The Wireless World

THE PRACTICAL RADIO JOURNAL

VOLUME XXXI

JULY 8th—DECEMBER 30th, 1932

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ILLUSTRATIONS

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BOOK REVIEWS

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EDITORIAL COMMENT.

The Enlarged "Wireless World"

WITH this issue *The Wireless World* greets its readers in a new form and awaits, with confidence, their verdict on its appearance and contents.

Since last week's issue announcing the proposed change, we have already had sufficient intimation from our readers to encourage us to believe that the inclusion week by week of full details of the Foreign Programmes, in addition to all the features of *The Wireless World* of the past, will meet with wide approval not only amongst our present readers but also that it will attract the interest of an extended circle. The importance of transmissions from abroad to listeners in this country is steadily increasing. Continental broadcasting is improving both in technique and in the quality of the programmes, and receiving sets capable of really satisfactory reception of long-distance broadcasts are now generally available at moderate prices, whether as commercial receivers or designs for home construction.

We take this opportunity of expressing our thanks to all those readers and friends in the radio industry who have offered us their congratulations in connection with the step taken with this issue. Only a few weeks ago we had the pleasure of similarly expressing our thanks in connection with congratulations on the celebration of the twenty-first birthday of *The Wireless World*, and it is extremely gratifying to have again received so many tokens of goodwill and appreciation of the efforts which we make in our endeavour to maintain the paper as *the* indispensable wireless journal.

Broadcast Quality.

UNDER Correspondence in this issue we publish one or two letters picked out from amongst a very large number which reached us promptly after the appearance of a letter from a reader who protested against the amount of space which was being devoted in the correspondence columns to the discussion of quality of reproduction in relation to frequency range. He implied that the present quality was satisfactory and that to discuss the matter was a waste of space in *The Wireless World*. How strongly other readers disagree with his point of view may be appreciated from a perusal of letters this week.

We believe that we were fully justified in opening our correspondence columns to a discussion of the question of quality and the range of frequencies which it is necessary for the transmitter to put out and the receiver to reproduce in order to give realistic results. Next to intelligibility in broadcast reproduction there is, in our view, no more important aim in the broadcasting problem than that which endeavours to attain the utmost realism so that the reproduction is comparable with the original.

As one correspondent remarks, there is no more suitable place in which to discuss the various aspects of the problems connected with broadcasting than the correspondence columns of this journal, and space devoted to this purpose certainly cannot be regarded as wasted.

Defects in Valves.

DEFECTS are sometimes present even in newly purchased valves owing to damage in transit or some unfortunate weakness in the manufacturing process, but more often a valve, which at the start of its life is satisfactory, deteriorates in use either gradually in the normal course of its life, or rapidly if a defect develops. In any event, it is by no means easy for the average set user to test individual valves for every possible form of misbehaviour, so that an article in this issue "When Valves Go Wrong" should make a special appeal, for the aim of the author has been to indicate symptoms in the behaviour of a modern receiver which may assist in leading to the diagnosis of a faulty valve and to reveal which valve in the receiver is to blame.

The AUTOTONE PORTABLE.

By F. L. DEVEREUX, B.Sc.

FIVE or six years ago the term "portable" was identified for all intents and purposes with a single type of receiver, namely, a five-valve set employing two aperiodic H.F. stages, a detector, and two L.F. stages, and housed either in a suitcase or vertical type of case. Nowadays the term embraces any type of receiver from a two-valve battery set with headphones to an all-mains superhet. with moving-coil loud speaker, provided that it is self-contained and can be lifted from one room into the next.

It is necessary, therefore, at the commencement of this article to define the scope and purpose of this design and to indicate the position it occupies in the general classification. In the first place, since it is intended primarily for outdoor use as an accessory to summer picnics and excursions, the question of weight has been given precedence over most other considerations affecting the design. The tendency of late among commercial portables has been to allow the weight to increase gradually in the competition for improved range and selectivity. As a result, many otherwise excellent portables cannot be carried for more than a hundred yards without discomfort, and should really be classified as transportables.

The "Autotone" portable is designed for loud speaker reproduction, and is consequently somewhat heavier than the lightweight type of portable designed for headphones. On the other hand, it is most decidedly lighter than the average screen-grid four-valve portable intended for long-distance foreign-station reception, and should appeal to those who may not possess a car or other mechanical transport.

Having decided that the set must be truly portable, the next problem was to find a circuit which would give the best possible performance for a given weight. The extraordinarily high sensitivity of the original "Autotone" receiver suggested that a simple reacting detector should give excellent results with a frame aerial, provided the necessary precaution was taken of correcting for loss of high tones due to the sharp tuning of the aerial circuit. There were three L.F. valves (including the tone corrector) in the original model, but in the portable, thanks to the introduction of the Multitone intervalve transformer, an equivalent L.F. performance has been obtained with two stages and a corresponding saving in weight. The "Multitone" transformer is compact, and the coupling unit between the detector and first L.F. valve is also very light by comparison with early intervalve transformers.

BRIEF SPECIFICATION.

Circuit.—*Three valves. Reacting detector and two L.F. stages with tone compensation.*

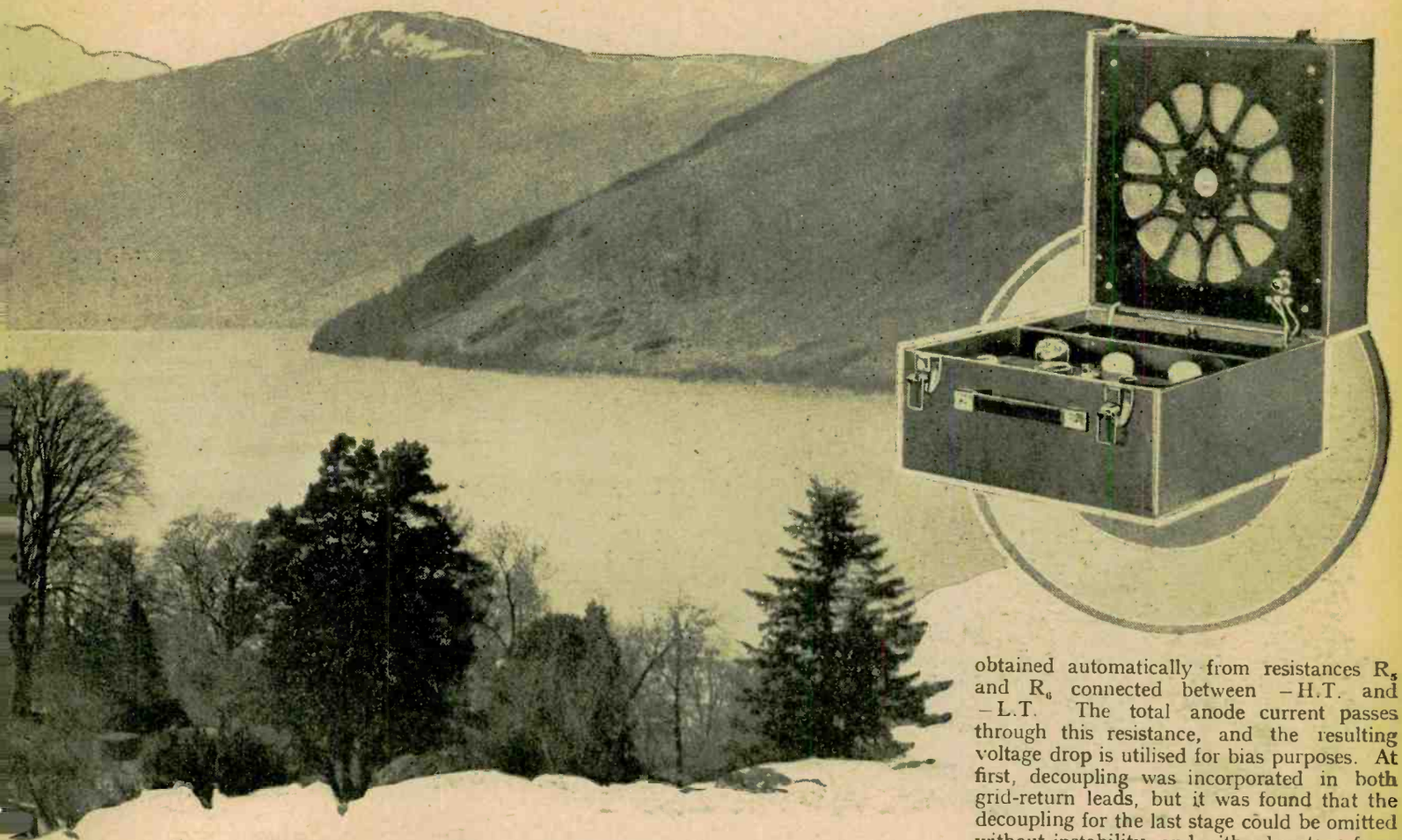
Current Consumption.—*L.T., 0.4 amp. at 2 volts; H.T., 6 mA. at 108 volts.*

Total Weight.—*25 lbs. (including batteries).*

Approximate Cost. — *£8 15s. (including valves and batteries).*

In the frame-aerial circuit it was decided to employ separate reaction coils rather than the centre-tapped Hartley circuit. This was done in order that the spindle of the tuning condenser C_1 might be earthed and so reduce hand-capacity effects. Readers will no doubt be curious regarding the function of the resistance R_2 in series with the reaction coils. This is included primarily to suppress a form of parasitic oscillation which occurs frequently on the long-wave range. As reaction is increased from zero, two oscillation points are observed. The first is at a fixed frequency in the vicinity of 300 metres, and appears to be determined by the inductance of the reaction windings in conjunction with stray capacities associated with the wave-range switch. If reaction is then increased until the second oscillation point is reached the frame winding takes control and the set tunes more or less normally. However, the set cannot be worked above the second oscillation point for obvious reasons, and below the detector is choked by the parasitic oscillations. This is by no means an uncommon trouble in reacting detector circuits, but the series resistance can always be relied upon to effect a cure.

As a matter of fact, this resistance is an advantage from another point of view, for it can be made to give practically constant reaction over the tuning scale. It is well



A Lightweight Loud Speaker Set with Tone Compensation.

known that normally more reaction is required as the wavelength is increased. The effect of the series resistance is just the reverse, and if too high a value is chosen more reaction may actually be required at the lower end of the tuning scale. In the present design 250 ohms gave the best results from the point of view of constant reaction, and also completely eliminated the parasitic oscillation.

The coupler TR_1, following the detector, is a self-contained filter-feed transformer unit incorporating its own feed condenser and anode resistance. The anode resistance is tapped for matching high- or medium-impedance valves, and, since the Cossor 210H.F. valve, under grid-detector conditions, falls into the latter category, the "dead end" of the anode resistance can be usefully employed as part of the decoupling circuit. To make the decoupling even more complete the usual 2-mfd. by-pass condenser has been divided into two parts with 1 mfd. across the internal and external sections of the decoupling resistance. The centre-tapped Ferranti C.2C. condenser is ideal for this purpose.

The Tone-correction Stage.

The connections of the "Multitone" transformer and tone-control potentiometer are quite straightforward, the outer ends of the resistance going to the terminals T.C. and the centre slider terminal to the grid. The primary is connected directly in the anode circuit of the first L.F. valve, since the D.C. through the winding under working conditions is under 1 mA. Decoupling is incorporated in this stage as well as in the detector anode circuit, and it is advisable to earth the core by connecting to one of the holding-down screws through a soldering tag.

We now come to an important feature of the circuit, namely, the provision of negative grid bias for the two L.F. stages. This is obtained automatically from resistances R_5 and R_6 connected between −H.T. and −L.T. The total anode current passes through this resistance, and the resulting voltage drop is utilised for bias purposes. At first, decoupling was incorporated in both grid-return leads, but it was found that the decoupling for the last stage could be omitted without instability, and with advantage from the point of view of both weight and cost. In our opinion, the time is not far distant when automatic grid bias will be general in portables, and, indeed, in all battery receivers, as a good deal of the distortion experienced when the H.T. runs down is due to over-biasing when a separate grid-bias battery is used. It is often possible to reduce the bias in the last valve, but not so easy in earlier stages, where the normal bias may be as low as 1½ volts. With automatic bias the H.T. and bias voltages fall in sympathy, and in this set quite pleasing quality is obtained down to 50 volts H.T., whereas

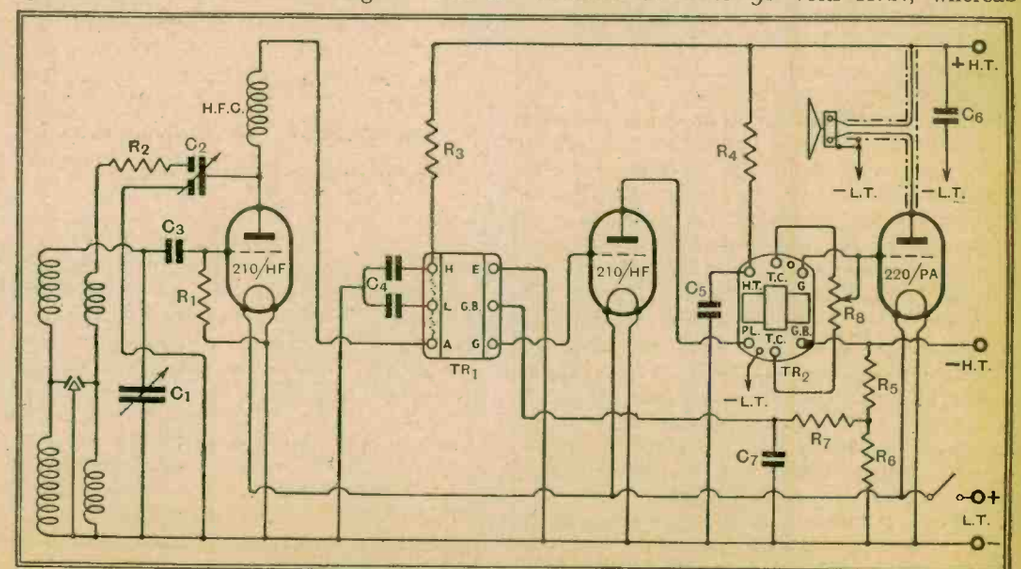
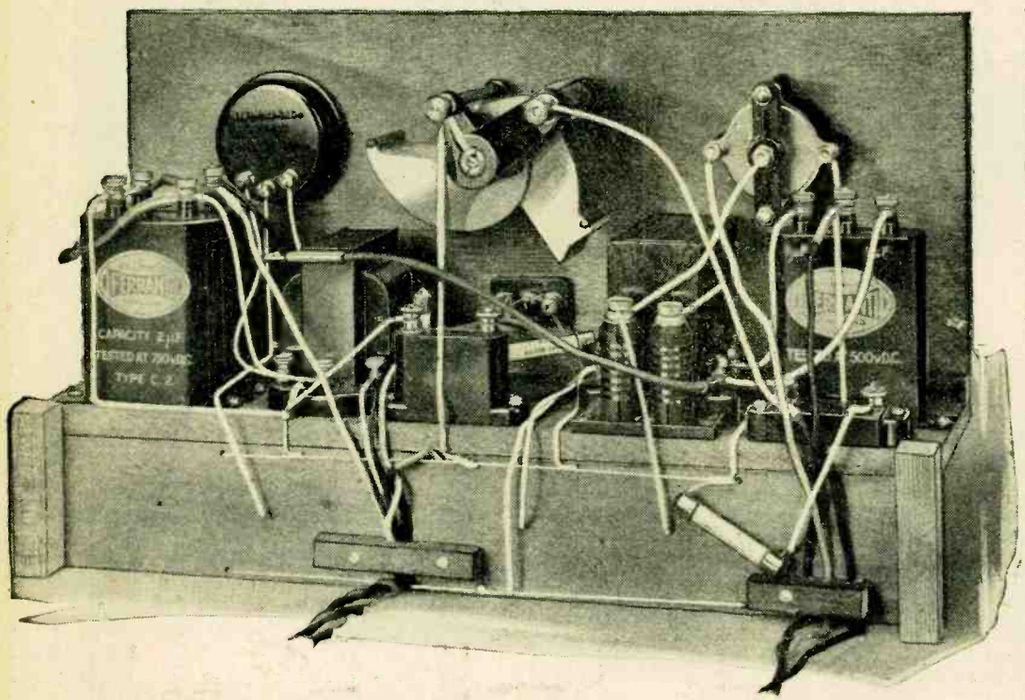


Fig. 1.—Complete circuit diagram. The connections of the intervalve couplings are indicated schematically. C_1, 0.0005 mfd.; C_2, 0.0002 mfd. differential; C_3, 0.0001 mfd.; C_4, 1 mfd. + 1 mfd.; C_5, C_6, 2 mfd.; C_7, 50 mfd. electrolytic; R_1, 500,000 ohms; R_2, 250 ohms; R_3, R_4, 20,000 ohms; R_5, R_6, 250 ohms (for Cossor valves); R_7, 50,000 ohms; R_8, 4 megohms.

The "Autotone" Portable.—

experiments showed that 75 volts was the limit with a separate bias battery.

The suitcase type of cabinet chosen greatly simplifies the process of construction. All the necessary panels and sub-panels are included,



Underside of the receiver unit. The loud speaker leads are attached when the unit is finally assembled in the cabinet

and when these are assembled in accordance with the diagram in Fig. 2, the layout and wiring can be proceeded with in accordance with Fig. 4. Supporting blocks must be provided for the underside of the valve platform and it may be advisable to strengthen the angle between the control panel and the vertical baseboard with $\frac{3}{8}$in. square corner fillets. The panel assembly is conveniently open, and no special sequence need be followed in wiring. It should be noted, however, that whereas the battery and frame aerial leads are permanently connected to the receiver unit the loud speaker leads must be attached or disconnected at the receiver end

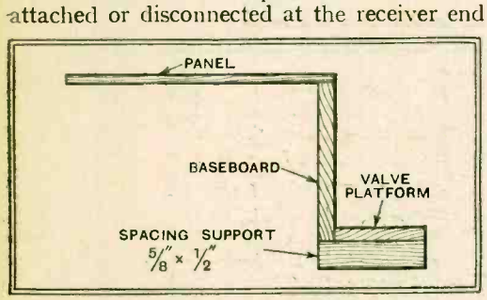


Fig. 2.—Correct method of assembling framework of receiver unit.

when the set is being assembled or dismantled. The reason for this will be obvious when we come to the constructional details of the frame aerial unit inside the lid. The metallised resistances R_1, R_5, R_6, and R_7 are self-supporting when suspended by the wires attached to their die-cast end-caps. The spaghetti resistance R_4 is carried by the terminals on condensers C_6 and C_7, but it may be necessary to solder an extension lead to the end of the resistance R_3 nearest to the [+H.T. common terminal on C_6.

Before fitting the grid bias resistances R_5 and R_6 it will be necessary to decide upon the type of valves to be used in the receiver. The decoupling resistance R_7 will remain the same whatever valves are used, but the values of R_5 and R_6 are determined by the grid bias and anode current normally taken by particular types of valve in use. The resistance values given in Fig. 1 apply to the Cossor group of valves used in the original set; representative alternatives are given in the table below.

Valves (See List of Parts)	R_5 (ohms).	R_6 (ohms).
Cossor	250	250
Marconi	450	250
Osram	450	250
Mullard	350	200
Mazda	500	250

It is hardly necessary to point out that once having decided on any particular group of valves any subsequent replacements must be of the same make and type; the bias resistances will automatically compensate for slight variations of characteristic between different specimens of the same type and make, but not necessarily between different makes of valve.

In preparing the frame aerial unit for the lid the first step is to mount the loud speaker unit. This is screwed to a $\frac{3}{16}$in. thick 3-ply disc $3\frac{3}{4}$in. in diameter with a centre hole for the adjusting screw. The disc is then fixed to the inside of the loud speaker fret with four wood screws, or preferably 4 B.A. countersunk screws and nuts. In the Lissen "Solenoid" unit the adjusting screw and driving rod, although in line with each other, are not exactly midway between the two fixing holes. This results in the unit being slightly off centre when screwed to the 3-ply disc.

The loud speaker cone covers the movement, so the braided twin leads must be connected to the terminals of the unit and a connection made between the frame of the unit and the braiding before the cone is fitted. The corners of the "Ripper" cone baffle must be cut to clear the corner posts of the frame former, while the baffle as a whole should be raised off the back of the fret by $\frac{1}{8}$in. wood strips. A gap is left in the bottom left-hand corner through which the braided loud speaker leads pass.

Winding the Frame.

After attaching the driving rod of the unit to the apex of the cone with suitable cone washers, the frame aerial and reaction coils may be wound. The ends of each winding are suitably terminated by drilling fine holes through the post at the bottom right-hand corner of the frame near the wave-range switch. The number of turns required and the disposition of the windings are given in Fig. 3. A gap of about $\frac{3}{16}$in. should be left between the end of the long-wave winding and the fret in order to pass the braided loud speaker lead. Also, make quite sure that the reaction coils are wound in the opposite direction to the tuned frame windings.

Having wired the ends of the frame windings to the wave-range switch and terminal sockets, the frame unit is fitted in the lid and the loud speaker leads joined to the receiver unit before the latter is finally screwed into the cabinet. It is important that the braiding should be connected to −L.T. at the receiver end; this connection is not actually shown in the wiring diagram. It is a good plan to insert a loose 3-ply strip of wood in the bottom of the battery compartment to protect the loud speaker and frame

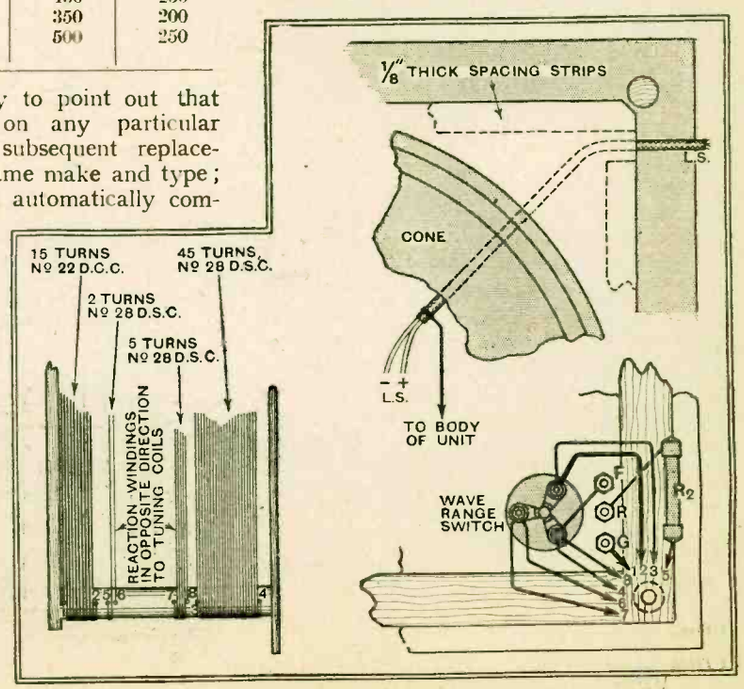


Fig. 3.—Constructional details and connections in the frame aerial—loud speaker unit.

aerial leads from actual contact with the batteries.

The set is now ready for use, and, if everything has been carried out according to instructions, should give give full loud speaker strength from Daventry on the long waves and the choice of at least two or three B.B.C. transmissions on the medium waves in any part of the country. In addition, Radio Paris, Eiffel Tower, and three or four other long-wave stations should come in well, and, after dark, ten or twelve foreign stations on the medium wave-band. These results were, in fact, obtained in and around London during the initial testing of the set. It was gratifying to find the performance on long waves in no way inferior to that on the medium waveband. This is a point which should always be looked for in any portable, for on the assumption that most country outings take place during the week-end, it is desirable that the popular Sunday programmes from Radio Paris should be available at good strength.

Hints on Tuning.

The correct procedure when tuning is first to increase the volume by means of reaction to the level required and then correct the quality by means of the tone control. The range of tone variation provided by the "Multitone" transformer will be found more than sufficient to cope with any loss of quality due to the sharpness of tuning of the frame aerial. There is thus ample scope for the exercise of individual taste in the adjustment of tonal quality after the initial high-note loss has been corrected. In general, more natural speech and greater clarity of diction will be obtained if the tone control is adjusted to favour the middle and upper-middle register rather than the bass. Music, on the other hand, calls for a generally lower pitch level to strengthen the loud speaker response below 200 cycles. This is especially important in the case of dance music, since the principal rhythm is almost entirely provided by the lower instruments.

This receiver is available for inspection by readers at the Editorial Offices, 116, Fleet St., London. E.C.4.

LIST OF PARTS.

After the particular make of component used in the original model, suitable alternative products are given in some instances.

1 Suitcase cabinet (Camco "Riverside")
3 4-pin Valve holders (Lissen Rigid Type)
1 Tone control transformer, type 4/1 (Multitone)
1 Tone control potentiometer (Multitone)
1 Universal "Transcoupler" (Bulgin)
(Benjamin "Transfeeda.")
3 Metallised resistances, 250 ohms, 1 watt (Dubilier)
1 Metallised resistance, 50,000 ohms, 1 watt (Dubilier)
1 Metallised resistance, 500,000 ohms, 1 watt (Dubilier)
2 Resistances, 20,000 ohms, spaghetti type (Tunewell)
(Bulgin, Goltone, Graham Farish, Igranic, Lewcos, Magnum, Ready Radio, Sovereign, Telsen, Varley.)
1 Slow motion variable condenser, 0.0005 mfd. with dial (Ormond R.426)
(Burton, Formo, Polar, Simplicon, Telsen, Utility, Wavemaster.)
1 Slow motion differential reaction condenser, 0.0002 mfd. (Ormond R.190)
(Burton, Formo, Polar, Simplicon, Telsen, Utility, Wavemaster.)
1 Fixed condenser, 2 mfds., centre tapped (Ferranti Type C.2.C)
2 Fixed condensers, 2 mfds. (Ferranti Type C.2)
(Dubilier, Formo, Franklin, Loewe, Savage, T.C.C., Telsen, Wego.)
1 Fixed condenser, dry electrolytic, 50 mfds. (T.C.C. Type 501)
1 Fixed condenser, mica, 0.0001 mfd. (Dubilier No. 610)
(Ferranti, Formo, Graham Farish, Hydra, T.C.C., Telsen.)
1 H.F. choke (McMichael Binocular Junior)

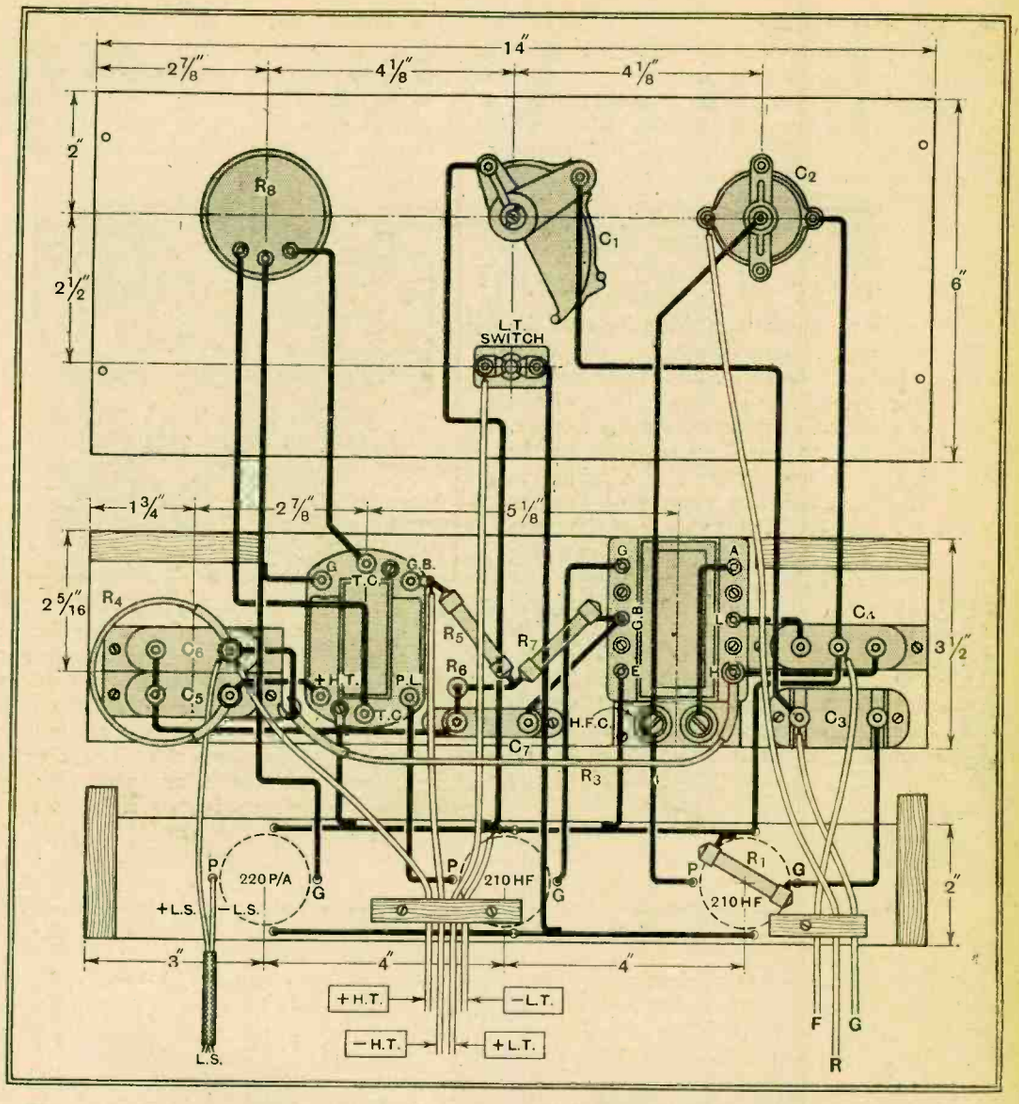
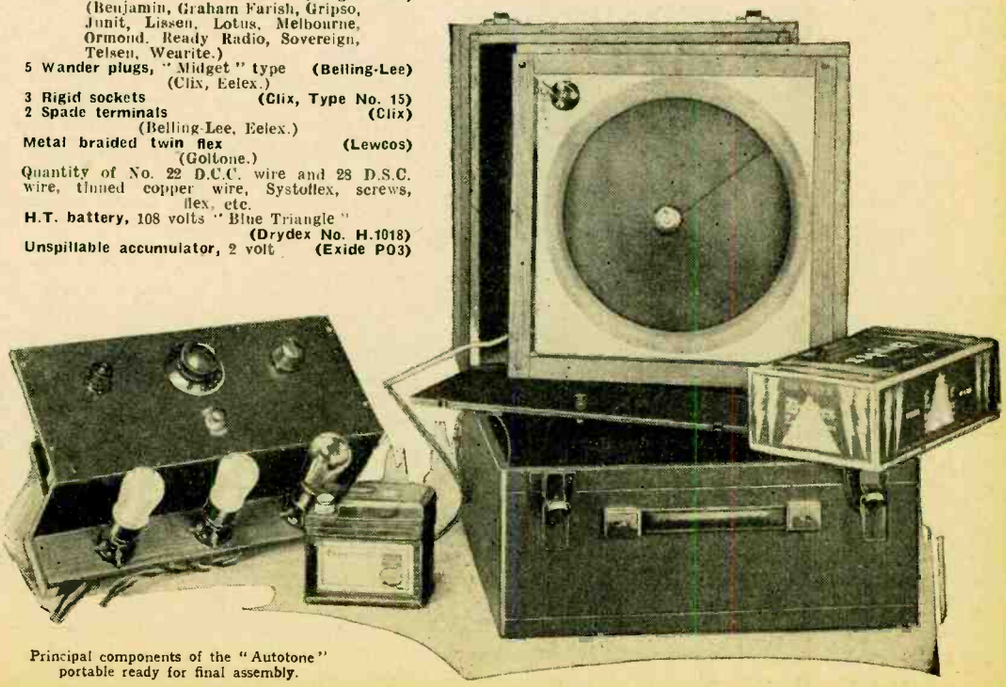


Fig. 4.—Layout and wiring of components in the receiver unit. An additional connection should be made between the loud speaker braiding and any convenient point on the common L.T. lead.

1 Loud speaker unit (Lissen "Solenoid" LN.5073)
(Ormond, Sixty-Sixty, Telsen.)
1 Cone diaphragm, 10in diameter
("Ripper," C. G. Johnstone, 154, Southwark Bridge Road, London, S.E.1.)
1 Push-pull switch "On-off" (Bulgin S.22)
1 Push-pull 3-way switch "High wave—Low wave" (Bulgin S.22)
(Benjamin, Graham Farish, Gripso, Junit, Lissen, Lotus, Melbourne, Ormond, Ready Radio, Sovereign, Telsen, Wearite.)
5 Wander plugs, "Midget" type (Belling-Lee)
(Clix, Eelex.)
3 Rigid sockets (Clix, Type No. 15)
2 Spade terminals (Clix)
(Belling-Lee, Eelex.)
Metal braided twin flex (Lewcos)
(Goltone.)
Quantity of No. 22 D.C.C. wire and 28 D.S.C. wire, tinned copper wire, Systoflex, screws, flex, etc.
H.T. battery, 108 volts "Blue Triangle" (Drydex No. H.1018)
Unspillable accumulator, 2 volt (Exide P03)

Valves. One Cossor 220PA, Two Cossor 210 H F.,
or One Marconi LP2, Two Marconi HL2,
or One Osram LP2 Two Osram HL2,
or One Mullard PM2A, Two Mullard PM1 HL.
or One Mazda P220, Two Mazda HL210.
(Approximate cost including valves and batteries, £8 15s.)



Principal components of the "Autotone" portable ready for final assembly.

When a Valve Goes Wrong

The Effect on the Behaviour of a Receiver.

IT is not an uncommon thing for even the most expensive of commercial receivers, or the most carefully built of home-constructed ones, to develop a fault of one kind or another. In most cases the trouble, when not due to an imperfect joint in the wiring, can be traced down to a failure in one of the many components of the set proper, and it is in this direction that one is inclined to turn one's attention when trying to locate the trouble.

Although as a general rule one is fairly safe in assuming that some component or other is at the bottom of the receiver's misbehaviour, there is always the possibility that one of the valves is the culprit, especially as the modern valve, with its dull-red filament and heavy coating of "getter" on the bulb, gives no external indication of any internal fault that may have developed.

Whether the fault be due to a valve or a component, the use of a milliammeter to check anode currents, and of a voltmeter to check voltages at different parts of a mains

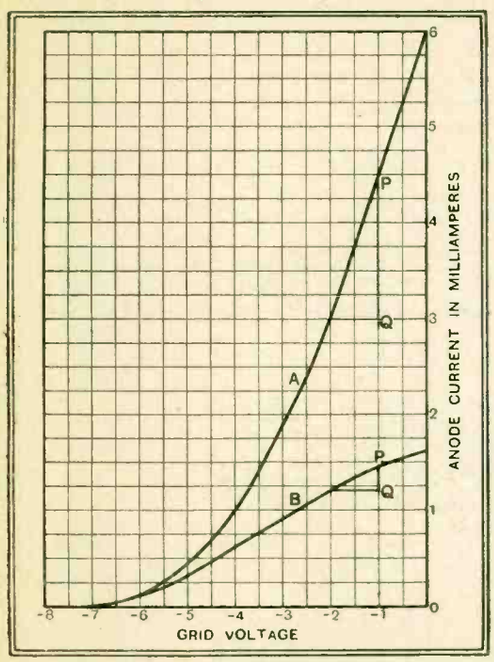


Fig. 1.—The effect of losing emission. A shows curve of a new screen-grid valve, while B shows a typical curve of a worn-out valve. In each case PQ shows the anode-current change brought about by altering bias by one volt. Roughly speaking, the amplification is proportional to the length of PQ in each case.

set, is almost essential if the fault is to be located quickly and with certainty. In discussing the various ways in which a valve can fail, and the results arising in a set from such failure, the assumption that voltages and currents can be readily determined must consequently be made.

It is probably true to say that the most elusive fault to trace is one that is so indefinite that one is not prepared to swear that it exists at all. Perhaps the set seems rather "dead," and distant stations that used to come in strongly are more difficult to find than when the set was new. It may be that the advent of summer has changed conditions of reception for the worse, or it may be only that results we thought were wonderful in the first flush of enthusiasm for a new set have now become commonplace and have lost their thrill.

Or, on the other hand, it *may* be that one of the screen-grid valves is losing emission.

If this has taken place, then, owing to the lowered efficiency of the filament or cathode, the internal resistance of the valve will have risen far above its normal value, and the amplification obtainable from it will have been correspondingly reduced. The set will therefore be far less lively than it should be, and distant stations, especially those for which full amplification is needed, will tend to disappear. The local station, on the other hand, will still be heard at full volume and with normal quality.

