also shows the inverse, i.e., the ideal pick-up characteristic for extracting the music. This last, of course, assumes that the rest of the chain is perfect or corrected for. When this is not so, or when the reverberation curve of the listening room is imperfect, then an appropriate modification can be most helpful.

In connection with this question of pick-up curves, it is most interesting to note the very general tendency to a falling characteristic which modern pick-ups have when used with the circuits recommended by their makers. This would seem to indicate that in their development they have been adapted to the work they have to do, and this may be taken as independent confirmation of the trend shown in the estimated curves of Fig. 6.

Short-wave Reception

NEWS-GATHERING CONDITIONS IN PROSPECT AND RETROSPECT

AFTER having just passed through a period of maximum sunspot activity, we are now undergoing the first winter of an approaching minimum of the solar sunspot cycle. This fact has been brought home to us in a forcible and rather disagreeable manner by the generally poor conditions for night-time short-wave reception that have existed for many weeks. But the story is not one of unrelieved catastrophe, as one might assume from reading the lay Press, which fails to give prominence to anything except the ill effects of the sunspot on wireless. If the editors would consult wireless engineers and not astronomers on the wireless aspects of the matter, they would learn that there is another side to the picture.

As we approach the sunspot minimum, the appearance of single spots or small groups has a marked effect on short-wave conditions. With the appearance of a new spot, after, say, a spotless solar disc of 10 days' duration, the whole waveband upon which good distant reception is obtainable will expand in both directions, but especially downwards (in wavelength). This effect will be noticeable on the very first day that the spot becomes visible (and sometimes even just before) and will persist until the activity disappears, when the conditions will revert to the point where only a narrow band of frequencies are suitable (and then often giving weak signals) at any time of the day.

This good effect, which may persist for about 14 days, the half period of the sun's rotation, may be marred by the usual ionosphere storm lasting about two days and which frequently follows the meridian passage of the spot. On balance, therefore, the appearance of a spot will produce about 12 days of improved reception, not only in signal strength, but also by making available a broader band of working frequencies. This effect will be especially noticeable in the evenings.

Actually, taking the world as a whole, short-wave receiving conditions are not as bad as they seem to be at present in this country, if only because only the northern hemisphere is in winter.

There is another reason for thinking conditions are worse than they actually are. I refer to the failure of the Americans, to whom so many of us turn for alternative programmes and especially news, to provide a short-wave service at all comparable with that provided by the B.B.C. The British overseas service must by now be somewhat ahead of its nearest and only serious competitor, the German "world-sender" at Zeesen.

Let us analyse in more detail the situation as it applies specifically to transmission across the Atlantic.

Best Daylight Frequency

During the hours of daylight throughout most of the year, the best frequencies for transmission from New York to London centre around 20 Mc/s or 15 metres.

It is true that during certain periods in the early afternoons or evenings in winter and spring much higher frequencies than 20 Mc/s can be used with success—witness the performance of the U.S. amateurs on 28 Mc/s (10 metres), but substantially, on a 12 months basis, the correct day frequency is approximately 20 Mc/s (15 metres).

Now, this is a fortunate state of affairs for two reasons, the first reason is the shorter the wavelength, provided it is not too short, the less power is required at the transmitter to produce a workable signal at the receiver.

This is brought about both by the fact that the loss suffered by a wave in traversing the ionised layers increases as the *square* of the wavelength and also by the lower noise level experienced on the shortest waves.

The second reason is that for effective transmission large aerials must be used and that the lowest part of the aerial should be at least one-half of a wavelength in height.

Now on 15 metres a half-wave is only $7\frac{1}{2}$ metres or about 25ft.; so that quite an effective aerial array may be supported on telegraph poles.

But to return to our winter night conditions, here the lowest wavelength, and in fact the only permissible wavelength, is in the region of 50 metres (6 Mc/s if we exclude

Short-wave Reception—

the 9.5 Mc/s (31 metres band), which has a period of usefulness not extending much later than 9 p.m. G.M.T. on most nights.

Now, more power and a much larger aerial system is required to give on 49 metres the same night-time signal/noise ratio in this country that can be obtained on 15 metres in the daytime. For example, the lowest part of the aerial system will have to be at least 80ft. above the ground, and it is interesting to note that for its 49-metre services on GSA and GSL the B.B.C. uses masts many times higher than that.

The American broadcasters, however, have no effective aerial arrays for use on frequencies lower than 15 Mc/s (above about 20 m.) unless the horizontal "V" used by WCBX is considered to be satisfactory in performance up to 25 metres.

As a partial proof of this contention a friend of mine recently drew my attention to the performance of WGEA Schenectady on 9.53 Mc/s (31.48 m.), which generally fades out at about the same time as WNBI on 17.78 Mc/s fails on evenings when both transmitters are audible. If WGEA'S antenna were as efficient as that of WNBI, then this station should, by virtue of its considerably lower frequency, remain a good signal for several hours after WNBI on 17.78 Mc/s (16.87 m.) has faded out.

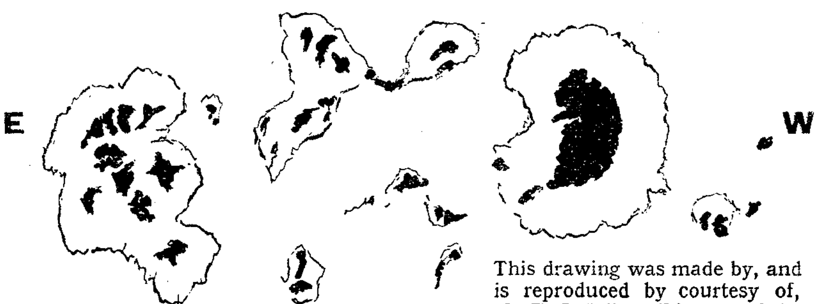
WNBI's 16-metre European array is a horizontal "V" 100ft. high and with two sides each 570ft. long; a similar aerial for Bound Brook's 49-metre wave would be 340ft. high and have sides nearly 2,000ft. long.

Actually, there is a European "V" at Bound Brook for the 6.10 Mc/s frequency, but it is only 180ft. high and the sides are even shorter than those of the 17.78 Mc/s array.

All international broadcasting services have to make a start somewhere, however, and it must be remembered that 80ft. poles were considered quite suitable by the B.B.C. in 1932 for its short-wave service. Similarly no doubt the seemingly erratic performance of the new Australian transmissions by VLG2 and VLG may be traced to the aerial system at the transmitting end, since the provision of an adequate system for waves about 20 metres is a difficult and costly business.

In the case of Australia, however, we must remember, that the path the signals follow is a very difficult one. They start, perhaps, in the heat of the Australian midsummer afternoon and travelling by the darkness path over S. America reach us in the early hours of a winter morning. No matter what the period of the year—except possibly during the equinoxes—all the possible combinations of summer light and winter darkness are sampled by the wave on its 12,000 miles journey from Australia. It is for this reason that transmissions from and to Australia are nearly always conducted on waves between 25 and 31 metres (12 and 9.5 Mc/s), although transmissions on 19 and even 16 metres are often very successful for a short period around midday in our winter, when there is daylight practically all the way.

Detailed drawing (to the scale of a sun disc diameter of 24 in.) of a large sunspot which was on the central meridian of the sun on January 5th. The dark parts represent the umbra, while the penumbra is shown by the outlines.



This drawing was made by, and is reproduced by courtesy of, Mr. F. J. Sellers, Director of the Solar Section of the British Astronomical Association.

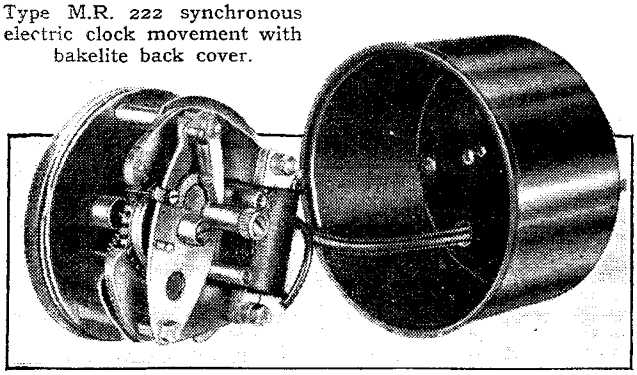
Let us, therefore, remember the special difficulties of wireless transmission from Australia when we don't get the best results on the newly inaugurated broadcasting service. Incidentally, any reports on these transmissions would be especially welcomed by Mr. A. H. Longstaff, London representative of Amalgamated Wireless of Australasia, at Australia House, Strand, London, W.C.2.

"ETHACOMBER."

M.R. Synchronous Clock Movement

An electric clock adds the finishing touch to receiving installations fitted in special cabinet work, and readers who make a hobby of designing their own cabinets may be interested to learn that clock movements of English manufacture are still available.

Type M.R. 222 synchronous electric clock movement with bakelite back cover.



The M.R./222 movement costs 17s. 6d. or 18s. 6d. with bakelite back cover. It is very well made with good bearings and silent running machine-cut gears. The rotor speed is only 187.5 r.p.m. which is much lower than usual, and the life of the movement should be unlimited.

Starting is by means of a spring-loaded trigger which is absolutely certain in action, and does not let one down when starting the clock on a wireless time signal.

A variety of sets of hands and numerals is available and the clock face can be designed to conform with the character of the cabinet work. The diameter of the movement is 2½in. (3in. with back cover) and the power consumption is less than 2 watts.

The movements are obtainable from M.R. Supplies, 68, New Oxford Street, London, W.C.1.

Peto Scott Trophy 6

COMMUNICATION TYPE AC SUPERHET. RECEIVER (FOUR VALVES + RECTIFIER AND BEAT FREQUENCY OSCILLATOR) PRICE : £10 19s. 6d. (WITH PROVISION FOR VIBRATOR, £12 9s. 6d.)

ALTHOUGH the basic circuit is simple and is without the RF stage which is standard in the Trophy 8, this receiver is nevertheless true to type, and its specification includes many of the features associated with professional communication instruments. Its performance is lively down to the shortest wavelengths, and its calibration is accurate. To the amateur whose interest is not limited to broadcast transmissions only it should make a strong appeal, for its wavelength coverage is continuous, and it is well equipped for morse reception.

Circuit.—A single tuned circuit precedes the triode hexode frequency changer, and is inductively coupled to the aerial. Provision is made for the connection of a doublet aerial system if maximum efficiency is required for one particular wavelength.

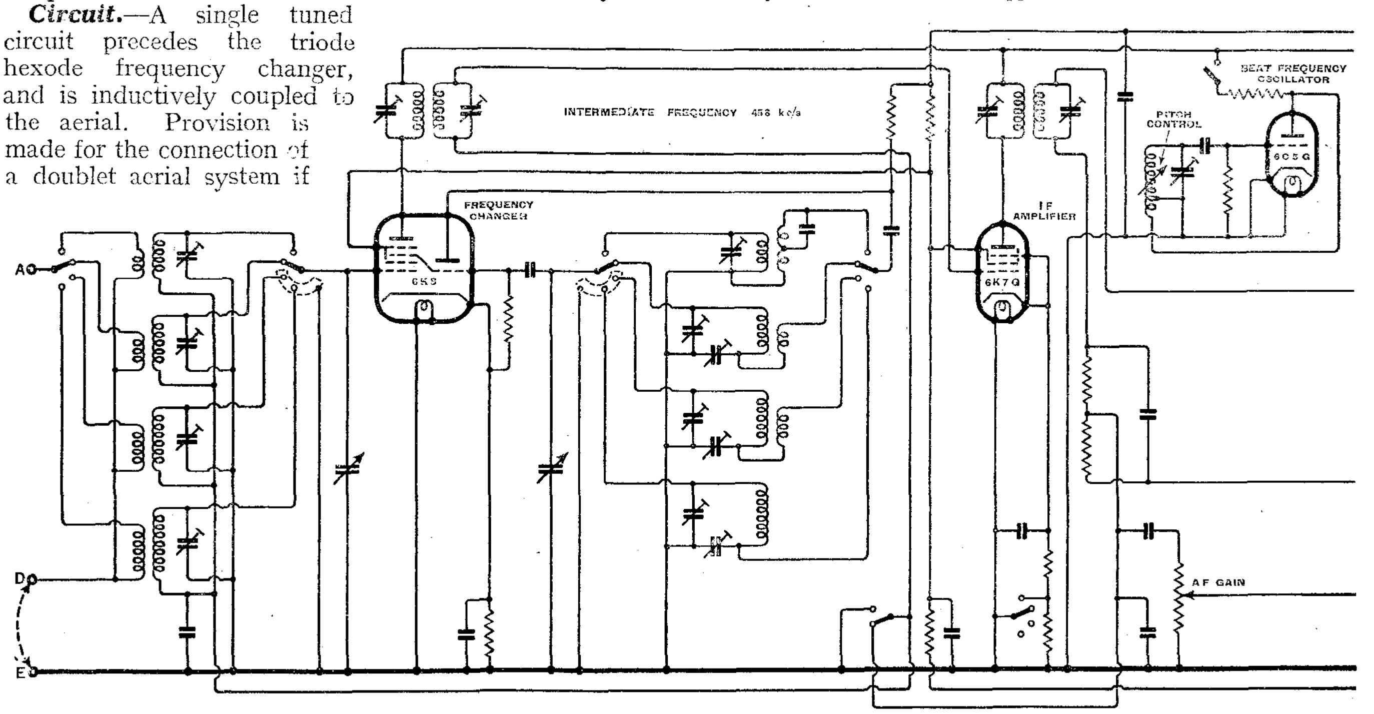
The single IF stage has an iron-cored input transformer, and an air-cored output transformer to the AVC and signal rectifier. This functions as a single diode with the anodes strapped and AVC is taken from the common load resistance after suitable filtering. The control voltage, which is delayed, is applied to the frequency changer and IF stage on all wavebands, but may be switched off when searching for weak signals or receiving morse. On the 6.5-20 metre band additional amplification is provided by reducing the bias on the IF valve.