When the Detector Fails.

The test for failing emission consists in measuring the anode current of the valve suspected; an anode current well below the normal value will prove definitely that the suspicions entertained are only too well founded, and that a new valve is required to restore the set to its original excellence.

The same fault occurring in the detector valve will manifest itself mainly as a deterioration of quality, which will become thin and harsh, though there may also be some loss of sensitivity. In sets using reaction it will be found that, as the valve slowly fails, it becomes more and more difficult to make the receiver oscillate, especially at the upper ends of the wavebands. This symptom is, perhaps, the most infallible indication of a dying detector. The proof consists, as before, in checking the anode current to determine whether it is lower than it should be.

If it is the output valve that is losing emission, the maximum volume of sound that can be had from the set before overloading begins will drop in sympathy with the falling anode current. This will be most noticeable when listening to the local station, especially as the ability to receive distant stations will not be affected, though the volume at which they can be heard will be subject to the same limitation as the local programmes. Once again, the milliammeter will indicate, by a low reading, that a new output valve is required.

WITH its dull-glowing filament and obscured bulb, the modern valve can give little visual indication of any derangement within. Yet although its reliability has enormously increased of late, the valve, on account of its extremely intricate construction, is not infrequently the source of the first fault to occur even in the most expensive receiver. The author here shows how troubles due to failing valves can be rapidly diagnosed.

Mains Rectifying Valves.

In making the suggested check of anode current it is necessary, especially in a battery-driven set, to make sure that the voltages applied to filaments, anodes, and grids are normal; an anode-current reading can only be informative when the operating voltages are known.

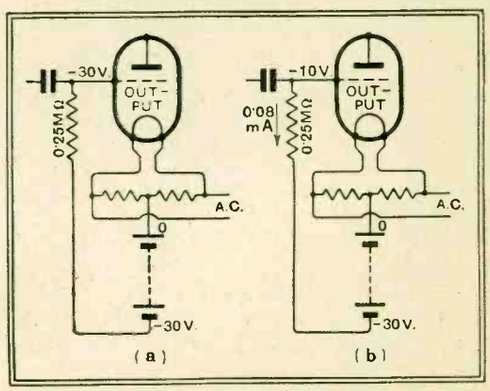


Fig. 2.—(a) Shows the normal voltages in the grid-circuit of an output valve which does not suffer from grid-emission. If grid-emission is present, as in (b), the voltage dropped across the grid leak by the resulting grid current may nullify nearly the whole of the bias.

If *all* the symptoms of failing emission occur together, so that high-frequency, detector, and output valves all seem to be suffering at once, it is more than probable that the accumulator of the high-tension bat-

When a Valve Goes Wrong.—

tery is running down—the effects of which are probably well known to every user of a battery set. In the case of an all-mains receiver, or a set using an eliminator on an A.C. supply, a similar failure of all stages of the set at once can often be ascribed to the rectifier. If the emission of this valve is falling off, its resistance will rise and the voltage dropped across it will also rise. Less voltage—in a bad case far less voltage—will therefore be available to operate the set. Investigation of the voltage at the H.T. *plus* terminal while the set is in operation will immediately indicate whether this diagnosis of the set's misbehaviour is correct.

Microphonic Troubles.

In all these cases, and, indeed, in any case where a valve is suspected of causing trouble, a fairly definite check can always be had by substituting a valve known to be in good condition for the one whose behaviour is considered doubtful. This test is likely to be the only one applicable if no milliammeter is to hand.

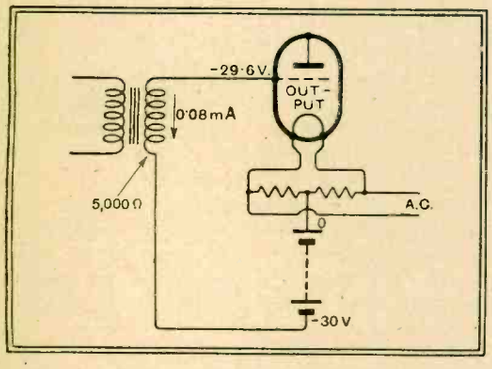


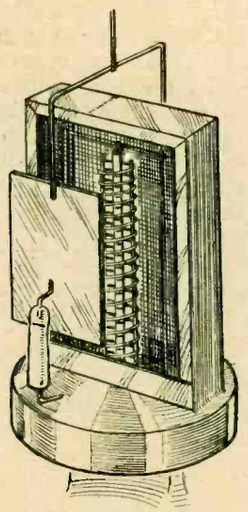
Fig. 3.—If the output valve is preceded by a transformer, the much lower D.C. resistance prevents any serious change in bias from resulting from any reasonable degree of grid-emission. Compare Fig. 2 (b).

Other faults that may develop in a valve are usually easier to detect than failure of emission, if only because the symptoms shown in the set are more definite. A microphonic valve, in which one of the electrodes moves slightly in response to a mechanical shock, is quite easy to defect.

In a bad case a howl or boom builds up as soon as the set is switched on, vibration of the filament being maintained by the sound-waves from the loud speaker, these, in turn, being caused by the variations in anode current arising from the vibrating electrode. Pointing the speaker away from the set, or taking it into another room, will stop the noise, as also will holding the hand round the offending valve tightly enough to damp out the vibrations. Where the valve is only slightly microphonic, the howl may not be maintained, but there will be a "pong" if the valve or the set is sharply tapped.

A less common form of microphonic trouble sometimes appears in mains valves, where crackles and bangs are heard in the speaker when the valve is jarred. Sometimes this is due to a loose cathode, but it may equally well arise from any kind of intermittent contact or partial short circuit. Care should be taken to blame the valve only if one is perfectly certain that the set itself is free from imperfect connections, and that the valve-pins are making really good contact in the valve holder.

Microphony in a screen-grid valve is not very common, but it leads to effects very puzzling to those who have not had experience of its results. In such a case the usual microphonic howl builds up only when a station is tuned in, for a carrier is necessary to enable the low-frequency currents due to the vibrating electrode to pass through the tuned couplings to the detector valve. The cure, in this as in the previous cases, is to replace the valve; but before doing so the filament wiring should be overhauled to make sure that the filament voltage at the valve-pins themselves is right up to normal, as certain types of filament have spring enough to vibrate only when run below their normal operating temperature.



Specially designed to prevent grid emission—the electrodes of a modern mains valve with ventilated gauze anode.

Occasionally, one meets a valve in which the filament or cathode is making intermittent or permanent contact with the grid. The minute clearances between these electrodes, amounting often to only a few tenths of a millimetre, cannot be increased without an appreciable loss of efficiency, so that modern valves are very prone to suffer from this fault. Usually, it is restricted to the factory, faulty valves being rejected at the test bench, but the knocks and bangs suffered in transit from factory to user will sometimes make it possible for a valve to develop this defect by the time it reaches the ordinary purchaser.

Dangers of Grid Emission.

If the contact between grid and emitting surface is intermittent, tapping the valve will evoke the most deafening crashes in the loud speaker. A milliammeter in the anode circuit will render visible the sudden fluctuations in anode current that are causing the noise. Certain complications are possible here; in the case of a screen-grid valve operating without bias no anode-current fluctuations may appear, as the grid is already at the same D.C. potential as one end of the filament. The noises will still occur if a signal is being received, for every time the filament touches the grid the signal will be short-circuited, and the anode current of the detector will jump back from the "deflected" to the "normal" value.

Permanent contact between grid and filament, in whichever valve it occurs, means that the signal is permanently short-circuited; a strong signal, however, may still be heard. The fault may be detected immediately from the fact that the anode current of the misbehaving valve will not vary as different bias voltages are applied to the grid.

A grid that has become disconnected from its pin will give rise to very similar symptoms; the two cases can be differentiated by a simple continuity test between grid and filament pins on the valve after removal from the set. But it must be remembered that if the grid pin fails to make contact in the holder it is not fair to blame the valve.

A mains valve, and especially an output valve of fairly high power, will sometimes suffer from grid emission. This is due to a little of the emitting material sputtering from the cathode or filament when the valve is on the pump, so that when the valve gets thoroughly hot in use the grid, as well as the cathode, begins to emit electrons. Owing to the fact that emission from the grid may not occur until the valve has been running some time, it is a fault that may very easily be missed in factory testing.

Output Valves.

If the D.C. resistance between the grid and cathode in the set is small, as would be the case if they were connected through the secondary of a low-frequency transformer, grid emission is not likely to give rise to any trouble at all in the set. In a resistance-coupled amplifier, on the other hand, where the output valve may have a grid-leak and decoupling resistance totally a quarter of a megohm or more, grid emission can be a very serious matter. As the grid loses electrons it becomes more and more positive, the minute current through the leak being able to do little towards neutralising this positive charge. With the decreased bias that the positive charge implies, the anode current rises above normal, thereby overheating the valve and accentuating the emission from the grid. Once started, the process is cumulative, and may progress so far that the valve is running with almost no bias, drawing, in consequence, an enormous anode current. Five minutes of this, and the valve goes soft, owing to the liberation of gas from the overheated anode; the gas ionises, and the bombardment of the filament by the positive ions soon destroys entirely its emissive properties. A new valve is then required.

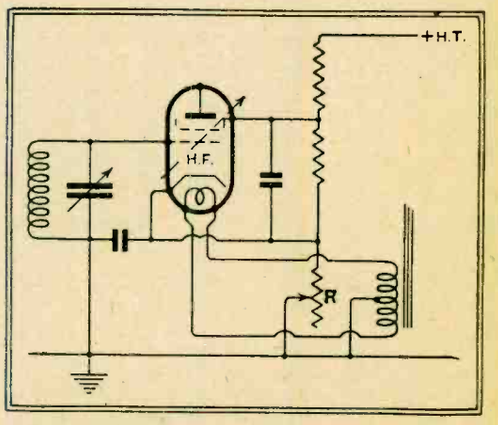


Fig. 4.—A usual circuit for controlling the bias to a variable-mu valve. Observe that the centre-tap of the heater winding is earthed, as is the grid, while the cathode is given a positive bias by adjustment of R. The bias voltage is thus applied between heater and cathode.

It is to minimise the likelihood of this unpleasant chain of events that it is usual for the makers of output valves of high power to stipulate in their instruction slips that the total D.C. resistance between grid and filament must not exceed some specified figure, usually 0.25 or even 0.1 megohm.

When a Valve Goes Wrong.—

The reduction of bias arising from grid emission is usually accompanied by a decrease in volume and a deterioration of quality, but the most characteristic effect is a large increase in hum. The high value found on reading the anode current is conclusive proof of the defect, but if the valve is allowed a few minutes to cool down while the milliammeter is being attached, grid emission will cease for the time being, and will only recur when the valve gets hot after further use.

The detector valve, with its high-resistance leak from grid to cathode, is the only other valve in which grid emission is likely to be troublesome. Faint and distorted signals suggestive of a heavily loaded detector are the result of this defect, which, owing to the fact that detector valves do not normally run very hot, is not a very common one.

A short-circuit, or bad leak, between cathode and heater in a mains valve will almost always lead to hum, which may on occasion be on a truly heroic scale. Tapping the affected valve will often cause a cure, even if only a momentary one, by jarring apart the two elements. In a screen-grid valve this fault manifests itself as a modulation hum, observable only when a station is tuned in. Owing to the fact that the high bias voltages used are generally applied between heater and cathode, the variable-mu valve is liable to modulation hum through faulty heater-cathode insulation.

Since the leak or short-circuit may disappear when the heater contracts on cooling, any test for continuity between them should be applied only when the heater is running.

It is not to be inferred from these notes that it is exceptional to find a valve that does not suffer from one or more of the faults that have been enumerated. On the contrary, the modern valve is so extraordinarily reliable that one is inclined to take its perfection for granted, and it is on this account that it has been thought worth while to draw attention to possible faults that might puzzle those who have not previously encountered them.

WIRELESS ENCYCLOPEDIA

No. 20

Brief Definitions with Expanded Explanations.

AS the name implies, the impedance of an A.C. circuit is the extent to which the passage of an alternating current through it is impeded. Like resistance, the impedance is expressed in ohms, and is given by the ratio of the R.M.S. voltage applied to the circuit to the R.M.S. current produced. When a steady *direct* current is passed through a straightforward circuit, where there are no generated or other internal electromotive forces, the only opposition encountered is that due to the resistance of the conductors themselves, Ohm's law being obeyed. Even in an A.C. circuit the same law applies for R.M.S. values of current and voltage, *provided there is no inductance or capacity in the circuit,* or in the very special circumstances where the effects of inductance and capacity neutralise each other, as in a series-tuned circuit.

But as a general rule the passage of an alternating current is impeded, not only by the actual or "ohmic" resistance of the circuit, but also by counter electromotive forces set up or induced by the cyclic variation of the current; in other words, the relationship between voltage and current depends also on the inductance and capacity in the circuit and on the frequency of the current.

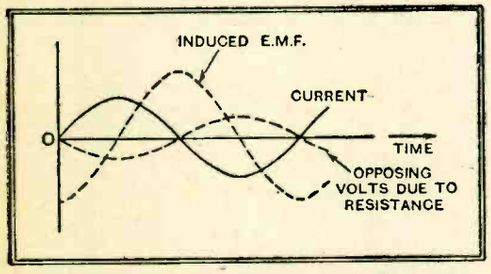


Fig. 1.—The broken line curves indicate the opposing voltages due to resistance and self-inductance. The induced E.M.F. and current are out of phase by a quarter of a cycle.

As an example, a simple coil of resistance R ohms and inductance L henrys will be considered, and it will be assumed that a sine wave of alternating current is driven through it, the R.M.S. value being I amperes and the frequency f cycles per second. If E is the R.M.S. value of the voltage required to drive this current, the impedance of the coil is $Z=\frac{E}{I}$ ohms. The value of E is that which is just sufficient to overcome the resistance R and the induced opposing E.M.F. arising out of the self-inductance L, with the current I flowing.

IMPEDANCE. The total opposition offered by a circuit to the passage of an alternating current through it, being due to the combined effects of resistance, inductance and capacity, or such of these as may be present in the circuit.

The part of the applied voltage absorbed in driving the current through the resistance is, by Ohm's law, $E_1=IR$ volts, being a sine wave exactly in step with the current, since the value at any instant is proportional to the current at that instant. Similarly, the portion of the applied voltage absorbed in driving the current against the opposing E.M.F. of self-induction is given by a like expression, being $E_2=IX$ volts, where X is a quantity depending on the inductance of the coil and on the frequency, being called the *reactance* of the coil at that frequency.

The reactance X needs a little explanation, because it is not in the nature of resistance, although it is expressed in ohms; it is numerically equal to the ratio of self-induced E.M.F. to current (R.M.S. values). Now, self-induction is that property of a circuit by virtue of which an electromotive force is set up in the coil whenever the current is changing, being equal, in volts, to the product of inductance in henrys to the rate of change of current in amperes per second; and Lenz's law states that this induced E.M.F. is always in such a direction as to oppose the changing of the current. On examining the sine wave of current in Fig. 1 it will be observed that the slope (or rate of change of current) is greatest just where the curve crosses the zero line, and so at this instant the induced E.M.F. will be greatest; in other words, the E.M.F. is passing through a maximum value when the current is passing through zero, and vice versa. *The induced E.M.F. and current waves are therefore just a quarter of a cycle out of step.*

This is the fundamental difference between resistance and reactance—for the former the current and opposing potential difference are in phase, whereas for the latter the current and opposing induced E.M.F. are a quarter of a cycle out of step. Consequently, the two component voltages IR and IX, which make up the total opposing voltage, are a quarter of a cycle out of phase, and can be represented by two straight lines, or vectors, at right angles, as in Fig. 2(a). The total voltage E is then given by the diagonal line OE, being $E=\sqrt{E_1^2+E_2^2}=I\sqrt{R^2+X^2}$ volts. And since the impedance is the ratio of volts to amps. its value is $Z=\sqrt{R^2+X^2}$ ohms. From this it can be stated that *the impedance of a circuit is equal to the square root of the sum of the squares of resistance and reactance.* The impedance triangle of Fig. 2 (b) gives the relationship between these quantities.

It is an easy matter to show that the greatest rate at which the current changes (as it passes through zero) is equal to $2\pi f$ times the maximum or peak value, and since the induced E.M.F. is equal to the product of inductance L and rate of change of current, it follows that the ratio of the maximum voltage to the maximum current, that is, the reactance, is equal to $2\pi f$L ohms. Thus, for a coil the reactance is directly proportional to the frequency and to the inductance.

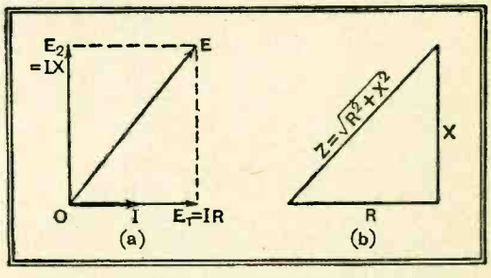


Fig. 2.—(a) Voltage vectors for the coil considered. E is the resultant of E_1 and E_2. (b) Impedance triangle of the coil.

The reactance of a condenser is inversely proportional to the frequency and capacity, being $-\frac{1}{2\pi fC}$ ohms, where C is the capacity in farads. The negative sign is used because capacitative reactance is opposite in sense to inductive reactance—a coil takes a current lagging in phase behind the applied voltage, whereas a condenser takes a leading current.

The full expression for the impedance of a circuit with resistance, inductance, and capacity in series is

$$Z=\sqrt{R^2+\left(2\pi fL-\frac{1}{2\pi fC}\right)^2} \text{ ohms.}$$

PRACTICAL HINTS AND TIPS.

AIDS TO BETTER RECEPTION.

IN a great number of modern A.C.-mains receivers, the field winding of a moving-coil loud speaker is used as a smoothing choke. This is a truly economical measure, as the need for an extra component is avoided, and, at the same time, energising current for the loud speaker magnet is obtained almost for nothing.

Choke-resistance Smoothing.

When following a design in which this arrangement is included, certain complications are apt to arise when it is desired to employ an existing loud speaker which has its own field-current supply system or is of the permanent-magnet type. As is fairly well known, the usual expedient is to connect, in place of the field winding, a suitable choke in series with a voltage-absorbing resistance; the total D.C. resistance of these two components should total that of the field winding replaced.

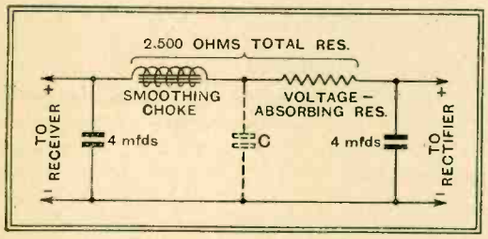


Fig. 1.—A smoothing choke, in series with a resistance, connected in place of a 2,500-ohm loud speaker field winding. The extra by-pass condenser C will help to minimise hum.

It has recently been found that when some designs are modified in this way there is apt to be a rather more pronounced background of hum than in the original model; when this effect is encountered, it is a good plan to connect an extra smoothing condenser of 2 or 4 mfds. in the position shown in dotted lines in Fig. 1.

Ignoring the effect of the choke, this resistance-condenser combination acts as a smoothing device in itself, and so the net result may be that a satisfactory supply is obtained even if the choke happens to be rather less effective than that of the loud speaker field which it replaces.

IT would seem that the majority of present-day A.C. valves do not attain entirely stable operating conditions until they have been working for a few minutes. It was for this reason that it was advised that a quarter of an hour should be allowed to elapse between the time of switching on and carrying out initial adjustments of the "Monodial" receiver.

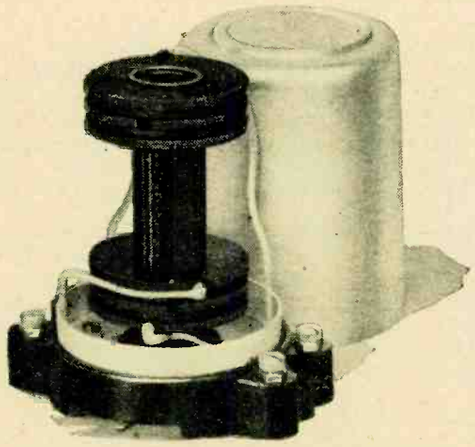
Ageing the Valves.

The same advice might well be given with regard to the majority of A.C. sets of the more ambitious type. It is wise to defer such critical operations as that of ganging until one can rest assured that the valves have settled down, and that there is no risk of one's work being negatived by subsequent frequency "wandering." Although the effect might pass entirely unnoticed in a straight H.F. set with circuits of relatively high resistance, it is particularly likely to give trouble in the oscillator valve of a superheterodyne with ganged tuning.

AFTER having carried out the usual initial adjustments, constructors of superheterodyne receivers seem to be inclined to leave their intermediate-frequency couplings severely alone. While it is not for a moment suggested that any good purpose would be served by continually readjusting this part of the receiver, it is perhaps worth while to point out that, after the set has been persuaded to work satisfactorily and when the niceties of its control have been acquired, it is worth while, at least, to try a few experimental alterations in coupling, to say nothing of the effect of retuning the I.F. currents. This, of course, relates mainly to the popular I.F. transformers of the band-pass type with two tuned windings magnetically coupled.

I.F. Band-pass Couplings.

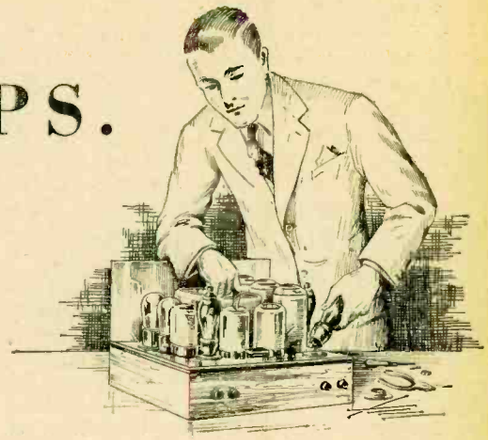
From some points of view it is a very satisfactory procedure to start with a very loose coupling. With the coils separated to the greatest possible extent, it is to be anticipated that selectivity will be abnormally high and that signal strength will be somewhat reduced, at the same time tuning of the I.F. coils will be extremely sharp. This is, perhaps, the greatest advantage of the procedure advocated, as the operation of setting the semi-variable condensers which are shunted across the windings can be carried out with extreme accuracy.



Primary and secondary coils of a band-pass I.F. transformer adjusted for minimum coupling.

As a next step, inter-circuit coupling should be progressively increased until the resonance curve is broadened to embrace a sufficiently wide range of side bands, the circuits being retuned, if necessary, after each adjustment is made.

In the absence of special instruments, it is rather a problem to know how far one can safely go in increasing coupling. Perhaps



the best method is to tune in a station that is known to be subject to interference from another in the neighbouring frequency channel, and which is customarily heard at about the same strength. Coupling is tightened until interference is heard, and is then slackened off until it just disappears.

It is hardly necessary to say that there is no "best" adjustment; the whole matter is one of compromise. One type of listener is quite willing to sacrifice a certain amount of selectivity in order to obtain "brilliant" reproduction, while another, realising that the number of stations receivable is now determined almost entirely by selectivity, will prefer to narrow down the response curve of the I.F. amplifier. It is fortunate that with the most popular modern designs both may be satisfied.

AN appreciable D.C. voltage is built up, by the action of rectification of the carrier wave, across the coupling resistance of a diode detector. When this coupling resistance is directly connected to the grid of a succeeding L.F. amplifying valve, voltage thus developed is effectively in series with any grid-bias voltage that may be applied from normal sources; unless this point is borne in mind there is a real risk that the valve will be over-biased under working conditions.

Diode Rectification and Bias.

The general rule to apply in these circumstances is that a battery valve will not need any additional bias. A mains-operated triode, in which grid current generally starts "early," should have a standing bias of about 1 volt, or slightly more.

IT is not always realised that the decoupling resistance used in conjunction with an automatic bias scheme offers a ready means of testing the valve in whose grid circuit it is connected for "softness," or deficient vacuum. If anode current is changed to any appreciable extent as a result of short-circuiting this resistance, it can almost invariably be assumed that the valve is soft; the extent of change in current is more or less a measure of the degree of softness, although the magnification factor of the valve concerned must always be taken into account. Current variations are always greatest when dealing with high-magnification valves.

Testing for "Softness."

NEWS of the WEEK.

Current Events in Brief Review.

Wireless on Duration Flight.

THE WIRELESS WORLD learns that Sunday next, July 10th, has been tentatively fixed by the Hon. Mrs. Victor Bruce for the start of her attempt on the duration (refuelling) record in the air. Mrs. Bruce intends to remain for a month in her specially equipped aeroplane, also carrying Marconi apparatus, from which she will be in constant wireless contact with a motor van station for making daily arrangements for refuelling and revictualling, besides the exchange of weather reports and news bulletins. The motor van with which it is hoped to follow the aeroplane to Portsmouth, Blackpool, Newcastle, and other towns, is equipped with a Marconi type AD.18a aircraft transmitter and receiver fitted behind the driver's seat of a Morris 10 cwt. van. The transmitter has a power of 350 watts.

All Ears on Lausanne.

LAUSANNE at the present time bristles with microphones. They are to be found in hotel parlours and bedrooms and at the Hotel du Château at Ouchy, where the Conference took place.

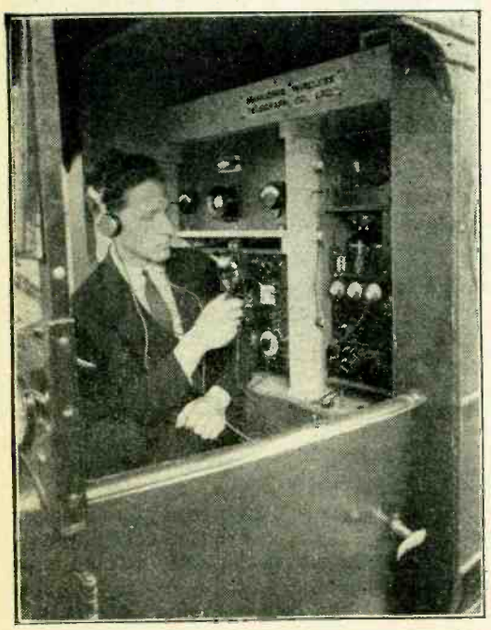
Our Lausanne correspondent states that Mr. Ramsay MacDonald, M. Herriot, Senor Grandi, and Herr von Papen all made speeches from *Radio-Suisse Romande*. Sometimes the delegates were speaking simultaneously to different countries; thus during the Conference the little town of Ouchy was the wireless centre of the world.

"Keep Calm" Broadcasts.

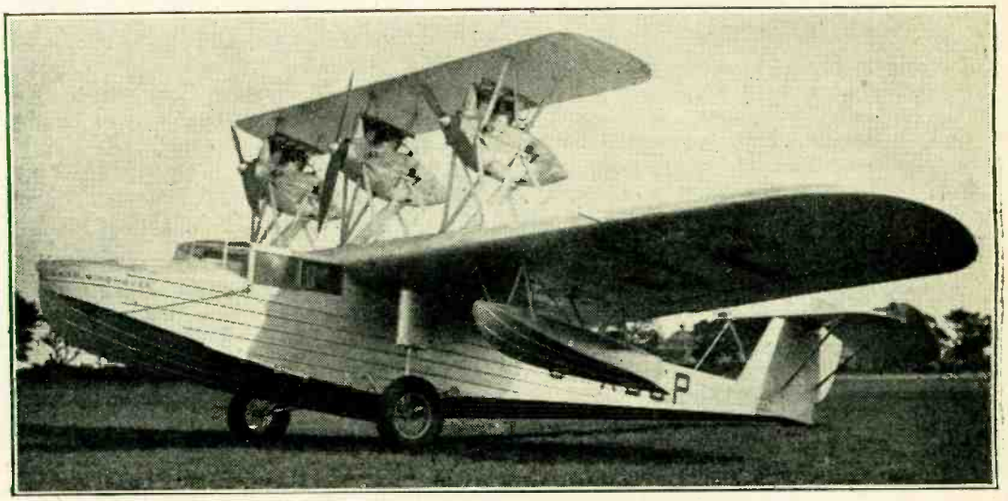
EVERY Monday and Friday at 1 p.m. Frenchmen are to have the opportunity of having "auto suggestions aroused by music" transmitted from the Radio-L.L. station in Paris.

According to our Paris correspondent, these special transmissions, which are calculated to promote optimism, calm, and confidence, will be under the control of Dr. Marcel Viard, who is adopting the principle initiated by Dr. Vachet, whose "auto suggestion" gramophone records have recently been transmitted from the Eiffel Tower station.

We wonder whether the statesmen at Lausanne will be listening.



"EARTH SPEAKING!" The Marconi AD 18, a 350-watt transmitter and receiver, which, in a high-speed motor van, will follow Mrs. Bruce's 'plane up and down the country.



FLYING FOR A MONTH. The Windhover machine, constructed by Messrs. Saunders-Roe, Ltd., which will be flown by the Hon. Mrs. Victor Bruce in her attack on the flight duration record. Constant wireless touch will be maintained with a mobile ground station.

"D.S.M." for Broadcasting.

LAST year Sir John Reith, Director-General of the B.B.C., was awarded the "Distinguished Service Medal" of the Columbia Broadcasting System of America for contributions to the radio art. This year the honour falls to Miss Amelia Earhart in recognition of the broadcast interview transmitted from Broadcasting House, London, after her world-famous flight.

Radio at Ottawa Conference.

ALTHOUGH the coming Economic Conference of the Empire's statesmen at Ottawa may have no direct bearing on wireless questions, it is fairly certain that it will come under the scope of the various business agreements which will be arrived at for the extension of Empire trade.

The flow of wireless business within the Empire is still lamentably small, as visitors to this country from the Dominions and Colonies are painfully anxious to point out. It would be a strange irony if the reorganised Empire Broadcasting Service, which opens at the end of this year, were to find practically all its listeners in possession of foreign receivers, yet this will actually be the case unless some radical changes are brought about at Ottawa.

Hours with the German Government.

"GOVERNMENT HOUR" has already appeared several times in the German broadcast programmes since the issue of the recent decree authorising the State use of the microphone. It is now definitely announced that only parties which held at least fifteen seats in the old Reichstag will be allowed their 25 minutes "on the air" before the big elections on July 31st. Communists are excluded.

A World-wide Listeners' Union?

M. SCHUBIGER, the editor of the Swiss radio journal *Le Radio*, is suggesting the formation of an international radio listeners' union.

Such a body might well shake the foundations of all national boundaries, but we are inclined to agree with our Berlin correspondent that listeners are insufficiently united in their aims and tastes ever to be included under one banner. Even in Germany, which is the land of clubs (every German is said to be a member of at least three!) the existing listeners' unions are either strongly political or have a continual struggle to maintain their membership.

An "opposite number" to the Union Internationale de Radiodiffusion, representing all European listeners, is a happy conception on paper, but in practice such a body would probably be rent with discussions and controversies before it was a week old.

The present Union Internationale seems, in this imperfect world, to be the best guardian of listeners' interests.

Neglected French Radio.

A BOMBSHELL seems to have fallen in French radio circles by the news that the British Members of Parliament visited Broadcasting House. One radio journal angrily asks: "Did anyone ever hear of a single French deputy manifesting the slightest desire to visit a French wireless station?"

There is a strong feeling in France that wireless and all its works are treated with too much official indifference.

No Nonsense in Spain.

THE Spanish police are taking summary steps against all listeners who oscillate to the detriment of their neighbours' reception. The penalty for a second offence is the cancellation of the listener's licence and the confiscation of his set.

New Radio Menace.

THE Austrian Landlords' Association have sent a special appeal to the Ravag Broadcasting Company to suppress all gymnastic lessons from the microphone which require jumping and other violent exercises. They base their plea on the fact that ceilings, as well as gas and electric fittings, in the big apartment houses in Vienna are beginning to show signs of strain.

No Instalment, No Wireless.

HIRE-PURCHASE traders have forestalled the Postmaster-General with a happy device which prevents purchasers on easy-payment terms from using their sets unless the appropriate instalment has been paid. According to the wireless correspondent of *The Daily Mail,* the device, which is the invention of a West Hartlepool engineer, consists of a time switch which is released by dropping a coin in a slot meter in the set, which operates a spring. When the time arrives for the next payment the spring will have run down, automatically switching off the set.

The Post Office have missed a fine opportunity by not using such a device for the collection of licence fees.

Satisfied Listener.

OVERHEARD in Vienna Café:—

A.: I have built a one-valve set with which I can receive whatever I want—morning, noon, and night.

B.: You can even get Berlin?

A.: I tell you, whatever I want.

B.: But this is colossal—to receive all stations with a one-valver!

A.: Who said "All stations"?

B.: Well, didn't you say you could receive whatever you wanted?

A.: Of course; but you see I only want Vienna!

German Word Competition.

PRIZES amounting to 1,000 marks are to be distributed by the German broadcasting authorities in connection with a word-finding competition which closes on July 25th. Like listeners in other countries, those in Germany frequently complain regarding the alleged misuse of their language at the microphone, and there are many who fear that the pure German tongue may suffer if great care is not exercised.

The Reichs-Rundfunk Gesellschaft have, therefore, come to the decision (writes our Berlin correspondent) to give listeners themselves a chance to find suitable German words for foreign terms which are in frequent use in the broadcasting studios. They are asked to suggest German words for the terms "Conférence" and "Conférencier," "Matinée," "Photomontage," "Phonomontage," and "Aktuell" (topical).

Television Developments in Germany.

PROFESSOR Dr. Leihäuser has been elected First President of the German Television Society, which has just held its third annual general meeting. Dr. Noack, a frequent contributor to *The Wireless World,* was also elected to the board. The offices of the society have been united with those of the Heinrich Hertz Institute at Berlin.

Television will play a leading part at the German Radio Exhibition in August, and among the exhibits will be the Telefunken ultra short-wave transmitter working on 7 metres with 25 kilowatts in the aerial (telegraphy) and 6.25 kilowatts (telephony). A special high-frequency cable will connect the output circuits with the aerial on the top of the Berlin broadcasting tower. The German Fernsch A.G., which is associated with the British Baird Company, will supply the telecinema transmitter to be installed at the Exhibition.

Broadcasting and the Law.

A GERMAN law, to take effect, must be published, but it has now been decided that the broadcasting of the text can serve in lieu of publication. To prevent error and to prove publication by broadcast, records are taken of the text exactly as it is read in the studio.

Empire Broadcasts from Australia.

MANY short-wave listeners will be interested in the new schedule of Sunday transmissions from station 2ME, Sydney, the Empire broadcasting station operated by Amalgamated Wireless of Australasia. The schedule as from July 3rd last is as follows:—

1st session,	0500-0700	G.M.T.
2nd ,,	0930-1130	,,
3rd ,,	1130-1330	,,
4th ,,	1830-2030	,,

The wavelength of 31.28 metres remains unchanged.

A Victory for Sponsored Programmes.

OUT of all the hue and cry about the "over-commercialisation" of American radio comes a 325-page report by the Federal Radio Commission which (writes our Washington correspondent) virtually amounts to a vindication of sponsored programmes.

The report, which has been sent to Congress, is the result of an exhaustive enquiry as to whether the Government should take over control as an alternative to trade-supported broadcasting. Among the pithy pars in this voluminous document is the following: "Any plan, the purpose of which is to eliminate the use of radio facilities for commercial advertising purposes, will, if adopted, destroy the present system of broadcasting." And: "Limitations upon the use of time for commercial advertising, if too severe, would result in a loss of advertising revenue to stations which in all probability would be reflected in the quality and quantity of programmes."

The Commission points out that a scheme to support broadcasting by licence fees as in other countries, comprehensive enough to satisfy every person in the United States, would require approximately 1,000 stations to supply three selections of programme. This would necessitate an installation cost of £30,000,000 and a technical maintenance cost of about £25,000,000 a year.

Waves of One-man Length.

APPARATUS for the production of oscillations corresponding to wavelengths between 14 and 80 centimetres was exhibited last week at the Annual Visitation to the National Physical Laboratory. The ultra-short waves were also dealt with in an interesting exhibit illustrating the researches of the laboratory for some years in the technique of transmission and reception on wavelengths below 10 metres. Particular attention has been given to the study of the effect of the ground on the propagation of short waves, and recent work has included measurements on a wavelength of 1.6 metres. It is interesting to note that this length is about the height of an average man, so that great care has to be taken in the field measurements to ensure that the observers do not produce a disturbing effect!

The most elaborate arrangements are made in the laboratories for testing the performance characteristics of wireless receivers over a wavelength range of from 7 to 2,000 metres. The screening is obtained by placing the oscillators supplying the test voltages in a cabin completely enclosed by sheets of tinned iron, the entrance to the cabin being through a trap-door having a mercury seal. To enable the observer to breathe, special arrangements have been made to provide adequate forced ventilation in the sealed cabin through tubes which permit the passage of air but not of electric waves.