The triode section of the detector stage is resistance coupled to a tetrode output valve. A switch jack is connected in the output circuit to feed headphones through a condenser, using the primary of the output transformer as a choke. The HT current is smoothed by the loud speaker field, and decoupling is provided only for the screens of the frequency changer and IF valves.

In the model tested, a switch and socket were fitted at the back for operating the set from a 6-volt battery. The filaments are fed direct and a vibrator unit delivering 70 mA at 250 volts is required. A suitable unit can be supplied by the makers of the set.

Performance.—As regards range and selectivity, the set is comparable with four-valve broadcast superheterodynes in which a single tuned circuit precedes the frequency changer. The sensitivity to weak signals is, however, high, and the feel of the set gives the impression that judicious use of regeneration has been made in the IF stage. With

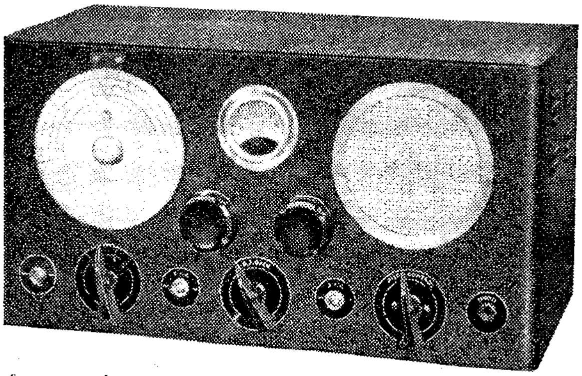
Circuit diagram of the Trophy 6. The tuning condensers incorporate ganged band-spread sections in parallel with the main capacities. The connections for an auxiliary filament battery and HT vibrator are supplied as an extra.



only one tuned stage at signal frequency some second channel interference is to be expected, and there is a sprinkling of tunable whistles on most wavebands. Repeat tuning points are very weak, however, and can be detected only in the more powerful stations.

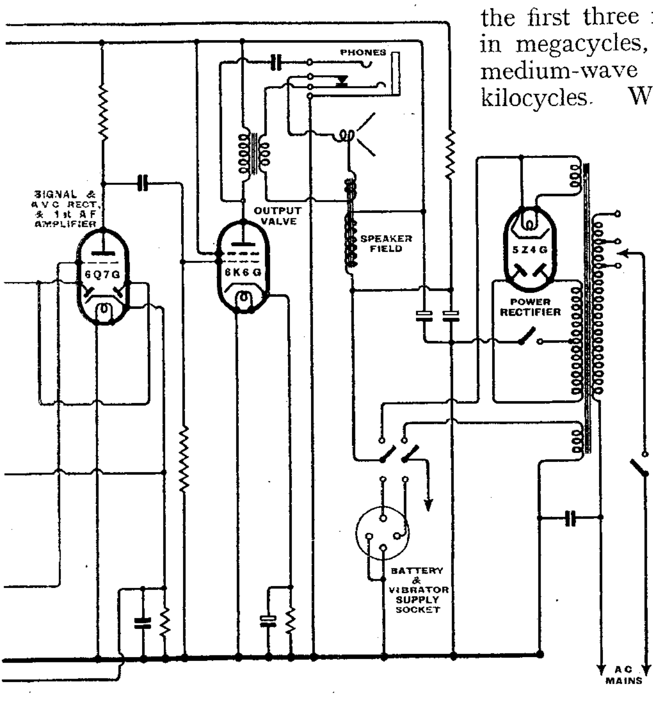
The quality of reproduction is rich in high frequencies and is inclined to emphasise background hiss, but its characteristics are admirably suited to speech, which is crisp and clear. There is some tendency to microphonic feedback at full gain on a strong carrier, but it is easily kept under control, since the low frequency response from the 4-inch moving-coil loud speaker is small.

Where this receiver scores over the broadcast set is in its performance at very high frequencies. Range No. 1 from 20 down to 6.5 metres is remarkably lively and also very uniform in its sensitivity throughout the range. The 13-metre broadcast band stands out, of course, and the beat frequency oscillator is useful in locating distant carriers on this as on the other three waveranges.



WAVERANGES

(1) 46-15 Mc/s (6.5-20 metres)
(2) 17-5.5 Mc/s (17.65-54.5 metres)
(3) 5.5-1.7 Mc/s (54.5-176.5 metres)
(4) 1700-550 kc/s (176.5-545 metres)



The four overlapping waveranges cover 6.5 to 545 metres without a break. The scales corresponding to the first three ranges are calibrated in megacycles, and the fourth (the medium-wave broadcast band) in kilocycles. With the band-spread condenser at zero, the calibration accuracy was checked at several points on each of the short-wave ranges and found to be well within the reading error of the scale. This is a standard not often reached in communication receivers costing considerably more than this set. The band-spread condenser has an open scale, and the final adjustment of stations on the shortest wavelengths can be made with ease and precision.

The provision of an adjustment on the front panel for the local oscillator enables the beat frequency to be adjusted to suit the phones or the listener's particular requirements. This, and the fact that the AVC circuits can be short-circuited makes the set ideal for morse reception and practice. Incidentally, the receiver may want slight retuning on the band-spread dial when the AVC switch is changed over.

Constructional Features.—The whole of the tuning condenser system including both tuning dials is suspended on rubber. The main tuning condenser is of a standard type and the two-gang band-spread condenser has been added to it. Extensions of the end plates of the main condenser carry the bearings for the moving vanes, of which there are two in each section. A single fixed vane between each pair is soldered direct to the appropriate section of the main condenser.

The controls are well laid out in the front panel of the all-metal cabinet, which is well ventilated and finished with a durable black crystalline enamel.

Makers.—Peto Scott Electrical Instruments, Ltd., Pilot House, Stoke Newington, Church Street, London, N.16.

BOOKS RECEIVED

The 1940 edition of the famous **Kelly's Directory**—officially known as the Post Office London directory—which has just made its appearance, is particularly noteworthy this year inasmuch as it contains a list of the wartime addresses of the many companies, including wireless firms, who have temporarily evacuated their London offices. The Directory, which embodies all its usual features, also contains the names of no fewer than five hundred London streets which have been renamed during the past twelve months.

The price of the Directory is 60s., and it is published by Kelly's Directories, Ltd., 186, Strand, London, W.C.2.

Freedom Calling. Pp. 64. Published by Frederick Muller, Ltd., 29, Gt. James Street, London, W.C.1. Price 6d.

The story of the secret German "Freedom Station," which has been transmitting on various short wavelengths at intervals since January, 1937, is told by the station's representative in Great Britain, who, of course, remains anonymous.

The Practical Engineer's Pocket Book, 1940. Published by *Electrical Trading*, 92, Long Acre, London, W.C.2. Price 2s. 10d. post free. A reference book of facts and formulæ; there are over 50 sections, and domestic as well as industrial applications of electricity are dealt with. The latest I.E.E. Regulations for the Electrical Equipment of Buildings are summarised.

Letters to the Editor

THE EDITOR DOES NOT NECESSARILY ENDORSE THE OPINIONS OF HIS CORRESPONDENTS

Reaction Control

I SHOULD like to express my appreciation of the recent article entitled "Smooth Reaction." In my opinion this subject deserves more mention than has been accorded it during the last year or two.

Perhaps something might be said about some of the snags often met with in practice. For instance, it has been my experience that the Colpitts circuit employing a choke in the cathode lead is prone to medium-wave break-through, and this may necessitate rather careful screening of the whole cathode circuit for its complete elimination.

In addition, modulation and tunable hums, and rapid motor-boating when oscillating, are usually found to be more troublesome when the cathode of the detector valve is not directly earthed.

Methods of getting over this that I have found effective in my own receivers are as follows:—

(1) Wiring up the heaters in twin lead-covered electric light cable, and earthing the sheath to the earth point of each stage.

(2) Connecting non-inductive 0.01-mfd. condensers from heater to earth, wired directly to the detector (and sometimes RF and first audio) valveholder.

(3) Adequate filtering of RF currents at the detector anode.

(4) Use of screened cable for power supply leads if a separate power pack is used.

(5) Screening the rectifying valve or complete power pack in perforated zinc.

(6) Connecting mica condensers of 0.001 to 0.01 mfd. across (a) mains leads, (b) mains to earth, (c) HT+ to earth, (d) anodes of rectifying valve to earth or cathode.

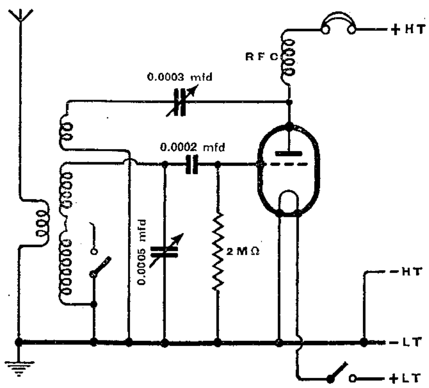
Of course, all these precautions are seldom required. Experiment will soon discover the simplest way of curing the trouble.

Another point that requires watching in a TRF receiver is the possibility of the RF stage oscillating before the detector. It usually pays to resort to fairly complete screening and careful choice of earth returns, etc. J. C. FIELD.

Redditch.

Miniature Receiver

AS I have received many letters regarding the midget set I described in last month's correspondence columns, I feel that some further details would be of interest. The circuit, as may be seen from the diagram, is a perfectly standard one-valve type. The really important component is the RF choke, which must be reliable if reaction is to be consistent over the whole tuning range, but at the same time it



Single valve reaction circuit described by Mr. Taylor.

must be small so that it does not take up too much space. The tuning coil should be small but efficient and I have found that the Telsen 349 midget iron cored dual range type is the most suitable. The valve must be a power or super-power type, and should be of a reliable make; an AF pentode may be used on a lower voltage of HT, but with a reduction in volume.

Normally the HT voltage is 18, although after a little experiment it can often be reduced to 9. The LT is two $1\frac{1}{2}$-volt unit cells in series, which actually give 3 volts, but this soon drops to 2 on load. The set is built into a small wooden cabinet, with midget knobs and a small QMB on/off switch. The tuning and reaction condensers are midget types, and so are the grid condenser and grid leak. A phone jack is a refinement, and if required this may be the type that will switch off the set as well when the plug is withdrawn.

The aerial should be a good outdoor one if the best results are to be obtained, and an earth is also necessary. I am hoping to experiment with reflex circuits working on low voltages, and also with the new 1.5 volt valves.

G. N. S. TAYLOR.

Newbury, Berks.

Sets for Active Service

THE technical problems of midget receiver design have been fully discussed both in the *Wireless World* and American technical journals. One or two receivers of the "pocket" variety were marketed some time ago but did not come into general use, probably owing to the very small capacity of the accumulator. Now that low-drain 1.4 volt tubes are available the design of small receivers for battery operation should be simplified.

Apart from "pocket" receivers, many men in the Services and Civil Defence organisations would probably welcome an English counterpart of the two-tube AC/DC receivers which provide loud speaker reception in most districts of the United States. The price asked across the Atlantic is about five dollars (25/-).

May I suggest that the radio trade consider the possibility of:

1. Producing three standardised "Service" receivers for mass production—
   - (a) a five valve mains superhet. in a strong wooden case;
   - (b) a cheap two-tube AC/DC receiver as a second set;
   - (c) a pocket receiver using two or three tubes, operating from dry batteries for HT and LT and providing reception on a single headphone.
2. Requesting the various organisations which provide radios and

other supplies for the Services to undertake the distribution of batteries and spare parts.

3. Making efforts to obtain duty-free admission of any midget valves, etc., which might be required from the United States. This concession, if granted, would roughly compensate for the higher prices of foreign goods consequent on the unfavourable exchange rate.

A. CLARKE.

Rossendale, Lancs.

I AM very interested in the suggestions put forward for suitable radio sets for use with the B.E.F.

As an overseas representative of a British firm my work keeps me travelling abroad for about nine months of the year—when dictators do not stop it.

Before my last trip I made enquiries regarding a suitable radio set for my purpose but had to leave without finding one.

What I wanted was a set with the following points, or most of them, included in its make-up:—

(1) A case not larger than 6in. × 14in. × 14in.
(2) Weight not so important but lightness preferred.
(3) The case able to stand usage, wet and wear.
(4) The interior and exterior able to endure tropical heat and dampness.
(5) No projecting knobs.
(6) Long wave unnecessary.
(7) Medium and short wave reception very good.
(8) A loud speaker preferred to earphones.
(9) Workable on AC, DC, ships' light sockets or dry batteries.
(10) The batteries standard and purchasable abroad.