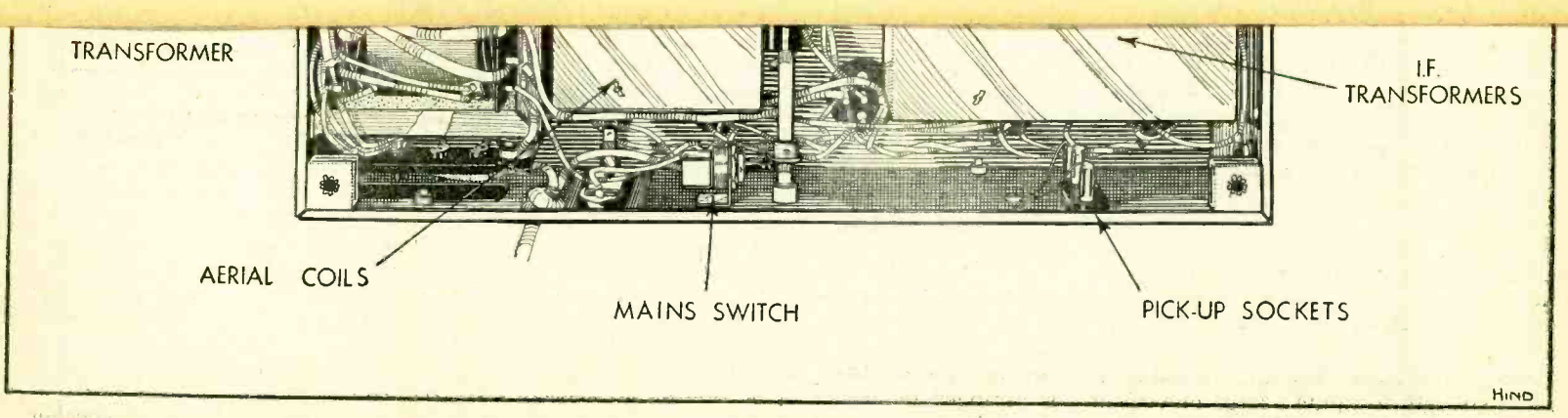
New Baird Televisor.

PROBABLY the most convincing television demonstration yet given in this country was staged by the Baird Television Company at their headquarters in Long Acre, London, W.C.2, on Thursday, June 30th, when *The Wireless World* was able to witness the new home "Televisor" in action. Although the actual transmission was carried out on a short line between two rooms, it was obvious that if comparable results could be obtained by wireless the new instrument could guarantee genuine entertainment value.

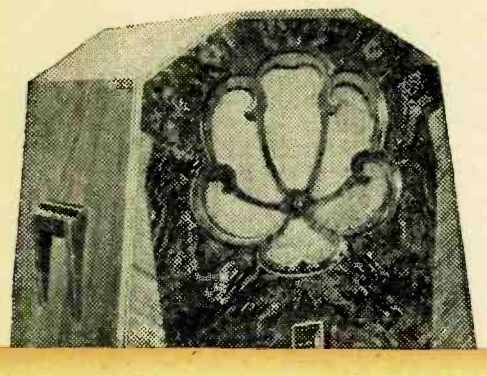
The images were thrown on a screen 4in. wide×9¾in. high and could be seen all over a large room with sufficient brilliancy to make the picture plainly visible even when the room was normally illuminated.

The new "Televisor" is extremely compact, measuring when closed 18in. long ×8in. wide× 13in. high. In operation the screen is pulled out as in a camera, permitting rough focussing. The whole apparatus is simply plugged into the electric mains and can be operated from any good wireless set. It is understood that the peak voltage required does not exceed 300. A mirror drum replaces the disc used in the present Baird models, and instead of the Neon lamp a special Kerr cell is used, making possible a brilliant image in black and white. The price at which the new Baird "Televisor" will be available to the public, probably in time for the Olympia Radio Show, has not yet been fixed, but we understand that it may range between £25 and £30.

TELEVISION FOR THE HOME CIRCLE. Mr. John L. Baird photographed last week with the new home televisor in which the image is projected on a screen and is visible all over a large room.



Two views of the chassis of the Ferranti Superheterodyne. A particularly ingenious shutter mechanism showing the appropriate waverange is provided.



THE FERRANTI SUPERHETERODYNE.

An A.C. Mains Transportable Receiver.

with a total of only four I.F. tuned circuits shows not only that the coils themselves are highly efficient, but that the initial adjustments are carried out with a remarkable preliminary H.F. stage, and for the I.F. circuit, and a potentiometer control of their grid bias provides both pre- and post-first detector volume control.

The Ferranti Superheterodyne.—to the receiver, the apparatus is all assembled on a single steel chassis. The total dimensions of this chassis are surprisingly small in view of the complex nature of the circuit, but it cannot be said that the components are in any way cramped. On the contrary, there is evidence of careful thought in the layout of the set, and key components are well spaced. The coils and I.F. transformers are individually screened, and the waverange switches are built into the metal containing boxes, and are actuated by cams on the switch rod. A further cam is fitted to this rod to control the mains switch, and, in addition, it operates a shutter over the wavelength scale, indicating clearly which of the two wavebands is available.

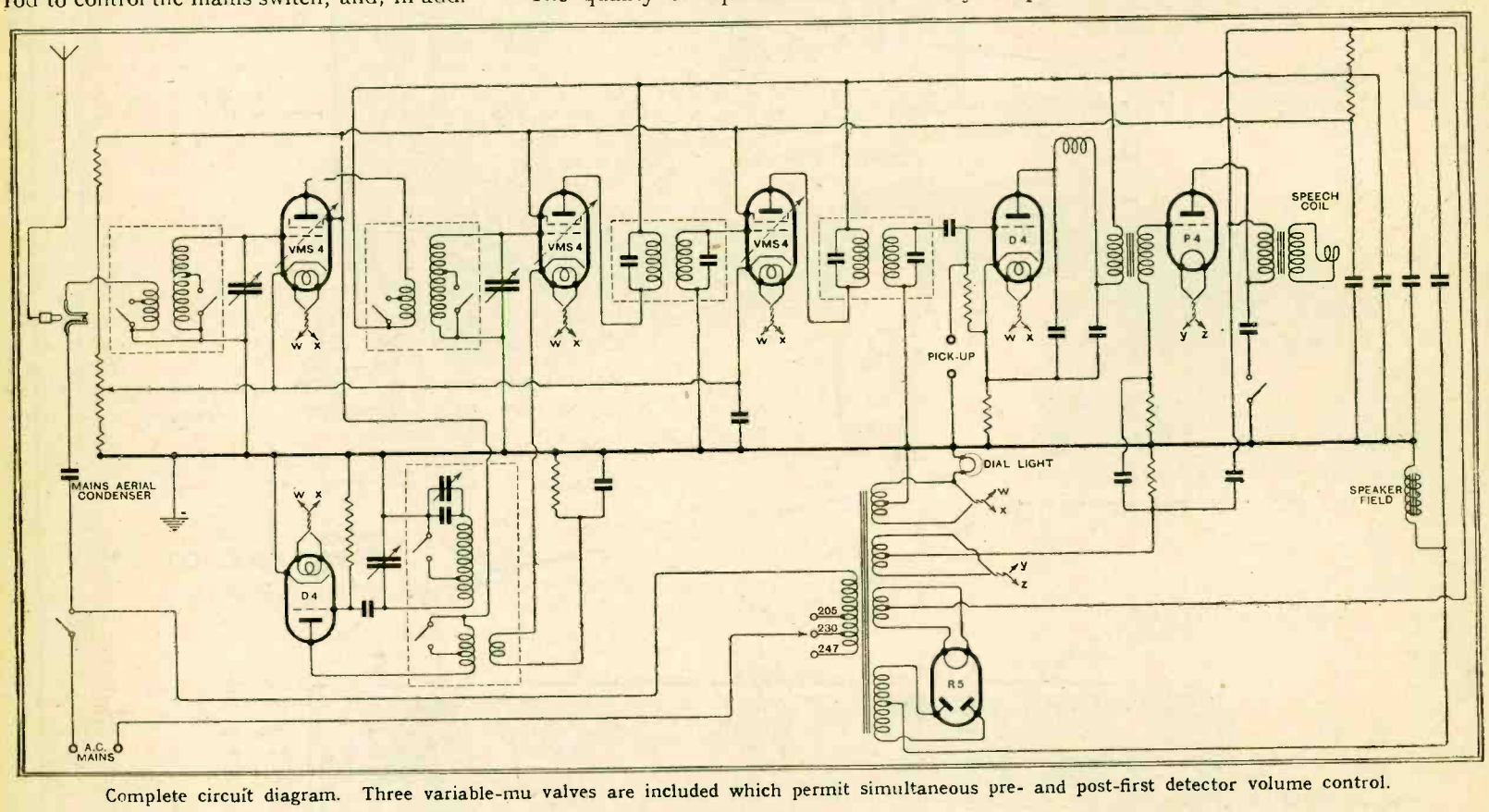
The wavelength scale itself moves horizontally by means of a cord drive from the condenser shaft, which is operated through a friction drive by the control knob. The scale is calibrated in wavelengths, and illuminated. The controls are completed by the waverange and on-off switch, the volume control, and a tone-control switch. This last is mounted inside the speaker grille, and allows of the connection of a 0.1-mfd. condenser across the primary of the output transformer. The quality of reproduction, of course, is far less pleasant when it is in circuit, but the general effect may prove more satisfactory at times when atmospherics are violent.

The Performance.

The performance of the receiver on test was highly satisfactory, and, although the selectivity proved to be a little below that of receivers setting a lower standard of quality, it was quite adequate for any normal purpose. At a distance of only nine miles from Brookmans Park it proved possible to receive Mülhacker without a large amount of interference from the London Regional, and Algiers was perfectly clear. The sensitivity was ample for the reception of the weakest stations, and at no time during the tests had the volume control to be set at maximum. Even with the mains aerial which is incorporated scores of foreign stations could be received. The results with such an aerial, however, are bound to be rather variable, since they depend largely upon the way in which the house-wiring is carried out; the makers wisely recommend the employment of an outdoor aerial, therefore, wherever it can be erected.

The quality of reproduction is unusually good, and the high frequencies, in particular, are exceptionally prominent. There is no trace of shrillness, however, and speech is reproduced without over-emphasis of the sybillants, and without any trace of boominess. The only point upon which criticism might be directed against the set is in regard to the matter of mains hum, for this is a little louder than it might be in a set so perfect in its other characteristics. The hum is no greater than that found in many other receivers, but with such an exceptionally high general performance one looks also for a lower hum level.

The mechanical construction of the receiver is very strong, and the general finish shows a high standard of workmanship and careful attention to detail. As a result, the set should give a reliable performance, and be free from servicing troubles. The cabinet is of pleasing appearance, and is fitted with handles for ready transportability.



Complete circuit diagram. Three variable-mu valves are included which permit simultaneous pre- and post-first detector volume control.

Next Week's Set Review—

LOTUS SG4 SUITCASE PORTABLE

BOOK REVIEW.

First Principles of Television. By A. Dinsdale, M.I.R.E. Pp. 241, with 130 diagrams, and 38 full-page plates. (Published by Chapman and Hall, Ltd., London. Price 12s. 6d.)

THE author of this book does not profess to describe every system of television that has been tied, but picks out the most outstanding proposals of the early workers, their aspirations, successes and failures, and, in the latter chapters, he describes in more detail the methods of those experimenters on both sides of the Atlantic who have gone farther along their chosen line of research.

In the early chapters, after considering the elementary principles of optics, the author discusses the nature and performances of Selenium and Photo-electric cells, and gives an account of the early experiments of Szczepanik, Rosing, Nipkow, Mihaly, Holweck, and Belin, and the later devices of Jenkins, Baird, the Bell Telephone Laboratories, Karolus, Von Ardenne, and Alexanderson. In describing colour television, he is evidently in error in giving red, blue and *green* as the primary colours and stating that yellow is a mixture of green and red, but this is a minor point which does not affect the general interest of the description.

Methods of synchronism are clearly discussed, and the importance of absolute synchronism, as distinguished from isochronism, is stressed.

The latter part of the book summarises the present state of advancement in England, America, Germany, and other countries, and concludes with a chapter on what we may reasonable expect in the near future, and what still remains to be overcome before television can be called a commercial proposition, though, in his preface, the author frankly states that "Progress in television is now so rapid that it is impossible for any book on the subject to be absolutely up to date," and instances a demonstration given in New York after the book had gone to press, in which close-up images were projected on to a screen six feet square with a scanning disc having only forty-five holes, thus somewhat nullifying some comparative statements made in the concluding chapters.

Altogether, we can recommend the book as a very readable and interesting work written without any pretence of going deeply into highly technical matters, and in which the author steers a careful course between the unwarranted optimism which would represent television as a fully developed success which, the day after to-morrow, will be considered almost as universally necessary as a broadcast receiver, and the gloomy pessimism which regards the many difficulties as unsurmountable.

W. H. M.

Unbiased

By FREE GRID.

Old Enough to be New?

IT is astonishing how ill-informed are the pundits of the lay Press who write the "Radio Corner" which practically all newspapers run nowadays. I am not referring to their lack of technical knowledge (for, after all, they are merely journalists and make no pretence of being trained radio engineers), but to their apparent ignorance as to such things as the manner in which special broadcasts are carried out.

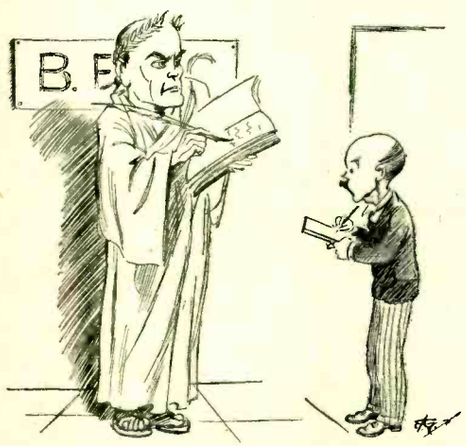
As a typical instance of this, I would point to a statement which was made by a writer in an article published recently in a national daily. The article in question deals with the subject of Big Ben's broadcast, and in it the writer naïvely informs us that one of Big Ben's secrets which has not hitherto leaked out is the fact that his microphone is housed in a football bladder. Now, not only did this piece of information "leak out" in *The Wireless World* several years ago, but this fact was chronicled shortly afterwards by almost every national daily, including the journal in question.

In yet another paper "news" is given of a wonderful instrument "which dispenses with the use of Morse and makes it possible to engage in oral conversation with a ship several hundred miles at sea." Fancy that, now!

Free and Easy.

PROBABLY everyone has read in the Press the translation of the Latin inscription which is just inside the entrance to Broadcasting House. I noticed that in every newspaper the wording of the translation was exactly the same, and so I conclude that it was officially issued by the powers that be at Portland Place.

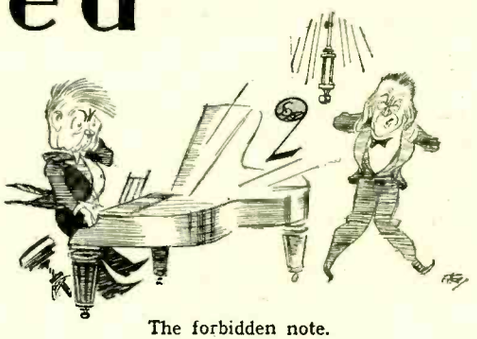
I was pleased to see that they had the grace to describe it as a "free" translation.



Which was written first?

What I would like to know, however, is whether the English version is a free translation of the Latin inscription or the Latin inscription a free translation of the English version: in other words, which was written first?

This is an important question.



The forbidden note.

Verboten?

CAN any pianist or other musician associated with the B.B.C. tell me which note on the piano it is forbidden to play at Broadcasting House? My question is prompted by a statement recently published by one whose word "goes" in matters pertaining to broadcasting.

It seems that this unspecified piano note is barred (no pun intended) simply because it causes the same trouble with the "mike" as does the name Cirencester ("Sissister" to the *intelligentsia*).

The explanation gives me a clue why a request for a certain song in the Children's Hour—sent in, at my instigation, by one of the little Grid Leaks some time ago—was apparently ignored. The song which I wanted was "Which Switch is the Switch, Miss, for Ipswich?"—an old favourite of mine which enjoyed great popularity in the earlier years of the century when the telephone was not the ubiquitous instrument it is to-day.

Do Loud Speakers Spit?

I HAVE always understood that the B.B.C. were very particular about barring words or sentences in which an excessive number of sibilants occur, owing to the embarrassment which these cause both to transmitter and receiver. I was all the more surprised, however, that they permitted the broadcasting the other night of that well-known Hebrew comic song, "Iz Izzy Azzy Woz?" (to the Gentiles, "Is Izzy As He Was?").

I happened to be ensconced in a chair directly in front of my loud speaker at the time, and I must confess that, although my receiver is second to none in dealing with sibilants, the effect was so realistic that I involuntarily shifted my chair in order to avoid the anticipated splutter which seemed, to my lively imagination, to be actually issuing from the loud speaker. This must be taken as a high tribute to the atmosphere which the B.B.C. managed to "put over" in the case of this particular broadcast.

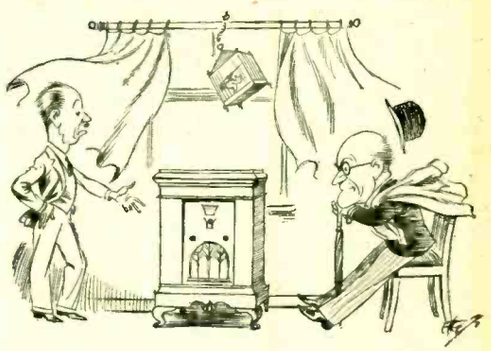
Strange Behaviour.

WEIRD and wonderful are the faults that beset wireless receivers, but one of the strangest was thrust on me the other day by a friend who begged assistance in diagnosing a peculiar trouble which had developed in a receiver belonging to a lowly acquaintance to whom he has always posed as a wireless expert.

The symptoms were most extraordinary. The set was actually an all-A.C. radio-gramophone of unimpeachable pedigree which, like the young lady of Leeds in the celebrated limerick, behaved exceedingly well when it did behave at all, but at other times was completely dumb. It had been noted by the owner of the set (who, although devoid of wireless knowledge, appeared to be above the average in intelligence) that on bright, sunny days the set behaved normally, although it would almost invariably cease working when night came on. When the weather happened to be normal for this time of the year, and we had donned our summer furs in this otherwise happy land of ours, the instrument could not be induced to work at all unless—and here comes the astonishing part—the window was closed. It would then function perfectly, irrespective of the time of day or of the state of the barometer.

Now, I always believe in adopting the methods of the medical profession on these occasions, so I immediately assumed a boiled-owl look of wisdom and proceeded to ask him the usual formal questions while I thought hard. A possible explanation of the phenomenon began to dawn on me, and, seeing a great opportunity to enhance my prestige, I began a terrifying cross-examination, and followed it with my diagnosis.

"The set is standing with its back to the window," I said, "and, in the interests of good reproduction, the back is not enclosed. It is clear that, as the instrument fails to work on a cold summer day, and knocks off after sundown even on those rare occasions



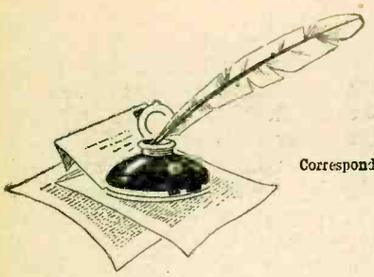
The symptoms were most extraordinary.

when the temperature is not below overcoat point in this country, its behaviour is directly dependent on the state of the thermometer and only indirectly on the time of day and the state of the barometer.

"It now becomes necessary, therefore, to find out why a fall in temperature can cause it to close down. Having given the matter careful consideration and eliminated all other causes, I can only come to the conclusion that the set is fitted with a thermal-delay switch which is faulty, insomuch that the contacts, instead of being held *firmly* closed, are only *just* closed by the associated heater in the set, with the result that they are released by the chilling breezes blowing into the back of the set from the open window. Quite elementary, my dear Watson."

My friend thanked me sarcastically, but, nevertheless, I knew by his respectful demeanour a couple of days later that my diagnosis had been correct.

I did not think it necessary to inform him that two similar cases of thermal-delay switches causing trouble in this manner had recently been brought to my notice; *ars est celare artem.*



Letters to the Editor.

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

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

The One Essential Paper.

I THINK that this is the first time that I have ever congratulated a periodical; but, really, I feel I must do so in the case of *The Wireless World*. The new features must make it the one essential paper for the radio enthusiast. I always look forward to Wednesday and my copy of *The Wireless World*, but I am quite certain that I shall look forward to it in future on Fridays with even more enthusiasm. W. T. CLARKE.

Torquay.

Extremely Pleased.

I WAS extremely pleased to read in the last issue of your valuable paper that you propose to include full programmes for foreign stations in your issues as from next week, and I sincerely hope that your new venture will receive the success it deserves.

I shall recommend your new paper to my friends, and, as a beginning, I pinned the red slip (from to-day's copy) on the notice board at the works where I am employed.

Again let me thank you for the continued freshness and sound articles contained in your weekly issues. A. JOWETT,

Hon. Treasurer,
The Halifax Wireless Club.

Broadcast Reproduction.

LIKE your correspondent C. J. Tomes, I, also, am a regular reader of *The Wireless World* and of *The Wireless Engineer*. Of course, this does not matter except in so far as it *may* entitle me to a small amount of your valuable space.

It is a great pity when your correspondents "waste space" by "useless argument."

I trust that *The Wireless World* will eventually succeed in educating the "ordinary listener," such as C. J. Tomes, that he may more fully appreciate the efforts of those whose aim, the only worthy one, is progress.

With great respect for your space and best wishes for *The Wireless World* and its continued success. A. H. B. CROSS.

Sheffield.

I SHOULD like to enter a formal protest against your publication of the letter from Mr. C. J. Tomes in your issue of June 15th.

First, he objects to the devotion of space to this controversy on Quality. What, then, does he want? Surely the pages of *The Wireless World* could hardly be better occupied than in ventilating this subject—one of the most important in the whole study of broadcasting.

Second, he evidently has not read the correspondence with any attention, for he does not even understand what Mr. Hartley is campaigning for. This is clear, for he apparently thinks that we "purists" are dissatisfied with the B.B.C. transmissions, whereas it has been made abundantly clear in the correspondence that we are trying to raise the quality of receivers till it equals that of the transmissions.

Third, and most serious, his letter makes no contribution to the discussion, containing only unsupported statements of opinion.

I myself have taken no part in this controversy since my letter of May 11th, for the simple reason that no one has attempted to attack the conclusions reached in that letter (which were generally in agreement with Mr. Hartley's point of view). I only write now to beg you to preserve the decencies of controversy; to reserve your space for those letters which, even if they hit hard, do contain some reasoned discussion; and definitely to close your columns to those who will not, or cannot, put forward reasoned arguments. P. K. TURNER.

Windsor.

AS an "ordinary listener" I wish to take exception to Mr. C. J. Tomes' letter in your issue of June 15th.

The recent articles on "Broadcast Reproduction," together with the correspondence of Messrs. Hartley, Bonavia Hunt, West, and others, has, to my mind, been intensely interesting, and I think it is unfair of Mr. Tomes to describe as "bickering" the opinions of Mr. Hartley and Mr. West.

After all, the Correspondence columns of *The Wireless World* provide a means whereby a subject can be debated to a certain extent, and I think that anyone who has followed the debate on "Broadcast Reproduction" will agree that it has been far from boring.

Personally, I hope we shall hear more of this controversial subject, and, incidentally, have a little more "bickering" from Mr. Hartley and others. WM. G. YOUNG.

Birmingham.

Quality and Frequency Range.

IF one cannot entirely agree with Mr. P. W. Willans, one cannot deny that his letter was of great interest. The suggestion that the upper frequencies should be still further exaggerated is, however, a dangerous one, especially as the B.B.C. seems to hold the view that certain exaggeration is justifiable.

It would be interesting to know just how long the B.B.C. has been interfering with the transmitter in this way. Its very silence on the matter magnifies the offence, being unfair to the man who goes to much trouble and expense to make his reception apparatus as perfect as possible. The B.B.C. has no right to depart from as faithful an electrical counterpart of the original as lies within its powers of achievement. To distort the frequency response is only permissible when correction is applied to restore the original characteristic within the entity. Thus the transmitting apparatus and microphone must be considered by themselves, and it is perfectly logical to distort at the transmitter to compensate for faults in the microphone, or vice versa.

At the receiving end a tone corrector after a high-note-cutting H.F. section is quite logical because the subject is a separate entity, and the currents available at the loud speaker terminals are, or should be, proportional directly to the modulations imposed on the carrier received. Or if a loud speaker is incorporated in the same cabinet as the set and sold together, it is correct to distort in the amplifier to correct faults in the speaker, or again, vice versa.

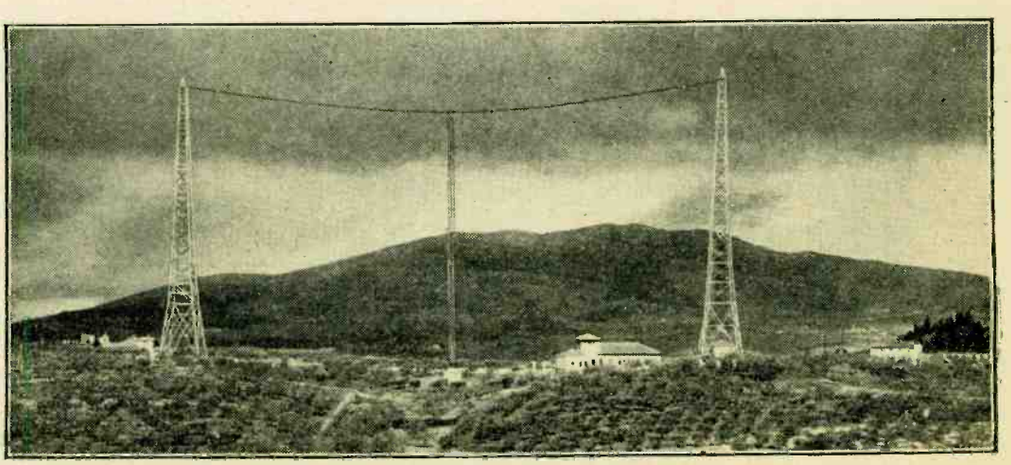
On the other hand, if the loud speaker and set are sold separately, it is up to the manufacturer to make each as perfect as possible without regard to possible sources of distortion elsewhere. The same applies to the distributors of programmes. The modulated wave must be as near as possible a hundred per cent. perfect. There is no other way possible. Any intentional distortion, in whatever form except when compensated internally, is intolerable, and must inevitably lead to the degradation of all classes of audio-radio instruments. If carrier wave interference justifies any alteration at the transmitter to ensure a good high-note response at the receiver in relation to interference level, that alteration should be made, not to the frequency characteristic, but to the carrier wave or the method of modulation.

Mr. Willans contends that the senses of the listener provide a sufficient standard from which to judge whether the reproduction is a satisfactory representation of the original. Well, it depends on what he hears. Whoever the listener, unless the reproduction is exactly the same as the original under each and every condition, it cannot satisfy him.

It seems to me that the question of directional distortion at the microphone must be considered negligible against the acoustical distortion in the home. The distortion at the microphone is a problem for the transmitting engineers, not for us; acoustical distortion in the home will no doubt receive attention when the transmitting and receiving equipment is worthy of it!

One more point. Why are sopranos so universally disliked? Does not the chart in Mr. Hartley's recent article tell us?

Shortlands, Kent. HUGH A. RAMPTON.



"RADIO-FIRENZE!" Few broadcasting stations can claim a finer site than Florence, which was recently opened by the Italian Broadcasting Company. The Marconi transmitter provides an aerial power of 20 kW.

Wireless Measurements in the Arctic Circle.

Radio Board's "Polar Year" Expedition.

FIFTY years ago a conjointed effort was made by the scientists of many different countries to conduct a year's observations on various phenomena within the Polar regions. The second "Polar Year" is now being held on the jubilee of the first, to take advantage of the general advancements of science and technique that have occurred in the interval.

Wireless expeditions are taking part from several countries, and a British expedition equipped by the Radio Research Board starts to-morrow (Saturday) on its way to Tromso, Norway, one of the most northerly civilised settlements in the world, and well within the Arctic circle. The expedition is being led by Prof. E. V. Appleton, a member of the Radio Board.

Last week a *Wireless World* representative had the opportunity of inspecting the gear before its despatch to Tromso.

The main experiments are, of course, concerned with the propagation of waves and with the investigation of the ionised regions of the atmosphere—now frequently described as the ionosphere. The chief method to be used is that, due originally to Breit and Tuve, of sending out very short wireless impulses and receiving these over a relatively small distance, so that the ray which has travelled over the ground path is still of moderate strength to serve as a datum time for the subsequent arrival of signal-pulses that have been up and down to the ionosphere. The emitted signal pulses are very short—half a millisecond, or less—and it is arranged that the receiver should pick up, record, and finish with the ground pulse before the first echo from the upper atmosphere is received. The time between the ground pulse and the first echo can thus be measured and used to determine the height from which that signal pulse has been returned. The first echo is, of course, frequently followed by others which have been up and down several times. These can all be separately received and recorded, while the method also permits determination of whether an echo has been returned from the lower (Kennelly-Heaviside) layer at about 100 km. or from the higher (Appleton) layer at about 230 km.

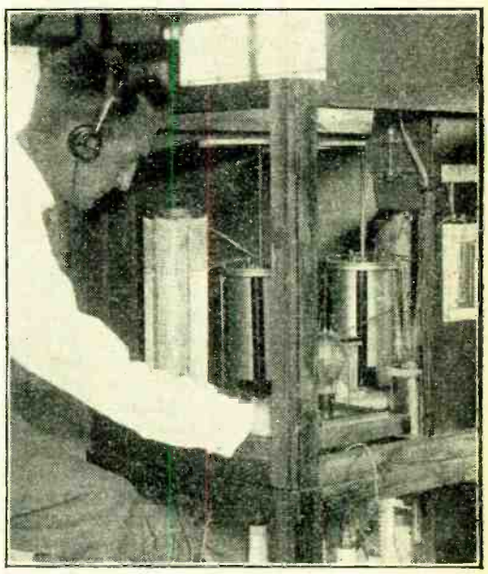
Recording is by cathode-ray oscillograph, which can be watched as a visual indicating device, or can be used for photographic recording. In the Radio Board's apparatus the signal is received on the oscillograph in conjunction with some recurrent time-scale. The brief signal-pulses are sent out from the transmitter at a controlled rate; in the case of Tromso the signal-pulses are at the rate of fifty per second, this group-frequency being controlled by the A.C. supply mains from which the transmitter is fed. At the receiver the time-base is controlled from mains of the same frequency, so that the ground-ray signal always lands on the same point of the time-sweep and gives a steady picture. Echo pulses received also stay for considerable periods at the same steady position on the time sweep, although their amplitude may be liable to very rapid fluctuations. The events of each successive 1/50th second are thus superposed on the top of each other, adding greatly to the intensity of the oscillograph picture. This steady type of trace greatly assists photography, and the recording method used by the Radio Research Station is to take snap photographs of about 1/5th second exposure at regular intervals.

The apparatus was demonstrated at Slough in operation on this normal type of reception. The receiver was a superheterodyne, carefully designed so as not to add spurious delays to the very brief signals, this being a matter of the utmost importance. The intermediate-frequency was at 100 k.c., of suitable band-pass type, its output being rectified so as to pass a unilateral impulse to the oscillograph.

A linear time-scale can be used, but in the demonstration at Slough the time-base actually shown was one of circular form, providing a longer time-scale than a diametric line. In this arrangement the cathode-ray spot is rotated at 50 cycles, thus occupying 20 milliseconds per revolution, while the signal makes radial departures from the circumference of the circle. A further modification consists in converting this circle into a two-turn spiral, each turn occupying only 10 milliseconds, so that a still further improvement in time-separation is provided. The receiver was demonstrated in operation on signals from a near transmitter, but at the time of the demonstration very few and only small echo-signals were being returned from either of the layers.

The oscillograph trace is photographed at regular intervals, say, of one or two minutes. The recording camera is electrically driven, and operates automatically at the required intervals. Additionally, for long periods of observation it can be arranged so as to switch off the oscillograph and to switch it on again just prior to the photographic exposure.

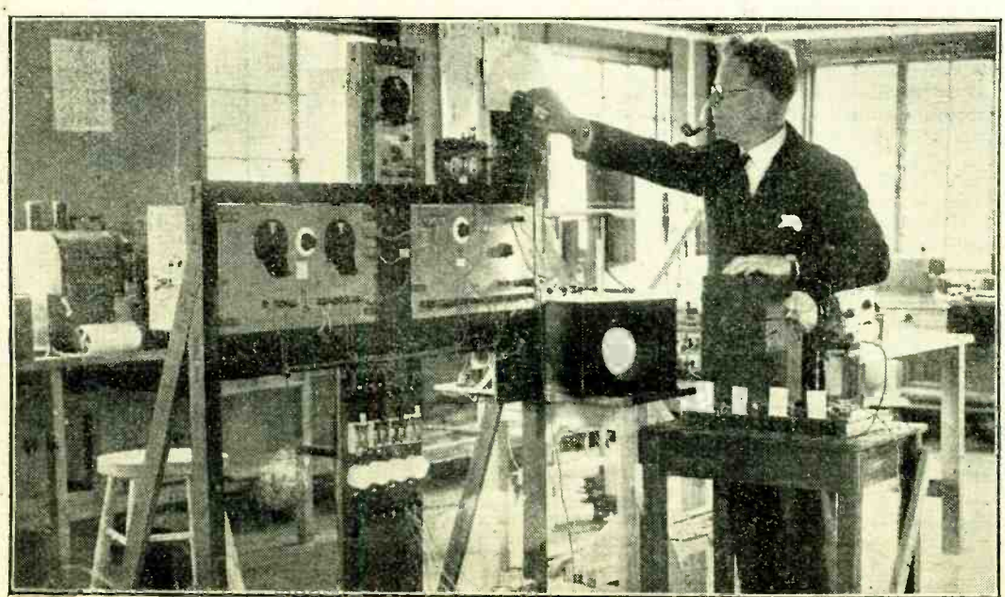
The transmitter, which was also constructed at Slough, operates on the "squegging" principle, but is fed from the A.C. supply, so that the frequency of the mains takes charge of the recurrence of the short signal-pulses. The transmitter uses a silica valve of nominal 3 kW. dissipation, although in this type of transmission its mean power must be much below its rated value. A mercury-vapour thyratron was additionally in use as a 50-cycle switch controlling the recurrence of the periods of oscillation. A cathode-ray oscillograph was used as a local monitor of the transmitter.



Mr. Brown with the transmitter to be used at Slough for communicating with Tromso.

Besides the receiver mentioned above, a further interesting receiver was also demonstrated at Slough, and is included in the gear for the expedition. This was devised to permit determination of the polarisation of the down-coming components. It is known that, as the result of the earth's magnetic field, the ionosphere does not merely reflect or return wireless rays, but also changes their polarisation, so that a wave which was plane-polarised may be returned with a circular or elliptical polarisation. Further recent experiments have shown that the returned wave may actually be split into two components, oppositely polarised. The new apparatus, which was described to our representative as a "wireless polarimeter," is designed to reveal these differences. It consists really of two receivers, joined to frame aerials mutually at right angles, and feeding into a cathode-ray oscillograph. It is thus in the form of a direction-finder, but is arranged so that individual pulses—ground ray or echo—can be separately received and examined, the arrival of the individual pulses again being separated on a circular time-scale controlled by the A.C. supply mains. Owing to the two-dimensional system, echoes, if elliptically polarised, show as ellipses on the time-base, and the direction of their rotation can be determined.

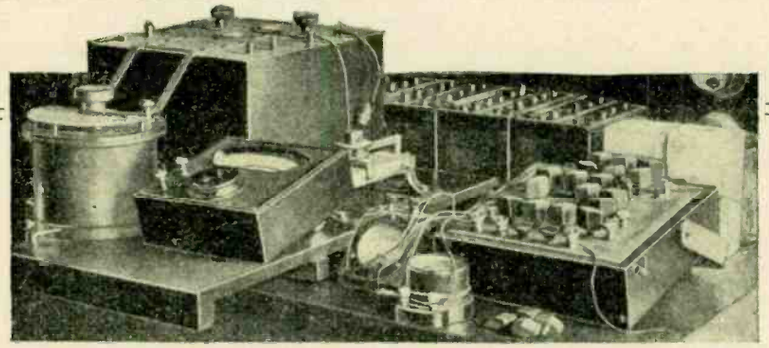
Besides the above apparatus, which is intended solely for the scientific experiments, short-wave transmitters and receivers are being installed at Slough and at Tromso, so that the expedition may be able to keep in touch with its headquarters.