I wanted a set that would work after a bicycle ride in Bermuda or a surf boat drenching on the West Coast; that would receive British news and American opinion from five thousand miles off.

If such a set is available I should be glad to hear of it. If not, I hope the given requirements will help to produce one in the near future. Manufacturers might be surprised at the extent of the market for a Serviceable Portable Radio.

Aberdeen. L. AULD.

News from the Clubs

Croydon Radio Society

Headquarters: St. Peter's Hut, Ledbury Road, South Croydon, Surrey.
Meetings: 1st Thursday in the month at 8 p.m.
Hon. Sec.: Mr. E. L. Cumbers, 14, Campden Road, South Croydon, Surrey.

At the January meeting the lecturer was Mr. P. G. A. H. Voigt. The large audience, many of whom had come through the black-out from remote parts of London, was an eloquent tribute to the lecturer's popularity, and afforded striking proof of the great interest that is taken in high-quality reproduction.

The next meeting will be on Thursday, February 1st, at 8.0 p.m., and the lecturer will be Mr. H. G. Menage, of R. A. Rothermel, Ltd., who will give a talk entitled, "The Latest Developments in Piezo Crystals."

The Slough and District Short-wave Club

Headquarters: Toc H. Headquarters, William Street, Slough, Bucks.
Meetings: Alternate Thursdays, at 7.30 p.m.
Hon. Sec.: Mr. K. A. Sly, 16, Buckland Avenue, Slough, Bucks.

At the December 21st meeting, Mr. Houchin continued his series of lectures on the "Fundamentals of Radio." The annual general meeting was held on January 4th. It was decided to continue constructional work on the club's receiver at the fortnightly meetings. Morse practice is held at all meetings.

North Manchester Radio and Television Society

Headquarters: 14, Prestwick Road, Prestwick, near Manchester.
Hon. Sec.: Mr. R. Lawton, "Gratton House," Whalley Road, Whalley Range, Manchester.

At the December 14th meeting, a letter from the G.P.O. sectional engineer was read, replying to certain points raised by the society concerning the wartime cancellation of Amateur Transmitting Licences and the confiscation of certain apparatus. It was also announced at the meeting that negotiations had been initiated with the chief postal censor regarding an arrangement whereby short-wave listeners could send reception reports to transmitters in certain countries on the G.P.O. "censored" list.

The next meeting will be held at 7 p.m. on January 23rd.

NEWS IN ENGLISH FROM ABROAD

REGULAR SHORT-WAVE TRANSMISSIONS

Country : Station	Mc/s	Metres	Daily Bulletins (G.M.T.)
America			
WNBI (Bound Brook) ..	17.78	16.87	3.0 a.m., 2.0‡, 5.0.
WRCA (Bound Brook) ..	9.67	31.02	3.0 a.m.
WCBX (Wayne) ..	6.12	49.02	6.55 a.m.
	9.65	31.09	4.0 a.m.
	11.83	25.36	1.55 a.m., 8.30, 10.50§‡, 11.30§‡, 11.45*.
	15.27	19.65	6.30§‡.
	21.56	13.91	1.0, 2.0†, 4.0*†.
WGEO (Schenectady) ..	9.53	31.48	4.0 a.m.‡, 8.30†, 10.15*, 11.25‡.
WGEA (Schenectady) ..	15.33	19.57	1.0, 2.0‡, 9.55§‡.
WPIT (Pittsburg) ..	6.14	48.86	4.0 a.m.‡.
	11.87	25.26	3.0 a.m.‡, 11.45§‡.
	15.21	19.72	2.0‡, 4.0†, 5.0.
	21.53	13.93	1.0‡, 2.0.
WCAB (Philadelphia) ..	6.06	49.50	1.55 a.m., 11.30§‡, 12.0 midnight.
	9.59	31.28	1.55a.m.,4.0a.m.§, 6.55a.m.§.
	21.52	13.94	8.30§‡.
WRUL (Boston) ..	6.04	49.67	4.0 a.m.§‡, 11.0‡.
	11.73	25.58	4.0 a.m.‡, 8.0.
	11.79	25.45	8.30§‡.
WRUW (Boston) ..	15.12	19.83	8.30§‡.
	11.72	25.60	11.0‡.
Australia			
VLQ	9.61	31.20	8.15 a.m., 12.30, 4.0.
VLQ2	11.87	25.00	8.15 a.m.
VLR ..	9.58	31.32	9.15 a.m. (9.20 Sun.), 1.20‡.
VLR3	11.88	25.25	2.20 a.m., 8.45§, 10.0.
China			
XGOY (Chungking) ..	11.90	25.21	11.0 a.m., 10.0.
France			
TPB6 (Paris-Mondial) ..	15.13	19.83	8.15 a.m.
TPB11	7.28	41.21	7.0.
TPA2	15.243	19.68	11.0 a.m.
TPA4	9.68	30.99	1.0 a.m., 2.50 a.m., 4.30 a.m, 5.15 a.m.
TPB7	11.885	25.24	4.30 a.m., 8.15 a.m., 7.0.
Fort de France	9.70	30.91	11.15.
Finland			
OFD (Lahti)	9.50	31.58	8.0 a.m., 9.40, 11.30.
	15.19	19.75	8.0 a.m., 9.40, 11.30.
Germany			
DJA (Zeesen)	9.56	31.38	5.15, 11.15.
DXB	9.61	31.22	8.15, 9.15.
DJB	15.20	19.74	10.15 a.m., 2.15.
OLR5A (Podébrady) ..	15.23	19.70	7.50.
SP48 (Warsaw) ..	6.14	48.86	7.45.
Hungary			
HAT4 (Budapest) ..	9.12	32.88	12.30 a.m.§.
HAS3	15.37	19.52	2.15†.

Country : Station	Mc/s	Metres	Daily Bulletins (G.M.T.)
Ireland			
Athlone	9.59	31.27	6.45, 10.0 (10.5 Sun.)
	17.84	16.82	6.45, 10.0 (10.5 Sun.)
Italy			
I2RO3 (Rome)	9.63	31.15	12.30 a.m., 6.18, 9.15.
I2RO4	11.81	25.40	12.30 a.m., 11.0 a.m., 3.55, 6.18.
I2RO6	15.30	19.61	12.30 a.m., 9.45 a.m., 3.55.
I2RO8	17.82	16.83	11.0 a.m.
I2RO9	9.67	31.02	11.16.
IRF	9.835	30.52	12.30 a.m.
IQY	11.76	25.70	12.30 a.m.
Japan			
JVW	7.25	41.34	8.5
JZI (Tokio)	9.53	31.46	8.5.
JZK	15.16	19.79	1.15 a.m.
Manchukuo			
Hsinking	11.77	25.48	2.50, 6.30, 9.0.
Newfoundland			
St. John's	9.48	31.64	10.30.
Portugal			
—	3.71	80.80	8.0 (Tues., Thurs. and Sat.)
Rumania			
—	9.28	32.33	9.45‡.
Russia			
RNE (Moscow) ..	12.00	25.00	9.30, 10.30, 12.0 midnight.
RW96	6.03	49.75	8.0, 10.30, 12.0 midnight.
	9.52	31.51	8.0, 10.30.
	15.18	19.76	8.0 a.m.
RKI	7.51	39.89	[illegible].30, 10.30.
	15.58	19.25	12.0 midnight.
RAL	9.60	31.25	8.0, 9.30, 10.30, 12.0 midnight.
RWG	7.36	40.76	9.30†, 10.30†.
—	8.06	37.22	8.0.
—	11.64	25.77	11.0 a.m.
—	11.90	25.21	9.30, 10.30†.
Spain			
FET1 (Valladolid) ..	7.07	42.43	7.45.
EAQ1 (Madrid) ..	9.86	30.43	3.25.
Sweden			
SBU (Motala)	9.53	31.46	9.45
SBP	11.70	25.63	9.45
Turkey			
TAP (Ankara)	9.46	31.70	8.15.
Yugoslavia			
YUA (Belgrade) ..	6.10	49.18	9.0.
YUC	9.50	31.56	9.0.

REGULAR LONG- AND MEDIUM-WAVE TRANSMISSIONS

Country : Station	kc/s	Metres	Daily Bulletins (G.M.T.)
Finland			
Lahti	166	1,807	9.30.
France			
Radio-Paris	182	1,648	9.45.
Germany			
Hamburg	904	331.9	12.15 a.m., 10.15 a.m., 2.15, 5.15, 8.15, 9.15, 11.15.
Bremen	758	395.8	(as above)
Hungary			
Budapest	546	549.5	10.10
Ireland			
Radio-Eireann	565	531	6.45‡, 10.0 (10.5 Sun.)
Dublin	1,348	222.6	(as above)
Cork	1,235	242.9	(as above)
Italy			
Rome	713	42[illegible]	6.18, 9.15, 11.16.

Country : Station	kc/s	Metres	Daily Bulletins (G.M.T.)
Latvia			
Madona	583	514.6	9.0 (Tues. and Fri.)
Kuldiga	1,104	271.7	9.0 (Tues. and Fri.)
Rumania			
Radio-Romania ..	160	1,875	9.55‡
Bucharest	823	364.5	9.55‡
Russia			
Moscow RVI	172	1,744	9.30, 10.30.
Spain			
Burgos	1,258	238.5	10.15.
Sweden			
Motala	216	1,389	9.45
Stockholm	704	426.1	(as above)
Falun	1,086	276.2	(as above)
Horby	1,131	265.3	(as above)

All times are p.m. unless otherwise stated. * Saturdays only. § Saturdays excepted. † Sundays only. ‡ Sundays excepted.

Technical Information

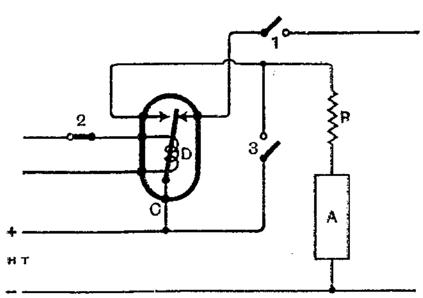
SUSPENSION OF INDIVIDUAL SERVICES

THE war has naturally made its call upon the technical personnel of the *Wireless World*, several members having already departed to war service tasks. With a reduced staff we find it necessary to suspend the postal reply service to readers' technical enquiries, which we have hitherto conducted.

We feel that in the present circumstances we should be failing in our duty to our readers as a whole if we continued to allow the time of technical members of the staff to be largely occupied with answering enquiries from individuals when, by relieving them of this work, their whole time can be devoted to the production of the best possible *Wireless World* for the benefit of all readers. Will those, therefore, who have been accustomed to send us their technical problems to solve please accept this intimation that individual requests for technical information must regretfully be declined so long as present conditions prevail?

Cathode Circuit Protection

INDIRECTLY heated cathodes of gasfilled rectifiers and relays require independent switching of the anode and cathode circuits in order that the cathode shall obtain its full working temperature before the anode circuit is closed. Failure to take this precaution results in rapid disintegration of the cathode surface and consequently short life for the valve. Generally, a thermally operated switch of the bimetal strip type is included in the cathode circuit when it is desired to make the circuit operable from a single switch and remove the possibility of the user neglecting to delay the anode switching, or of closing this circuit too soon.



Although the time of closure of the thermal switch is not very accurate, it is sufficiently good to ensure the necessary delay, but it has one disadvantage. The thermal delay on closing is also present on opening circuit and the bimetal contact does not open until an appreciable time after the exciting coil has been switched off. Hence it is possible by accident or otherwise to open the circuit and close it again before the bimetal switch contacts have separated, the time interval being sufficient for the valve cathode to cool down. The thermal switch may thus be the cause of damage it is designed to avoid.

This may be overcome by the simple addition of a relay of the telephone type with three contacts and an additional contact on the bimetal switch.

Referring to Fig. 1, which shows the position of the contacts when the supply is disconnected, D is the operating coil of the bimetal switch and A a relay with three contacts, 1 and 3 being normally open and 2 normally closed.

When the valve cathode circuit is closed, the coil heats up until the contact arm C makes on the left hand side. This operates relay A, closing contacts 1 and 3 and opening 2. The operation of 3 locks relay A in circuit and the opening of 2 isolates the heater coil D which gradually reverts to its original position. When the contact arm C again makes on the right-hand side, the HT circuit is closed through it and the closed contact 1. If at any time the HT circuit is opened or the supply switched off, relay A will release and its contacts revert to their original positions, so that the whole cycle outlined must be repeated before the HT circuit can be closed again and the cathode of the valve cannot be damaged by switching off for a short time and then closing circuit again.

Moreover, since the HT circuit is closed only after the thermal switch has reverted to its original condition, its operation is more consistent than with a simple thermal switch, since no permanent set in the contact arm is produced by being kept in circuit for a long period, though, of course, its variability due to atmospheric temperature still remains. R. C. W.

Random Radiations

By "DIALLIST"

Bargains

LATELY I've come across one or two people who had bought or were on the verge of buying television sets, of all the unlikely things! I could hardly believe my ears when the first of them told me what he'd done; but when he explained the position I agreed that it was no bad thing to do. He had been offered a brand new television-cum-radio receiver at a mere fraction of its original price. And when I say radio receiver, I mean a pretty good "all-wave" set—in a console cabinet, naturally. His argument was: "Television will be going again some day—perhaps sooner than some folk think. Until it does I have a good wireless set to use. When television broadcasts are resumed I shall be ready for them." That seems to be sound common sense and if you come across any of these instruments offered at bargain prices, you might do a lot worse than snap one of them up.