Mr. Geoffrey Builder, a member of Professor Appleton's party, with the superheterodyne receiver, cathode-ray oscillograph and recording camera for photographing echoes reflected from the upper atmosphere.

LABORATORY TESTS

Review of New Radio Products.



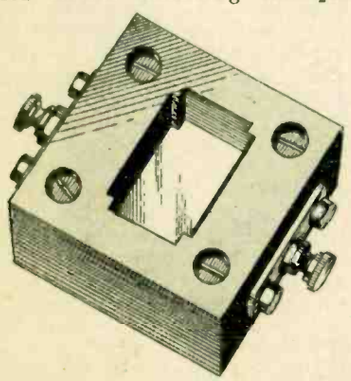
PARIMA SELENIUM CELLS.

THE PARIMA MANUFACTURING CO., 21, Bromley Road, Catford, London, S.E.6, have introduced a range of selenium cells, certain models of which have been developed for operating mechanical devices by the change in the brilliancy of the light to which the cell is exposed. A detailed description of the numerous functions coming within the scope of these cells could not be dealt with here, and it must suffice to mention but a few only.

These cells have a wide field of usefulness in conjunction with all types of alarms, for they are so sensitive that the change in resistance to filtered light—often referred to as an invisible ray—is so considerable that sufficient current will pass through the cell, and its external circuit, to operate a sensitive relay without the need for further amplification. It is a simple matter to arrange a selenium cell and a relay so that the broadcast set is disconnected automatically when the light in the room is switched out, so precluding the possibility of overlooking this and leaving the receiver operative all night.

Special models have been developed for use with talking pictures, also for gramophone reproduction, and exceptionally good results are being obtained.

The standard models operate with a potential of 100 volts only, the characteristics varying with the design and the area of the active surface exposed. The cell illustrated has a dark resistance of 2 megohms, and a light resistance, at 240 foot candles, of 20,000 ohms. The normal working range lies between 20,000 ohms and 800,000 ohms. This model has a sensitised surface measuring 1in. × ½in., and



Parima selenium cell with a sensitised surface measuring 1in. × ½in.

costs 15s. It is robustly made, and enclosed in an ebonite case fitted with side terminals. A cell with a sensitised surface of one square inch costs 20s.

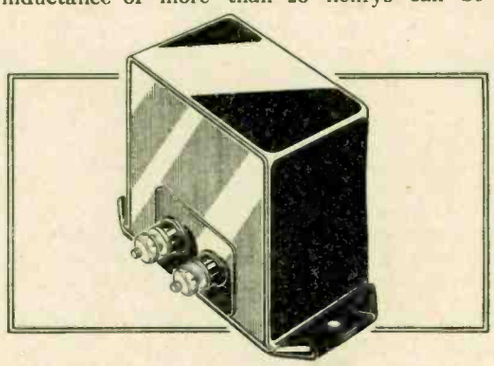
PEPPER L.F. CHOKE.

MADE by Trevor Pepper, 48, Wake Green Road, Moseley, Birmingham, this L.F. choke has been introduced to meet the demand for an inexpensive component having a reasonably high inductance. It is particularly well suited for use in smoothing circuits either in battery eliminators or in mains sets, provided the maximum current does not exceed 25 mA.

The measured inductance with various amounts of D.C. flowing was found to be as follows:—

D.C. in mA.	Inductance in henrys.
0	36.2
5	28.5
10	22.5
15	18.5
20	16.0
25	15.2

It will make a satisfactory output choke when small power valves are employed, for an inductance of more than 20 henrys can be



Pepper smoothing choke rated to carry 25 mA.

assured, since in most cases the anode current will not exceed some 10 mA.

The choke is enclosed in a metal case finished in black enamel. The D.C. resistance is 840 ohms, and the price 3s. 11d.

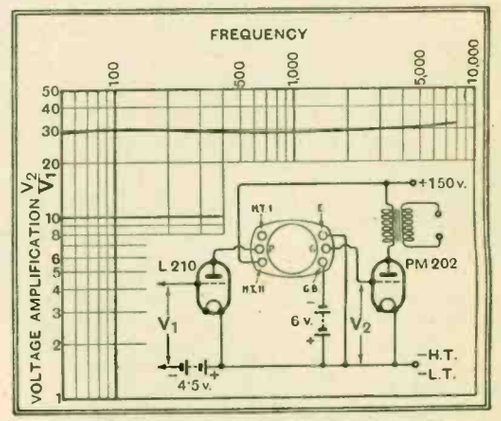
BENJAMIN TRANSFEEDA.

THE practice of parallel feeding intervalve L.F. transformers so that the steady D.C. anode current does not traverse the primary winding, which makes available a much higher impedance to the low audible frequencies than otherwise would be the case, has now resulted in the introduction of an entirely new type of component. The Transfeeda, as the Benjamin Electric, Ltd., appropriately designate their new model, embodies in a compact unit measuring 2⅜in. × 2in. × 3¼in. high, a wire-wound resistance rated to carry 1½ watts, a coupling condenser, and a small L.F. transformer.

The resistance has a total value of 50,000 ohms, but is tapped at 30,000 ohms for use with low impedance valves. The primary inductance of the transformer is of the order of 85 henrys, which value is, of course, maintained under all working conditions, since it is not affected by the magnitude of the anode current taken by the preceding valve.

The makers state that the amplification curve is sensibly straight from 37 cycles up to the limit of audibility. Our measurements were made using a valve of some 10,000 ohms A.C. resistance, and the 30,000-ohm tapping on the unit.

The curve here reproduced would seem to justify well the makers' claim, for over the full range of frequencies covered there is negligible change in the amplification afforded by the stage. The high level of the curve down to frequencies of 50 cycles is of particular interest, since this assures a correct proportion



Amplification curve of Benjamin Transfeeda.

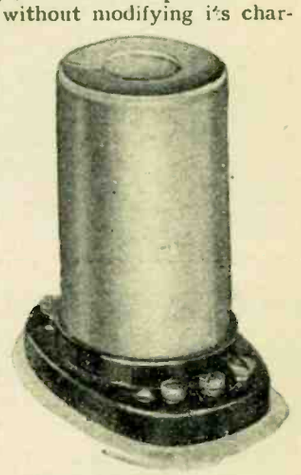
of bass response to give a full round tone to the reproduction. With the actual combination employed a gain of 30 times is recorded, this being about 1.8 times the amplification factor of the preceding valve. The step-up ratio of the transformer is 1 : 3.

A neat moulded bakelite base carries the six terminals, arranged so that they fall quite conveniently when wired in a circuit, while the various component parts are enclosed in a metal case finished in warship grey.

Valves up to 30,000 ohms impedance can precede this unit without modifying its characteristics, and by including an external resistance those of still higher impedance may be employed.

These units should undoubtedly have a well-merited popularity, for they enable a high quality of reproduction to be attained at the small cost of 11s. 6d. only.

The makers are Benjamin Electric, Ltd., Brantwood Works, Tariff Rd., Tottenham, London, N.17.



Benjamin Transfeeda, consisting of a resistance-fed L.F. transformer in compact form.

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Change of Name.

Henry E. Taylor, Ltd., 51-53, Church Street, Greenwich, London, S.E.10, who some time ago acquired the goodwill, patents, trade marks, and stocks of Burndept wireless apparatus and continued to market the more popular models of this marque, announce that the name of the company has now been changed to Burndept, Ltd. A general reduction in prices has been effected, which came into operation on June 15th last.

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Ferranti Model A.C.6. Amplifier.

In the review of this constructor's amplifier, published in *The Wireless World* dated June 8th last, the mains rectifier was described as a U.12. The rectifier now recommended is the U.14, or one of similar characteristics.

READERS' PROBLEMS.

THESE columns are reserved for the publication of matter of general interest arising out of problems submitted by our readers.

Readers requiring an individual reply to their technical questions by post are referred to "The Wireless World" Information Bureau, of which full particulars, with the fee charged, are to be found on page 20.

Voltage Adjustments.

VOLTAGE is ordinarily applied to the screening grid of an H.F. valve through a potentiometer arrangement, consisting of two fixed resistors connected in series and joined across the source of H.T. supply. This method is illustrated in Fig. 1, where the potentiometer elements are indicated by R and R_1. An adjustment of voltage may be made by varying both resistance values simultaneously, or by altering either element alone.

This latter point is appreciated by a correspondent, who has reached the conclusion that the voltage at present applied in his receiver is excessively high, but he is in error in supposing that a *decrease* in applied voltage could be brought about by *increasing* the value of either R or R_1.

To reduce the voltage applied, the value of R (the upper limb) may be increased; or, alternatively, the value of R_1 may be decreased. As to which method is chosen is a matter of small importance, and may be largely governed by convenience; if the amount of current drawn by the potentiometer is already as high as can be tolerated it would clearly be

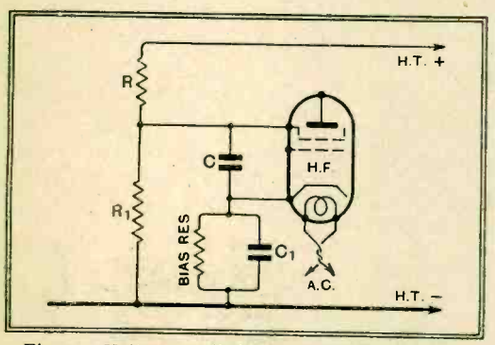


Fig. 1.—Voltage applied to a screening grid may be adjusted by varying either R or R_1, the two elements of the feed potentiometer. The usual by-pass condensers are marked C and C_1.

better to increase the value of the upper limb, but if there exists a surplus in the H.T. supply circuits it might be better to bring about the desired change in screening grid voltage by decreasing the value of R_1, the lower element.

The Oscillator Valve.

WHEN a superheterodyne receiver works normally at the lower end of the wavelength scale, but fails altogether to receive signals at wavelengths greater than, say, 450 metres, we have almost certain evidence that the emission of the oscillator valve has fallen off. A reader whose set is behaving in this way would be well advised to check the condition of his valve. The effect is one that is fairly common, and is due to the fact that with the usual fixed inductive relationship between grid and plate coils the effective coupling falls off progressively as wavelength is increased. Unless the valve be in good condition, self-oscillation may stop suddenly when a critical wavelength is reached.

Another query dealing with a superheterodyne oscillator has been received from a reader; in this case it has been found that the valve fails to oscillate at any position on the wave-range scale, and we are requested briefly to enumerate the possible causes of its failure to function.

Assuming a normal circuit arrangement, the possibilities of trouble will probably be covered by the following list: (1) A defective oscillator valve; (2) a faulty contact between one or more of the valve pins and their corresponding sockets in the holder; (3) a fault in the oscillator coil assembly—probably an open circuit in grid, anode, or pick-up coils; (4) defective wave-range switches.

The fact that appropriate H.T., L.T., and grid bias voltages are applied to the valve should be confirmed as accurately as possible.

Artificial Centre Point.

IN an attempt to remove an annoying background of hum in his A.C. mains receiver, a reader has tried the expedient of wiring a 30-ohm potentiometer across the filament of his output valve. Instead of joining the centre tap of the transformer winding which feeds this filament to the earth line through a bias resistance, the tapping has been ignored, and the earth connection in question has been taken from the potentiometer slider.

Our correspondent is delighted with the result of this change, as hum has almost entirely disappeared. Being of an enquiring turn of mind, he asks if we can tell him why this apparently minor alteration has been so fruitful of results.

Unless some very unusual condition exists in the set, we think that the effect as described provides clear evidence that the centre tap on the L.T. transformer secondary was misplaced; by fitting a potentiometer, it has become possible accurately to locate an artificial centre point on the filament, and thus to balance out disturbing A.C. voltages.

The Longest Day.

WE are always suspicious when we receive complaints concerning "fading" at this time of year. As a general rule, it may be assumed that true fading does not take place during daylight; at the time of writing the longest day has only just passed, and, as a consequence, comparatively little listening is done under conditions of darkness.

From one reader's description of effects observed in his set, we are strongly inclined to think that the trouble is not fading at all, but an intermittent fault. In any case, he can carry out a conclusive test as to whether our opinion is correct by listening carefully in daylight—at least an hour before sunset—and noticing whether fluctuations of signal strength then take place.

New Variable-mu Valves.

WE are asked whether the new type V.M.S.4 valves could be substituted for the older pattern which was specified for the "Monodial A.C. Super."

So far as this receiver is concerned, the new valves may be considered as being interchangeable with the older ones, but a slight increase in sensitivity is to be expected as a result of using the latest pattern.

Leaky Coupling Condensers.

IT is usual to recommend that mica coupling condensers should be employed in resistance-coupled amplifiers, rather than those with a paper dielectric. This is because condensers of the latter type are more likely to leak; any current leaking through them would produce a voltage across the succeeding grid leak that is in opposition to that derived from the normal source of bias. (See Fig. 2.)

The whole subject is possibly not of very great importance, and now that condenser manufacture has improved, there is little reason why one should not employ a paper dielectric condenser in this circuit, at any rate if the possibility of leakage is envisaged, and if need be, compensated for by applying rather more negative bias voltage than would normally be needed.

The matter of paper *versus* mica for coupling condensers is brought up by a reader, who says, in effect, if mica-dielectric condensers are desirable for resistance-coupled amplifiers, why is it not customary to specify them for modern parallel-fed auto transformer-coupled circuits, where the operating conditions are the same?

Ignoring for the moment the fact that on the score of expense it would be quite impossible to use mica condensers for most parallel-fed transformer circuits, we would point out, if we may, that conditions are *not* quite similar, and that the effect of any leakage that may exist will be much less serious than in the case of a resistance-coupled amplifier.

With a grid leak of 0.25 megohm—quite a normal value—a leakage current of no more than 10 microamperes would build up a reversed bias voltage of 2.5—by no means negligible. But in a parallel-fed auto-transformer circuit, the ohmic resistance of the transformer primary might well amount to no more than 1,000 ohms, in which case the positive bias developed across it, and consequently applied to the grid of the succeeding valve, would amount to no more than 0.01 volt, which may be ignored with safety.

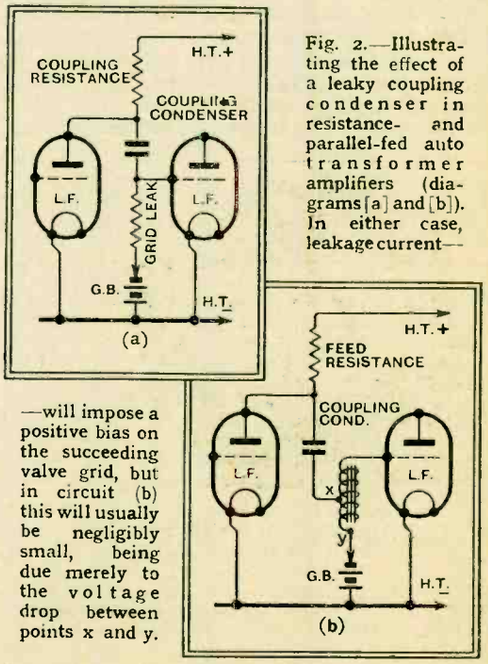


Fig. 2.—Illustrating the effect of a leaky coupling condenser in resistance- and parallel-fed auto transformer amplifiers (diagrams [a] and [b]). In either case, leakage current—will impose a positive bias on the succeeding valve grid, but in circuit (b) this will usually be negligibly small, being due merely to the voltage drop between points x and y.

Mains-operated Valve Voltmeter.

WE are asked whether there is any basic reason why a valve voltmeter should not be supplied with H.T and L.T. voltage from the mains through normal "eliminator" circuits.

The trouble here is that absolute constancy in mains voltage can never be expected. By suitable design, the effect of these fluctuations might be overcome to a certain extent, but it is seldom that a mains-fed valve voltmeter could be employed for really accurate working; one of the reasons for this is that, even if suitable compensating controls were fitted, the mains voltage may vary almost from one instant to another, and it would be almost impossible to follow them quickly enough.

Switch Contacts.

WRITING on the subject of intermittent reception on the medium waveband, a querist states that it is only possible to hear signals after "juggling" with the wave-change switch knob, of which the position appears to be extremely critical.

He asks us not to rush to the conclusion that this is a clear case of defective switches—these components, incidentally, are built into the tuning coil bases. They have all been carefully examined, and would appear to be in perfect order. Information is requested as to other possible causes of this trouble.

As our correspondent seems to realise, an effect of this nature would be due, in ninety-nine cases out of a hundred, to a faulty switch, and we must admit that we are not quite satisfied that this is not responsible in the present case. If it is *not*, then we think the trouble will ultimately be traced to a defective soldered connection on to one of the switch blades; the fixed end of this blade may be slightly distorted by the actuating cam in such a way that contact is interrupted in some positions.

Effect of the Cabinet.

WE sometimes get puzzling questions dealing with sets which function perfectly before they are placed in the cabinet, but which display inexplicable faults when mounted in their final position. But, fortunately, here we have one of those cases where the answer is simple.

Our correspondent states that his H.F.-det.-L.F. battery set is perfectly stable when the chassis is outside the cabinet, but instability over almost all the tuning range is evident as soon as it is placed inside; he goes on to say that the loud speaker is mounted in the cabinet.

This latter statement provides a clue to what we feel convinced is the real solution. No doubt a certain amount of H.F. energy is flowing in the loud speaker leads and windings; while these are well separated from the receiver all is well, but there is almost certainly interaction between the loud speaker and the input end of the set when these are placed in proximity to each other.

The remedy here would be to insert an H.F. choke between the output valve anode and its lead, and at the same time to shunt a fixed condenser of about 0.002 mfd. between the anode of this valve and earth.

The Simplest Band-pass Circuit.

IT is asked what type of simple band-pass filter (with adjustable or semi-adjustable coupling between the circuits) we would recommend in a case where a stereotyped design is not to be followed, and where use is to be made, as far as possible, of existing coils and other components.

Taking everything into consideration, we would recommend unreservedly that the band-pass filter should be of the "top-end capacity" type, in which the circuits are linked by means of a very small variable or semi-variable condenser, which is joined between their high-potential ends. This arrangement has the advantage that almost any types of coils may be used without alteration, and that changes in effective coupling, in order to meet varying conditions, may be made in the simplest possible manner. Further, the arrangement has the advantage of extreme cheapness.

Of the other methods of coupling that might be considered, "bottom-end capacity" is certainly the best, but it has the disadvantage that experimental changes of coupling cannot readily be made, as a variable condenser of suitably high capacity is virtually unobtainable. Alternatively, the use of a number of fixed condensers of capacities round about 0.01 mfd. is clumsy and expensive.

Simple magnetic coupling is similarly ruled out by the mechanical difficulty of providing means for changing coupling, and sometimes by considerations of space, as large coils must generally be mounted at considerable distance from each other.

Variable Sideband Loss.

IT has been found by a few builders of the Monodial A.C. Super that the quality of reproduction is deeper at the high wavelength end of the tuning range than at the low. To a certain extent this is inevitable, for the selectivity of, and hence the amount of sideband cutting introduced by, the signal frequency circuits increases with an increase in wavelength.

Over the whole of the medium waveband, however, the change in quality should be so small as to be undetectable by ear, and the effect should only be just noticeable at the upper end of the long waveband. The large change of quality noticed by one or two builders, therefore, shows that in their sets the pre-selector circuits are too sharply tuned. This can only be due to the effects of regeneration, and the probability is that the H.F. valve is in a state of incipient oscillation.

The remedies for this quality variation, therefore, are the same as those for actual instability in an ordinary straight H.F. set, and care should be taken to see that the screening of the H.F. stage is fully effective, that a good earth is used, and that the various by-pass condensers are all in good condition.

FOREIGN BROADCAST GUIDE.

BRUSSELS (INR)

(Belgium).

Geographical position: 50° 50′ 16″ N.; 4° 21′ 12″ E.

Approximate air line from London: 218 miles.

Wavelength: 509.3 m. Frequency: 590 kcs. Power: 15 kw. (Copenhagen rating).

Time: Greenwich Mean Time (Belgium adopts B.S.T.).

Standard Daily Transmissions.

06.00 B.S.T., and every hour until 10.00 (Sun.); reports on carrier pigeon races; 12.00, gramophone records or concert; weather; 15.30 (Sun.), running commentary on football or other matches; 17.00, gramophone records or concert; 19.30, news (*Journal parlé*), talks; 20.00, main evening programme; 22.00 late press news; 22.10, dance music (not nightly).

Announcer: Man. (All announcements are made in the French language.)

Opening Signal: Deep-toned hooter followed by pips indicating hour.

Call: *Ici Bruxelles INR* (pron: *Ee-enn-air*) usually followed by the name or initials of the association responsible for the broadcast, e.g., I.N.R. (*Institut National de Radiodiffusion*); R.E.S.E.F. (*Radio Emission Socialiste d'Expression Française*); R.C.B (*Radio Catholique Belge*).

Closes down with usual French good-night greetings followed by Belgian National Anthem (*La Brabançonne*).

Scrapping Old Sets.

SUGGESTIONS for modernising an out-of-date "portable" of the type embodying two aperiodic H.F. stages, a detector, and two L.F. amplifying valves, are requested by a reader, who finds that this old receiver is quite inadequate for modern needs.

The trouble here is that the circuit arrangement included in the receiver is inherently lacking in selectivity, and we fear that little or nothing can be done without making radical alterations. In fact, it would practically be necessary to rebuild the set, using, perhaps, the existing cabinet and loud speaker, a frame aerial, and some or all of the L.F. components.

More Magnification: More Smoothing.

WHEN modifying a published design in any way that will tend to increase the overall magnification—at any rate L.F. magnification—it will be fairly obvious that any residue of ripple that may escape the smoothing devices will become more evident in the form of hum.

Those readers who propose to modify designs by adding, say, an intermediate low-gain L.F. stage, should always remember the possible need for adding to the normal smoothing equipment.

The Wireless World INFORMATION BUREAU.

Conditions of the Service.

(1) THE service is intended primarily for readers meeting with difficulties in the construction, adjustment, operation, or maintenance of wireless receivers described in *The Wireless World*, or those of commercial design which from time to time are reviewed in the pages of *The Wireless World*. Every endeavour will be made to deal with queries on all wireless matters, provided that they are of such a nature that they can be dealt with satisfactorily in a letter.

(2) Communications should be addressed to *The Wireless World* Information Bureau, Dorset House, Tudor Street, E.C.4, and must be accompanied by a remittance of 5s. to cover the cost of the service. The enquirer's name and address should be written in block letters at the top of all communications.

(3) The fee of 5s. covers the reply to any wireless technical difficulty, but in special cases, where the enquiry may involve a considerable amount of investigation, an increased fee may be necessary. In such cases a special quotation will be made.

(4) Questions should be clearly written and concisely worded in order to avoid delay. Where enquiries relate to trouble experienced in receivers built to specifications in *The Wireless World* a complete account should be given of the trouble, and especially the symptoms.

(5) Where reference is made to published articles or descriptions of apparatus, the title of the article, the date of publication in *The Wireless World*, and the page reference number should be given, in order to facilitate reply.

(6) Full circuit diagrams, constructional details of apparatus, or values of components for home-designed receivers cannot normally be supplied, but circuit diagrams sent in with queries will be checked and criticised.

(7) Particular makes of components cannot, in general, be recommended, but advice will be given as to the suitability of an individual component for a particular purpose specified by the enquirer.

BROADCAST BREVITIES

By Our Special Correspondent.

Overshooting the Mark.

SOMETHING grimly ironical has been happening on the roof of Broadcasting House. While the B.B.C. engineers have been vainly hoping, against their better judgment, that the Falkirk transmissions would carry farther and please more people than could reasonably be expected, the seven-metre transmitter, operating in secret, has done the trick. It has carried very much farther than anyone expected, and has pleased people nearly forty miles away.

Joy in Essex.

I learn that, in the first test, one amp. in the aerial brought a good report from Chelmsford!

This is enough to make the Regional Scheme shake in its shoes.

Ultra Shorts for B.B.C. Television ?

It would not surprise me if the B.B.C.'s ultra-short wave station were to be used publicly for the first time as a television transmitter.

Mr. Baird tells me that the ultra-short waves are proving a great success at Long Acre. With the start of regular television transmissions from Broadcasting House towards the end of this month a splendid opportunity will be available for trying them out on Mr. Ashbridge's seven-metre outfit.

Television badly needs an exclusive wave channel in the region where the width of the frequency band used is not vitally important.

"G.B.S." Next Monday.

GEORGE BERNARD SHAW, as I mentioned last week, will make his contribution to the "Rings of the Ladder" series on Monday next, July 11th. "G.B.S." graduated as a novelist by way of a land agent's office in Dublin, a telephone office in London, and the editor's chair of a musical review. In four years he wrote his first five long novels and had them all refused by publishers. He well-nigh starved, and in the intervals preached Socialism at the street corners. He will tell listeners of these early struggles to mount the ladder.

Ye Olde Promenade Concert.

ALTHOUGH August 6th is the date of the opening night of the "Proms" season, we are to have an appetiser on August 1st in the form of a replica of the first Queen's Hall Promenade Concert, which took place in 1895. The B.B.C. Orchestra will be conducted by Sir Henry Wood.

The Thirty-eighth Season.

Sir Henry, who, I am glad to know, has never been in better health than he is to-day, will be directing his thirty-eighth season of Promenade Concerts.

Monday will remain Wagner night and Friday Beethoven night. Wednesday concerts will be devoted alternately to Bach and Brahms while, as usual, Saturday will be "popular."

Tuesdays and Thursdays will be miscellaneous in character, with a good sprinkling of British works.

A Prom. a Night.

During August the Promenade Concerts will be broadcast in the National programme on the 6th, 9th, 11th, 12th, 15th, 18th, 20th, 22nd, 24th, 26th, and 30th of the month. All the other concerts in August will be broadcast regionally, so that listeners will be able to tune in the Queen's Hall from one or other of the B.B.C. transmitters every night.

Better Music at Christmas.

Music at Christmas time is usually of a rather stereotyped nature, and the B.B.C. is therefore to be congratulated on the decision to supplement "Good King Wenceslas," with "Christmas Proms.," to be broadcast from the Queen's Hall from December 31st to January 14th, with Sir Henry Wood as master of the ceremonies.

A Stunt Broadcaster.

AN interesting arrival in this country from Australia is Mr. Danvers Walker, who, for three years, has made a speciality of "stunt" broadcasts, filling the rôle of running commentator for a public whose thirst for thrills is almost insatiable. Mr. Walker's commentaries, given over the chain of "A" class stations, have covered everything from a half-hour spent in trying to make a cable tunnel sound interesting, to a day on a radio-equipped plane telling Australia of the search for a missing expedition.

A Dilemma.

"My worst moment," Mr. Walker told me, "occurred at the opening of the Sydney Harbour Bridge. I had previously had a struggle to get through the crowds to reach the microphone which 'covered' the actual opening ceremony.

"My relief at getting there was short-lived. To the amazement of us all, the tape was cut just before Mr. Lang advanced to perform the ceremony. What was I to tell listening Australia?"

The Bald Facts.

"You will realise the dilemma when I tell you that my strict instructions were to say nothing that might in any way be construed as unfavourable to the State, and yet here the most unexpected and unfavourable thing had happened.

"I decided to give the bald facts. After narrating how something most unusual had occurred, that the tape had unexpectedly been cut, etc., I made no further comment on this ugly situation, but confined my remarks to a description of the bridge and the waiting crowds."

If It Happened Here.

No problem quite like this has ever faced a running commentator in this country, but I should certainly like to hear what Mr. Lyle would say, for instance, if the Derby winner bit its owner in the unsaddling enclosure. And how would Mr. Allison communicate the sudden private discovery that the football referee was an escaped crook?

Broadcast history was recently made by the Lyons (La Doua) station, which transmitted a commentary from the summit of Mt. Blanc. The announcer is here seen at a height of about 15,000ft.

"B.B.C. Sensation."

THE long-standing rivalry between Edinburgh and Glasgow on broadcasting matters, to which I referred recently, finds expression in a delightful sally under the title "B.B.C. Sensation" in the *Glasgow Evening News*.

The Song of the Mew.

"Strong feeling," says the writer, "is being manifested in the Gantocks (a rocky islet near Dunoon) over the attitude taken by the B.B.C. in regard to the broadcasting of the song of the famous 'Gantocks Sea Mew.' This rival of the nightingale had been promised ten broadcasts throughout the season, on a basis of £100 a night. A letter received from Mr. Leghorn Samson subsequently cut down this number to five broadcasts, and the popular Mew has been loud in its protests.

A Cry from the Gantocks.

"It is understood that Mr. Leghorn Samson has insisted upon auditions from the Mew, which has been invited to travel through to Edinburgh.

"The comment of the Gantocks Mew is pungent. 'Where is Edinburgh?' it enquires."

So This is Fame!

THE story of Henry Hall and his cigarette case can be briefly told. The leader of the B.B.C.'s Dance Orchestra was motoring to Broadcasting House the other morning when he ran out of oil. Managing to reach a garage, he explained to the boy who had been left in sole charge that it would not be possible to pay for the oil at the moment as he had inadvertently left home without even a penny. He gave his name, however, and waited for the oil.

"Henry Hall?" queried the lad, and shook his head blankly. "You know," said Mr. Hall. "Leader of the B.B.C. Dance Band!"

"B.B.C.?" came the vague retort.

In the end "H.H." had to leave his gold cigarette case as security.

But he got a receipt for it.

BROADCASTING STATIONS ABROAD.

ARRANGED IN ORDER OF WAVELENGTH.

Wavelength in Metres.	Frequency in Kilocycles.	Power in kW.	Station.	Tuning Positions.
1935	155	7	Kaunas (Kovno) (Lithuania)	
1875	160	8.5	Huizen (Holland). (*Exchanges wavelengths with Hilversum every three months.*)	
1796	167	54	Lahti (Finland)	
1724	174	75	Radio Paris	
1635	183.5	60	Zeesen (Königswusterhausen) (Germany). (*Generally relays Berlin.*)	
1600	187.5	10	Irkoutsk, RV14 (Russia)	
1554.4	193	30	Daventry, 5XX, National	
1538	195	7	Ankara (Angora) (Turkey)	
1481	202.5	100	Moscow, RV1 (Old Komitern) (Russia)	
1446	207.5	13	Eiffel Tower, FLE, Paris	
1412	212.5	120	Warsaw I (Poland)	
1380	217.5	100	Novosibirsk, RV6 (Russia)	
1350	222.2	0.5	Tunis-Kasbah (Tunisia)	
1348	222.5	30	Motala (Sweden). (*Relays Stockholm*)	
1304	230	100	Moscow, WZSPS (Trade Union) (Russia)	
1260	238	10	Baku, RV8 (Russia)	
1229.5	244	0.6	Boden (Sweden). (*Relays Stockholm*)	
1200	250	5	Stamboul (Turkey)	
1200	250	21	Reykjavik (Iceland)	
1170	256	25	Tashkent, RV11 (Russia)	
1154	260	7.5	Kalundborg (Denmark)	
1117 / 1100	268.5 / 272.7	40	Moscow, Popoff RV58 (Russia)	
1105	271.5	35	Minsk Koloditschi, RV10 (Russia)	
1083	277	60	Oslo (Norway)	
1071	280	10	Tiflis, RV7 (Russia)	
1035	290	36	Kiev, RV9 (Russia)	
1000	300	100	Leningrad, Kolpino RV53 (Russia)	
968	310	10	Alma Ata, RV60 (Russia)	
938	320	20	Kharkov, RV4 (Russia)	
882	340	20	Saratov, RV3 (Russia)	
849	353.4	4	Rostov-on-Don, RV12 (Russia)	
825	363.6	50	Sverdlovsk, RV5 (Russia)	
770	389	0.6	Ostersund (Sweden). (*Relays Stockholm*)	
760	395	1.3	Geneva (Switzerland)	
720	416.6	20	Moscow, RV2 (Experimental) (Russia)	
690	434.6	1.5	Oulu (Finland)	
644	465.8	10	Kazan, RV17 (Russia)	
575	521.5	1.2	Samara, RV16 (Russia)	
574.7	522	2.5	Ljubljana (Yugoslavia)	
569	527	0.25	Freiburg-im-Breisgau (Germany). (*Relays Stuttgart.*)	
568.1	528	2	Grenoble (France)	
566	530	0.25	Hanover (Germany). (*Relays Hamburg*)	
565	531	16	Wilno (Poland). (*Relay Station*)	
560	536	0.25	Augsburg (Germany). (*Relays Munich*)	
560	536	1.5	Kaiserslauten (Germany). (*Relays Munich*)	
560	536	0.7	Hamar (Norway). (*Relays Oslo*)	
555.5	540	1	Tampere (Tammerfors) (Finland). (*Relays Helsinki.*)	
550	545	18.5	Budapest No. 1 Lakihegy (Hungary)	
542	554	10	Sundsvall (Sweden). (*Relays Stockholm*)	
533	563	1.5	Munich (Germany)	
525	571	3	Palermo (Italy)	
525	571	15	Riga (Latvia)	
517	580	15	Vienna (Rosenhügel) (Austria)	
509	589	15	Brussels No. 1, Velthem (Belgium). (*French Programme.*)	
508	590	10	Astrakhan, RV35 (Russia)	
501.7	598	10	Nijni Novgorod, RV42 (Russia)	
500.8	599	20	Florence, 1FI (Italy)	
495.8	605	1.2	Trondheim (Norway)	
488.6	614	120	Prague, No. 1 (Czechoslovakia)	
486.2	617	10	Oufa, RV22 (Russia)	
480	625	50	North Regional (Manchester)	
480	625	10	Ivanovo-Voznesenk, RV33 (Russia)	
472.4	635	60	Langenberg (Germany)	
465.8	644	1.5	Lyons la Doua, PTT (France)	
459.4	653	60	Beromünster (Schweizerischer Landessender) (Switzerland).	
453.2	662	0.6	San Sebastian, EAJ8 (Spain)	
453.2	662	1	Pori (Uleaborg) (Finland)	
453.2	662	0.5	Danzig. (*Relays Königsberg*)	
453.2	662	0.5	Klagenfurt (Austria). (*Relays Vienna*)	
453.2	662	0.7	Porsgrund (Norway). (*Relays Oslo*)	
453.2	662	1	Salamanca, EAJ22 (Spain)	
453.2	662	0.1	Tromsö (Norway)	
453.2	662	0.5	Bodö (Norway)	
453.2	662	0.15	Upsala (Sweden). (*Relays Stockholm*)	
450.4	666.7	10	Odessa, RV13 (Russia)	
447.1	671	0.7	Paris, Ecole Superieure, PTT	
447.1	671	0.35	Aalesund (Norway)	
447.1	671	0.15	Rjukan (Norway). (*Relays Oslo*)	
447.1	671	0.08	Notodden (Norway)	
447.1	671	0.5	Tartu (Esthonia)	
441.2	680	50	Rome, 1RO. (*Short-wave Station, 2RO on 25.4 m.*)	
435.4	689	55	Stockholm (Sweden)	
431	696	2.5	Belgrade (Yugoslavia)	
424.3	707	3	Madrid, EAJ7 (Union Radio). (*After 7.0 p.m.*)	
424.3	707	1.3	Madrid, EAJ2 (Radio Espana). (*Up to 7.0 p.m.*)	
424.3	707	100	Moscow, Imini Stalina (Russia)	
419	716	1.5	Berlin, No. 1, Witzleben (Germany)	
416.4	720.5	2.5	Rabat (Morocco)	
413	725	1.2	Dublin (Irish Free State)	
410.9	730	1.3	Madrid, EAJ7 (Spain)	
408.7	734	16	Katowitz (Poland)	
403.8	743	25	Sottens (Radio Suisse Romande) (Switzerland)	
398.9	752	25	Midland Regional	
394.2	761	12	Bucharest (Roumania)	
389.6	770	1.5	Frankfurt-a-M. (Germany)	
389.6	770	10	Archangel, RV36 (Russia)	
385.1	779	8	Radio-Toulouse (France)	
385.1	779	10	Stalino, RV26 (Russia)	
381	788	16	Lwow (Lemburg) (Poland)	
379.7	790	1	Seville, EAJ5 (Union Radio) (Spain)	
376.4	797	50	Scottish Regional (Falkirk)	
372.2	806	1.5	Hamburg (Germany)	
370.1	810.5	0.8	Radio, LL, Paris	
368.1	815	10	Helsinki (Finland)	
368.1	815	1	Bolzano (Italy)	
368.1	815	10	Kharkov, RV20 (Russia)	
367.6	816	0.7	Fredrikstad (Norway). (*Relays Oslo*)	
364.1	824	1	Bergen (Norway)	
363.6	825	16	Algiers (Algeria)	
360.6	832	60	Mühlacker (Stuttgart) (Germany)	
355.9	843	50	London Regional (Brookmans Park)	
352.1	852	7	Graz (Austria). (*Relays Vienna*)	
348.8	860	7.6	Barcelona, EAJ1 (Spain)	
348.8	860	10	Leningrad, RV70 (Russia)	
345.2	869	11.5	Strasbourg, PTT (France)	
341.7	878	35	Brno (Brunn) (Czechoslovakia)	
337.8	888	15	Brussels II, Velthem (Belgium). (*Flemish Programme.*)	
334.4	897	1.35	Poznan (Poland)	
331.4	905	7	Milan (Italy)	
328.2	914	60	Poste Parisien (France)	
325	923	1.5	Breslau (Germany)	
321.9	932	10	Göteborg (Sweden). (*Relays Stockholm*)	
318.8	941	0.5	Sofia (Bulgaria)	
318.8	941	0.25	Dresden (Germany). (*Relays Leipzig*)	
318.8	941	1.5	Naples, 1NA (Italy)	
315.8	950	1.6	Marseilles, PTT (France)	
312.8	959	1.7	Cracow (Poland)	
312.8	959	10	Genoa, 1GE (Italy)	
309.9	968	1	Cardiff	
308.6	972	0.7	Radio Vitus (Paris)	
307	977	0.5	Falun (Sweden)	
307	977	0.75	Zagreb (Yugoslavia)	
304	986	13	Bordeaux Lafayette, PTT (France)	
301.5	995	50	North National (Manchester)	
298.8	1004	11	Tallinn (Esthonia)	
296.1	1013	7	Hilversum (Holland). (*Up to 4.40 p.m.*)	
296.1	1013	20	Hilversum (Holland). (*After 4.40 p.m.*) (*Exchanges wavelengths with Huizen every three months.*)	
293.5	1022	0.7	Limoges, PTT (France)	
293.5	1022	2.6	Kosice (Czechoslovakia)	
291	1031	10	Viipuri (Viborg) (Finland). (*Relays Helsinki*)	
288.5	1040	—	British Relay Stations	
286.8	1046	0.7	Lyons (Radio-Lyon) (France)	
286	1049	0.8	Montpellier (France)	
283.6	1058	0.5	Berlin, No. 2 (Germany) } (*Relay Stations Synchronised*)	
283.6	1058	0.5	Magdebourg (Germany) } (*Relay Stations Synchronised*)	
283.6	1058	0.5	Stettin (Germany) } (*Relay Stations Synchronised*)	
283.6	1058	0.5	Innsbruck (Austria). (*Relays Vienna*)	
281.2	1067	0.75	Copenhagen (Denmark)	
278.8	1076	13.5	Bratislava (Czechoslovakia)	
276.5	1085	60	Heilsberg (Germany). (*Relays Konigsberg*)	
273.7	1096	7	Turin (Italy)	
271.5	1105	1.3	Rennes, PTT (France)	
271.5	1105	10	Minsk, RV10 (Russia)	
269.8	1112	0.25	Bremen (Germany). (*Relays Hamburg*)	
267.6	1121	8	Valencia (Spain)	
265.8	1128.5	1.3	Lille, PTT (France)	
263.8	1137	11.2	Moravska-Ostrava (Czechoslovakia)	

BROADCAST STATIONS ABROAD (In Order of Wavelength).

Wavelength in Metres.	Frequency in Kilocycles.	Power in kW.	Station.	Tuning Positions.
261.5	1147	50	London National (Brookmans Park)	
259.3	1157	2	Leipzig (Germany)	
257.1	1167	10	Hörby (Sweden). (*Relays Stockholm*)	
255.1	1176	0.7	Toulouse, PTT (France)	
253.1	1185	5	Gleiwitz (Germany). (*Relays Breslau*)	
251.5	1193	0.25	Trollhätten (Sweden)	
251.5	1193	1	Barcelona, EAJ15 (Assoc. Nat.) (Spain)	
251.5	1193	1	Almeria, EAJ18 (Spain)	
249.6	1202	—	Prague, No. 2 (Czechoslovakia). (*Temporary*)	
249.6	1202	0.2	Kalmar (Sweden). (*Provisional*)	
249.6	1202	0.8	Juan-les-Pins, Nice (France)	
247.7	1211	10	Trieste (Italy)	
245.9	1220	0.3	Varberg (Sweden)	
245.9	1220	0.01	Bloemendal (Holland). (*Sundays only*)	
245.9	1220	0.5	Berne (Switzerland)	
245.9	1220	0.4	Cartagena (Spain)	
245.9	1220	0.2	Eskilstuna (Sweden). (*Relays Stockholm*)	
245.9	1220	0.25	Cassel (Germany). (*Relays Frankfurt*)	
245.9	1220	0.5	Linz (Austria). (*Relays Vienna*)	
245.9	1220	0.5	Pietarsaari (Finland)	
245.9	1220	0.4	Säffle (Sweden). (*Relays Stockholm*)	
245.9	1220	0.5	Turku (Abo) (Finland). (*Relays Helsinki*)	
244.1	2229	0.5	Basle (Switzerland)	
242.3	1238	1	Belfast (N. Ireland)	
240.6	1247	0.5	Stavanger (Norway)	
238.9	1256	2	Nürnberg (Germany). (*Relays Munich*)	
237.2	1265	0.2	Orebrö (Sweden). (*Relays Stockholm*)	
236.2	1270	3	Bordeaux, Sud-Ouest (France)	
235.5	1274	0.07	Nimes (France)	
235.5	1274	0.5	Kristiansand (Norway)	
233.8	1285	1.65	Lodz (Poland). (*Relay Station*)	
232.2	1292	0.25	Kiel (Germany). (*Relays Hamburg*)	
232.2	1292	0.25	Norrköping (Sweden)	
230.6	1301	0.12	Malmö (Sweden). (*Relays Stockholm.*)	Synchronised
230.6	1301	0.25	Karlstad (Sweden)	Synchronised
230.6	1301	0.2	Hälsingborg (Sweden)	Synchronised
230.6	1301	0.2	Umea (Sweden)	Synchronised
227.4	1310	0.5	Uddevalla (Sweden)	
226	1328	0.15	Hüdiksvall (Sweden). (*Provisional*)	
224.4	1337	1	Cork (Irish Free State)	
221.7	1353	10	Fécamp, Radio-Normandie (France)	
221.4	1355	0.4	Helsinki, No. 2 (Finland)	
219.9	1364	0.3	Béziers (France)	
218.5	1373	0.5	Flensburg (Germany)	
218.5	1373	0.5	Salzburg (Austria). (*Relays Vienna*)	
217	1382	0.5	Königsburg (East Prussia) (Germany)	
215.6	1391	0.2	Halmstad (Sweden)	
215.6	1391	0.1	Brussels, Radio-Conférence	
214.4	1400	10	Warsaw, No. 2 (Poland)	
209.8	1430	—	Budapest, No. 2 (Hungary)	
207	1450	0.15	Boras (Sweden)	
206	1460	0.2	Ornsköldsvik (Sweden)	
204.1	1470	0.2	Gävle (Sweden)	
202.7	1480	0.25	Kristineham (Sweden)	
201.3	1490	0.25	Jönkoping (Sweden)	
195	1530	0.2	Karlskrona (Sweden)	

PRINCIPAL SHORT-WAVE STATIONS.

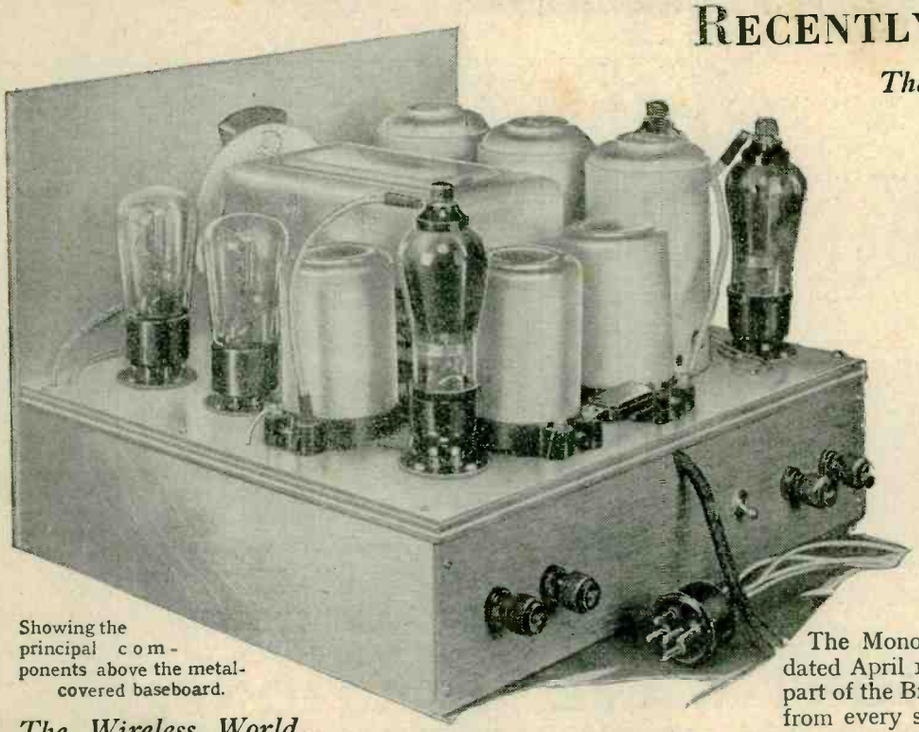
ARRANGED IN ORDER OF WAVELENGTH.

(N.B.—Times of Transmission, given in parentheses, are approximate only and represent B.S.T.)

Wavelength in Metres.	Frequency in Kilocycles.	Call Sign.	Station.	Tuning Positions.
14.28	21,018	OK1	Podebrady (Czechoslovakia)	
14.55	20,618	PMB	Malabar (Java). (*Daily* 11.00–16.00)	
15.5	19,350	—	Nancy (France). (*Daily* 21.00–22.00)	
15.93	18,830	PLE	Bandoeng (Java). (*Tues.* 14.10–16.40)	
16.3	18,400	PCK	Kootwijk (Holland). (*Daily* 16.00)	
16.32	18,380	FZA	Saigon (Fr. Indo China). (*Sun.* 19.00–21.00.)	
16.57	18,105	W9XAA	Chicago, Ill. (U.S.A.). (*Relays WCFL*)	
16.82	17,804	PCV	Kootwijk (Holland), "*Voice of Holland.*" (*Sat.* 15.40.)	
16.9	17,750	HSP	Bangkok (Siam). (*Sun. and Tues.* 21.00)	
18.4	16,300	PCL	Kootwijk (Holland). (*League of Nations Station.*)	
19.56	15,340	W2XAD	South Schenectady, N.Y. (U.S.A.). (*Daily* 21.00.)	
19.68	15,244	FYA	Pontoise (France). (*Colonial Stn. E-W*)	
19.72	15,210	W8XK	East Pittsburg, Pa. (U.S.A.). (*Relays KDKA.*)	
19.73	15,200	DJB	Zeesen (Germany). (*Daily* 14.00–18.00)	
19.84	15,120	HVJ	Vatican State, Rome. (*Daily* 12.00)	
20.5	14,630	XDA	Chapultepec (Mexico). (*Daily* 20.30)	
21.5	13,950	—	Bucharest University (Roumania). (*Wed. and Sat.* 20.00.)	
23.38	12,820	—	Rabat (Morocco). (*Sun.* 12.30)	
24.0	12,500	CT3AQ	Funchal (Madeira). (*Tues. and Thurs.* 10.30–12.30.)	
25.2	11,900	FYA	Pontoise (France). (*Colonial Stn. N-S*)	
25.25	11,880	W8XK	East Pittsburg, Pa. (U.S.A.). (*Relays KDKA.*)	
25.27	11,870	VUC	Calcutta (India). (*Weekdays* 02.45 *and* 15.15.)	
25.34	11,840	W9XAA	Chicago, Ill. (U.S.A.). (*Relays WCFL*)	
25.4	11,810	2RO	Prato Smeraldo, Rome. (16.00 *and* 19.30)	
25.42	11,800	VE9GW	Bowmanville (Canada). (*Daily* 19.00–09.00.)	
25.46	11,777	F3ICD	Saigon (Fr. Indo China). (*Fri.* 15.30)	
25.5	11,760	XDA	Chapultepec (Mexico). (*Daily* 21.00)	
25.53	11,750	G5SW	Chelmsford. (*Relays Daventry National daily, ex. Sun.*)	
25.63	11,700	FYA	Pontoise (France). (*Colonial Stn. E-W, daily* 21.00.)	
26.22	11,440	DHA-DHC	Nauen (Germany). (*Fri., Sat., Sun.* 22.00.)	
28.2	10,365	PLR	Bandoeng (Java). (*Daily* 11.00–15.00)	
28.98	10,350	LSX	Buenos Aires (Argentina). (*Daily* 21.30)	
29.3	10,238	TI4NRH	Heredia (Costa Rica). (*Daily* 23.00 *and* 03.00.)	
30	10,000	—	Belgrade (Yugoslavia). (*Mon.* 21.00)	
30.4	9,869	EAQ	Aranjuez (Spain). (*Sat.* 19.00)	
31.10	9,640	HS2PJ	Bangkok (Siam). (*Mon.* 02.00–05.00)	
31.25	9,598	CT1AA	Lisbon (Portugal). (*Fri.* 23.00)	
31.28	9,590	VK2ME	Sydney (Australia). (*Sun.* 07.00, 11.00, 18.00.)	
31.3	9,582	W3XAU	Philadelphia, Pa. (U.S.A.). (*Daily ex. Thurs. and Fri.* 21.00.)	
31.35	9,570	W1XAZ	East Springfield, Mass. (U.S.A.). (*Relays WBZ.*)	
31.35	9,570	SR1	Posen (Poland). (*Tues. and Thurs.* 19.30)	
31.38	9,560	DJA	Zeesen (Germany). (*Daily* 14.00)	
31.48	9,530	W2XAF	Schenectady, N.Y. (U.S.A.). (*Relays WGY*)	
31.51	9,520	OXY	Skamlebaek (Denmark). (*Relays Copenhagen.*)	
31.55	9,510	VK3ME	Melbourne (Australia). (*Wed. and Sat.* 11.00.)	
31.75	9,450	—	Rio de Janeiro (Brazil). (*Daily* 23.30)	
31.86	9,415	PLV	Bandoeng (Java). (*Tues.* 14.40)	
32.26	9,300	—	Rabat (Morocco). (*Sun.* 19.00)	
32.85	9,130	HB9OC	Zurich (Switzerland). (*Daily* 11.30–22.00)	
34.68	8,650	W2XV	Long Island, N.Y. (U.S.A.). (*Fri.* 23.00)	
36.92	8,125	PLW	Bandoeng (Java). (*Daily* 11.00–15.00)	
37.2	8,060	OU1TH	Vienna (Techn. College). (*Mon. and Thurs.* 21.30.)	
38.0	7,890	PK3BK	Socrabaia (Java). (*Tues., Fri., Sat.* 11.40)	
39.7	7,556	HKF	Bogota (Colombia). (*Westinghouse Labs.*)	
40.7	7,370	X26A	Nuevo Laredo (Mexico). (*Thurs.* 17.00)	
41.0	7,320	HSP2	Bangkok (Siam). (*Mon.* 14.00)	
41.5	7,320	—	Budapest (Hungary). (*Tech. Sch.*) (07.30–08.10.)	
41.5	7,230	HB9D	Zurich (Radio Club) (Switzerland). (*1st and 3rd Sun.*)	
41.6	7,211	EAR58	Teneriffe (Radio Club) (Canary Islands)	
41.7	7,195	VS1AB	Singapore (Malay States). (*Sun. and Wed.* 15.30.)	
42.0	7,143	VK2HR	Sydney (Australia)	
43.0	6,970	EAR110	Madrid. (*Tues. and Sat.* 23.30)	
43.0	6,970	PK3BK	Soerabaia (Java). (*Tues. and Thurs.* 11.10)	
45.0	6,667	FM8KR	Constantine (Algeria). (*Mon. and Fri.* 23.00.)	
45.0	6,667	PL3CH	Soerabaia (Java). (*Mon., Wed.* 12.40)	
45.38	6,611	REN	Moscow	
46.69	6,425	W3XL	Bound Brook, N.J. (U.S.A.). (*Fri. and Sat.* 22.00.)	
48.0	6,250	CN8MC	Casablanca (Morocco). (*Relays Rabat*)	
48.35	6,205	HKC	Bogota (Colombia). (*Daily* 16.00)	
48.62	6,170	HRB	Tegucigalpa (Honduras). (*Daily* 01.00)	
48.65	6,167	X1F	Mexico City (Mexico)	
48.8	6,147	VE9CL	Winnipeg (Canada). (*Daily ex. Sun.* 00.30)	
48.86	6,140	W8XK	East Pittsburg, Pa. (U.S.A.). (*Relays KDKA.*)	
49.02	6,120	W2XE	Long Island, N.Y. (U.S.A.). (*Relays WABC.*)	
49.05	6,122	F3ICD	Saigon (Fr. Indo China). (*Daily* 12.30)	
49.18	6,100	W3XAL	Bound Brook, N.Y. (*Relays WJZ.*)	
49.22	6,095	VE9GW	Bowmanville, Ont. (Canada)	
49.34	6,080	W9XAA	Chicago, Ill. (U.S.A.). (*Relays WCFL*)	
49.34	6,080	W2XCX	Kearny, N.J. (U.S.A.). (*Relays WOR*)	
49.4	6,072	UOR2	Vienna. (*Tues.* 13.00, *Thurs.* 15.00, *Sat.* 23.00.)	
49.4	6,072	ZTJ	Johannesburg (S. Africa). (*Daily* 16.30)	
49.43	6,069	VE9CS	Vancouver, B.C. (Canada)	
49.46	6,065	—	Motala (Sweden). (*Relays Stockholm*)	
49.5	6,060	W3XAU	Philadelphia, Pa. (U.S.A.). (*Relays WCAU.*)	
49.5	6,060	W8XAL	Mason, Ohio (U.S.A.). (*Relays WLW*)	
49.5	6,060	VQ7LO	Nairobi (Kenya Colony). (*Daily* 16.30)	
49.59	6,050	VE9CF	Halifax (Nova Scotia). (*Relays CHNS*)	
49.67	6,042	W2XAL	Coytesville, N.J. (U.S.A.). (*Relays WRNY.*)	
49.7	6,040	PK3AN	Soerabaia (Java). (*Daily* 11.40)	
49.83	6,020	W9XF	Chicago, Ill. (U.S.A.). (*Relays WENR*)	
49.96	6,005	HRB	Tegucigalpa (Honduras). (*Daily ex. Sun.* 00.00–05.00.)	
50.0	6,000	EAR25	Barcelona, Radio Club (Spain). (*Sat.* 21.00.)	
50.0	6,000	RW59	Moscow	
50.0	6,000	—	Bucharest (Roumania)	
50.0	6,000	ZL3ZC	Christchurch (New Zealand). (*Wed.* 03.00, *Sat.* 07.30.)	
50.26	5,970	HVJ	Vatican State, Rome. (*Daily* 20.00)	
51.22	5,857	XDA	Chapultepec (Mexico)	
54.52	5,502	W2XBH	Brooklyn, N.Y. (U.S.A.). (*Relays WCGU*)	
58.0	5,172	OK1MPT	Prague (Czechoslovakia). (*Tues. and Fri.* 20.30.)	
58.3	5,145	PMY	Bandoeng (Java). (*Tues.* 14.40)	
62.5	4,800	W2XV	Long Island, N.Y. (U.S.A.). (*Fri.* 23.00)	
70.2	4,273	RW15	Khabarovsk (Russia). (*Daily* 10.00–13.00)	

RECEIVERS for DISTANT RECEPTION.

RECENTLY DESCRIBED.



Showing the principal components above the metal-covered baseboard.

The Wireless World MONODIAL A.C. SUPER.

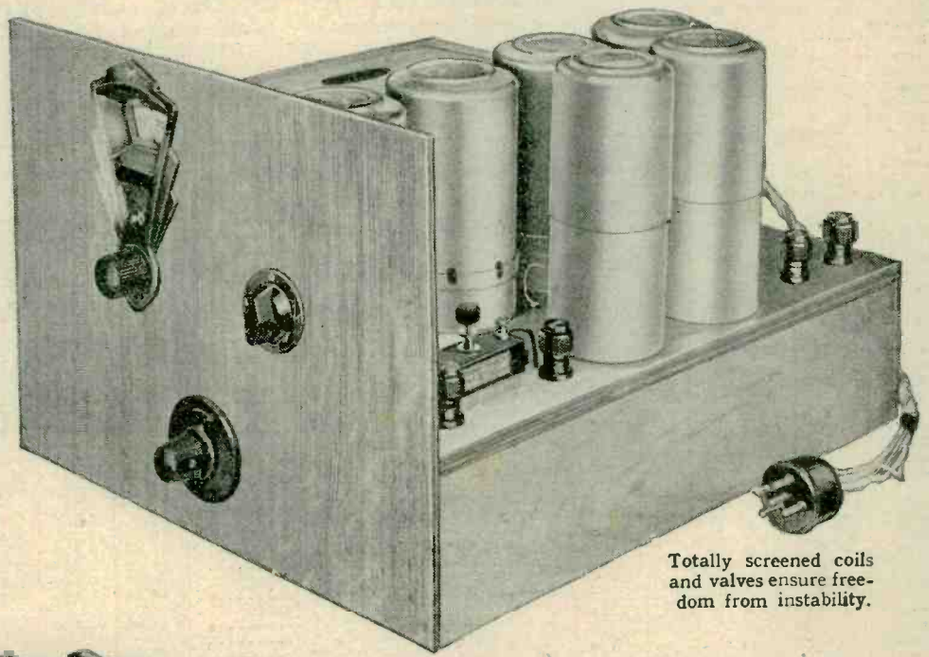
THIS seven-valve ultra-selective superheterodyne receiver has been specially designed for the long-distance listener who wishes to have all the European stations at his command. Simple to construct, it is also simple to operate, being equipped with one-dial tuning and the ideal form of volume control made possible by the use of variable-mu valves in both the preliminary H.F. and intermediate stages. During initial tests after ganging adjustments had been made, some 120 different stations were logged.

With selectivity of so high an order due to the presence of band-pass filters with no fewer than 8 tuned circuits, some sideband attenuation takes place, but the high notes reduced in the early stages of the receiver are restored to their full brilliancy by a special tone-correcting valve stage in the L.F. amplifier. The equipment comprises two separate units—a receiver chassis and a power unit—both of which are built on metal-covered baseboards.

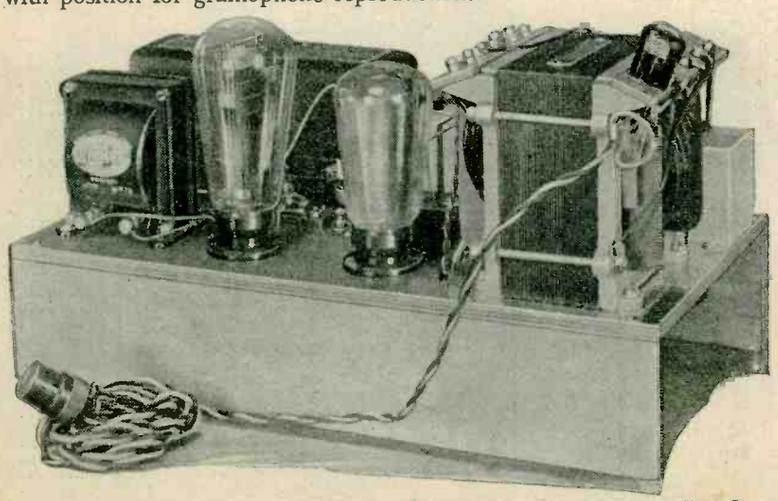
The Monodial A.C. Super, which was described in our issues dated April 13th, 20th and 27th, 1932, will give the listener in any part of the British Isles interference-free reception with good quality from every station of reasonable power on the Continent.

The Wireless World MODERN STRAIGHT FIVE.

A LONG-RANGE sensitive set for the connoisseur of quality reception. A "Straight" design is followed comprising two variable-mu H.F. stages, power detector and an output stage capable of giving superlative quality of reproduction from at least 50 different stations. An output valve able to deliver between 5,000 and 6,000 milliwatts undistorted A.C. energy to the speaker has been chosen; this is sufficient even for the largest rooms and ensures that music will sound "live" and natural through being rendered at about the original volume level. The volume can, however, be perfectly regulated by the variable-mu control. Provision has been made for a gramophone pick-up and the power amplifier is particularly well suited to the reproduction of records. Like the Monodial A.C. Super, the receiver (described on June 22nd and 29th, 1932) is composed of two units, the power pack being so designed as to be equally suitable for following the Monodial receiver chassis. The three controls consist of dual volume control and mains on-off switch, single dial tuning with illuminated scale, and waveband switch with position for gramophone reproduction.



Totally screened coils and valves ensure freedom from instability.



The power amplifier has a straightforward layout and is easy to build. It is connected to the receiver chassis by a five-membered cable and plug.

POWER UNIT suitable to follow either of above receiver chassis.

CAPABLE of delivering 5 to 6 watts undistorted A.C. energy, this power pack can be connected to the output of either the A.C. Monodial or the Modern Straight Five receiver units (illustrated above). The circuit and general design conform to the most advanced amplifier technique.

To prevent parasitic H.F. oscillations in the output stage special circuits are arranged in both grid and anode of the power valve, and mains background noise is practically eliminated by electrostatic screening of the primary of the mains transformer. To safeguard condensers from high voltages during the period while the valves are warming up, a thermal delay switch has been included so that the H.T. circuit is not completed until one minute has elapsed after switching on. Comprehensive decoupling and generous smoothing equipment ensure freedom from L.F. instability and mains hum.

The amplifier was described in the issues of *The Wireless World* dated June 22nd and 29th, 1932.

The Wireless World

A PRACTICAL RADIO JOURNAL

(22nd Year of Publication)

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CONTENTS OF THIS ISSUE.

EDITORIAL COMMENT.

The D.C. to A.C. Change.

THE change from direct to alternating current is taking place at the present time all over the country, and as the scheme is likely to take several years before it is completed, we may anticipate that for a long time to come these changes in the nature of the supply will occur to disturb the user of mains wireless sets. This being so, it seems highly desirable that a consistent policy should be adopted by all electricity supply authorities in their attitude towards the consumer in the matter of replacements of wireless apparatus or compensation for the effects of the change. There is at the present time a great deal of ill-feeling on this question, and this is intensified from the consumer's point of view because of the extraordinarily divergent views of the different electricity authorities.

We have come across numerous instances where very large sums have been paid out by way of compensation in adapting consumers' D.C. sets to make them suitable for operation on the new supply, whereas in adjoining districts consumers have been bluntly told that no compensation or modification of apparatus will be entertained, and in many cases, because of lack of persistence or influence on the consumer's side, the supply authorities have been able to get away with this attitude.

It seems to us that some middle course should be adopted. It is absurd for the supply authorities to imagine that in face of the well-defined regulations relating to a change of supply they can treat the consumer with indifference, whilst at the same time no reasonable consumer ought to expect an over-generous attitude to be adopted by a supply corporation which is, in any case, involved in considerable capital outlay in connection with the change.

We would suggest that a scale of compensation should be devised, limited to a certain maximum figure and perhaps graded in terms of the number of valve stages in the consumer's existing set. It ought not to be difficult to devise some such scheme which would be acceptable on both sides, but the outstanding and most urgent requirement is that a uniform policy should apply throughout the country.

Above all, we urge that no suggestion of a distinctive rate for using wireless sets from the mains should ever be entertained. Such a scheme is not only ridiculous on the face of it, but would be absolutely unworkable in practice. There is already a tendency to introduce far too many regulations in this country in various directions which depend for enforcement on the honesty of the individual, but are always open to being disregarded for lack of means of enforcement.

New Language Records.

EDUCATIONAL bodies all over the country have taken note of the fact that interest in learning foreign languages has increased at an enormous pace during recent years. Figures giving evidence of this tendency have been published frequently and it has been suggested that it is a part of the new international outlook and is directly associated with the increasing interest in foreign travel. But it would seem to us that there is a more obvious reason for this growing interest in languages other than our own. Broadcasting has brought foreign tongues into our homes, and just as we should feel ill-at-ease at having to entertain as our guests foreigners whose language we could not understand, so when we hear ourselves addressed through the medium of our sets in various languages from abroad we become bitten with the desire to understand what is being said.

Elsewhere in this issue we refer to a new series of language gramophone records which have been designed to teach languages in what is probably the most efficient method possible, namely, by hearing the spoken word in conjunction with a printed guide. The study of these records, supplemented by listening direct to transmissions from stations abroad, will give an added interest to the foreign broadcast programmes.

Navigation by Wireless

By
C. G. PHILLIPS, B.Sc.

In the "No Man's Land" of the Broadcast Listener.

BETWEEN the medium and long broadcast wavebands the ether is alive with various Government and commercial services of which the ordinary listener knows little. This article deals with those vital wireless services which have made life so much easier for navigators on sea and in air.

ON most present-day broadcast receivers there is a kind of "No Man's Land" between about 500 and 1,100 metres, and not a few listeners probably imagine that there is nothing to be heard in this gap. One of the chief uses to which this band of wavelengths is put is the handling of traffic which, in various ways, assists navigation.

At present, navigation can be divided into two main groups, the first being marine and the second aerial. Special services exist for each of these, catering for the particular requirements of shipping and aircraft. The greatest aids afforded by wireless to navigation are those applying to distress, position finding, and weather reports.

Let us take the case of shipping first.

The chief maritime application of wireless, and perhaps the only one which is appreciated by the public, is that of saving life, and there are special arrangements made for dealing with ships in distress.

On the 600-metre wave, where most of the ship-to-shore work is carried out, there are two listening periods in each hour, from fifteen minutes past to eighteen minutes past,

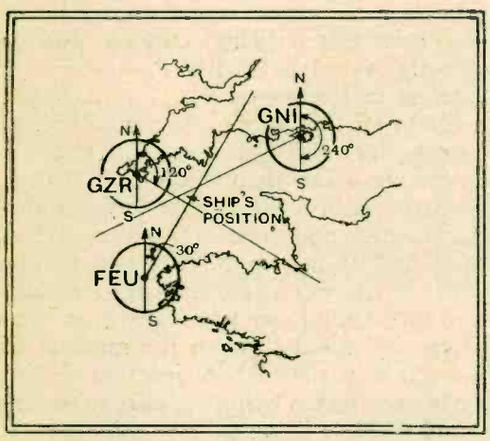


Fig. 1.—This shows how a ship's position is plotted from three land stations :—GZR (120°), GNI (240°) and FEU (30°).

and from forty-five to forty-eight, during which all stations must cease transmitting and listen for SOS signals. A ship in distress sends the "alarm signal"—a series of dashes—which operates any auto alarms attached to receivers of ships in the vicinity, and brings operators on watch, if they are not already there. This is followed by the distress call SOS, the name of the ship, the position, and particulars of the distress. Usually the ship nearest the distressed vessel takes charge of the situation, all other stations being requested to cease transmission. When contact has been established arrangements can then be made for other ships to go to its assistance, and messages are also handled between the master of the vessel and the owners regarding what to do in the particular circumstances.

If necessary, contact can also be established with one of the many ocean-going tugs which are always standing by for such emergencies.

Besides life-saving, there are many other ways of assisting sea-going navigators, among which D/F (direction finding) work is of considerable significance. There are several methods by which a ship can establish its position by wireless. The oldest method is the one by which two or three land stations take bearings on the ship simultaneously and plot these on a chart. The three lines usually form a small triangle, and the centre of this is taken to be the ship's position.

Finding a Ship's Position.

The system in general use is the goniometer or Bellini-Tosi method. Two single loop aerials are rigidly fixed exactly at right angles to each other, and these are connected to two fixed coils inside the station, also at right angles to each other. Inside these coils is symmetrically placed another coil, called the search coil, which can be rotated about a vertical axis, and which is connected to the input of the receiving gear. The operation is as follows.—

A signal whose direction makes an angle of θ with the loop AB will induce in it an E.M.F. proportional to $\cos\theta$ and in loop CD proportional to $\cos(90-\theta)$. Currents exactly proportional to each of these will be induced in the smaller loops and they will produce a resultant field identical in direction with the original field. A small rotating coil placed in this field will behave exactly as an ordinary frame aerial with direct signals, *i.e.*, when at right angles to the resultant field the minimum E.M.F. will be generated and a minimum signal will be heard in the receiver. The coil is rotated by a handle and pointer which moves over a circular scale graduated from 0-360 degrees. The goniometer is calibrated and is then available for supplying

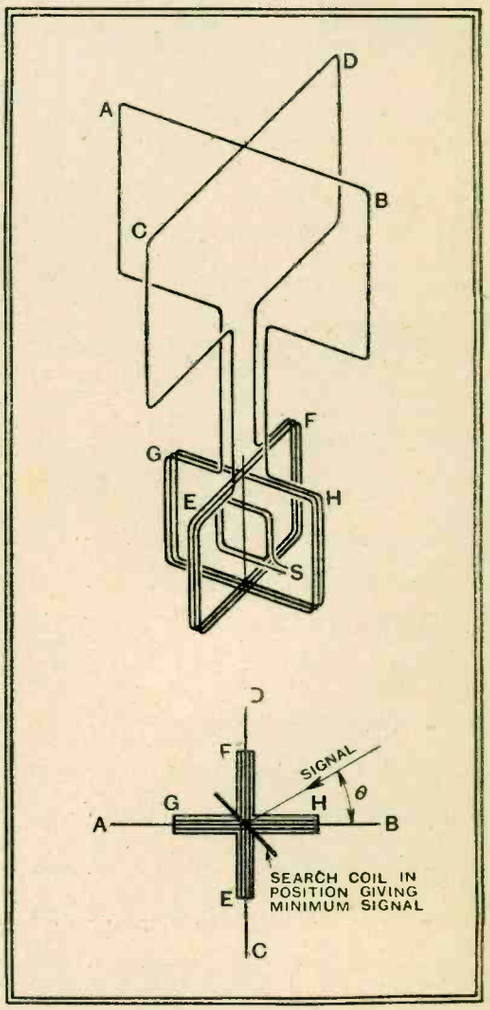


Fig. 2.—Perspective and plan views of the Bellini-Tosi system of direction finding. AB and CD are the outside loop aerials, EF and GH being the interior field coils; S is the section coil.

Navigation by Wireless.—

bearings. This system has advantages over the Robinson rotating frame aerial, as the search coil is very light and rapid or "snap" bearings are easily taken. The "sense," *i.e.*, the side of the station on which the ship is, cannot ordinarily be determined, but this is usually known, or can be found with special "sense finding" apparatus.

The drawbacks to this method are (*a*) the expense to the owners, as each position costs about 5s., and (*b*) the time taken to supply a number of ships with bearings.

Most ships are now fitted with D/F apparatus, and they can take bearings on any known stations at any time they wish, and a large number of vessels can do this simultaneously, as no transmission takes place from the ship. The stations working on 600 metres do not usually send for long periods, so a special system of radio beacons is being built up around British and foreign coasts. These are transmitters of ½ to 1½ Kw, operating on a wavelength of about 1,000 metres. They are installed at many points around our

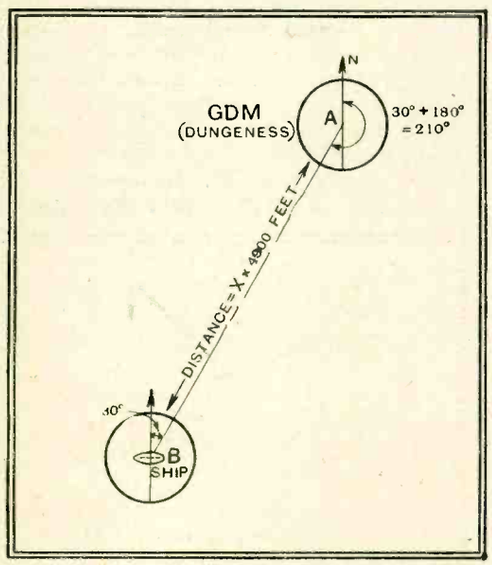
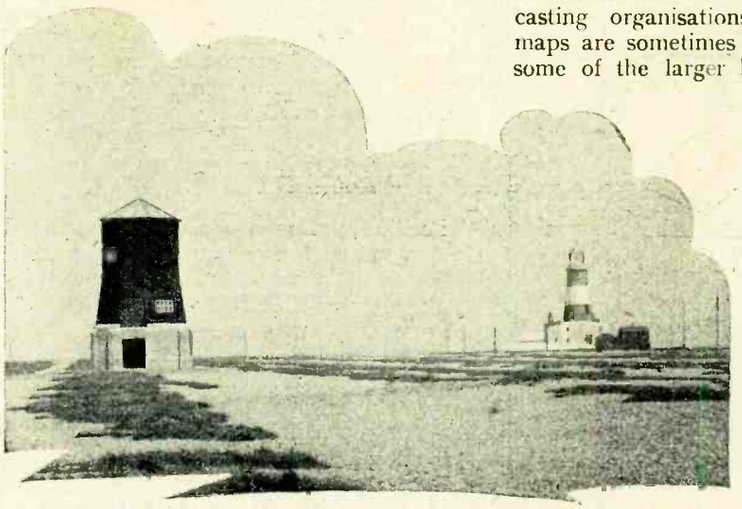


Fig. 3.—Showing (a) the method of plotting bearing when D/F apparatus is on board the ship. (b) Determining distance by wireless and submarine sound signal in conjunction, the time interval between each being x seconds. The line AB is drawn at the correct angle from A, and the distance 4,900x is then cut off, thus giving the ship's position.

coast, usually in lightships or near lighthouses, and are automatically operated by a device which switches on the transmitter at predetermined times, the transmitter sending a characteristic signal. The English radio beacons are arranged to send a call sign, such as GDM, nineteen times, followed by a long dash and GDM sent once again. This gives a good signal for D/F purposes. From the bearing of the beacon on the ship, the reciprocal bearing, *i.e.*, that of the ship on the beacon, is calculated and can then be plotted on a chart.