Wired Television

For good and sufficient reasons the broadcasting of television programmes from the Alexandra Palace's aerials has had to be suspended, but Mr. S. Sagall, who has done valuable work in the development of television, recently made an interesting suggestion. Why not, he asks, develop wired television and use it so long as the war lasts? Television transmissions can be made in this way: the G.P.O. is, or was, engaged in research into the subject long before the war started. If we don't do something of the kind there is a risk that American radio manufacturers, who are going right ahead with television while we are forced to stand still, will capture television, just as Hollywood captured the cinema industry whilst the world was engaged in the Great War. On the other hand, if we develop wired television we can keep public interest alive. Also, those engaged in research and development will see to it that we retain our place at the front of the race instead of lagging behind. There's a lot in that suggestion and I hope that something may come of it.

History Repeats Itself

Talking of television in the United States reminds us of a frank report on the present position there that I saw the other day. When the U.S.A. first became television-conscious the head of a big firm, connected with the radio industry over there, wrote to me to ask for my views on a course that they were considering. They don't make complete receivers of any kind, but they do make component parts of high grade. Television, they said, seemed to offer a new field. Would I let them know what I thought of their prospects, basing my recommendations on knowledge of what had happened in this country. My advice to them was not to rush in, but to await developments. I told them what had happened in one country: immense public interest in television whilst it was still in the laboratory stage; the whole country eagerly awaiting its arrival as a popular hobby; tremendous enthusiasm in the lay papers; then when it did come crowds flocking to demonstrations, exhibitions, and so on; everything apparently all set for something like a boom; BUT for a long time the public would do everything but buy. I said that it would be more interesting to see whether history would repeat itself during television's early days in the States.

A Queer Parallel

It has. Television arrived there, after a long period of keyed-up expectation, heralded by the blaring of all the trumpets and the banging of all the drums at the disposal of a Press second to none in its knowledge of how to use these instruments for the fullest effect. There was television at the World's Fair; there were television demonstrations galore. Uncle Sam and his wife and family rolled up to see television and to be televised. The whole United States was enthusiastic. Regular programmes began from a number of stations. The ball, in a word, was set rolling. But was it? As matters have turned out, the early history of television on the far side of the Atlantic has so far been very much what it was on this. To quote the report I mentioned in the preceding paragraph, "sales of television receivers have hitherto been negligible." Uncle Sam and his wife and family, in a word, are doing exactly what Mr. and Mrs. John Bull and family did not so long ago. They will read anything that's written about television, they will go a long way to see it, but when it comes to the marketing of receivers, their sales resistance is found to be, as ours was at first, of a singularly high order.

Why Is It?

Curious that things should have panned out on lines almost exactly so similar in the Old World and the New. It was suggested over here that the key reason for unwillingness to purchase was to be found in the poorness of the programmes broadcast. The Americans resolved from the first that that kind of thing would never be said about theirs. Both at the World's Fair and elsewhere, first rate entertainment was put over. We thought that the original television receivers might have been too dear for the purses of most people. They were far cheaper in America. We knew that only some 60 per cent. of our potential "lookers-in" in the London area had suitable supplies of mains-borne electric current. In the States the percentage of those who live in areas served by television transmitters and have the right kind of mains current is probably 90 or more. Lastly, it was suggested by some that our people had been told so often that real television had arrived when it hadn't, that when it did come they had lost interest. Nothing of the kind happened in America. Little was heard of television in the lay Press till it really was on the way. The public was certainly not let down again and again by empty promises. Why did television find it so hard to make its way into homes on both sides of the Atlantic

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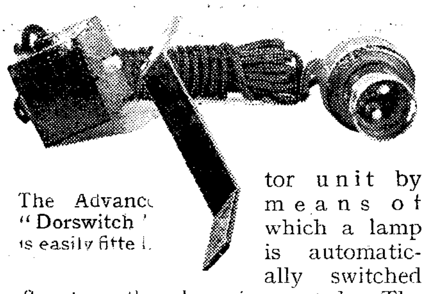
A.R.P. Black-out Switch

ADVANCE COMPONENTS, LTD., of Back Road, Shernhall Street, Walthamstow, London, E.17, well-known as manufacturers of wireless accessories, have produced an adaptor unit by means of which a lamp is automatically switched off when the door is opened. The "Dorswitch," as it is called, comprises a lamp adaptor, enclosed spring switch, and a stop bracket for attachment to the door. Complete with 12ft. of flex wire and fixing screws, the device costs 4s. 6d.



The Advance "Dorswitch" is easily fitted.

for some time after it had become a reality? I can't find the answer at the moment. Can you?

A "Lifer for Methuselah!

THE other day I was wondering just how many years in concentration camps my foreign listening would have earned me since the war broke out, had I been a dweller in the Fatherland! So far as I can calculate my combined sentences would have run into four figures. How awful it must be to live in a country where even your sessions at the controls of the wireless set may land you into fearsome pains and penalties! It's quite possible that the threat of these very pains and penalties does quite a bit to *encourage* listening to stations abroad. Stolen fruits are proverbially the sweetest. In your younger days you probably smoked your first cigarette because you were strictly forbidden to do such a thing. I can quite imagine the German household which possesses a set that will bring in foreign stations saying to its collective self, "If these stations are forbidden, they must be sending out exciting things. We must be missing a lot by obediently abstaining from listening to them. Let's have a go at them and see what there is that is so evil for us to hear." I know that if I were in their position the temptation would be far too strong—particularly to a long-distance enthusiast.

The Leaking Accumulator

READER, have you ever had a leaky accumulator in a portable set? I sincerely hope that you haven't, for the results are far from jolly. I have a portable of the suitcase type, which lies on its back with the lid raised when it is in use. The other day I lifted mine off the table—and the bottom fell out of it. The wretched accumulator had somehow sprung a leak and it's surprising how far a little dilute sulphuric acid can go and what damage it can do. It had completely rotted the wood of the case; had soaked through it and ruined a table cover and the table top beneath it. It had penetrated from the battery compartment through the partition into the body of the set. And what a mess there was there! Almost all of the wiring will have to be re-done. Some components I have saved by alkaline treatment, but others will, I fear, have to be renewed. All that happened during three or four days when the set was out of use. I've made a job of the case by repairing it with plywood and leathercloth and I've got most of the rewiring done. The set is working again, but I am sadly afraid that I'll have breakdown after breakdown in the months to come as further now unseen effects of acid corrosion manifest themselves. If you have a celluloid cased accumulator of whose acid-holding qualities you're at all doubtful, take my advice and discard it. It can do many times more damage than it's worth.

Short-wave Black-out

BETTER THINGS TO COME

OUR contributor "Ethacomber," who discusses elsewhere in this issue the effect of present solar activity, forecasts that conditions for night-time short-wave reception will improve progressively during the month of February.

Murphy "78" Series

HIGH-PERFORMANCE CONSOLE AND RADIOGRAM

THESE receivers, the production of which was held up at the outbreak of war, are now to be released in limited numbers.

The A78C is the successor to the A40C, which it resembles in appearance. It is, however, fitted with two loud speakers giving better sound distribution. There are four degrees of selectivity with equivalent audio frequency responses up to 8,500, 7,000, 5,000 and 3,000 cycles. The short-wave side is similar to that of the A76 recently reviewed and includes band spread tuning and a special RF stage. For high quality reception a "side chain" IF stage and rectifier supply AVC, but in the position of maximum selectivity this IF valve is included in main receiving chain.

The A78RG gives even better quality than the console, for it has a larger baffle area and "acoustic tube" control of the radiation from the back of the speakers. A side-by-side arrangement of the radio and gramophone controls has been adopted and separate lids for the two compartments are provided on the top of the cabinet. The record changer takes eight mixed 10in. or 12in. records and is fitted with a crystal pick-up in which either steel or fibre needles may be used.

The price of the A78C is £42, and the A78RG costs £95.

Short-wave Stations of the World

Arranged in Order of Frequency and Wavelength

Station	Call Sign	Mc/s.	Metres	kW
Moscow (U.S.S.R)	RIA	5.85	51.24	15
Moscow (U.S.S.R)	RNE	6.00	50.00	20
Zeesen (Germany)	DJC	6.02	49.83	5–40
Moscow (U.S.S.R)	RW96	6.03	49.75	100
Vatican City	HVJ	6.03	49.75	25
Boston (U.S.A.)	WRUL	6.04	49.67	20
British Oversea Service	GSA	6.05	49.59	10–50
Philadelphia (U.S.A.)	WCAB	6.06	49.50	10
Motala (Sweden)	SPO	6.06	49.46	12
Zeesen (Germany)	DJN	6.08	49.35	5–40
Bound Brook (U.S.A.)	WNBI	6.10	49.18	25
British Oversea Service	GSL	6.11	49.10	10–50
Wayne (U.S.A.)	WCBX	6.12	49.02	10
Sinkiang (Manchukuo)	MYCY	6.12	49.02	—
Pittsburgh (U.S.A.)	WPIT	6.14	48.86	28
Winnipeg (Canada)	CJRO	6.15	48.78	2
Wayne (U.S.A.)	WCBX	6.17	48.62	10
Vatican City	HVJ	6.19	48.47	25
Rome (Italy)	IAC	6.35	47.21	50
Radio-Nations (Switzerland)	HBQ	6.67	44.94	20
Barcelona (Spain)	EAQ1	7.03	42.7	—
Valladolid (Spain)	FET1	7.07	42.43	0.25
Burgos (Spain)	EA1BO	7.07	42.43	—
Lisbon (Portugal)	CSW8	7.26	41.32	10
Radio-Mondial (France)	TPB7/11	7.28	41.21	25
Moscow (U.S.S.R.)	RWG	7.36	40.76	15
Moscow (U.S.S.R.)	RKI	7.51	39.89	25
Budapest (Hungary)	HAT4	9.12	32.88	5
Radio-Nations (Switzerland)	HBL	9.34	32.1	20
Ankara (Turkey)	TAP	9.46	31.70	20
Belgrade (Jugoslavia)	YUC	9.50	31.56	10
Lahti (Finland)	OFD	9.50	31.58	1
Belgrade (Jugoslavia)	YUC	9.50	31.56	—
Melbourne (Australia)	VK3ME	9.51	31.55	5
British Oversea Service	GSB	9.51	31.55	10–50
Moscow (U.S.S.R).	RW96	9.52	31.51	100
Warsaw (Poland)	SP31	9.52	31.49	5
Schenectady (U.S.A.)	WGEO	9.53	31.48	100
Calcutta (India)	VUC2	9.53	31.48	10
Tokio (Japan)	JZI	9.53	31.46	50
Motala (Sweden)	SBU	9.53	31.46	12
Vatican City	HVJ	9.55	31.41	25
Schenectady (U.S.A.)	WGEA	9.55	31.41	20–25
Bombay (India)	DUB2	9.55	31.40	10
Zeesen (Germany)	DJA	9.56	31.38	5–40
Millis (U.S.A.)	WBOS	9.57	31.35	10
British Oversea Service	GSC	9.58	31.32	10–50
Melbourne (Australia)	VLR	9.58	31.32	2
Sydney (Australia)	VK2ME	9.59	31.28	20
Huizen (Holland)	PCJ	9.59	31.28	60
Philadephia (U.S.A.)	WCAB	9.59	31.28	10
Delhi (India)	VUD2	9.59	31.28	10
Athlone (Ireland)	—	9.59	31.27	—
British Oversea Service	GRY	9.60	31.25	10–50
Moscow (U.S.S.R.)	RAL	9.60	31.25	20
Cape Town (S. Africa)	ZRL	9.61	31.22	5
Oslo (Norway)	LLG	9.61	31.22	5
Zeesen (Germany)	DXB	9.61	31.22	5–40
Budapest (Hungary)	HAD	9.62	31.17	—
Rome (Italy)	I2RO3	9.63	31.15	25–100
Wayne (U.S.A.)	WCBX	9.65	31.09	10
Lisbon (Portugal)	CS2WA	9.65	31.09	2
Vatican City	HVJ	9.66	31.06	25
Buenos Aires (Argentine)	LRX	9.66	31.06	7
Rome (Italy)	I2RO9	9.67	31.02	25
Zeesen (Germany)	DJX	9.67	31.02	5–40
Bound Brook (U.S.A.)	WRCA	9.67	31.02	35
British Oversea Service	GRX	9.69	30.96	10–50
Buenos Aires (Argentine)	LRA1	9.69	30.96	7
Lisbon (Portugal)	CSW7	9.74	30.80	10
Rome (Italy)	IRF	9.83	30.52	30
Madrid (Spain)	EAQ	9.86	30.43	10
Buenos Aires (Argentine)	LSX	10.35	28.99	12
Lisbon (Portugal)	CSW6	11.04	27.17	10
Radio-Nations (Switzerland)	HBO	11.40	26.31	20
Warsaw (Poland)	SPD	11.53	26.01	2
Rome (Italy)	IQY	11.67	25.70	—
Motala (Sweden)	SBP	11.70	25.63	12
Moscow (U.S.S.R.)	IRA	11.71	25.62	15
Radio-Mondial (France)	TPA4	11.72	25.60	12
Winnipeg (Canada)	CJRX	11.72	25.60	2