A further development of the radio beacon makes D/F work still more simple, the only apparatus required on board being a receiver and an accurate stop watch. A beacon of this type is in operation at Orfordness, and consists of a directional aerial, rotating at a uniform rate of one revolution per minute. Two dots, known as starting signals, are emitted when the minimum signal is radiated north or east, the remainder of the time being occupied by a continuous dash. The operator on board starts his stop watch at the instant of hearing the north starting signal unless he happens to be due north of the beacon, when the east starting signal must be used. When the minimum signal is heard



The radio beacon at Orfordness.

in the phones the watch is stopped, and the number of seconds multiplied by six gives the bearing in degrees of the ship from the beacon.

A similar system is one which sends a characteristic signal on each compass bearing by means of a rotating beam aerial. A beacon of this type was for some time in operation at Inchkieth, Scotland, working on about 6 metres.

Submarine Signalling.

Besides being able to find its bearing from a beacon, a ship can also find its distance if the beacon is equipped with submarine signalling apparatus. Certain characteristic signals are emitted simultaneously by the radio beacon and the submarine transmitter. They are not received simultaneously at the ship, because, whereas the W/T signal requires no appreciable time to cover the distance between beacon and ship, the sound travels comparatively slowly (at 4,900 feet per second) in water, so that the time interval in seconds between the arrival of W/T and submarine signal, multiplied by 4,900, gives the ship's distance in feet from the beacon. Both the bearing and the distance along this line being found, the position is known. D/F bearings may be plotted on a gnomonic chart without correction, since great circles appear as straight lines, but if a mercator's chart is used, a convergency correction must be applied.

Present-day D/F apparatus is capable of fair accuracy under favourable conditions, bearings within one or two degrees being obtainable, but serious errors arise when bearings are taken at dusk or dawn, or when the bearing line cuts the coast line at an acute angle, and to combat this the Marconi-Adcock system has been evolved.*

Weather plays a very important part in navigation, and W/T again proves very useful in communicating meteorological information to and from ships at sea. Weather forecasts are prepared twice a day by the meteorological institutions of most countries, and are sent out by radio telegraphy for the benefit of shipping. The ships themselves often co-operate in the preparation of these forecasts by sending in by radio reports taken at certain fixed times to the weather forecasting organisations. Complete weather maps are sometimes sent by Fultograph to some of the larger liners. Gale warnings, identical with those we sometimes hear from B.B.C. stations, are radiated on the 600-metre wavelength, preceded by the International safety signal, T T T, and thus masters of ships receive a warning long before they would have done by direct observation and can make provision accordingly.

Another important service entrusted to the wireless organisations of maritime countries is the sending of navigational warnings, giving information about changes in the position of light buoys or land marks, or details of dangerous wrecks and floating mines. In the ice season, ice warnings are sent, containing advice as to the best passages for vessels to take.

Time is a vital factor in the older methods of position finding, and in this connection many countries have organised services of time signals, sent out from their high power commercial stations, and having a high degree of accuracy. They can usually be received in any part of the world.

Many of these services are now radiated by the B.B.C., so that ships not carrying regular W/T operators have the benefit of much useful information.

The application of wireless to aerial navigation has developed on similar lines to those

The D/F apparatus on Sir Douglas Mawson's Arctic exploration ship, "Discovery II."

* See *The Wireless World*, February 24th, 1932, pp. 192-195.

Navigation by Wireless.—

of marine navigation, but with modifications made necessary by the peculiar needs of aircraft.

Aircraft differ fundamentally from ships in two respects. First, they travel at a much greater speed, and secondly, they can move in three dimensions instead of two. Further, any wireless apparatus to be carried in the air must be specially designed so as to be as light as possible.

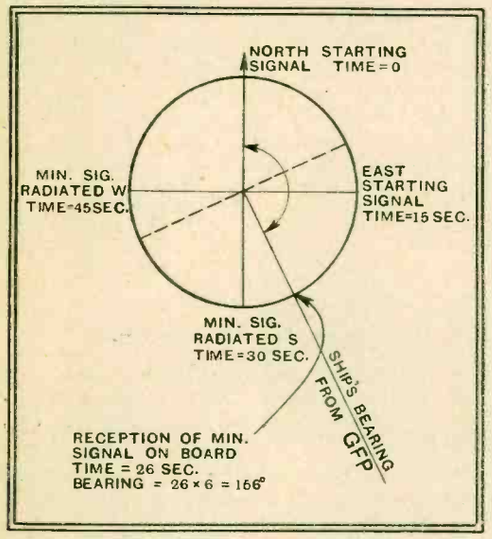
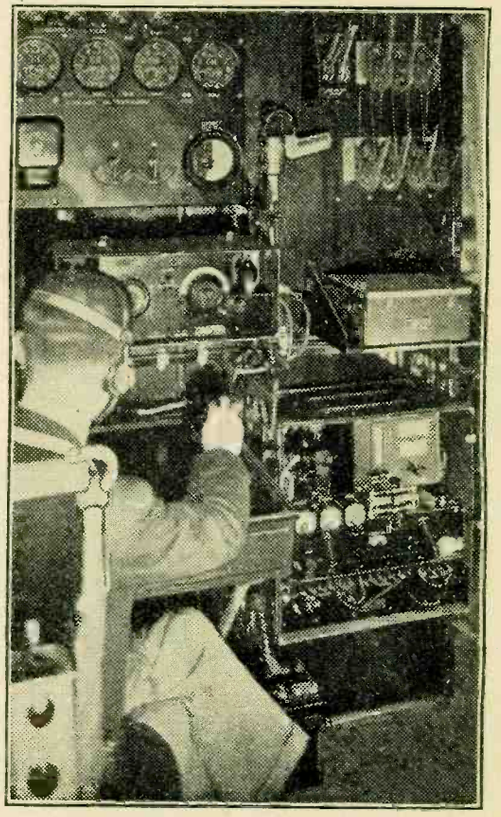


Fig. 4.—How a ship's bearing is found from the Orfordness Beacon.

In the air, as at sea, safety of life is the first consideration, and on the European air lines all passenger-carrying machines are in constant communication with ground stations, and can immediately inform them of any trouble. This is particularly necessary when there are large stretches of sea or desert ground on the route, and there have been frequent cases of successful rescues from machines which have made forced landings, and communicated their positions to their bases.

Rapid D/F for Aircraft.

Position finding is again a very valuable feature in aerial navigation, since in addition to fog and darkness, there is the factor of low cloud to complicate matters. Since aircraft move rapidly, any successful method of D/F must be one which will give bearings in the minimum of time. Aircraft cannot usually carry elaborate apparatus, so the most commonly used method is that whereby the machine runs the transmitter for a short time while bearings are taken by three independent ground stations. These stations are situated at Pulham, Croydon, and Lympne in the case of the English service, and the bearings taken by Pulham and Lympne are communicated to Croydon by radio, where they are plotted on a special map in conjunction with the Croydon bearing, the position then being wirelessed from this station to the machine. As a rule only three or four minutes elapse between the machine running its generator and the receipt of the position, so this method has been developed to quite a high state of efficiency. Similar networks of D/F stations are working in other parts of Europe so that aircraft on any of the air routes can readily get their positions.



A typical passenger aircraft radio installation. The photograph was taken on one of the "Kent" type flying boats used on the Indian and African air routes.

A new application of directional transmission is one which automatically informs the pilot if he is on his correct course or not. In this system two identical loop aerials, each radiating the same power, are set up at right angles to each other, and arranged so that the bisector of the right angle coincides with the great circle course along which machines are to fly. Keying is so arranged that the spacing wave from one aerial coincides with the marking wave from the other so that if the machine is on the bisector, a continuous dash is heard. On either side of the bisector, one or other of the component letters predominates and warns the pilot that he is off his course. He then steers his machine until the continuous dash is again heard and he is once more on his correct course.

A modification of this system is the visual indication method, and this has been installed at Croydon Airport. In this case the carrier from each loop is modulated at a characteristic frequency, and the output of the receiver is connected to two vibrating reeds, each tuned to one of these frequencies. The amplitude of vibration varies with the signal strength, and if the machine is on its course, will be the same for each reed, two lines of equal length appearing on the dashboard, but when it is off course the lines become unequal. Pilots are informed how far they have gone along the course by low power "marker beacons" spaced at regular intervals.

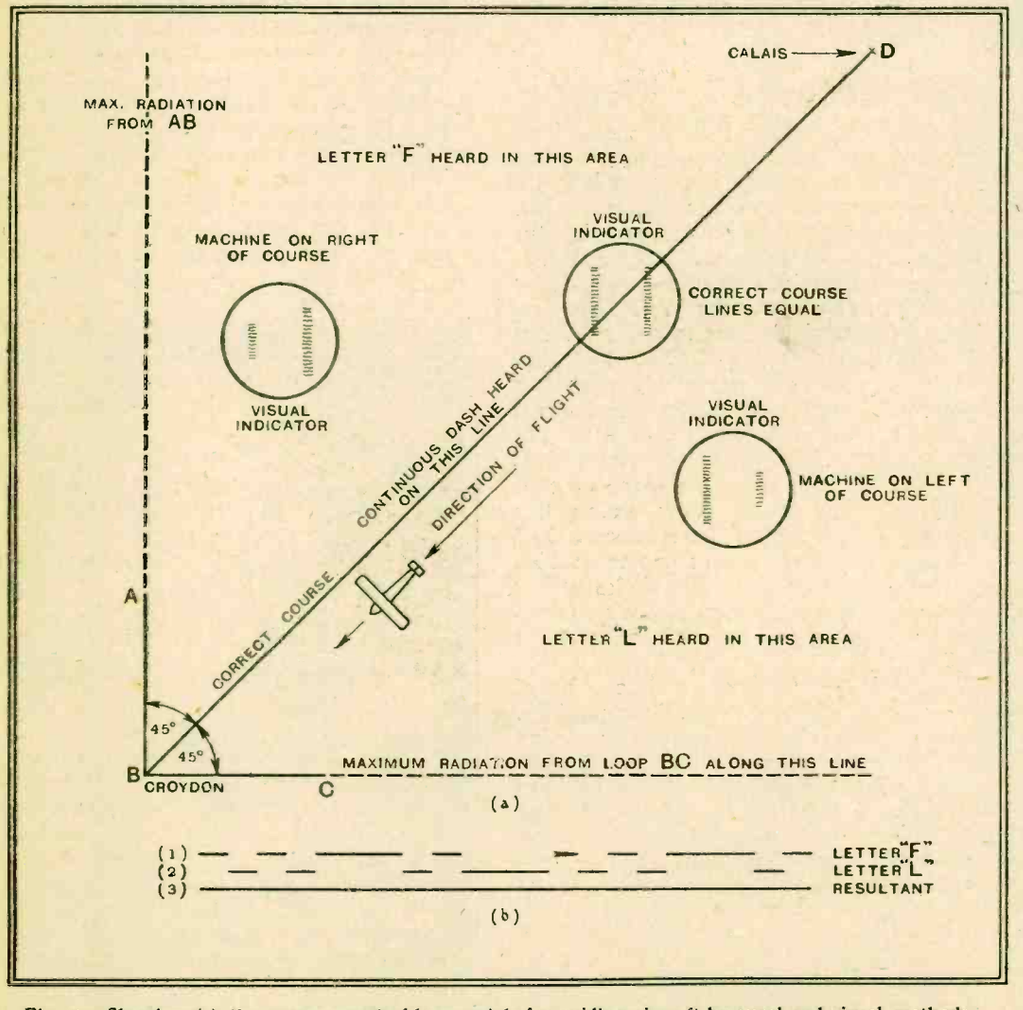


Fig. 5.—Showing (a) the arrangement of loop aerials for guiding aircraft by aural and visual methods. In (b) it is shown how marking and spacing waves of letters "F" and "L" fit in and give a continuous dash if both are of equal strength.

Navigation by Wireless.—

Weather is even more important to aircraft than to shipping, since the effect of wind is much more pronounced, and as a result, there is a very efficient weather reporting organisation in operation on all the European air routes.

Hourly observations are taken at various stations on the routes, and if these are equipped with transmitters, the reports are sent out in code, although in some cases a central station transmits the observations for a number of points in one country. These reports contain a very full account of conditions, including wind direction at various altitudes, visibility, amount of cloud, height of lowest cloud, and general information as to the nature of the weather. By an ingenious international code, all this is condensed into a few groups of figures, thus shortening the message considerably, and incidentally avoiding language difficulties when the reports are taken by other countries.

Choosing Route and Height.

These hourly route reports are taken down and decoded by other stations on the air lines, and are then available for any machine requiring them. At Croydon they are also exhibited on a map, so that pilots can get some idea of conditions before leaving the ground. Knowing the wind velocity and direction at various altitudes, pilots can decide which is their best flying height, and as there are considerable variations in direction at different levels, this is a very important point, for naturally if a following wind is available at any particular height, then that height is chosen. Machines in flight can always get up-to-date information on weather conditions from ground stations and can apply it to the choice of their route.

Position reports are regularly sent in by aircraft, and plotted on a map at the control station, so that in case of low visibility warning can be given to two machines which are close together and in danger of collision.

As a result of the development of W/T in connection with aerial navigation, there has been a considerable increase in night flying, and it is now possible for machines to be guided almost completely by ground stations, even though bad weather conditions prevent the pilot from getting a glimpse of the earth.

In the case of service flying, most of the above principles are equally applicable, but a further application of W/T is found in the manœuvres which take place from time to time. The machines report their positions to their headquarters, and the staff there are enabled to get a bird's eye view of the situation, and can direct operations very much more effectively than by other means.

Although most of this work takes place in the morse code, and is unintelligible to the average listener, some very interesting hours may be spent on 900 metres, where a certain amount of telephony working takes place between ground stations and aircraft, and the A.A. weather reports for private flyers are radiated on 833 metres (telephony). Yet the vast majority of ordinary listeners, many of whom own sets which will cover these wavelengths, appear to be totally unaware that the ether is used for any other purpose than the propagation of song and story. Often more romance can be found in "No Man's Land" than in any broadcasting studio.

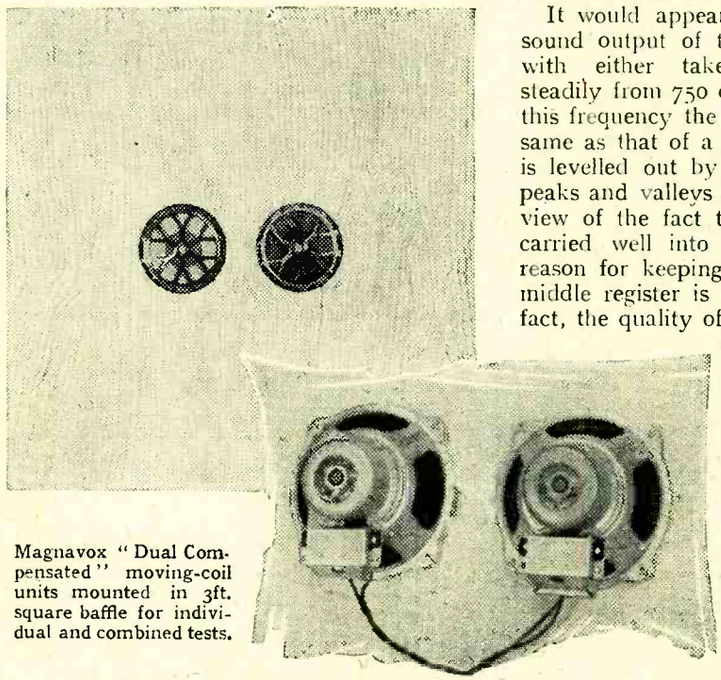
DUAL UNIT LOUD SPEAKERS.

Advantages Exemplified by New Magnavox Units.

THE idea of using dual loud speaker units to improve frequency response and increase efficiency and power-handling capacity is not new to readers of this journal. As long ago as June, 1930, we gave a constructional article showing how to combine the output from two moving-iron units to obtain a practically uniform response from 50 to 6,000 cycles. More recently the review of the R.G.D. "Supersonic" radio-gramophone afforded an example of the use of dual moving-coil loud speakers in a commercially produced receiver.

In America there has been virtually a "landslide" in favour of dual-unit loud speakers. At the recent trade show in Chicago more than 80 per cent. of the new-season's models were equipped with reproducers of this type. This development would appear to be the result of a general reduction in the size of the cabinet work in the latest American sets. The problem which the loud speaker manufacturers have had to face is to satisfy the public demand for a full bass response with a reduced effective baffle area, but without increasing the bass resonance.

The method finally adopted involves the use of two units of slightly dissimilar characteristics in which the principal resonances are off-set or "staggered," and it is found that many advantages emerged other than those for which the system was originally evolved.



Magnavox "Dual Compensated" moving-coil units mounted in 3ft. square baffle for individual and combined tests.

These are well exemplified in the Magnavox "Dual Compensated" units which are now available in this country. Externally the units resemble the type D.C.140, with the 7in. diaphragm, but the weight and texture of the diaphragm has been modified in each case to suit the special requirements of dual working. The speech coils are connected in parallel and supplied from a single output transformer attached to one chassis.

Frequency measurements on a pair submitted for test revealed that one unit (with black diaphragm) had a bass resonance at 80-85 cycles, and was more efficient in the medium-high register between 1,000 and 2,000 cycles than in the extreme top. The other unit (with grey diaphragm) was best in the top register between 2,000 and 6,000 cycles and less sensitive in the medium-high than the black-diaphragm unit; the bass resonance was at about 90-95 cycles. In both units the middle register from 150 to 750 was lower than usual, and the output in the extreme bass in the region of 50 cycles was about 10 decibels below the general level of the curve.

Mutual Compensation.

The speech coils were then connected in parallel, care being taken to see that they were in the correct phase. The first effect to be noticed was a wonderful improvement in the extreme bass. At 50 cycles the output was up by at least 6 decibels, and neither of the individual bass resonances could be detected. The apparent disappearance of the principal resonances is quite in accordance with theory, for when one unit is at resonance its coil impedance rises, with the result that the other unit whose impedance is lower takes the greater share of the available current. This phenomenon also increases the power-handling capacity of the combination, since the limiting factor is the excursion of the diaphragm at resonance.

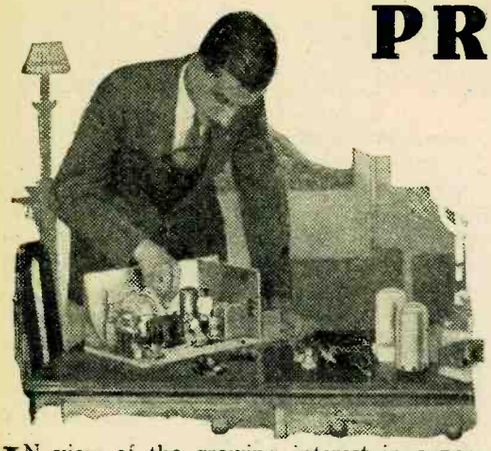
It would appear from our tests that the sound output of the dual units, compared with either taken separately, increases steadily from 750 cycles downwards. Above this frequency the general level is about the same as that of a single unit, but the curve is levelled out by the superposition of the peaks and valleys of each loud speaker. In view of the fact that the additive effect is carried well into the middle register, the reason for keeping down the output in the middle register is obvious. As a matter of fact, the quality of speech was excellent and quite free from hollowness. The improved bass response, without any defects due to prominent resonances, was, however, best appreciated when listening to music, which also demonstrated that brilliance in the upper register need not necessarily be accompanied by stridence.

To summarise, the chief arguments that can be advanced in favour of dual units are as follows: (1) Increased electro-acoustic efficiency, particularly in the bass and middle register; (2) better quality resulting from the levelling of peaks and vaileys in the upper register; (3) reduction in "boom" due to major resonances and increased power-handling capacity due to mutual shunting of speech coils in parallel.

Our experiments with the Magnavox units fully endorse these claims.

PRACTICAL HINTS AND TIPS.

AIDS TO BETTER RECEPTION.



IN view of the growing interest in super-heterodyne receivers, it seems advisable to emphasise the fact that the type of band-pass filter which employs a large coupling condenser, common to two circuits, is often unsuitable for this type of set. It is therefore advised, as a general rule, that the so-called "bottom-end capacity" filter, and also certain types of mixed filter, should be avoided.

Not for Super-heterodynes.

The use of such filters may introduce a peculiar form of interference, which has been traced to long-wave stations, at the frequency of which the coupling condensers in question offer a considerable reactance. Inductive filters, and filters coupled by "top-end" capacity, are free of this trouble.

WHEN starting to build a new set, there is a very natural tendency to waste no time over apparently unproductive preliminaries, but to begin operations by removing the components from their boxes and mounting them forthwith in their final positions. It is urged with some confidence that it is a far better plan to make a start by devoting half an hour to a thorough examination of all the parts, and even to carrying out rough electrical tests, before they are finally screwed down. If a defective piece of apparatus happens to have escaped the vigilance of the manufacturers' test department, it is much easier to detect a fault, whether it be electrical or mechanical, while the component is freely accessible, and while the work of testing is unhampered by interconnecting leads. In addition, a single faulty part may be responsible for damage to other components when first switching-on the finished set.

Making Haste Slowly.

Experience shows that attention may most usefully be devoted to the points mentioned in the following list.

It is worth while to go over the valve holders very carefully with a pair of pliers, and to make sure that all the contact springs or sockets are properly fixed in position, and are in firm electrical contact with the terminals. A valve may then be inserted in the holder to assure oneself that each of the pins is a good fit in its corresponding socket. Almost all modern valve holders are cleverly designed and well made, but one cannot expect these components, which obviously represent very good value at their present low prices, to have been subjected to exhaustive electrical and mechanical tests after assembly.

Even if a couple of dozen fixed condensers are to be included in the set, it will not take many minutes to test them roughly, and, by doing so, the possibility of an expensive short-circuit will be largely avoided.

Built-in trimmers on ganged condensers may be examined in order to make sure that the adjustment works properly, and that the thin sheet of dielectric which is usually included is in its correct position.

It is hardly necessary to test modern tuning coils electrically, but if they include built-in wave-change switches it is wise to make an examination, and even an electrical test, of the switch contacts. Indeed, all switches to be included in the set may well be tested, as these components are susceptible to damage, and are not generally given an electrical test by their makers.

Any mechanical moving parts that will be inaccessible after assembly should be examined, adjusted if necessary, and even lubricated, if it seems likely that they will benefit from this attention.

Although not directly connected with our present subject, it may be pointed out that solder does not take kindly to nickel plating, and so it is worth while to file away the external coating from soldering tags that have been treated in this way.

THE "Modern Straight Five," described in the issues of *The Wireless World* for June 22nd and 29th, is, as its name would imply, an entirely straightforward receiver; although it is completely up to date, there are no freakish or experimental features in its design. It will therefore be obvious that this set may be considered as a very satisfactory model to work to for those who wish to modernise an out-of-date A.C. mains receiver. All the H.F. and L.F. circuits are simple and easy to trace, but, due mainly to the use of an inter-connecting plug-and-socket arrangement, the anode feed system has a fictitious air of complexity. Readers who are building this set, as well as those who are using it as a basis for modifying existing receivers, may accordingly be interested in the simplified diagram given in Fig. 1.

Dissecting an Anode Feed System.

From this diagram it will be seen that the full H.T. voltage delivered by the rectifier, less a small drop in the smoothing choke LFC_1, is applied to the output valve.

Feed current for the detector and H.F. valve anodes is given extra smoothing by means of the speaker field winding, and at the same time voltage is reduced to a suitable value by this component in conjunction with an extra resistance (R_{23}).

The function of the resistance R_{15} is important; this may be regarded as an artificial load, in parallel with that normally imposed by the valves and the screening-grid potentiometer. Its purpose is to ensure that the voltage applied to the H.F. valve anodes and screens shall remain reasonably constant, irrespective of changes in current consumption brought about by variations of grid bias.

IT is often recommended that stage-by-stage tests of a receiver should be carried out by temporarily eliminating the H.F. stage or stages. To do this, the aerial is joined to the anode lead of the last H.F. valve through a very small condenser, and the set should then work as a simple detector-L.F. combination. If it does so, conclusive proof is afforded that any defect that may exist is in the H.F. amplifier or the input circuits.

Testing by Substitution.

When it is suspected that the coils used in an input band-pass filter are defective, the correctness or otherwise of this diagnosis may almost invariably be checked by carrying this test a stage farther, and substituting each individual coil in turn for the tuned winding which precedes the detector. From this point of view it is fortunate that all the tuned windings in a modern set are usually identical; the various coil assemblies differ only with regard to such additions as aerial coupling coils, filter coupling coils, and the positions of tappings, etc.

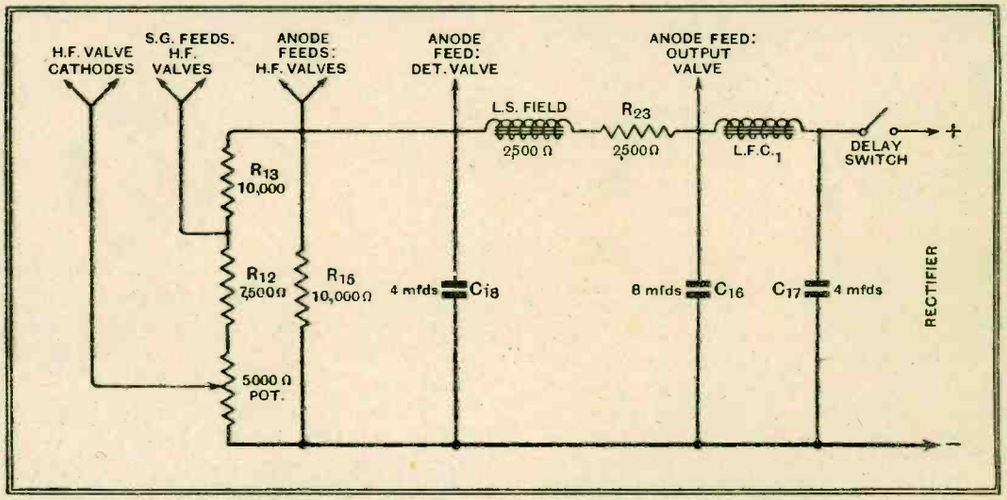


Fig. 1.—Anode feed system of the "Modern Straight Five": a simplified diagram showing how H.T. voltage is distributed to the various valves.

THIS note is for the benefit of readers who may wish to carry out experiments with the superheterodyne system of reception without going to the length of following a published design in its entirety.

Oscillator Feed.

As is well known, the phenomenon of frequency changing is brought about by injecting locally-generated oscillations into the grid circuit of the first detector valve. In most modern sets, at any rate when indirectly heated valves are employed, these oscillations are introduced by inductive coupling into the cathode circuit of the valve in the manner shown in Fig. 2 (*a*).

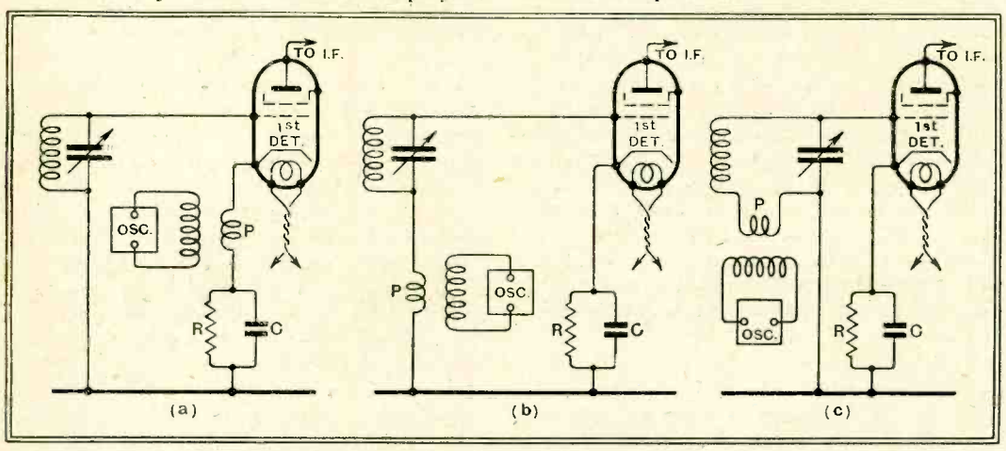


Fig. 2.—Various methods of introducing locally generated oscillations into the first detector grid circuit of a superheterodyne receiver. The usual bias resistor and by-pass condenser are indicated by R and C respectively.

In this diagram the transfer (or pick-up) coil is indicated at P; as a rule some half-dozen turns or so of wire are included in it.

Obviously, this method of introducing the frequency-changing oscillations is not applicable when using battery valves; it may also be inconvenient to use it in certain other circumstances. Alternative methods are indicated in diagrams (*b*) and (*c*).

In the first case, the pick-up coil is inserted in the grid-return lead of the first detector, while in the second it is in series with the tuned circuit, and at its low-potential end.

WHEN the maximum volume obtainable from a superheterodyne receiver is abnormally low, one naturally suspects the L.F. amplifier, and particularly the output valve, in just the same way as when dealing with an ordinary "straight" receiver. If it is found that this end of the set is in order, suspicion should at once be directed towards the I.F. amplifier; if really serious "side-band loss" is taking place here the apparent volume will generally appear to be small. Of course, if everything else is in order the loud speaker will be receiving a full measure of the lower frequencies, but as the ear—and possibly the loud speaker itself—is not very sensitive to these frequencies, we have at once an explanation of the effect.

Volume and High-note Loss.

When dealing with an up-to-date set with band-pass I.F. circuits, the remedy, of course, is to tighten the couplings. In a less modern set, with single-tuned circuits, practically all that can be done is to ensure that I.F. tuning is not being unduly sharpened by the effect of stray reaction; accordingly, both screening and decoupling of the various plate and grid circuits should be improved.

A VERY satisfactory form of tone control, affecting proportional amplification to the lower and middle frequencies only, consists of an air-cored L.F. choke, in series with a variable 25,000-ohm resistance, shunted across the primary of the L.F. transformer.

Bass Attenuation.

This arrangement has the advantage that it is applicable to the majority of modern receivers. A suitable inductance is 0.3 henry, which happens to be the value specified for the "Autotone" receiver, for which coils are obtainable commercially for a few shillings.

When the variable resistance is set at its maximum value, the choke is not effective to any great extent as a shunt for low frequency impulses, and so practically no modification of tone is introduced. Attenuation of the lower register increases proportionately as the value of the resistance is reduced.

A device of this sort can be turned to good account for compensating for over-emphasis of low notes in sharply tuned circuits.

IT was recently suggested in these columns that a loose valve base might be secured in position quite firmly by means of a wide rubber band. Another method of making a repair, which is in some cases preferable, is to introduce a few drops of methylated spirits into the valve cap at the loosened joint. In a few minutes the cement will be softened, when valve and base may be pressed together and put aside for the cement to set. When dealing with valves having a hole through the base, the spirit may be introduced at this point.

Another Valve-repairing Tip.

GOOD work is being done in combating the ill effects of man-made interference to broadcast reception, and already means have been found to restrict, if not to prevent entirely, radiation from most kinds of electrical machinery and apparatus.

Screened Aerial Down-leads.

As a result of studying the activities of various organisations that have been carrying out research in this direction, one is confirmed in the opinion that the problem is best attacked at its source, and that comparatively little can be done to remedy matters at the receiving end. But authorities in Germany and America, as well as our own Post Office officials, seem to be unanimous in admitting the possibilities of screening the aerial down-lead for a part, or even for most, of its length. Interference is often due to re-radiation from house-wiring, etc., and the down-lead is in a particularly favourable position to pick up this radiation.

Unfortunately there is another side to the picture—the use of screened lead-in wires is accompanied by special problems of its own. Capacity must be kept as low as possible, and the dielectric between the actual conductor and the earthed screen must not be allowed to introduce heavy losses. At the best, there is bound to be some falling-off in signal strength. The ideal insulating or dielectric material between conductor and shield is air, but it is obviously impossible to avoid the use of a certain amount of solid matter.

Our Berlin correspondent sends us photographs of screened wires that have been developed in Germany for general high-frequency work and for the particular purpose in question. The specimen shown on the left side of the accompanying illustration is intended for ordinary domestic use, and is relatively inexpensive. The conductor of this cable is insulated by means of a plaited covering of loosely twisted paper "string," which makes an efficient dielectric, of which the main constituent is air. Next comes a damp-proof insulated wrapping, and finally the external metal-braided cover.

The other illustration of a high-frequency cable shows an arrangement which approaches more closely to the ideal. Here the conducting wire is separated from the screen almost entirely by air, and is maintained in its correct position by means of a series of porcelain rings.

Showing the construction of low-capacity screened H.F. cable of the type suitable for shielding aerial down-leads.

Amateurs in this country who would like to try the effect of this method of shielding should be able to devise a cable of reasonably low capacity by employing a conductor of thin insulated wire in a loosely fitting braided metal tube of the type that is already obtainable commercially. It should be emphasised that lead-covered or braided wire of the type intended for L.F. work is totally unsuitable.

WIRELESS ENCYCLOPEDIA

No. 21

Brief Definitions with Expanded Explanations.

INDUCTANCE. ***The term generally employed to denote the degree of self-induction or co-efficient of self-induction of a circuit, and sometimes used as an alternative term for the property of self-induction.***

Self-induction is that electromagnetic property of a circuit by virtue of which an electromotive force is induced in the circuit itself whenever the current is changing.

SELF-INDUCTION is a property possessed by any circuit in the vicinity of which a magnetic field is produced when a current of electricity is passed through the circuit. The intensity of the field depends on the nature of the circuit and on the strength of the current. For instance, when an insulated wire is wound in the form of a solenoid or coil, a relatively powerful magnetic field is set up through the centre of the coil for a given value of current. An isolated magnetic pole situated in a magnetic field would experience a force, and the lines along which such forces act are generally referred to as *lines of force*, and the intensity of the field, or field strength, is defined as the force exerted on a unit magnetic pole.

In the case of a coil carrying a current the lines of force pass through the coil parallel to the axis, and spread out in a brush-like manner at the ends, as shown in Fig. 1. If any one line of action is followed completely round, it is found to be a completely closed loop, so that the field really consists of a number of closed magnetic loops linked with some or all of the turns of the coil.

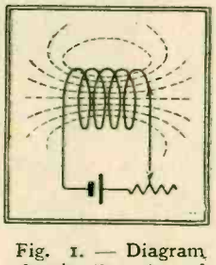


Fig. 1. — Diagram showing the nature of the magnetic field produced by a cylindrical coil.

The total magnetic influence passing through the coil is referred to as the *magnetic flux*, and is said to consist of a definite number of lines of force or "maxwells."

Now, it was one of Michael Faraday's greatest discoveries that, whenever the magnetic flux linked with a circuit is varied, an electromotive force is induced or generated in the circuit during the time of variation, and, further, that the value of this induced electromotive force is exactly proportional to the rate at which the flux is varied. Since each line of force is a closed loop, it follows that, whenever the number of loops linked with the circuit is varying, the turns or convolutions of the circuit must be "cutting" the lines of force, and this leads to another conception, namely, that, whenever a conductor cuts the lines of force of a magnetic field, an E.M.F. proportional to the number of lines cut per second is induced in the conductor.

Reverting to the case of Fig. 1, where the magnetic flux linked with a coil is produced by a current in the coil itself, it is obvious that, if the current is varied, the magnetic flux linked with the coil will vary also, being directly proportional in the case of an air-cored coil. From this it follows that *an electromotive force will be induced in the coil whenever the current is changing.* It is this property of the circuit which is referred to as self-induction, or sometimes as self-inductance. It should be noted that self-induction only manifests itself when the current is *changing*, and that the magnitude of the induced E.M.F. is proportional to the rate of change of current—the actual value of the current at any instant is quite immaterial.

The practical unit in which self-inductance is expressed is the *henry*; the self-inductance of a circuit is said to be one henry if one volt is induced in it when the current is changing at the rate of one ampere per second. The self-inductance of a circuit expressed in henrys is referred to as the *co-efficient of self-induction*, and it is usually denoted by the letter L.

If the current in a circuit of inductance L henrys changes from I_1 to I_2 amperes in t seconds, the average rate of change during this time is $\frac{I_2 - I_1}{t}$ amperes per second, and the average induced E.M.F. is equal to $L \times \frac{I_2 - I_1}{t}$ volts.

Lenz's Law.

It is of prime importance to know the direction in which the induced E.M.F. acts in relation to the direction in which the current is changing. This information is given by Lenz's law, which states that the induced E.M.F. of self-induction always acts in such a direction as to oppose the changing of the current. This means that if the current is increasing the self-induced E.M.F. will be in opposition to the applied E.M.F. which is actually producing the current, and is, therefore, negative with respect to the applied voltage, and sometimes called a "back E.M.F." or counter E.M.F. On the other hand, when the current is falling, the induced E.M.F. is in such a direction that it tends to maintain the current.

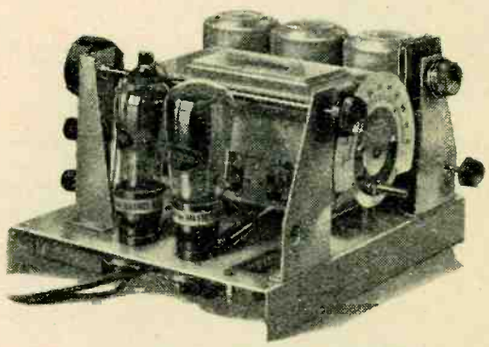
From this point of view self-induction may be considered as that which tends to prevent any change of current in a circuit, and it is therefore sometimes referred to as "electrical inertia." A heavy body resists the taking up of motion when a force is applied to it on account of its inertia—a back pressure proportional to the mass of the body and to the rate of change of velocity is brought into play. Once moving, the body tends to retain this motion, even after the impelling force has been removed. This mechanical law of motion is in every way similar to the law of self-induction, the term "electrical inertia" being justified.

Self-inductance plays a very important part in A.C. circuits, because the current is changing at all times, except those instants every half-cycle when it passes through the maximum values. A current varying according to a sine law causes a self-induced E.M.F. at every instant proportional to the rate of change of current. This induced E.M.F. also obeys a sine law, and is called a reactive voltage, its ratio to the current (R.M.S. values being taken) is called the *reactance* of the circuit, its numerical value being $2\pi fL$ ohms, where f is the frequency of the current. The current and induced E.M.F. are out of phase by a quarter of a cycle.

HAYNES "QUALITY" RECEIVER.

Four-valve Kit-Set for A.C. Mains Operation.

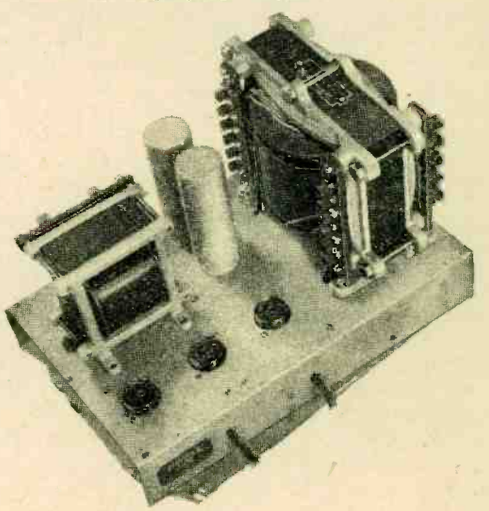
PARTICULARS of the circuit and other information relating to the "Quality" receiver introduced by Haynes Radio, 57, Hatton Garden, London, E.C.1, have been received by us in the form in which it will be available to



The receiver unit, incorporating the H.F. and detector stages.

the purchaser. From the illustrations reproduced from those supplied it will be seen that the apparatus is contained in two units, the one comprising the H.F. and detector circuits and all controls, while the other embodies the L.F. amplifier and mains equipment.

It is mentioned that particular attention has been given to the attainment of a high order of selectivity compatible with distortionless reproduction, and although long-range reception is not stressed, the arrangement of the circuit suggests that in this respect its performance will compare very favourably indeed with contemporary receivers having a similar number of amplifying stages.



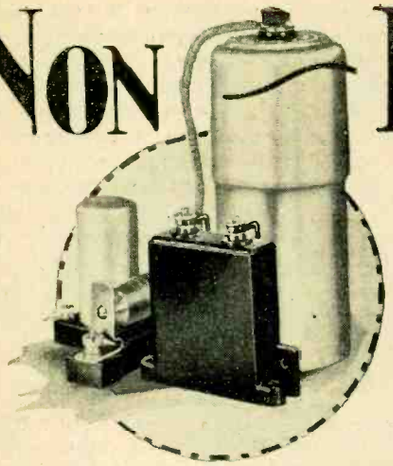
L.F. amplifiers and mains equipment are on a separate chassis.

The specification includes all the latest developments likely to enhance its performance even to the provision for operating dual compensated loud speakers.

NON INDUCTIVE CONDENSERS

Their Characteristics and Advantages.

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



IT is well known that stable high-frequency amplification of any magnitude is possible only with a screen-grid valve in which the interelectrode capacity has been reduced to a very small figure. It is, however, not so widely known that the internal screening of the valve is ineffective unless there is complete absence of H.F. signals on the screen, a condition necessitating the use of non-inductive by-pass condensers. The characteristics of this type of condenser and its many important applications in a modern receiver are dealt with in detail.

THE paper-dielectric condenser, of capacity from 0.1 to 4 mfds., has two distinct fields of use in a modern receiver. In principle, both are the same in that the condenser is used to provide a path of low impedance for an alternating current, while at the same time preventing the passage of direct current along the same route. Even outside the receiver proper the same holds good; in the H.T. unit shown diagrammatically in Fig. 1, for example, the current delivered by the rectifier, while consisting chiefly of d.c., will still have mixed up with it quite an appreciable a.c. component derived from the mains. Since full-wave rectification is in use, this a.c. current will have a frequency double that of the supply mains—probably, therefore, 100 cycles.

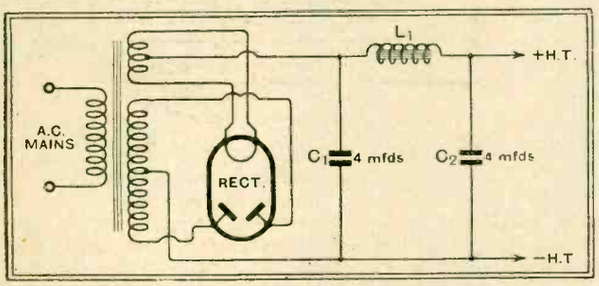


Fig. 1.—In the smoothing circuit of this eliminator the condensers C_1 and C_2 are included to by-pass alternating currents (hum) from the H.T. plus line to earth.

Short-circuiting Hum.

To 100-cycle voltages, the condenser C_1 has an impedance of about 400 ohms, thereby allowing quite a number of milliamps. to flow through it if the alternating voltage has the usual value of some 10 to 25 volts. To direct current, of course, C_1 offers an infinite resistance; the net effect of the condenser is therefore to drain away some of the ripple, and so lessen the hum in the receiver.

The choke L_1, being wound of wire, will pass direct current readily enough, but its impedance to the ripple will be high. It therefore tends to protect C_2 from the alternating voltages that are known to exist across C_1; C_2 is inserted to provide as easy a path as possible for such hum as L_1 fails to stop, allowing it to pass to earth instead of proceeding to the receiver.

Besides fulfilling an important rôle in the eliminator, the paper condenser finds numerous applications in the receiver. Two of its many uses in the low-frequency part of the set are shown in Fig. 2, which shows the circuit diagram of a power detector followed by an output valve. The output choke L_2 has to oppose the passage through it of the signal currents flowing in the anode circuit of the last valve, diverting them through the feed-condenser C_4 to the loud speaker. As before, C_4 has a large capacity in order that it may have as low an impedance as possible to the alternating currents representing the speech or music which have to pass through it, while at the same time it has to prevent the flow of direct current from anode to earth.

Short-circuiting Signals.

The resistance R_1 and the condenser C_3 inserted to provide decoupling for the anode circuit of the preceding valve have duties similar to those of L_2 and C_4, the main difference being that while the latter deal with wanted signals, the former are inserted to drain away signal-currents that might be harmful. It is not desirable to allow the signal-currents flowing through the anode-circuit of the detector to pass into the eliminator, since motor-boating or other troubles might result. They are therefore deflected by the resistance R_1 and persuaded to pass through C_3 to earth, so being rendered harmless. Once again, the condenser's sole duty is to act as nearly as possible as a short-circuit for the unwanted signals.

On the high-frequency side of the set the paper condenser is used most frequently to connect the screens of the screen-grid valves to cathode, as shown by the condensers C_5 in Fig. 3. Since the introduction of the variable-mu valve the condensers C_6, serving to connect the cathodes to earth, have also become necessary. In both these cases the condenser is intended to provide a path of the lowest possible impedance to the signals, which, at this stage of the set, are in the form of high-frequency currents. In the case of the screen condenser in particular, it is essential that the impedance offered to the signal currents should be as low as can possibly be managed, since the internal screening of the valve depends entirely upon the complete absence

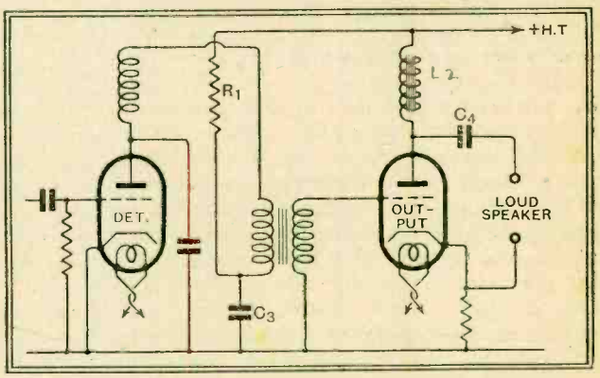


Fig. 2.—Both the output condenser C_4 and the decoupling condenser C_3 are required to have as low an impedance as possible to the signal-currents they have to pass.

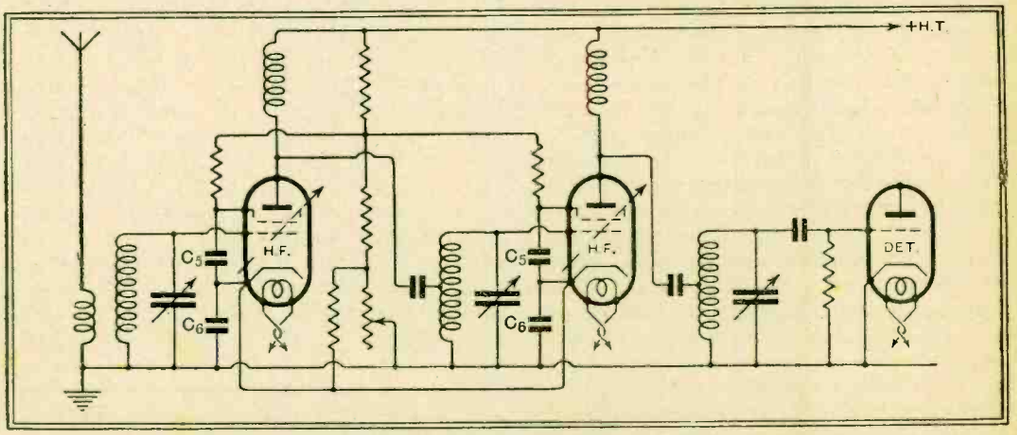


Fig. 3.—Two variable-mu stages of amplification. Condensers C_5 allow high-frequency currents to pass from screen to cathode; condensers C_6 pass them from cathode to earth. It is very desirable that non-inductive condensers should be used for all such positions as these.

Non-Inductive Condensers.—

of high-frequency voltages from the screen.

In the low-frequency cases it was suggested that the ideal could be approached by choosing a condenser of large capacity, and though this would at first sight appear to be just as good a solution in the high-frequency case, one has to walk warily.

Paper condensers are made of long strips

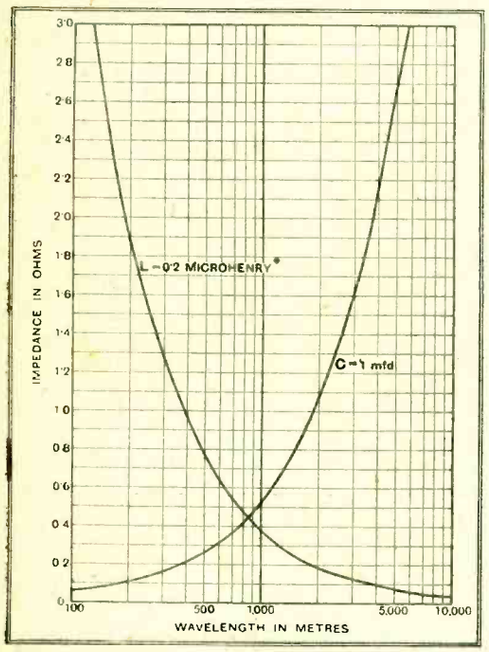


Fig. 4.—(Right) Curve showing impedance of a theoretically perfect 1-mfd. condenser at various wavelengths. (Left) The same for an inductance of 0.2 microhenry. This figure is typical of the "inductive" condenser.

of metal foil rolled up with paper interleaving, and it is very obvious that such an arrangement will mean that the condenser will behave to some extent like a coil of wire. It will, in fact, have inductance, unless steps are taken to prevent it, as well as capacity, and this inductance may have very disturbing effects at high frequency.

In Fig. 4 the curve marked "C=1 mfd." shows the impedance theoretically to be expected of a condenser of this capacity at wavelengths from 100 to 5,000 metres. It amounts to a little less than 0.3 ohm at 550 metres, dropping to about one-tenth of an ohm at 200 metres. If one could rely upon an actual condenser to have impedances no greater than this, one could accept it as a sufficiently close approximation to a complete short-circuit for all the practical needs of a screen-grid earthing-condenser.

Suppose, however, that the foils were so wound that they had an inductance of one-thousandth that of the average medium-wave tuning coil. This figure sounds minutely small, but the curve marked "L=0.2 microhenry" shows the impedance offered by this tiny inductance at various wavelengths. At 5,000 metres it is small; rising to just over a third of an ohm at 1,000 metres, 0.7 ohm at 550 metres, and nearly 2 ohms at 200 metres. Comparing this last figure with the 0.1 ohm of the perfect condenser at the same wavelength, it becomes clear that although the inductance of a condenser may be small, its effect may outweigh that of the capacity by nearly twenty times.

The combination of inductance and capacity is characteristic of a tuned circuit, and the wavelength to which such a circuit tunes is that for which the inductance and the capacity offer the same impedance. In the case shown in Fig. 4, this wavelength is about 850 metres, so that one might expect the total impedance of a 1 mfd. condenser of this inductance to be a minimum at this point.

The U-shaped curve of Fig. 5 gives the total impedance of such a condenser for a number of wavelengths. The minimum is reached at 850 metres (resonance), below which wavelength the impedance rises rapidly. The curve "C=1.0 mfd.," referring to a perfect condenser of this capacity, is repeated, for the sake of easy comparison, from Fig. 4. For all wavelengths below 600 metres the impedance of the inductive condenser is greater than it should be, the discrepancy increasing very fast as the shorter wavelengths are approached.

The use of such a condenser as this to act as a by-path for high-frequency currents from the screening-grid of a valve to earth or cathode (C_5 in Fig. 3) might well decrease the internal screening of the valves enough to cause instability at the lower wavelengths.

Avoiding Instability.

With intent to avoid this result, several makers of condensers have given considerable attention to the reduction of the residual inductance to much lower limits than those assumed for the calculation of the curve of Fig. 5. As a result of their research condensers are now available in which the residual inductance has been reduced until it is no more than one-tenth of the value upon which were based the curves we have just been discussing. If we take this decreased figure, which may be regarded as typical of the "non-inductive" condensers by first-class manufacturers, and work out the resulting impedance as before, we arrive at the results shown in Fig. 6. In this diagram the total impedance of a condenser of capacity 1.0 mfd., residual inductance 0.02 micro-

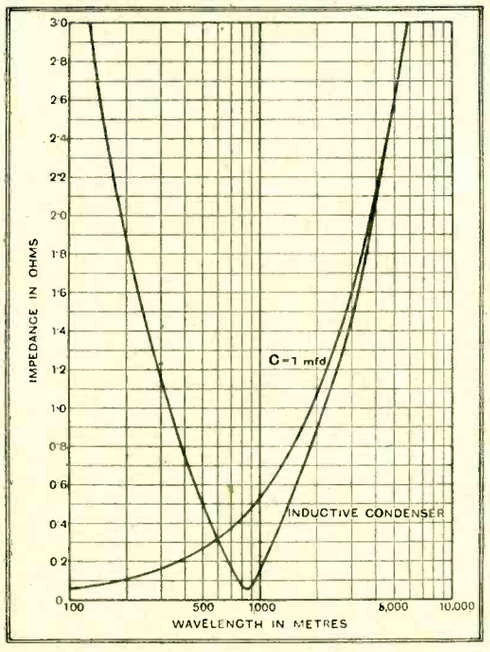


Fig. 5.—Total impedance of an "inductive" condenser (C=1 mfd., L=0.2 μH, r=0.05 ohm) at different wavelengths. For comparison, the curve of a perfect condenser of the same capacity.

henry, and H.F. resistance 0.05 ohm is compared with that of a theoretically perfect condenser of the same capacity.

Examination of the curves will show that the total impedance of the practical non-inductive condenser is the same as that of a theoretically perfect condenser at 200 metres, the minute residual inductance only affecting

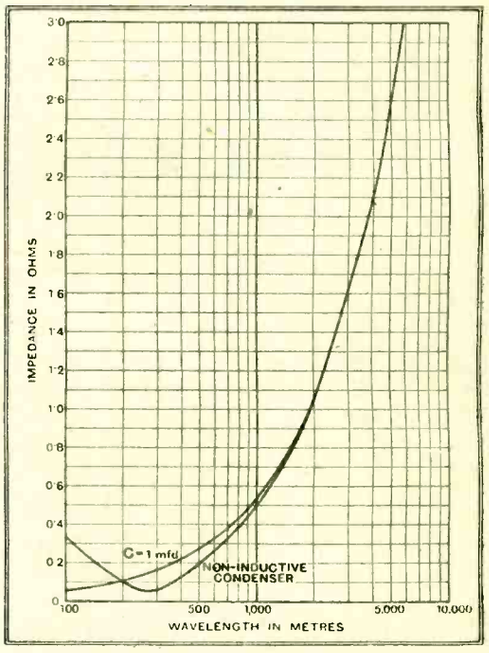


Fig. 6.—Total impedance of a "non-inductive" condenser (C=1 mfd., L=0.02 μH, r=0.05 ohm) at various wavelengths. For comparison, the curve of a perfect condenser of the same capacity.

the performance, and that but slightly, at wavelengths lower than this.

At wavelengths greater than 200 metres the impedance of the actual condenser is *less* than that of a perfect condenser of the same capacity. This apparently odd result arises out of the fact that the two impedances, one capacitative and one inductive, tend to cancel one another; at about 270 metres the condenser would have no impedance at all were it not for its resistance.

The curve shows very clearly that for all wavelengths from 100 to 700 metres this typical non-inductive condenser has a total impedance of less than one-third of an ohm. For such critical positions in the set as those occupied by C_5 and C_6 of Fig. 3, it is hardly possible to choose a condenser which will more closely approximate to the ideal.

For duties such as those carried out by the condensers of Figs. 1 and 2, there is no particular point in choosing a condenser of non-inductive type. Fig. 4 shows the reason for this; as the wavelength rises, the impedance offered by the inductance falls away to negligible proportions. Even the highest audio-frequency signal corresponds to a wavelength so great that it is quite outside the range of the diagram, while the lower frequencies would fall farther away still.

It is not to be concluded that a non-inductive condenser is unsuitable for low-frequency work, or for smoothing; its extra excellence is wasted, that is all. But there can be no question that for all positions in the receiver where the condenser has to carry current of high-frequency, it is very desirable indeed to choose one of non-inductive type.

UNBIASED

By

FREE GRID.

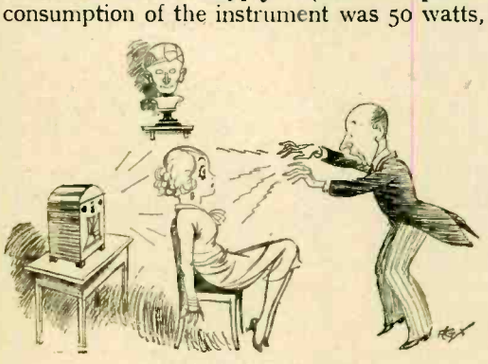
That Dose of Salts.

I SUPPOSE that most of us in the course of our journey from the cradle to the grave have had Epsom salts inflicted upon us to cure some temporary distress brought about by dietetic indiscretions. In America this great panacea is used not only to relieve human ills, but also to rejuvenate accumulators which have come on evil days through the neglect of their owners. It is interesting, however, to read in the report of the Bureau of Standards that the beneficial effects given by the use of this substance in accumulators is purely imaginary. The report states that in a series of tests the administration of this dope caused an accumulator to lose 47 per cent. of its charge in four weeks as compared with 8 per cent. which was lost by a similar but dopeless accumulator over the same period of time.

A Pirate at Bay.

I RATHER like the latest excuse put forward by a pirate who was hauled before the beak for working a wireless set without a licence, and, in my opinion, he deserved to get off with a caution. He had not purchased one, he said, because the B.B.C. had misled him into believing that radio was the cheapest form of amusement by stating that three evenings entertainment could be had for the low cost of 1d. He argued that actually the cost worked out at well over 1s. for one evening, and that for this sum he could have far better entertainment at the local cinema.

The way in which he arrived at this figure was distinctly interesting. Apart from the 10s. licence, he said, his four-valve all-mains receiver, which was in use for ten hours daily, cost him between £4 and £5 per annum for current supply. (Since the power consumption of the instrument was 50 watts,



Neurological treatment.

and he operated it from a lighting socket at a cost of 6d. per unit, these figures must be accepted.) In addition to this, he argued pessimistically that he must write off a sum of nearly £20 each year for depreciation, because, to keep up to date, he must purchase a new receiver each year, and dispose of his old ones at dust-bin prices.

Unfortunately, this ingenious bit of accountancy did not melt the magisterial heart. Personally, I think that if he runs the set for ten hours daily he might legitimately have added the handsome sum which he must have to pay yearly for neurological treatment for his wife and family.

Valvular Pyrotechnics.

A SHORT while ago in these notes I had occasion to refer to the awe-inspiring death cry which a thousand-watt lamp gives when it is dropped, either accidentally or with malice aforethought. According to a report in one of the more respectable of our Sunday newspapers, this is nothing compared with the display of pyrotechnics given by the ordinary wireless valve in like circumstances.

The newspaper having thrilled its readers to the marrow by a description of an explosion in a motor van in which (1) the sides of the van were blown out, (2) the back axle twisted, (3) the starting wheel torn from its shaft, (4) the roof blown off, (5) glass sprinkled over a radius of thirty yards, blandly informs them that the explosion was obviously caused by electricity passing from overhead tramway wires through the valves in some wireless sets which the van was transporting.

In my opinion, this is straining the credulity of the regular readers of even that journal; the law of libel alone prevents me from mentioning it by name.

The Safest Plan.

STATISTICS, although anathema to many people, have always been of absorbing interest to me. I was extremely interested to read a statement the other day by an authority on the subject to the effect that the weather forecasts broadcast by the B.B.C. are wrong seven times out of ten. Surely it would be a simple matter for the B.B.C. to turn this adverse balance into a highly favourable one and thus acquire much kudos in meteorological circles by simply instructing the announcer always to broadcast the converse of the forecast which is handed to him.

A Real Surprise Item.

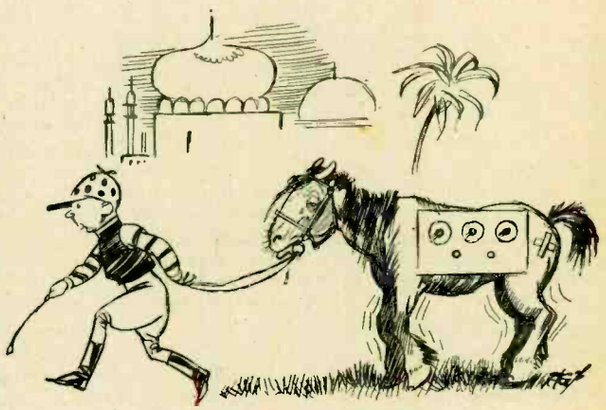
SURPRISE items and stunt broadcasts have always been very pleasing to my depraved tastes, and I am sorry that such things occur so rarely nowadays. I suppose, however, that it became increasingly difficult for the B.B.C. staff to conceive new stunts each week during the time that these were a regular feature, and I am, therefore, going to propose that the Corporation call in the aid of all their millions of listeners by asking them to send in suggestions.

To show that I am quite serious in this matter, I will not only make the first suggestion, but will undertake to carry it out myself if they will grant me the necessary facilities. Briefly, my suggestion is that a broadcast be made from a haunted house. I will guarantee to supply the house if the B.B.C. will undertake to provide the necessary microphones and extension lines.

It might, of course, be argued that the programme will be attended with uncertainty, but I can definitely assure the B.B.C. that this risk would be not one whit greater than that attendant upon the broadcasting of the nightingale. People of nervous temperament would, of course, be asked to switch off their sets, and, in order to forestall any qualms among the Portland Place staff, I would assure them that I would undertake the entire broadcast myself, requiring neither announcer nor engineer.

Where Old Sets Go?

LIKE the old song which used to question the locality in which the common house fly hibernated, I have often wondered where manufacturers' surplus stocks went when



Passed off as a Yearling

they were replaced by new models. A full-page advertisement in a well-known Continental journal has enabled me to find out where at least one old veteran—vintage 1929—is passing itself off as a yearling; curiously enough the country concerned has never had the reputation of being ahead of the rest of Europe.

Wireless—Weather or No.

IN the early days of broadcasting there was an old superstition that wireless waves were responsible for the vagaries of our summer weather. This died out several years ago, but almost immediately rose, phœnix-like, from its ashes, but in converse form, so that our summer weather was held responsible for the vagaries of our summer reception. I wonder how much longer this superstition that the summer, *per se*, causes the reaching-out power of our receivers to fall woefully short of their winter standard will continue! Actually, all that happens is that daylight persists until within about an hour and a half of midnight during the mid-summer season, and the cause of our not receiving so many distant stations at, say, 8 p.m. in the summer as we do at the corresponding hour in winter is exactly the same as that which prevents us hearing so many stations at mid-day as we do at 8 p.m. on winter evenings, namely, our old friend the Heaviside layer.

NEWS of the WEEK.

Events of the Week in Brief Review.

Luxemburg Goes Ahead.

THE high-power sponsored programme station at Luxemburg is not to be recognised by the Union International de Radio Diffusion unless its organisers are prepared to choose a wavelength which will not clash with the transmissions of the members of the Union.

We understand, however, that the station will pursue its plans by radiating its transmissions within the next few weeks on a wavelength of 1,250 metres. The first item in each day's programme will be at 7 a.m., when news bulletins will be delivered in English, French and German. This will be followed by a short concert. The station will then remain silent until noon, when light orchestral music will be given until 2.30. From 8 to 11 each evening sponsored programmes of English, French, and German advertisers will be transmitted, and from 11 to 12 music will be provided by dance bands selected from various countries

After Ten Years.

A "PIRATE" fined 10s. at Sunderland Police Court the other day, "did not know that a licence had to be taken out."

Germany Tells the World.

TO enable overseas listeners to make a schedule for listening to Germany's world-wide short-wave station at Zeesen the list of programme events for the week is regularly broadcast from 4 to 4.30 B.S.T. The programme is first read in German and then in English. The short-wave station has the call sign DJB for daytime, working on a wavelength of 19.73 metres; at night the wavelength is 31.38 metres and the call sign DJA.

According to our Berlin correspondent, a second short-wave station is being erected close to the existing transmitter, and it will probably work on 25 and 49 metres.

Germany certainly appears to be losing no opportunity of getting a secure niche on the short-wave band.

The Coventry Radio Convention.

A PROGRAMME of great interest was outlined for the benefit of the trade and Press at the General Electric Company's Radio Convention held at Coventry last week. The plans for the coming season were discussed, and new sets were exhibited and demonstrated. Outstanding features in the 1932-33 programme include an entirely new kit set for battery operation which should worthily uphold the traditions of the popular "Music Magnet" series, and a number of attractive three- and four-valve receivers. In the sphere of valves, a new battery variable-mu type is to be introduced; and an ingenious new spring support for the filaments of battery-heated Osram valves is to be employed in forthcoming types.

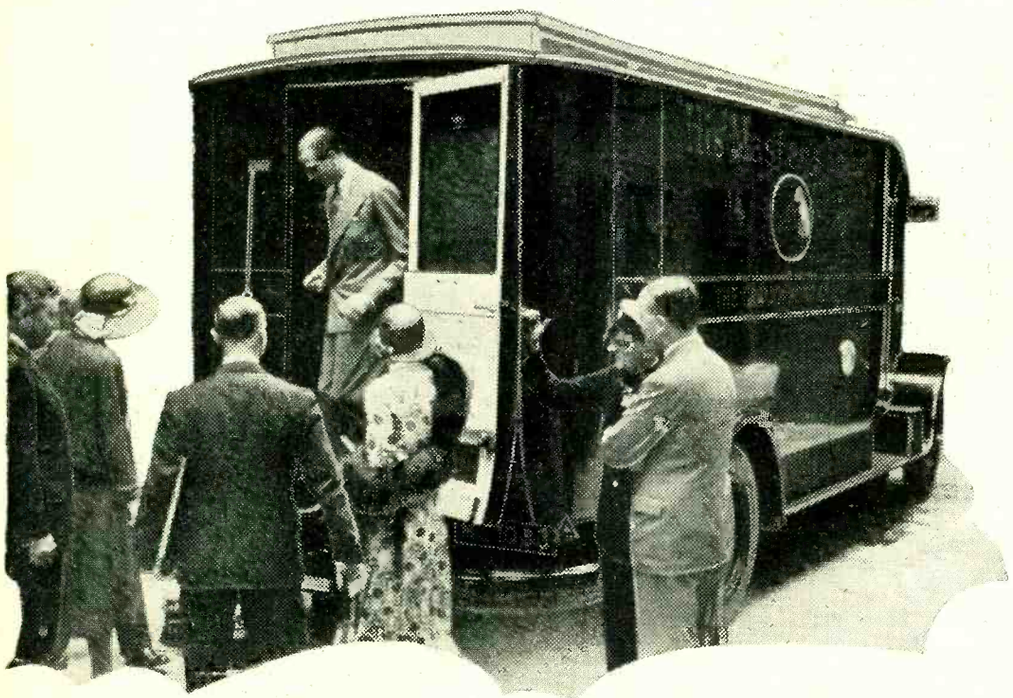
500kW from America.

TO European ears distance rather diminishes the force of America's latest declaration that an era of broadcasting power is to be introduced "exceeding by far the greatest wattage ever planned in 'high-power-minded' Europe."

The Federal Radio Commission has at last sanctioned the use of broadcasting powers in America to the extent of 500 kW., and the first station to take advantage of the new emancipation will be WLW Cincinnati, which is already considered to be the best heard station on the American continent; it will soon be heard on its new power after 5 a.m. B.S.T.

The station, which belongs to the Crossley Radio Corporation, will employ a steel shaft 850ft. high as an aerial mast to determine how much additional "coverage" is possible with the increased power. If the tests prove that a centrally located station with tremendous power can cover the entire United States, great changes in the American system of broadcasting, particularly network radio, may result.

Up to the present the highest experimental power ever attempted in the United States is the 400 kW. for which KDKA has been licensed. The highest regular power in the United States, however, is only 75 kW., which is used by XER at Villa Acuna, Mexico



ROADSIDE RECORDING. H.R.H. Prince George leaving the new H.M.V. Mobile Recording Car which he recently inspected at the recording studios in St. John's Wood. The car contains two complete recording outfits and cost over £10,000 to equip

VALVES IN EMBRYO. Mr. H. de A. Donisthorpe demonstrating the assembly of a model valve at the General Electric Company's Radio Convention at Coventry last Friday.

"Radio" Play at Club Meeting.

A NEW dramatic vogue has been set by the Slade Radio Society, Birmingham. At the last meeting a "radio" play, specially written for the occasion, was enacted through an amplifier system and reproduced by loud speakers, thus giving the impression of a broadcast play. The whole of the apparatus, with the exception of the loud speaker, was concealed from the view of the audience.

One advantage of the radio play was instantly apparent; the parts were taken by three individuals, but by "doubling" the impression of a much larger cast was conveyed to the listeners.

The idea seems attractive from many points of view. It is just possible that amateur efforts of this kind might be productive of drama which would be worthy of the broadcast microphone; in any case, the experiment seems to have helped club members to appreciate the difficulties which face the dramatic department of the B.B.C.

While the idea is especially suitable for development at club meetings, there seems to be no reason why amateurs in their own homes could not devise radio plays or charades which could be reproduced over the loud speaker.

A Broadcasting Museum.

WITH nine years of activity to record, it is not surprising that Germany's permanent museum of broadcasting is not being assembled in the twinkling of an eye. But, according to our Berlin correspondent, there are already signs of activity on the top floor of the Berlin Radio House, where the exhibits are put on view.

One interesting feature already installed is an electrical map of Germany showing the development of broadcasting step by step. Pressure on a single white button sets the apparatus in motion, and year after year from 1923 onwards the illuminated network of stations is seen to grow until the visitor sees at a glance the present-day position of broadcasting.

While plans of some of the exhibits remain secret, it is known that there is to be a very full range of representative broadcasting receivers.

Beautifying Broadcast Voices.

A BROADCAST "voice beautifier" is America's latest contribution to listeners' welfare, and it scarcely surprises us to learn that its inventor is that most prolific of modern radio idealists, Mr. O. H. Caldwell. Mr. Caldwell demonstrated the device during a recent nation-wide broadcast. The voice beautifier, he explained, can give charm and persuasiveness to any speaker by means of compensators and filters that eliminate the objectionable tones and emphasise the desirable. By feeding the various outgoing lines through appropriate compensators New Englanders might hear a Yankee twang, Southerners a Dixie drawl, and Westerners their customary breezy accent, all coming from the same talker.

The B.B.C. ought to welcome Mr. Caldwell with open arms, as he could put an end to the growing controversy as to whether broadcasting is killing the old country dialects. With voice filters the announcers would be able to penetrate all barriers and would be welcomed as members of the family, whether they were heard in Rotherhithe or Rotherham, Wigan or Oxford.

The Dinner Was Successful!

THE French Press is waxing sarcastic over the failure of the recent running commentary from the locomotive of an express train between Paris and Havre. Apparently the commentary was broadcast "perfectly" from the train, but it failed to get beyond the transmitter owing to a technical defect.

Criticism is levelled at the amount of publicity accorded to a test which was by no means certain of execution, but there is unanimity as to the complete success of the commemoration banquet, which was cooked and consumed without any technical or other hitch!

Small Advertisements

THE approach of the August Bank Holiday necessitates slight alterations in our printing arrangements. The latest date on which small advertisements can be accepted for *The Wireless World* of August 5th is Friday, July 29th.

Should Auld Acquaintance be Forgot?

NO wireless exhibitions are to be held in Auckland or Wellington (New Zealand) this year, the excuse being that current models are little changed from those of 1931, and that the public is well acquainted with them.

How It Is Done.

AMERICAN set exporters are stealing a march on their rivals by sending receivers for assembly in New Zealand. These are advertised as "New Zealand built"!

Automatic Sets for Indian Villages.

FERRO-CONCRETE pill-boxes with a loud speaker on the top of each will soon be dotted about the villages of Western India if Mr. E. Duncan Smith, wireless consultant to the Government of India, can bring about his new scheme for introducing wireless into places which have never even heard European musical instruments. Mr. Smith was for some time on the staff of the Aberdeen broadcasting station.

Each listening post will contain a seven-valve superheterodyne set operated automatically so that only occasional attention will be required. It will be impossible for the villagers to have access to the receivers. Transmissions would be made from a 49-metre transmitter at Poona.