Station	Call Sign	Mc/s.	Metres	kW
Huizen (Holland)	PHI	11.73	25.58	20
Oslo (Norway)	LKQ	11.73	25.56	5
Boston (U.S.A.)	WRUL	11.73	25.56	20
Vatican City	HVJ	11.74	25.55	25
Warsaw (Poland)	SP25	11.74	25.55	5
British Oversea Service	GSD	11.75	25.53	10–50
Rome (Italy)	I2RO15	11.76	25.51	—
Zeesen (Germany)	DJD	11.77	25.49	5–40
Boston (U.S.A.)	WRUL	11.79	25.45	20
Zeesen (Germany)	DJO	11.80	25.42	5–40
Rome (Italy)	I2RO4	11.81	25.40	100
British Oversea Service	GSN	11.82	25.38	10–50
Wayne (U.S.A.)	WCBX	11.83	25.36	10
Lisbon (Portugal)	CSW5	11.84	25.34	10
Zeesen (Germany)	DJP	11.85	25.31	5–40
Budapest (Hungary)	HAD	11.85	25.31	—
British Oversea Service	GSE	11.86	25.29	10–50
Madras (India)	VUM2	11.87	25.28	10
Pittsburgh (U.S.A.)	WPIT	11.87	25.26	24
Melbourne (Australia)	VLR3	11.88	25.25	2
Radio-Mondial (France)	TPA11/12	11.88	25.24	12
Chungking (China)	XGOY	11.90	25.21	35
Moscow (U.S.S.R.)	RNE	12.00	25.00	20
Warsaw (Poland)	SPW	13.63	22.00	10
Radio-Nations (Switzerland)	HPJ	14.54	20.64	20
Rome (Italy)	IQA	14.79	20.28	—
Moscow (U.S.S.R.)	RKI	15.04	19.95	25
Rome (Italy)	I2RO12	15.10	19.87	—
Zeesen (Germany)	DJL	15.11	19.85	5–40
Vatican City	HVJ	15.12	19.84	25
Warsaw (Poland)	SP19	15.12	19.84	5
Radio-Mondial (France)	TPB6	15.13	19.83	25
British Oversea Service	GSF	15.14	19.82	10–50
Motala (Sweden)	SPT	15.15	19.80	12
Tokio (Japan)	JZK	15.16	19.79	50
Oslo (Norway)	LKV	15.17	19.78	5
Moscow (U.S.S.R.)	RW96	15.18	19.76	100
British Oversea Service	GSO	15.18	19.76	10–50
Lahti (Finland)	OFD	15.19	19.75	1
Zeesen (Germany)	DJB	15.20	19.74	5–40
Ankara (Turkey)	TAQ	15.20	19.74	20
Pittsburgh (U.S.A.)	WPIT	15.21	19.72	18
Lisbon (Portugal)	CSW4	15.21	19.72	10
Huizen (Holland)	PCJ2	15.22	19.71	60
Podebrady (Bohemia)	OLR5A	15.23	19.70	15–30
Rome (Italy)	I2RO14	15.23	19.70	—
Radio-Mondial (France)	TPA2	15.24	19.68	12
British Oversea Service	GSI	15.26	19.66	10–50
Wayne (U.S.A.)	WCBX	15.27	19.65	10
Philadelphia (U.S.A.)	WCAB	15.27	19.65	10
Schenectady (U.S.A.)	WGEA	15.27	19.65	20–25
Zeesen (Germany)	DJQ	15.28	19.63	5–40
Delhi (India)	VUD4	15.29	19.62	10
Buenos Aires (Argentine)	LRU	15.29	19.62	7
Rome (Italy)	I2RO6	15.30	19.61	50
British Oversea Service	GSP	15.31	19.60	10–50
Schenectady (U.S.A.)	WGEA	15.33	19.57	20–25
Zeesen (Germany)	DJR	15.34	19.56	5–40
Budapest (Hungary)	HAS3	15.37	19.52	5
Moscow (U.S.S.R.)	RAL	15.15	19.35	15
Oslo (Norway)	LKW	17.75	16.90	5
Zeesen (Germany)	DJE	17.76	16.89	5–40
Huizen (Holland)	PHI	17.77	16.88	20
Bound Brook (U.S.A.)	WNBI	17.78	16.87	35
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Rome (Italy)	I2RO16	21.52	13.94	—
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British Oversea Service	GST	21.55	13.92	10–50
Wayne (U.S.A.)	WCBX	21.57	13.91	10

Recent Inventions

Brief descriptions of the more interesting radio devices and developments disclosed in Patent Specifications will be included in these columns.

A NOVEL WIRELESS SET

A SUPERHET is built to resemble a standard reading lamp. The first section, comprising the mixer stage, is located in the base. The IF stage is housed inside the vertical column or stanchion of the lamp, while the AF amplifier, power pack and loud speaker are situated inside the shade. The tuning controls are mounted around the base, which also contains the variable tuning condensers.

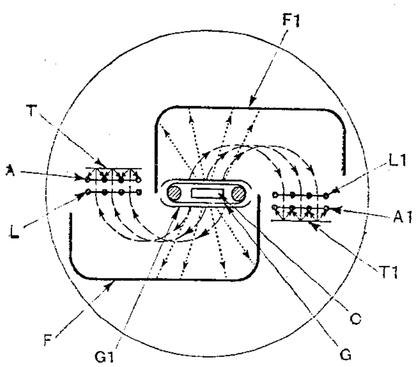
D. J. Crowley. Convention date (U.S.A.), December 4th, 1936. *No.* 512141.

o o o o

THERMIONIC AMPLIFIERS

THE performance of a grid-controlled amplifier can be improved by passing the primary stream through an electron multiplier before it reaches the anode, the secondary current so produced serving to increase the mutual conductance between grid and anode. It is found, however, that there is a tendency for the multiplying action to fall off, as time goes on, this being due, it is thought, to the action of the barium atoms emitted from the coated cathode on the sensitised surface of the target electrodes.

The invention seeks to prevent this deterioration by using a valve of the construction shown in cross-section in the accompanying diagram, and by applying to it an external magnetic field which forces the primary stream of electrons to travel from the cathode C and grids G, G1 in the curved path shown in



Electron multiplier construction.

dotted lines. At the end of this path, they pass through "lens" grids L, L1 and open anodes, A, A1 on to "target" electrodes T, T1, the resulting stream, amplified by secondary emission, being finally collected by the anodes. Curved field-plates F, F1 prevent any barium atoms emitted by the cathode C from reaching and so damaging the sensitive target electrodes. Actually the barium atoms take the straight line paths shown in dotted lines.

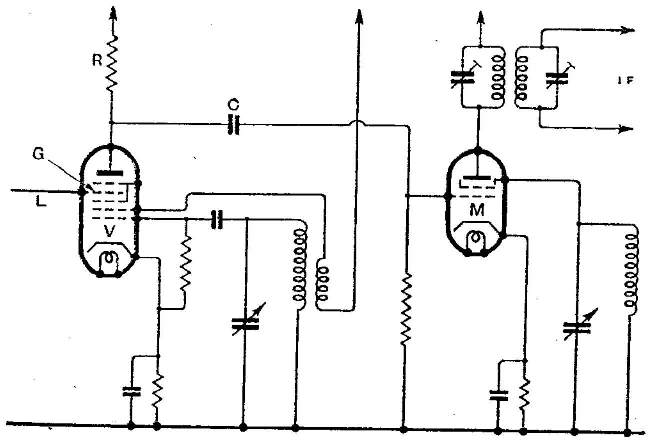
Marconi's Wireless Telegraph Co., Ltd. and G. B. Banks. Application dates February 17th and June 21st, 1938. *No.* 511449.

o o o o

CUTTING OUT ELECTRICAL INTERFERENCE

A KNOWN method of tackling the problem of interference is to throw the receiving circuits out of action, both for signals and interference, so long as the latter is present. Since interference usually takes the form of highly damped impulses which last less than the 100th part of a second, the effect of the interruption is not noticeable to a listener, the signals appearing to come through continuously and without break. According to the invention, the interfering impulses are applied in such a way that they paralyse the local oscillator of a superhet, and so interrupt reception for a fractional part of a second.

The figure shows a local oscillator V, which is coupled to a separate modulating valve M through a resistance R and condenser C, the modulator being coupled to the first IF stage in the usual manner. An interfering impulse, after rectification, applies a paralysing bias to the grid G *via* the lead L, and so momentarily throws this valve out of action, thus breaking the continuity of the signals fed to the loud speaker for the duration of the disturbing impulse.



Auto-suppression circuit for electrical interference.

Magyar Wolframlampa Co. Convention date (Hungary) September 21st, 1937. *No.* 511329.

o o o o

INTERFERENCE IN TELEVISION RECEIVERS

ONE effect of interference, especially local disturbances, upon a television receiver is to produce objectionably bright flashes or spots on the picture; another is to upset the proper focusing of the scanning spot, so that it "spreads" and causes distortion.

According to the invention, both sources of trouble can be prevented by inserting a shunt circuit, consisting of a diode rectifier and a condenser, across the load circuit of the first detector. When a disturbing impulse arrives, the shunt diode becomes conductive, and so by-passes most of the disturbance into the condenser. In other words, it acts as a "limiter" to prevent the interference from creating any undesirably large modulating potential.

Kolster-Brandes, Ltd.; C. N. Smyth; and R. J. Berry. Application date, February 18th, 1938. *No.* 511519.

o o o o

SOUND-REPRODUCING DIAPHRAGMS

A DIAPHRAGM, suitable for a telephone, microphone, or moving-coil loud-speaker is made of solidified cellulose "foam." This material may be produced from cellulose by a fermenting process, or by blowing air through it, or by mixing it with any gas-producing substance. The product has a microscopically fine cellular structure, with a density of 0.1 gramme per cubic centimetre, and sufficient rigidity for the purpose in view.

The solidified foam, after being cut out to the required shape is cemented to a thin backing sheet of aluminium foil, the protruding edges of which are first crinkled or corrugated to increase resilience, and are then clamped to a peripheral support.

H. Sell. Convention date (Germany) December 18th, 1937. *No.* 513289.

o o o o

SMOOTHING IN TRANSMITTER CIRCUITS

IN a high-powered radio transmitter, where power is supplied from a common rectifier or DC source to the final stage of a class B modulator, it is found that at certain low frequencies the smoothing elements in the supply line develop an "anti-resonance" effect which causes a pronounced distortion of the transmitted signal. The reason is that the power source and filter present a high impedance, of some thousands of ohms at the frequency in question, to the modulator, thus forming, in effect, an unwanted modulation circuit which reacts upon the output fed to the transmitting aerial.

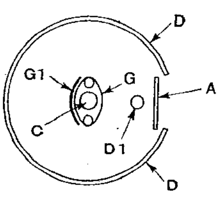
According to the invention, a transformer is included in the DC supply line, the primary winding of which consists of the usual series choke coil, while the secondary winding is short-circuited by a resistance. This prevents large changes of impedance in the smoothing circuit and power source, and so avoids the low-frequency distortion in question.

Marconi's Wireless Telegraph Co., Ltd., and H. Cafferata. Application date March 4th, 1938. *No.* 513164.

o o o o

VISUAL TUNING INDICATORS

RELATES to the type of "glow" indicator in which a long cathode is surrounded by a helical control grid wound with a varying helical pitch (i.e., with a variable-amplification factor) so that as the applied signal voltage increases, the glow caused by the impact of the electrons on a fluorescent anode rises to a sudden maximum. In this type of indicator the anode is usually arranged with the fluorescent surface facing the cathode, so that the glow is to some extent obscured because both the grid and cathode come between it and an observer.



Increasing brightness of tuning indicator.

The difficulty is avoided by constructing the glow tube in the way shown in cross section. The cathode C is surrounded by a spiral grid G, of varying pitch, the side farthest from the anode A being blocked by a solid sheet G1. One of the deflecting electrodes D is in the shape of a cylinder, which is gapped, as shown, to enable the fluorescent anode A to be clearly seen. The other deflecting electrode consists of a rod D1 which is placed between the anode and the grid. The arrangement ensures that at least the greater part of the electron stream strikes the anode A on the side turned away from the cathode and facing the observer.

The M-O Valve Co., Ltd. and H. S. Smith. Application date May 20th, 1938. *No.* 511386.

o o o o

PRESS-BUTTON TUNING

IN some press-button tuning systems, if the listener attempts to use the manual tuning control while one of the selecting buttons is still depressed, he is liable to strain or damage the driving motor; in addition, a disagreeable "chatter" or vibrating movement is imparted to the tuning knob.

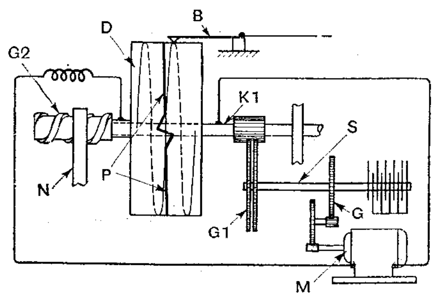
Both these defects are avoided by using an arrangement in which, directly the motor has brought the tuning condenser into a position corresponding to the wavelength of the selected station, the motor circuit is automatically opened, and remains so, until another selector button is depressed, irrespective of whether the manual control knob has meanwhile been operated or not. In this way it becomes impossible to start-up the driving motor inadvertently, except in the very unlikely event of the listener operating both selector button and the manual tuning knob simultaneously.

E. K. Cole, Ltd., and A. W. Martin. Application date, February 18th, 1938. *No.* 511503.

o o o o

THE figure shows an arrangement for increasing the precision of a press-button tuning system in which the variable elements are motor-driven. The spindle S of the tuning condenser C is geared at G to the motor M, and is also connected to the contact-making spindle K1 through gearing G1. The latter is made proof against backlash by using double gear-wheels, which are urged by a spring in opposite directions.

The contact drum D is made in two parts separated by a strip P of insulation. Its spindle K1 carries a worm gear G2, which engages with a fixed nut N, so that the drum D is moved longitudinally as it rotates. This causes the brush B (which is operated by the station-selecting button not shown) to move over the drum D in a spiral path, so that it intersects the insulating strip P at an angle, thereby increasing the effectiveness of the "break" required to arrest the tuning condenser C and the



Device for increasing precision of press-button tuning.

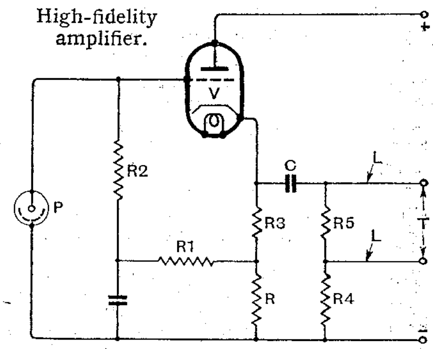
driving motor M, at the required tuning point. The ratio of the gearing G1 is such that the brush B makes more than one traverse over the drum for each complete rotation of the tuning condenser.

Murphy Radio, Ltd., J. D. A. Boyd, and L. Fisher. Application date March 16th, 1938. *No.* 512730.

o o o o

PHOTO-ELECTRIC AMPLIFIERS

A PHOTO-ELECTRIC cell P is coupled to an amplifying valve V by a circuit which contains no reactive elements, this being particularly desirable when handling television signals. The necessary anode potential for operating the photo-electric cell is developed across a resistance R in the anode-cathode circuit of the amplifier, and is applied through the series resistances R1, R2, the anode of the cell being directly connected to the grid of the amplifier. Grid bias for the grid of the amplifier is supplied by the resistance



R3, the output being taken from the terminals T through a blocking condenser C.

The resistance R4 is small compared with the resistance R5, and is used to balance out disturbing potentials produced in the line LL, by feeding back to it a corresponding voltage applied in phase opposition.

Baird Television Ltd., and P. E. A. R. Terry. Application date, March 4th, 1938. *No.* 512327.

o o o o

INTERLACED SCANNING

IT is essential with interlaced scanning to ensure strict timing between the line and frame frequencies, as otherwise successive frames do not fit together accurately. In practice there is a tendency for the line impulses to trigger the frame oscillator prematurely, and the object of the invention is to avoid this.

The mixed signals are applied to an input valve which separates the picture signals from the two sets of synchronising impulses. The line impulses are transferred through a condenser and a transformer coupling to the line oscillator, whilst the slower framing impulses are coupled to their oscillator through a branch circuit which includes a resistance, in series with the coupling coil to the line oscillator and a diode rectifier.

The arrangement is such that any impulses that appear across the resistance and tend to trigger the frame oscillator prematurely are automatically balanced by corresponding impulses from the line oscillator applied to the resistance in opposite phase.

Baird Television, Ltd., and D. V. Ridgway. Application date March 15th, 1938. *No.* 512795.

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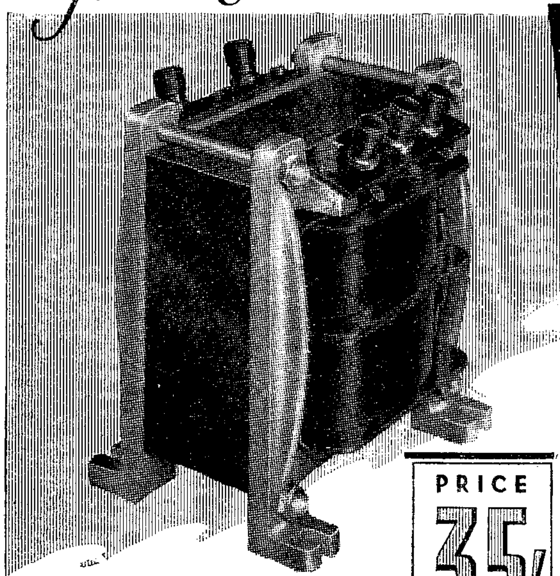

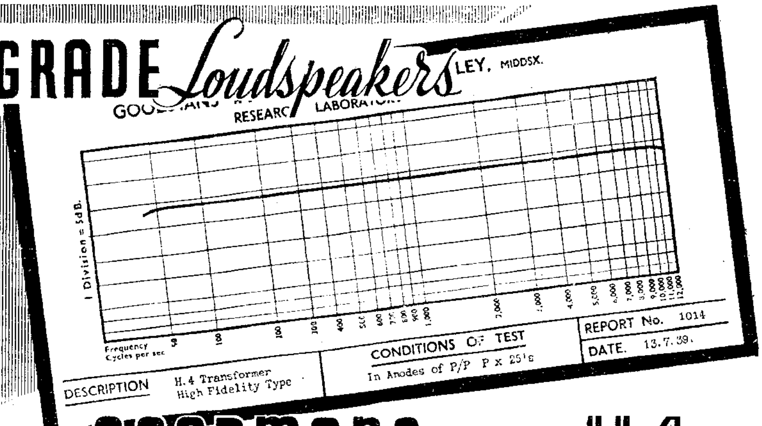

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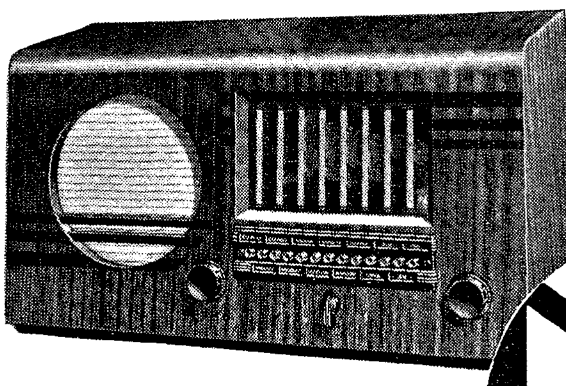

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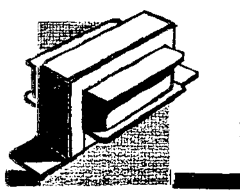

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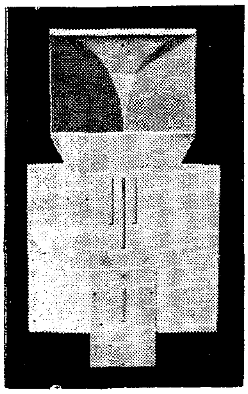

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ALL P.A. Accessories in Stock; trade supplied.

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VORTEXION, Ltd., 182, The Broadway, Wimbledon S.W.19. 'Phone: Lib. 2814. [8241

NEW MAINS EQUIPMENT

VORTEXION Mains Transformers, chokes, etc., are supplied to G.P.O., B.B.C., L.P.T.B.; why not you?

VORTEXION, Ltd., 182, The Broadway, Wimbledon, London, S.W.19. Telephone: Liberty 2814. [8782

SHORT-WAVE EQUIPMENT

G5NI for Short Wave Equipment; largest stocks in the country; communication receivers; National agents; American and British Valves, etc. See advertisement on page 2.—44, Holloway Head, Birmingham. [0531

"H.A.C." one-valve Short-wave Receiver, famous for over 5 years, now available in kit form; complete kit of precision components, accessories, full instructions, 12/6, post 6d., no soldering necessary; descriptive folder free on request.—A. L. Bacchus, 109, Hartington Rd., S.W.8. [8840

NEW LOUD-SPEAKERS

BRAND New Speakers.

SAVE Pounds. 1½d. stamp for list of British and American P.A. speakers. Example: P.A. speaker with transformer, weight 21lb., incorporating curved cone; 52/-.

CHALLENGER RADIO CORPORATION, 31, Craven Terrace, London, W.2. Paddington 6492. [8789

BAKERS' Brand New Surplus Speaker Bargains.

£9 Only.—Usual price £16; brand new corner horn speakers in beautifully finished polished walnut corner horn cabinet, frequency range 30-12,000 cycles, amazingly realistic reproduction.

£3/10.—Usual price £6; brand new Baker super power electro magnet speakers, as solely specified for the "Wireless World" Quality Four receiver.

45/-.—Usual price £5; brand new Bakers super power permanent magnet speakers, ideal for use with Quality receivers, exceptional bargain.

65/-.—Usual price £9; brand new Bakers permanent magnet speakers with new type infinite baffle, wide frequency range and exceptional transient response.

BAKERS SELHURST RADIO, The Pioneer Manufacturers, 75, Sussex Rd., South Croydon. [8725

SECOND-HAND LOUD-SPEAKERS

18IN. Epoch, 200 v., £3; 12in. B.T.H., A.C., £2; or exchange P.M.—3rd Floor, 120, Drury Lane, W.C.2. [8830

VOIGT Unit, twin diaphragm, as new; ⅔ list.—42, Glanbrydan, Uplands, Swansea. [8836

EASY L·R·S TERMS

(or Cash as you prefer)

For first-class performance and highly efficient short-wave reception, excellent workmanship, the most reliable components with a super safety-factor margin to ensure years of service

You can't better an

ARMSTRONG QUALITY ALL-WAVE R-G CHASSIS

Thousands are made and sold every year **but you never see them offered at reduced prices.** There is no need because a good job is **always** in demand. The prices are reasonable—very reasonable—from **8** to **17 Gns.** (plus only 5% war increase).

An outstanding example of Armstrong value is:—

Model SS10. 10 v. Superhet-Straight R-G Chassis.

Price £13.4.0, or 45/- with order and 10 monthly instalments of 23/-.

Orders are executed in rotation so SEND TO-DAY for illustrated literature of all models with particulars of our convenient terms. (See Armstrong advt., p. 12.)

In addition to the Armstrong range, we shall be glad to quote for all other high-grade equipment, such as Sound Sales Amplifiers, Voigt Speakers, Haynes Radio, AvoMeters, and PORTABLE A.R.P. RECEIVERS.

ELECTRICAL APPLIANCES

This department—well known to readers—specialises in the supply of Electric Fires, Clocks, Irons, Fans, Vacuum Cleaners, in fact every device for the modern home, operated by electricity.

ALL ON OUR CONVENIENT TERMS

In accordance with our established policy we stock only lines of proved reliability. This is your guarantee of satisfaction backed by our 15 years advertising in the "Wireless World."

HARDSHIP IN THE SERVICES

cannot be avoided

but there is one easily overcome. Ever shaved in the open air with no hot water, no cold water—only ice? Try it just once then you will appreciate the joy of a DRY-SHAVE with

VICEROY Non-Electric DRY SHAVER *(Made by Rolls Razors Ltd.)*

Send one to your friend serving at home or abroad. He will thank you every time he uses it. It's the handiest dry-shaver obtainable. Just press the lever and you get an amazingly smooth and comfortable shave—anywhere, at any time.

Complete in plush-lined case. Cash **2 Gns.**, or **10/-** with order and 5 monthly payments of **7/-**.

The New Sunbeam SHAVEMASTER Electric DRY SHAVER (Again available from stock)

Still the best Electric Shaver made The New "**475**" Comb and hollow-ground Cutter gives a closer and faster shave than ever. Operates on 100/250 v. A.C. or D.C.

Complete with resistor and adaptor in leather case. **4 Gns.**, or **10/-** with order and 8 monthly payments of **10/-**.

EITHER SHAVER SENT ON 14 DAYS APPROVAL

against cash, or on first instalment of **10/-**. Should Shaver be returned, **7/6** will be refunded.

BRING YOUR SHAVER UP TO DATE

The new "475" Comb and Cutter fits any old type Shavemaster. We can supply these heads from stock. 7/9 post free.

Write TO-DAY for illustrated particulars of the above

Evacuation address: **Est. 1925**

THE LONDON RADIO SUPPLY COMPANY
"Winden," Ardingly Road, Balcombe, Sussex

ELECTRADIX

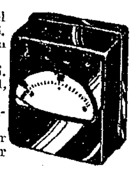
ASK FOR OUR NEW ILLUSTRATED SIGNAL LIST, JUST OUT

WAR EQUIPMENT FOR SERVICE WORK

Service Type Signallers' Double Headphones, with flat leather headbands for steel helmet wear, 120 ohms, by S.T. Co., **3/6,** 4ft. cords **6d.** Single 60 ohm phones with cord DIII, **1/6.** **FIELD Telephone Exchanges,** 5-line and 20-line portable. Twin and Single Cable. **HEADPHONE CORDS.** Service, 6ft., fitted 2-pin plugs and 2-hole socket. **2/-.** **Radio Phone Cords, 2/6. CRYSTAL SETS.** Boudoir, **6/6.** B.M. Table, **7/6.** **LEARNERS' MORSE PRACTICE SET,** Sound Type No. 10, with Key and Buzzer on base, **3/-.** Visual Type No. 2A with Key and Lamp on base, No. 3A Duplex with Key and Buzzer and Lamp for sound and visual, line plug is on base, **7/-.** **Siemens Service Set, 17/6.**

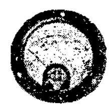
FIELD SERVICE TESTERS

DIX-MIPANTA VEST POCKET TESTER. A versatile moving-iron multi-range meter for service on A.C. or D.C. THREE ranges of volts: 0–7.5, 0–150, 0–300. Black bakelite case, 2½in. × 2¼in., with pair of test leads and plugs, **19/6.**



ELLIOTT BATTERY TESTERS. Govt. Model 108, Mov. Coil Ammeter and graded theo., **37/6.**
LINESMEN'S DETECTORS, Q. and I. Galvo. in leather Case, **15/-.**
HORIZONTAL BRASS-CASED GALVOS, 7/6.
CELL TESTERS, Megger 3–0–3 mov. v. coil, Aluminium Case, **25/-.**
LISTENING MIKES, steel-clad Electradix, indestructible; are ears outside your dug-out.
MORSE KEYS. Few Ex WD Keys reserved for Services. New Keys now in production for training code users. First-class at low prices.
A good small key on moulded base is the TX pivot arm, excellent for learners, **3/6.** Full size, well finished key, all brass, solid pivot bar, adjustable tension, etc. B.2, **7/6**; Superior Type P.F., fully adjustable, nickel finish, **9/6**; High Grade Type IV, plated fittings, polished wood base, a fine key, **10/6.** Special Key on 3-switch box for buzzer and 2 lamps, C.A.V., **6/6.**
BUZZERS, small type, with cover, **1/6.** **Power Buzzers,** with screw contact and adjustable spring armature, **2/6.** **Heavy Buzzer** in Bakelite case, **3/6.** **Siemens Morse Transmitters,** with key and brass-cased Power Buzzer, **17/6.** Magneto Exploders, **25/-.** Field Telegraph Sets. Details on request.
BELLS. G.P.O. type trembler Circular Desk Bell, with movement in gong, **1/6.** Wall Bells, trembler, **2/6.** Ditto, large size, **7/6.** Signal Bells, large, metal, 12-volt single stroke Bells, **10/-.**
SIGNAL LAMPS by Lucas and Aldis, hooded for night and day use, telescope sights, key and discs; for tripod or hand use. Heliographs Mark V, with spare mirrors in leather case, with mahogany tripod.
MORSE RECORDING. No. 1 G.P.O. Inkers, on mahogany base with tape reel under. No. 2 Lightweight Army Field Morse Inkers, fold up into wood case. No. 3 Super Model Army G.P.O. Field H.Q. Morse Inker, brand new, entirely enclosed and fitted every refinement, current indicator, key, tape container, etc. Mahogany Tape Container, G.P.O., desk top with brass reel in drawer, cost 40/-, for **3/6** only. Morse Paper Reels, **8d.**

RECTIFIERS AND CHARGERS FOR A.C. MAINS, 230 volts 5 kW. Rectifier, Philips, valve, D.C. output 230 volts, tapped transformer, **£12.**
A.C. CHARGERS, DAVENSET, Type G.C. Wall Garage Charger, 25 volts 6 amps., 3 circuit 40 cells at once, **£6 10s.** Type H.T.3, Steel cased, bench type, for 180 cells at 1, 2, and 3 amps., **£14 10s.** Type A.S.C.4, Steel cased, 4 circuit with indicators, automatics and regulators for 80 cells, **£14 10s.** 230 volts **PHILIPS'** "Three-in-One" No. 1087 single circuit, 24 volts 10 amps., Steel case, bench type, **£7 10s.**
230 volts **B.T.H.** Tungar Chargers, 75 volts 10 amps., 2 circuits, rheo, and tap controls, **£12 15s.** H.T. Tungar for output D.C., 120 volts amp., **£6 10s.**
230 volts **WESTINGHOUSE** single circuit Wall Charger, 15 volts 6 amps., for car batteries, **£6 18s.**
D.C. CHARGERS. Davenset D.C.2. Steel cased, bench type, 2 circuits and meters, wheel rheos., 230 volts 1 and 3 amps., **£5 10s.**
A.C. ROTARY CHARGERS. 3-phase Motor 200 volts to D.C. Dynamo 8 volts 15 amps., **£4 17s. 6d.** R.C.A. 3-ph. Motor 220 volts coupled to D.C. Dynamo 500 volts 200 m.a., **£5 10s.** Metvick 3-ph. 1 h.p. Motor coupled to D.C. Dynamo 12 volts 30 amps., **£6.** Single phase to D.C., Higgs 230 volt A.C. Motor coupled to D.C. Dynamo 8 volts 16 amps., **£7 10s.**
D.C. ROTARY CHARGERS, 3 h.p. 220 volt D.C. Motor 6 volt 250 amp. Dynamo, **£16.** 200 volt Motor 25 volts 8 amps., Dynamo, **£4.** Motor 220 volts 8 volts 50 amps. Dynamo, **£6 10s.** And others up to 6 kW.
300 CELL A.C./D.C. CRYPTO MOTOR-GEN. SET. For 220 v. A.C. mains. For Radio Cell Circuits and ten 12-volt 10 amp. Car Batts. D.C. output 160 volts 20 amps. Sale, **£32.**
ROTARY CONVERTORS, D.C. to A.C. Kindly state your wants and we will send list of suitable sets.
STATIC CONVERTERS. A.C. to D.C. 40 watts output, steel cased Input 230 volts A.C. 50 cycles, output 440 volts 60/100 m.a. D.C. with valves, **45/-.** A.C. mains to D.C. 120 watts at ½ amp. for D.C. sets on A.C. 220 v., steel clad with valves, **50/-.**



CHARGING METERS, central zero, charge and discharge in all switchboard sizes, from 2in. dial up to 15 amps., **7/6,** to 8in. dial switchboard meters.
D.C. GENERATORS. Shunt wound. 110 volts 1 amp., **15/-**; 200 volts ½ amp., **17/6**; 200 volts 1½ amp., **26/-.**
LUCAS AERO, 9/12 volts, 120 watts D.C., enclosed, 4,000 revs. As used on Aircraft wireless. Cost £15. Reduced Sale Price, **12/6.**
DYNAMO H.T. DUAL, 600 volts for H.T. 100 m.a. and L.T. 6 volts 5 amps. Reduced Sale Price, **15/-.**

Send for Special 1940 Sale List "W."

ELECTRADIX RADIOS
218, UPPER THAMES STREET, LONDON, E.C.4.
Telephone: Central 4611

TRIPLE CONE CONVERSIONS

BAKERS' Triple Cone Conversions Will Immensely Improve Reproduction of Your Present Speaker. No matter what type or make you possess, British or American, you can considerably improve frequency response and quality of reproduction by having a triple cone fitted. Enables you to bring your speaker right up to date and obtain really realistic reproduction at the cost of a few shillings; free descriptive leaflet from the pioneer manufacturers of moving coil speakers since 1925.—Bakers Selhurst Radio, 25, Sussex Rd., South Croydon. [8724

CABINETS

A CABINET for Every Radio Purpose.

SURPLUS Cabinets from Noted Makers Under Cost of Manufacture.

UNDRILLED Table, console and loudspeaker cabinets; from 4/6.

RADIOGRAM Cabinets; from 30/-.

INSPECTION Invited.

H. L. SMITH and Co., Ltd., 289, Edgware Rd., W.2 Tel.: Pad. 5891. [0485

OCCUPY Your Mind in the Blackouts!

BUILD Your Own Radiogram.—Marvellous 7-gn. cabinets from £1.—Particulars, Cameo Co., 23, Denmark St., W.C.2. Tem. 5900. [8823

CHALLENGER RADIO CORPORATION for the finest obtainable cabinets, table, Console and radiogram; also record-changers at £5/11; send 1½d. stamp for list "illustrated."—Challenger Radio Corporation, 31, Craven Terrace, London, W.2. Paddington 6492. [8790

DYNAMOS, MOTORS, ETC.

ALL Types of Rotary Converters, electric motors, battery chargers, petrol-electric generator sets, etc., in stock, new and second-hand.

A.C. D.C. Conversion Units for Operating D.C. Receivers from A.C. Mains, 100 watts output, £2/10; 150 watts output, £3/10.

WARD, 46, Farringdon St., London, E.C.4. Tel.: Holborn 9703. [0518

A.C. and D.C. Motors from 19/6; new and second-hand, guaranteed; also repairs department.—Easco, 1-3, Brixton Rd., S.W.9. 'Phone: Reliance 1694. [0644

G.E.C. Rotary Converter, 200-250 D.C. to 200-250 A.C., 200 watts, in silence cabinet, with filter, perfect, £6/6; another, as above, 500 watts output, £8/10.—Johnson Engineering, 86, Great Portland St., W.1. [8816

VALVES

ALL Types of American Tubes in Stock of Impex and Arcturus makes at competitive prices.

WE Can Also Supply a Full Range of Guaranteed Replacement Valves for Any British non-ring, American or Continental type at an appreciably lower price.

SEND for Lists of These, and also electrolytic condensers, line cords, resistances, etc.

CHAS. F. WARD, 46, Farringdon St., London, E.C.4. Tel.: Holborn 9703. [0452

METROPOLITAN RADIO SERVICE.—American valves, in all types, trade supplied.—1021 Finchley Rd., N.W.11. Speedwell 3000. [0436

Wanted

WANTED, one Hivac Midget screen-grid valve, type XSG.—Allson, "Tower View," Guibal Rd., Lee, S.E.12. [8821

TEST EQUIPMENT

MULTIMETERS, 1,000-5,000 Ohms-volt (using new Ferranti 2½in. scale instruments), also 4in. scale type, limited number, kits or assembled; from 3 gns.

PROBE Valve Voltmeter, bridge, multimeter, etc., components. Stamp for list.

"W.W." Allwave Test Oscillator, new, valves; £4.—L. A. Maclachlan and Co., Strathyre. [8839

Wanted

WANTED.—All wave service oscillator, perfect condition.—Thos. Cooke, 33, Little Oaks Rd., Aston, Birmingham. [8835

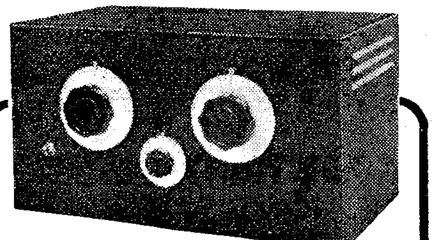
COMPONENTS

SECOND-HAND, CLEARANCE, SURPLUS,

PREMIER RADIO.

PLEASE See Our Displayed Advertisement on page 5. [0488

COULPHONE RADIO, Ormskirk.—Collaro A.C. motors, 12in. turntable, 25/-; Rola G.12, energised, 52/6; P.M., 65/-; midgets; portables; valves; 1½d. stamp 1940 list. [8810



EDDYSTONE
IMPROVED EVERYMAN SHORT-WAVE RECEIVER

Here is a Set, that, for LESS than the price of many ordinary Broadcast Receivers, offers you not only Broadcast Reception but Short-wave Reception as well. When we tell you it will tune from 9.85 metres to 2,000 metres and offers you accordingly a wealth of variety and interest whenever you switch it on, you will agree that here is an exceptional instrument—and moreover EXTRAORDINARY value for your money.

WORLD-WIDE REPUTATION FOR PERFORMANCE & RELIABILITY

It comprises an aperiodic high frequency valve, a screened-grid detector and a two-stage audio amplifier section. The aperiodic high frequency circuit is fitted with a specific purpose in mind. The stage does not, in itself, afford much degree of gain *but it ensures completely stable operation with freedom from blind tuning spots and hand capacity, and a smooth consistent reaction control.* It also prevents re-radiation on the aerial when regeneration is applied so that no interference is caused and further enables much greater degree of gain and selectivity to be obtained from the high magnification screened-grid detector stage.
The first audio stage is resistance-coupled and is followed by an L.F. transformer. The bandspread method of tuning makes the receiver easy to handle and facilitates the thrill of long distance reception on the short wavebands—which this Set provides in ample measure.
This Receiver enables you to tune from 9.85 metres to 2,000 metres and covers all popular wavebands including the Empire transmitters at Daventry, such stations as Rome, Moscow, Berlin, Pittsburg, Schenectady, etc.; also ships at sea, coast stations, trawlers, aircraft, police and the medium and long-wave broadcast—lively interest all the time.
Together with valves and coils tuning 9.85 metres to 96 metres, simply outstanding value at—

£10 - 15 - 0
for World-wide Listening

(Extra coils for intermediate wavelengths up to 2,000 are available.)

WRITE NOW FOR AN "EVERYMAN" SET—OR LITERATURE.

STRATTON & Co. Ltd.
EDDYSTONE WORKS, BROMSGROVE ST., BIRMINGHAM
OR SERVICE DEPOTS

WEBB'S LONDON: 14 Soho Street, W.1. BIRMINGHAM: 133 New St., 41 Carr's Lane, 23 Shirley Road, Acocks Green.

COUPON

To STRATTON & Co., Ltd., EDDYSTONE WORKS, BROMSGROVE ST., BIRMINGHAM

Please send me full descriptive details of the Improved "Everyman" Short-wave Receiver and address of my nearest stockist.

Name ....

Address ....

....

COMPONENTS—SECOND-HAND CLEARANCE, SURPLUS, ETC.

R.

RADIO CLEARANCE, Ltd.

63, High Holborn, W.C.1. 'Phone: Holborn 4631.

FILAMENT Transformers, input 200-250 volts, output 4 volts, 4 amps., 4 volts 6 amps.; 4/11 each.

G.E.C. Mains Transformer, American windings, 350-0-350 volts, 65 m.a., 5 volts 2 amps., 6.3 volts 2.5 amp.; suitable for replacement in G.E.C. models; 5/6 each.

24 Mfd. Can Type Electrolytics, 450 volts working; 1/6 each.

T.C.C. 8 mfd. Can Wet Type Electrolytics, 450v. working; 1/3 each.

PRESS Button Units, with 6 press buttons, ready for wiring into set, with circuit; 6/11 each.

GRAMPIAN 10in. Moving Coil Speakers, 10 watt type, 15 ohm speech coil, 2,500 ohm field, 15/-; with Pentode output trans., 17/6.

STRANDED Push Back Wire, 1d. per yard.

CHASSIS Mounting Valve Holders, American, 4-5-6 and 7-pin, 4d. each; Octals, 6d. each; Loctals, 10d. each; 7-pin English type, 3d. each.

ROTHERMEL Piezo Crystal Speakers, 7½in. cone, list 55/-, our price 10/6 each; 10in. cone, 12/6 each.

POLAR N.S.F. 1 Watt Resistances, 4d. each, 3/9 dozen; all sizes up to 2 meg.

WEARITE Mains Transformers.—R.C.B. type, 350-0.350v. 80 m.a., 5 volt 2 amps., 6.3 volts 5 amps., 6/11.

TYPE R.C.4., 500-0-500v., 150 m.a., 4 volts 2 amps., 4 volts 2.5 amps., 4 volts 5.6 amps., 4 volts 2 amps.; 21/-.

PHILCO Mains Transformers, American windings, 350-350 volts, 65 m.a., 6 volts 3 amps., 5 volts 2 amps., 5/- each; ditto but 80 m.a., 6/6 each; ditto but 90 m.a., 7/6 each.

WEARITE 110 K./C. I.F. Transformers; 1/- each.

AMERICAN C.T.S. Volume Controls, finest made, divided spindles, length 2½in. with switch, 2,000, 5,000, 10,000, 25,000, 100,000, 2/6 each; wire wound, 5 watt (less switch), 10,000, 25,000 ohms; 2/- each.

R.K. Senior 12in. Energised Speakers, 20 watt type, 1,000 ohms field, 11 ohms speech coil, 32/6; with tapped transformer, 3,000 and 7,000 ohms, 35/-.

PLESSEY 2-gang Straight Condensers, ceramic insulated, 1/6; Plessey 3-gang straight condensers, ceramic insulated, 2/-.

PLESSEY Dry Electrolytics, can type, 12×16 mfd., 350 volts working, 1/6 each; 6×6 mfd., 500 volts working, 1/6 each; 12 mfd., 450 volts working, 1/6 each; 8×8×8 mfd., 500 volts working, 2/11 each; 16×8×4×4 mfd., 500 volts working, 2/11 each; 12×8×8×8 mfd., 500 volts working, 2/11 each; 16 mfd., 450-volt working, 1/3 each.

B.I. Wire-end Type Bias Electrolytics, 50 mfd., 12 volts, 1/3 each; 50 mfd., 50 volts, 1/6 each.

TUBULAR Wire-end Non-inductive Paper, all sizes up to 0.1, 5d. each; 4/9 per dozen.

METAL Case, 1-hole fixing, electrolytic condensers, 550-volt working, 8 mfd.; 2/6 each.

STANDARD Telephone Headphones, resistance 2,000 ohms and 4,000 ohms; 6/11 per pair.

VOLUME Controls, 1,000 ohms, with switch; 1/3 each.

0.0005 3-gang Tuning Condenser Units, with trimmers; 2/11 each.

PLESSEY Energised Speakers, 10in. cone, 2,500 and 1,000 ohm field, with trans., 12/6 each; 6in. cone, 2,500 and 1,500 ohm field, 5/11 each.

RUBBER Grommets; 4d. dozen.

BATTERY Output Pentodes, well-known make; 3/11 each.

BATTERY Double Diode Triode, well-known make; 3/3 each.

RAYTHEON First Grade Valves, largest stockists, all types in stock, including glass series, glass octal series, metal series, bantom series, single-ended metal series, and resistance tubes, all at most competitive prices; send for valve lists.

ALL Orders Must Include Sufficient Postage to Cover.

HOURS of Business: 9 a.m.-6 p.m. week-days, Saturdays 9 a.m.-1 p.m.

RADIO CLEARANCE, Ltd., 63, High Holborn, London, W.C.1. Telephone: Holborn 4631. [8793

COMPONENTS—SECOND-HAND CLEARANCE, SURPLUS, ETC.

RYALL'S RADIO, 280, High Holborn, London, W.C.1, offer new goods, post free.

ELLIPTICAL Speakers, Celestion, suitable Ekco replacements, 750 ohms, less transformers, speech 25 ohms, new, handle 8 watts, carry up to 120 m.a.; 3/9 each to clear.

SPEAKERS, pairs, brand new, elliptical cone speakers, made by first class firm, quality of reproduction outstanding, push-pull pentode transformer, fields 325 ohm for smoothing choke, 8,600 as bleeder, circuit available, handle 10-15w.; 10/9 pair.

HEAVY Duty Mains H.F. Chokes, Goltone, 75w. high inductance type, 1/6; 180w. low inductance type, 1/-.

MAINS Transformers, drop through chassis type, top cover with mains adjustment, input 200-250v., outputs 350-350, 80 m.a. 4v. 2½a., 4v. 4-5 amp., heavy jobs, 6/9 each.

REDUCTION Drives (epicyclic) Polar ex Ferranti, and Plessey, long or medium spindles, ratio 10-1; two for 1/3 or 3/9 dozen.

PLESSEY Fully Screened 2-gang Condensers, short spindles, with top trimmers, 2/9; Plessey midget 2-gangs semi screened, 2/9; both 0005 straight type.

PLESSEY 3-gang Straight Type Condensers, top trimmers, fully screened, brand new, 2/9; Cossor 3-gangs ditto, 1/9, or 12/- dozen.

FERRANTI Air Core Type Tuning Coils, transformer wound, can be used as band pass, tuned grid with reaction, chassis type; three for 2/6, with coil connections.

I.F. Caps, Aii, size 1¾×1½×4in. high, complete with double trimmers, 4/9 dozen; Erie 60 ohm, ½-watt resistances, 1/3 dozen; NSF 1 watt ¼ megs, 1/3 dozen; 600 ohm, wire wound 3 watt resistances, four for 1/3; Cornel-Dubilier mica, sizes 001, 002, 003, 1/3 dozen.

THIMBLE Top Caps, 24 for 1/3; clip on bulb holders, 12 for 1/3; volume controls, ½ meg. with switch, Morganic Stackpole, ex K.B., 1/9; Murphy type ½ meg. with D.P. switch, 1/9.

BRITISH Type Magic Eye Valves, 4v. ½a. heater, octal base, 3/3; UD2 super power 2v. valves, 2/3 each; similar Triotrons.

AMERICAN Washer Type 4 and 7 Pin Valve Holders, 2/3 dozen; British 5 and 7 pin VII, 2/6 dozen.

MAGNAVOX 7in. Cone Speakers (8in. overall), ribbed pattern, ideal replacement speakers, 2,000 ohms pentode transformers, 7/-, new; also R. & A. 2,500 ohm 7in. type speakers, pentode transformers, 7/9; Plessey 6,500 ohm, 8in. speakers, with pentode transformer, 6/6.

SATOR ½meg. Pots with Switch, 1/3 each, 7/9 dozen; 10,000 ohm broad base tone control type, less switch, 1/3 each, 6/9 dozen.

ELECTROLYTICS, B1, 20×20 mf. at 350v., 25×25v., two for 1/6; size 3in.×2¼in., B.1 2×2×2, 400v. peak, 1/3 each, 9/- dozen; 25×25v., two for 1/6; Plessey 30×8×2, 300v. wkg., 1/6 each, 12/- dozen; TCC 8 mf. wet type 802 upright cans, 440v. wkg., 460v. peak, 1/9 each, 15/9 dozen.

U.S.A. Tubes, first grade, in sealed cartons; 80's 4/3, 6A7 4/9, 42 4/9.

SATOR 1,500v. Test Tubular Condensers, assorted, equal numbers, 0.0002-3-5, 0.001, 0.03, 0.05, 0.002-3, mica; all at 50 for 2/6.

ASSORTED Resistances, 50 for 2/6; 1-watt carbon, U.S.A. make, reasonable assortment given, sizes approx. 450-12,000-17-60-70-90-120 thousand ohms.

SYSTOFLEX 1½ mm., ½ gross, 5/-; twin screened 2×14-36, British made, 12 yards, 2/6; minimum quantities.

REX Type Switches, 4B. 2P. 4w., with shorting plate on 5 switches, 2/6 each, length 7in., spindle 2in.; ditto, 3w. 4P. 3B., 1/6; 3w. 3P. 3B., with shorting plate, 1/6; 3w. 2P. 4B., 1/6; any combinations of this item supplied; screens, 3in.-¾in.×3in.-⅝in., 5 for 1/3.

TRIMMERS on Porcelain Plessey, double and single, 50-100-200-160 ohm. approx.; 50 for 2/6; special price quantities.

CLIX Valve Holders, 5-pin and 7-pin antimicrophonic type, 3 for 1/6; 7-pin circular, with cover, slotted ends, 3/3 dozen, 24/9 gross.

CLIX Valve Holders, 7-pin, lemon shape, brass, tag ends, 2/3 dozen (1/3 half), 18/9 gross; 4- and 5-pin circular, with cover, slotted ends for soldering, 2/9 dozen, 18/9 gross.

CLIX Valve Holders, 5-pin square and 4-pin long oblong types, 1/3 dozen, 10/9 gross; Clix socket strips, 2-3-4-5-6 sockets, various markings, equal numbers, mixed, 6 for 1/3, 10/9 gross; plugs, 1/3 dozen.

SCREENED Leads, about 4 yards, 3-way, two only screened, 1/3; extra heavy for car sets, with spades, 1/3, 2¼ yards.

HAMMERLUND 30mm. Midget Trimmers on Pazolin, 1/9 dozen; Ultra type brown knobs, octangle, plain arrow, L.S. 1/9 dozen, 8/6 gross assorted, 10/6 gross plain or arrow.

SMALL Iron Core Coils, made by Varley, aerial and oscillator, 465 k/c, 2/6 pair, with coil connections for straight type gang.

WEARITE 110 kc. I.F.'s with Top Trimmers, 1/6 each; sets band pass air core superhet coils, ex Halycon, screened chassis type, 4/9 set five; 110 kc. with coil details. [8796

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ALL Guaranteed. Postage extra.

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15/-.—Service man's component kit, electrolytic condensers, volume controls, resistances, tubular, mica, paper condensers, valve holders, etc.; 120 articles contained in strong carrying case, 9in.×7in.×7in.; 15/- the kit.

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5/-.—100 wire-end resistances, assorted capacities, ½ and 1 watt; 5/- per 100.

5/-.—6 volume controls; 5/-.

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Thursday, February 8th.

INDEX TO ADVERTISEMENTS

Printed in England for the Publishers, ILIFFE AND SONS LTD., Dorset House, Stamford Street, London, S.E.1, by THE CORNWALL PRESS LTD., Paris Garden, Stamford Street, London, S.E.1. "The Wireless World" can be obtained abroad from the following: FRANCE: W. H. Smith & Son, 248, Rue Rivoli, Paris; Hachette et Cie, Rue Réaumur, Paris, and branches; Messageries Dawson, 4, Rue de Faubourg Poissoniere, Paris. BELGIUM: W. H. Smith & Son, 74-75, Boulevard Adolphe Max, Brussels. AUSTRALIA: Gordon & Gotch, Ltd., Melbourne (Victoria), Sydney (N.S.W.), Brisbane (Queensland), Adelaide (S.A.), Perth (W.A.), and Launceston (Tasmania). NEW ZEALAND: Gordon & Gotch, Ltd., Wellington, Auckland, Christchurch and Dunedin. INDIA: A. H. Wheeler & Co., Bombay, Allahabad and Calcutta. CANADA: Imperial News Co., Toronto, Winnipeg and Vancouver; Benjamin News Co., Montreal; Gordon & Gotch, Ltd., Toronto. SOUTH AFRICA: Central News Agency, Ltd.; Wm. Dawson & Sons (S.A.), Ltd., Cape Town. UNITED STATES: The International News Co., New York.