A Man with a Mission.

PEOPLE who suffer from the activities of the loud-speaker enthusiast next door may sympathise with amateurs all over the world who are complaining of the noise made by the Rev. J. N. Martins, of Johannesburg.

According to a *Morning Post* correspondent, the Rev. Mr. Martins, at the age of 73, has begun what he considers his life work in creating a wireless congregation all over the world. In order to disseminate his teachings, he has installed in his little hall in a Johannesburg suburb an expensive short-wave transmitter which operates on 42.2 metres with an output of ½ kW. He has started full of vigour, and delivers his radio addresses both in Afrikaans and English.

Unfortunately, amateurs all over the world are complaining that Mr. Martins' telephony upsets their morse transmissions; 300 South African amateurs have already registered a formal protest, but Mr. Martins still carries on with 500 watts at his beck and call. Amateurs are limited to a maximum of 50 watts.

The amateurs have now delivered an ultimatum; they declare that unless Mr. Martins limits his talks to two minutes per diem he will find 300 transmitters loaded with 500 watts shrieking morse at him in unison.

The *casus belli* is that Mr. Martins is intruding on the 41- to 43-metre band which was issued to amateur transmitters all over the world by the Washington Conference. If the 300 amateurs of South Africa are unable to dislodge him it is believed that radio enthusiasts from further afield will begin to take up the cudgels.

The World's Busiest Amateur?

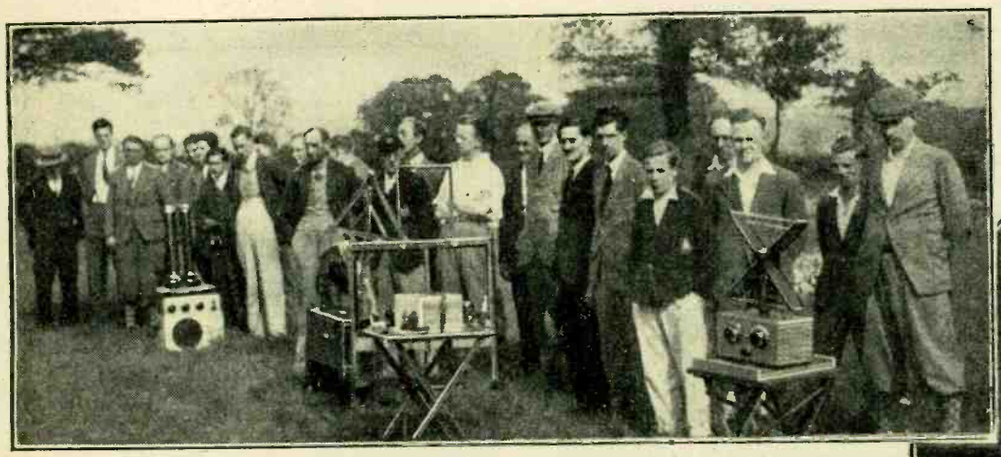
THE "Q.S.O. King" of amateur radio, Fremont F. Purdy, operator of W4FM at Kingsport, Tennessee, claims that his establishment of 17,293 two-way contacts with other amateur stations since August, 1929, constitutes a world record. The figure shows that Mr. Purdy must have secured about 17 contacts or Q.S.O.'s every day, Sundays and holidays included, for a period of nearly three years.

A Triumphant Industry.

IF ever a note of hope was sounded in a grey world, it was sounded by Mr. W. S. Verrells, chairman of E. K. Cole, Ltd., on July 5th, when, at the company's Annual General Meeting he dazzled those present with figures showing that the radio industry had nearly quadrupled its turnover since 1926. From a retail turnover value of practically nothing in 1922, and some seven million pounds in 1926, the industry, he said, had advanced to some twenty-five million pounds in the year 1931, and, therefore, was competing very closely for first place in the electrical group of industries.

It was estimated that direct employment was now provided by radio manufacturers and distributors for some hundred thousand persons, to which must be added a large number who benefited indirectly. The Company's share in the extension was revealed by the comparison of the net profit of £12,000 in 1929 with the record of £131,200 last year.

Not the least interesting feature of the situation is that the growth of the industry shows no sign of slacking off.

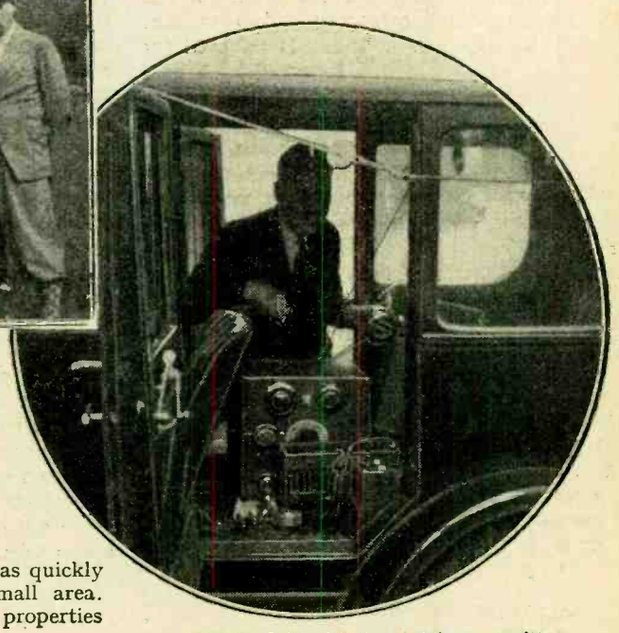


Some of the winning sets. Most of the receivers used employed three valves and a small frame aerial.

ON THE TRACK OF A ROAMING TRANSMITTER.

MORE than eighty members of five radio societies participated in the June field day of the Golders Green and Hendon Radio Society, which took the form of a direction-finding competition organised by Lt.-Col. H. Ashley-Scarlett, D.S.O.

In the first part of the competition, which ranged over a large area of Hertfordshire, the transmitting station was mobile, and it was the object of the competing parties to log its route. Later on the transmitter was hidden in a field near Ridge Church. A second transmitting station (5RD), the exact position of which was known to all, was used as a reference or check station. This proved of the greatest utility, as it was quickly discovered that errors due to local conditions were by no means constant in a small area. With the aid of the check station it was possible not only to check the directional properties of the receivers, but to compensate for errors.



Mr. Corfield with the mobile transmitter.

LOTUS S.G.4 SUITCASE PORTABLE.

An Inexpensive Self-contained Receiver with Ample Range.

UNTIL a couple of years ago there was a considerable diversity of opinion as to the best circuit arrangement for a battery-operated portable receiver. A great number of these sets included two aperiodic H.F. stages, which provided little real amplification; this arrangement is happily now defunct. Other designers pinned their faith to an H.F. amplifier with one tuned and one aperiodic stage, while sets with two tuned H.F. stages were not unknown.

Almost the only arrangement that has survived the test of time is the four-valve circuit with one tuned H.F. stage, a grid detector, and two L.F. amplifying valves. With singular unanimity, practically all makers of portables have adopted this basic circuit, and most convincing arguments have been put forward in support of it.

The Lotus S.G.4 Suitcase Portable, with which we are here concerned, is a good example of a straightforward set, with no unnecessary complications, for which this circuit arrangement has been adopted. Starting at the input end, it will be seen from the accompanying circuit diagram that the medium- and long-wave frame aerials are connected in parallel for reception on the former waveband by means of a switch. Simple tuned-anode coupling is adopted for the H.F. stage, which is followed by a grid circuit detector, for which component values are those generally accepted as giving the best possible compromise. Reaction between plate and grid circuits of the detector is controlled by a differential condenser, connected in such a way that the rotor may be earthed; thus hand-capacity effects are avoided, and construction is simplified.

Precautions Against Instability.

The first L.F. stage, coupled by a resistance to the detector, employs fairly conventional values; a ¼-megohm H.F. stopper is inserted in series with the grid. Coupling to the output valve is by means of a transformer, of which the secondary is shunted by a loading resistance.

Circuit design has been simplified very considerably by the avoidance of a number of the decoupling components which are so often found necessary in similar sets. The H.F. anode circuit is decoupled, and the screening grid of the same valve is fed through a voltage-absorbing resistance; apart from this, no special precautions are observed, except that a by-pass condenser is joined in parallel with the output valve anode circuit, in order to keep out of the loud speaker leads any residue of H.F. energy that may escape the "stopper."

Tuning may best be described as of the semi-ganged variety; both tuning condensers are rotated by means of edgewise dials mounted on the same axis and adjacent to each other. These dials are calibrated directly in wavelengths. Beneath the loud speaker grille is a small variable condenser, which only comes into operation when an external aerial-earth system is joined to the adjacent sockets.

A light aluminium box encloses the receiver unit proper, and also provides the necessary isolation between H.F. coupling coil and frame aerial.

For a set that is obviously intended to be really portable, the container is of sensible design and workmanlike construction, without any attempts at unnecessary ornamentation. It is covered in good quality leathercloth; the fastenings are strong, and it is noted with special approval that the channelled lid fits so well that the set could be carried through heavy rain without risk of damage.

High-Grade Accessories.

Although the Lotus set is an inexpensive example of its class, no unwise economy has been observed in the selection of accessories. The L.T. cell is a 20 ampere-hour Exide of the unspillable jelly-electrolyte type. As the valve filaments consume a total of 0.6 amps, this battery should be capable of operating the set for over thirty hours. A Drydex 108-volt H.T. battery is used, and, very sensibly, intermediate voltage tappings have been avoided; this complication always causes confusion to the non-technical user. As to the valves, the H.F. amplifier and detector are of Cossor make, while the first L.F. amplifier and output valve are chosen from the Mullard range. The last-mentioned valve is one of the latest high-efficiency triodes, which gives a good output, although economical of anode current.

In spite of the small amount of decoupling, and the unusual freedom from complications, it was impossible to find the slightest trace of instability, either of the H.F. or L.F. variety. Sensitivity on the long waveband is surprisingly high, when one remembers that the collector is a small frame aerial; indeed, it is so good that reception of the long-wave National station could be depended upon almost anywhere in these islands, and good signals from Radio Paris seem to be obtainable under quite unfavourable conditions.

On changing over to the medium band, there is the usual slight falling-off in range, but on this score there are no grounds for complaint. A full-powered station seems to be receivable under any reasonable conditions at fully a hundred miles' distance in broad daylight, and often at greater range. This may not sound so spectacular as to say that most of the worth-while Continental transmissions are receivable in favourable circumstances—which generally means after dark—but it is a greater tribute to the inherent sensitivity of the set. Of course, we are here speaking of the performance when using only the built-in frame aerial; the use of an external aerial will seldom be necessary, and, indeed, is hardly to be advocated under normal conditions, as selectivity is bound to suffer as a result of making this addition.

With regard to this quality, the true "circuit selectivity" of the Lotus set passes muster, without being exceptionally high. However, thanks to the marked directional properties of the frame, interference of almost any type may be avoided, and the set gives no trouble on this score.

A set with a fully ganged tuning system would be somewhat easier to operate, but tested against the Lotus Portable with its independently controlled circuits, would probably lose on sensitivity through imperfect alignment. The small amount of knack necessary to obtain best results with the side-by-side drum control system is soon acquired; a fair proportion of either waveband can be explored by rotating the dials simultaneously with a single finger. Operation would be still easier if wavelength calibration were a little more exact, but it is accurate enough to serve as a very useful guide to the adjustment of the circuits.

Quality of reproduction is well up to the standard to be expected from a set which is economical in upkeep—the total H.T. consumption of the model tested amounted to little over 8 milliamperes. Speech is clear and intelligible, and the L.F. frequency range covered is quite adequate; moreover, there are no objectionable resonances.

A well-prepared booklet of instructions is supplied, and the makers have been thoughtful enough to include a complete circuit diagram with all values marked on it.

FEATURES.

General.—*Four-valve self-contained portable receiver, primarily for operation with built-in frame aerial, but external aerial and earth sockets are fitted. Battery operated*

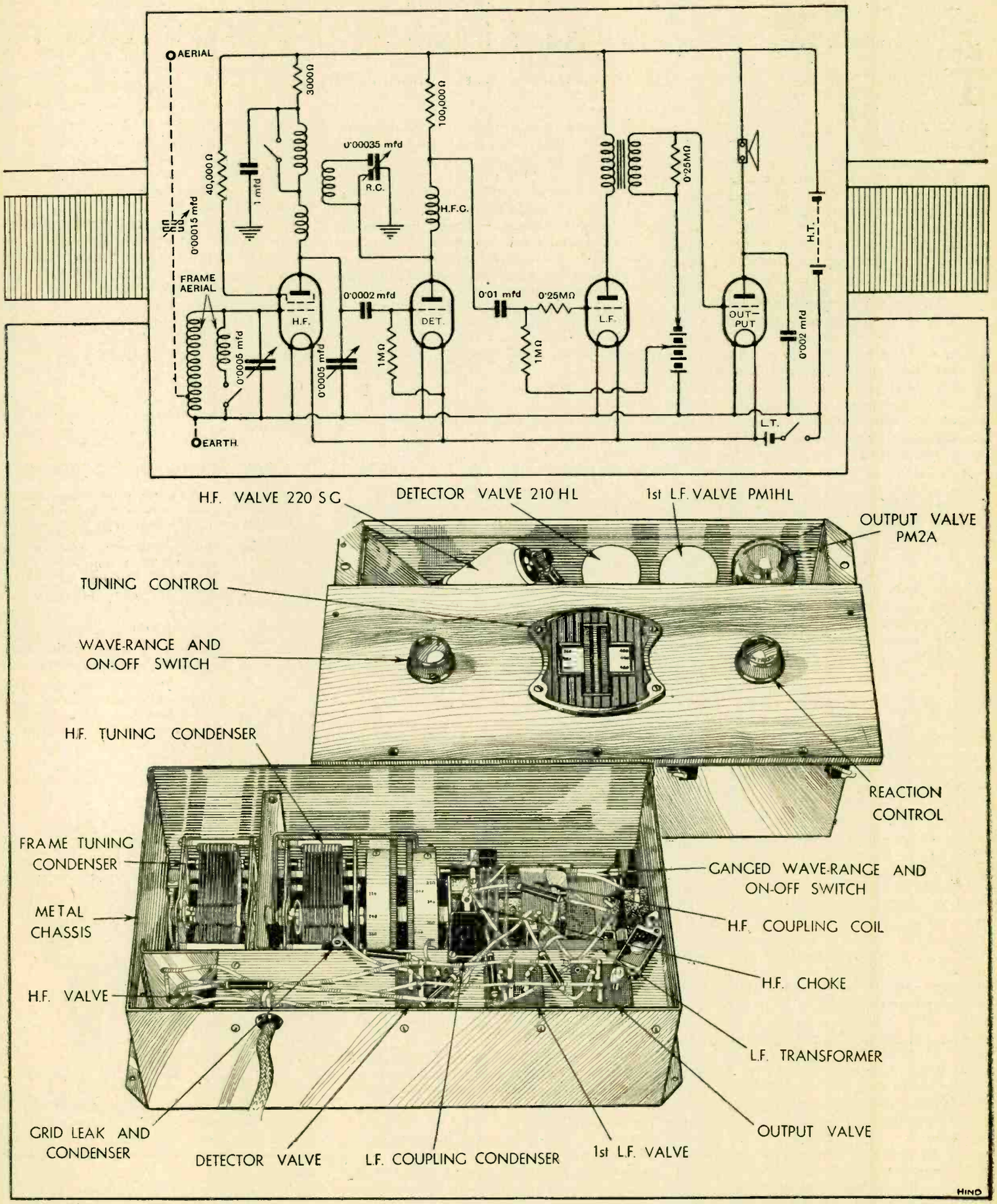
Circuit.—*One screen grid H.F. valve, coupled by tuned anode system to a grid detector, which is followed by resistance- and transformer-coupled L.F. stages. Triode output valve.*

Controls.—*(1) Semi-ganged tuning by side-by-side drum dials, which may be rotated simultaneously. (2) Reaction. (3) Combined on-off and wave-range switch.*

Price.—*12 guineas.*

Makers.—*Lotus Radio, Ltd., Lotus Works, Mill Lane, Liverpool.*

A SIMPLE BUT EFFICIENT SELF-CONTAINED SET.



Two views of the Lotus Portable Receiver unit, and (above) the complete circuit diagram. Connections of an optional external aerial are shown in dotted lines.

NUTS TO CRACK.

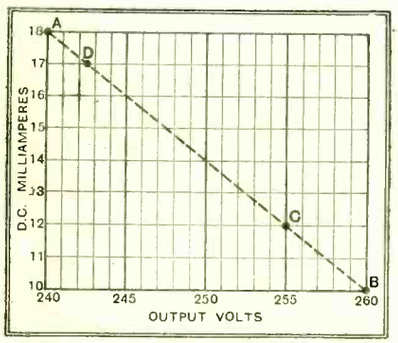
Instructive Problems and their Solution.

THE present series has been started by *The Wireless World* for the benefit of readers who like to work out little problems for themselves and be sure that the results they obtain are correct. At frequent intervals wireless problems are presented, and in the following instalment the answers are given with the methods of working them out, and hints on possible points of difficulty. Problems 53, 54, and 55 have already been given, and below the answers appear, whilst another set of problems is included this week for treatment in the next instalment.

QUESTION 53.—**A battery eliminator is capable of supplying 18 mA. at 240 volts and 10 mA. at 260 volts. A portable receiver to be used with it takes 2 mA. for H.F. and det. valves, and 10 mA. for power valve, all at 150 volts. What series resistance would be required to absorb the surplus voltage of the eliminator, and what is the D.C. power expended in it?**

Answer—8,750 *ohms;* 1.26 *watts.*

The total current taken by the receiver is 2+10=12 mA. We must first of all find the output voltage of the eliminator when supplying this current. For this purpose the best plan is to draw a small graph showing the relation between output current and voltage over the working range given in the question. In the figure the output volts from 240 to 260 are shown on the horizontal axis, while the D.C. values between 10 and 18 mA. are shown on the vertical axis. The points A and B illustrate the two working cases



Showing relation between output voltage and current supplied by eliminator.

specified, and we shall not be far wrong in assuming that the intermediate points representing corresponding values of voltage and current will lie on the diagonal line joining A and B. The particular point on this line for which the current is 12 mA. is shown at C, and it will be seen that the voltage value at this point is 255. Accordingly, this may be taken as the actual voltage supplied to the receiver.

The problem now becomes the simple one of finding a resistance capable of passing 12 mA. and such that the P.D. across it is simultaneously the difference between 255 and 150 volts—that is, 105 volts.

By Ohm's Law such a resistance R=E/I =105/0.012=8,750 ohms.

The power expended in the process is evidently given by I×E, i.e., 0.012×105, or 1.26 watts.

The actual power rating of the resistance employed should, of course, be well above this figure to allow an ample margin of safety.

QUESTION 54.—**If a potentiometer of 50,000 ohms is connected directly between the eliminator terminals for use with a S.G. valve, what will be the altered value of the series resistance required in the above question?**

Answer—7,708 *ohms.*

Nothing is here said regarding the screen current taken by the screened-grid valve. In view, however, of the very small anode current taken on the H.F. side, we shall be justified in completely neglecting it. Thus the potentiometer will entail an extra current load on the eliminator, the amount of which will be given in amperes by dividing the actual voltage output by 50,000. For the moment, however, this voltage output is unknown, but it is easy to see that, in view of the extra current taken, it will be less than the 255 volts obtained before the potentiometer was connected. We shall therefore adopt the value 250 volts as near enough to obtain a working approximation to the potentiometer current, which is thus in the neighbourhood of 250/50,000 amperes, or 5 mA. (It will be seen that, even if our estimate of output voltage is in error by as much as 10 volts, our estimate of the potentiometer current will be wrong by only 10/50,000 amps., or 0.2 mA.—a quite insignificant amount.)

The total current drawn from the eliminator will thus be in the neighbourhood of 12+5, or 17 mA., and reference to the above output graph will now enable us to ascertain the actual output voltage. For a current of 17 mA. this is seen to be 242.5 volts, as shown at the point D. The volts to be dropped across the resistance will then be 242.5 less 150, or 92.5 volts. The current passing through the resistance is, however, still the same as before, viz., 12 mA. For the resistance value we thus have R=E/I= 92.5/0.012=7,708 ohms.

QUESTION 55.—**By means of an input potentiometer the power output of a certain amplifier can be varied between 0.1 watt and 10 watts. What is the power range in decibels?**

Answer—20 *decibels.*

The "decibel" system of expressing the difference between two power levels is now coming into everyday wireless use, and today it is quite common to express in decibels the range in volume which a receiver can handle. It is important to realise that the decibel is not a "physical" unit such as the volt or the watt; it might rather be called a "comparative" unit, in that it always expresses a *comparison* between two "physical" quantities. The units compared are usually those of power; thus, in comparing one amount of power with another on a decibel basis we may refer either to the ratio between them or else to the difference between them in relation to one of the powers. The point to notice is that a given amount of power is not expressible in decibels; it is only when there is a comparison, stated or implied, that we have recourse to this unit.

The decibel-number is thus equivalent to a ratio between two powers, the nature of the equivalence being more precisely defined as follows: *The difference between two power levels expressed in decibels is equal to ten times the common logarithm of the ratio between the two powers.*

In the present instance the ratio between the two powers representing the extremes of the range is 10/0.1 or 100, the common log. of which is 2. Accordingly, the difference between the two power levels is 10×2, or 20 decibels, which thus expresses the power range. Note that a power amplifier varying in output from, say, 3 to 300 watts would have exactly the same decibel range.

Erratum: In Question 51 on p. 682 in second and third lines below the figure, symbols i_a and v_a should be interchanged.

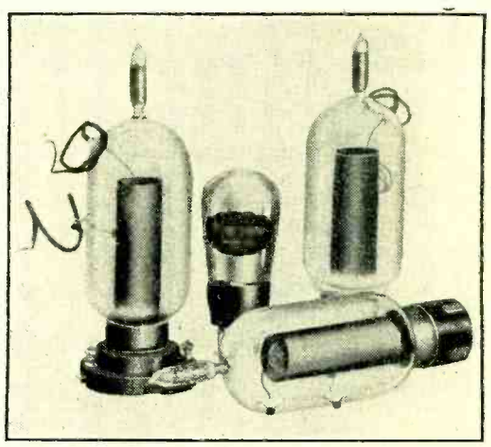
NEXT SERIES OF PROBLEMS.

QUESTION 56.—**A power valve whose nominal A.C. resistance and optimum load are quoted as 1,400 ohms and 3,500 ohms, is coupled by a choke-filter to an output transformer. If the moving-coil speaker used has an impedance of 2,100 ohms at 256 cycles, what should be the turns ratio of the transformer? If an additional similar loud speaker were connected in parallel with the first, what should be the transformer ratio?**

QUESTION 57.—**A loud speaker whose inductance is 1.15 henrys is coupled to a power valve through a condenser of 2 mfds. To what frequency will the combination be resonant?**

QUESTION 58.—**A two-valve portable set obtains "free" grid bias on the output valve by means of a 600-ohm resistor between the H.T. and L.T. leads. With a valve of 6,500 ohms A.C. resistance the grid bias is 7 volts negative. With another valve of 8,000 ohms A.C. resistance it is only 4.5 volts negative. The H.T. supply being 120 volts, what is the steady anode current in each case?** NUTCRACKER.

WAR-TIME VALVES.



An interesting group of some really historic valves, with a typically modern product included in the group for comparison purposes. These early valves are of the Marconi-Round type, produced in 1915. Good as they were in their day, they are a very far cry from the Marconi H.L 2 which accompanies them.

BROADCAST BREVITIES.

By Our Special Correspondent.

Drama in the Entrance Hall.

I SOMETIMES think that the entrance hall in Broadcasting House affords as much interest and entertainment as can be found in any of the studios. The other morning I watched an "ordinary listener"—by all appearances a retired farmer—stroll in and loudly congratulate the commissionaire on the quality of the programmes.

He said, among other things: "You've got a very plain announcer ("We've got several," corrected the commissionaire), and I do like your transmissions from St. Martin's Church."

The commissionaire bowed.

Eric Gill's Statuary.

While this was going on, Mr. Eric Gill, armed with a chisel and wearing a blue beret and smock, was putting finishing touches to his new figure of "The Broadcaster," which stands on a pedestal directly facing the main entrance.

This striking piece of statuary portrays a sower spreading the seed.

Shortsighted?

Someone said it looked like Henry Hall sowing his wild oats.

The B.B.C. "At Home."

The B.B.C. are separating the sheep from the goats in the flood of applications received to view the new headquarters. These are the technical people and the non-technical, and it has been decided that two parties of the former and two of the latter shall be taken over the building each day, beginning on Tuesday, August 2nd.

Each party will consist of fifteen persons.

Select Parties.

The distinction between the two kinds of visitor is a wise one. It would be a weariness of the flesh for all concerned if people primarily interested in the control room or studio acoustics were placed under the same yoke as those whose thoughts are centred on the vaudeville dressing rooms, or the "effects" department.

The engineers hate such questions as "What is the wavelength from London to Brighton?"

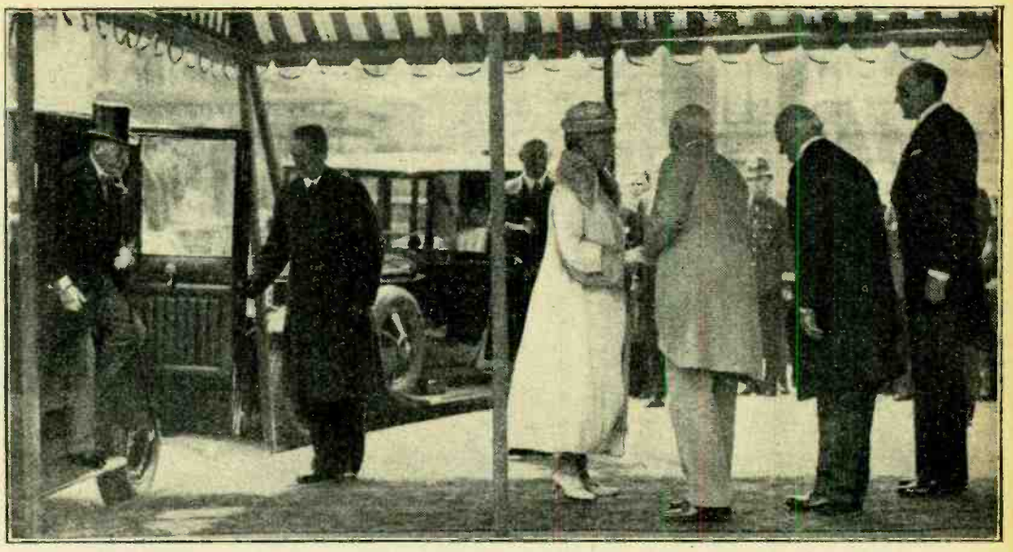
Bertram Fryer's Successor.

THE departure of Bertram Fryer, the B.B.C. vaudeville organiser, naturally raises the question of a successor. I understand that his trusty lieutenant, John Sharman, is likely to take over this singularly delicate job. The tactful handling of operatic "stars" is no sinecure, but when it comes to vaudeville favourites—one feels like a cactus in a bathing tent.

Broadcasting the Yodel.

MANY listeners must have wondered how the yodelling expert in that excellent broadcast play, "Flags on the Matterhorn," was able to put his voice across without wrecking the microphone.

Actually, the yodeller took up a stance outside the "soundproof" windows of the dramatic studios. When he yodelled at the top of his voice he was just able to make himself heard on a studio microphone, which was the effect intended.



ROYALTY AT BROADCASTING HOUSE.—Their Majesties the King and Queen arriving at the new B.B.C. headquarters for an informal inspection of the studios and offices on Thursday, July 7th. Left to right: Mr. J. H. Whitley (chairman), Lord Gainford (vice-chairman) and Sir John Reith (director-general).

Television on Monday.

MONDAY next, July 18th, will probably see the start of regular television transmissions from Broadcasting House. I understand that, for the present, the schedule provides for television programmes on Mondays, Wednesdays, and Fridays, from 11 to 11.30 p.m.

Seeing the Saxophones.

As forecast in *The Wireless World*, Midland Regional, on 398.9 metres, will co-operate in the television tests, this transmitter being employed for the sound side of the broadcasts. Vision will be transmitted from London National on 261.3 metres.

Most of the programme material will consist of dance music, which will be contributed not by the bands which happen to feature in the regular programmes, but by special combinations imported for the purpose.

I wonder how many lookers-in will be able to stand a close-up of a crooner?

No Prizes Offered.

By the way, I hate the term "looker-in." Nor does "looker" appeal to me. "Televisionary" suggests a crystal gazer, and I can't take kindly to "Televisionist." "Televisor" is the name of the receiving instrument.

Can any reader suggest an expressive term for a person who tunes in and looks at a television image?

The Churchillian Episode.

IF indications were needed to show how largely the B.B.C. is now under State control, I think we should find them in the Churchill episode. Students of the Press will know that Mr. Churchill's offer to broadcast his views on the world economic situation was declined by the B.B.C. They will have noticed that a tremendous pother followed, in which the Corporation was severely criticised for denying Mr. Churchill his "right" to the use of the ether, but that the excitement subsided as quickly as it had risen.

Did They Know?

Is it not a reasonable hypothesis that the B.B.C. declined the Churchillian offer knowing that within a day or two the Government was about to make its momentous announcement of the Conversion Loan?

It is quite probable that the B.B.C. will now accept Mr. Churchill's offer, knowing that the great man is now in possession of facts which might materially influence his views on the world's financial prospects.

First Night of the "Proms."

THE opening night of the "Proms" season, August 6th, provides a programme which is pleasantly typical of the fare provided at the opening of all the "Proms" seasons during the past thirty-seven years. Elgar's "Cockaigne" overture, the "William Tell" overture, Handel's "Largo," the Prologue to "Pagliacci," the "Valse Triste," and, as a cornet solo, "Una voce poco fa," are the items which will be heard by National listeners, with the "Prince Igor" dances and Liszt's "Hungarian Fantasia," played by Katharine Goodson.

In one respect the season will be exceptional. There is to be only one "first performance"—that of "Epithalamion," by Edgar Bainton.

The Traveller's Return.

THE Ridgeway Parade keeps on parading. I hear that Philip Ridgeway, who returns with his company to the microphone on July 19th (National) and 20th (Regional), intends to include in his "Song and Dance Show" excerpts from the stage display which he has been giving while on tour during the past five months.

Nothing else quite like the Ridgeway Shows ever takes place in the B.B.C. studios, and for this reason alone it will be well worth while to give Philip a good hearing.

On with the Dance.

IF you want good broadcasting yarns you must get them from the horse's mouth. Here is a new and completely true story from a New York friend who organises sponsored programmes over the American network.

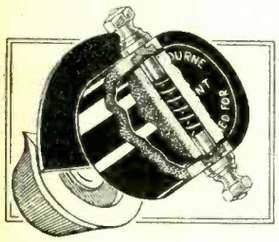
A series of programmes is being run by the manufacturers of a well-known fruit salt, and it is the custom on each occasion to introduce the programme with a commercial credit announcement read by a nervous old gentleman of 60, who keeps a nearby chemist's shop. Although he has broadcast several times, he invariably gets violent "mike" fright. The other evening, instead of saying, "This is William S. Gordon, of Schoonmaker's Drug Store," he got tongue-twisted, and the American network of half a hundred stations heard: "This is William S. Gordon, of Schoonmaker's *Bug* Store."

LABORATORY TESTS

ON NEW RADIO PRODUCTS.

MELBOURNE S.W. COIL AND ROTARY SWITCH.

A SET of coils conforming in every particular with the specification given in the article dealing with the super-regenerative receiver designed for short-wave reception, and described



Melbourne on-off rotary switch with spring-loaded contacts.

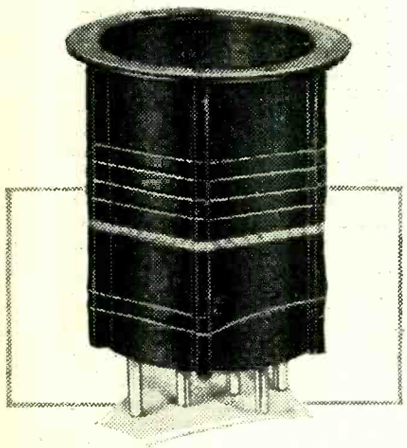
in *The Wireless World* dated May 18th last, can now be obtained from the Melbourne Radio Supply, Norwood Buildings, Hoe Street, Walthamstow, London, E.17.

Tested in the receiver in question a sample 30-metre coil functioned correctly, and was quite satisfactory in every respect, and covered the same wave range as the original coil with which it was compared. The 30- and the 50-metre coils cost 3s. each.

This firm make also a range of small components, included in which is a rotary switch of novel design. Contact is made by two spring-loaded plungers which, mounted in an ebonite barrel, rotate within a casing of the same material. The plungers spring into cup-shaped indentations on the inside faces of the terminal shanks and connect opposite pairs together.

One pair of fixed contacts only are required for the "on-off" switch, the "off" position being defined by the plungers engaging in two small holes in the cylinder walls.

On the other hand, the gramo-radio switch has four cup-shaped contacts, two are interconnected, and this model functions as a single-pole change-over switch. They cost 1s. 6d. and 1s. 9d. respectively.



Melbourne S.W. coil for super-regenerative receiver.

TUNEWELL BAND-PASS COILS.

THE new series of screened coils just introduced by Tunewell Radio, Ltd., 54, Station Road, New Southgate, London, N.11, are wound on 1¼in. ribbed ebonite formers enclosed in lacquered copper screening boxes and mounted on moulded bakelite bases in which are accommodated the wave-change switches. The filter coils, designated A_1 and A_2 respectively, are capacity coupled, a condenser of a few m-mfds. only joining their high potential ends, while one of the order of 0.05 mfd. is recommended for connecting their low potential ends. Since the value of the high potential coupling condenser is exceedingly critical the makers have embodied it in the assembly of the second member of the filter, but the large condenser is not included.

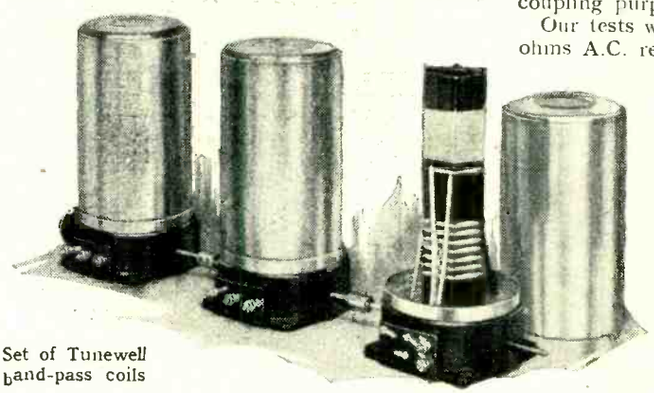
Both sections of the aerial coil A_1 are provided with tappings one-third up from the low potential ends, and the aerial is connected to the appropriate tapping by the wave-change switch.

The H.F. coil, designated G_1, can be used either as a tuned anode or as a tuned grid coil. This coil is tapped one-third down from the high potential end for the anode connection of the H.F. valve; the wave-change switch automatically selects the correct tapping for the medium and the long wavebands. A reaction winding is embodied in this unit also.

The switch springs are made of phosphor-bronze each tipped with gold-silver contacts, and they operate with a rotary action.

The medium-wave section of each coil has an inductance of 175 microhenrys, while that of the long-wave inductance is 2,000 microhenrys. All coils are matched to within ½ per cent.

A peak separation maintained reasonably constant at 10 kc. was obtained with a specimen set of coils by fitting a lower end coupling



Set of Tunewell band-pass coils

condenser of slightly lower value than 0.05 mfd. This size is advised, however, where conditions demand a high order of selectivity, since the peaks close in a shade at 250 metres and are in still closer contiguity at 500 metres.

Exceptionally good results were obtained with the coils fitted in a standard receiver; the selectivity, and especially the sensitivity, being most marked.

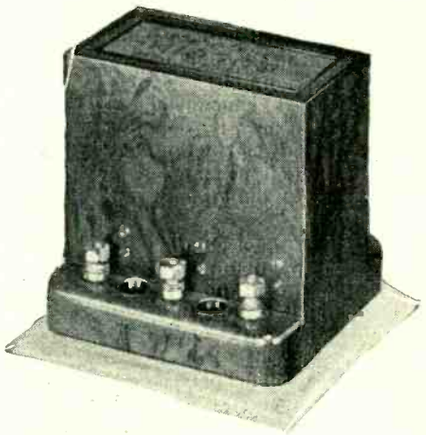
These coils measure 3⅛in.×3½in.×6½in. high, and the complete set of three costs 31s. 6d.

BULGIN TRANSCOUPLER.

THIS new coupling unit, which is intended to replace existing direct-fed L.F. transformers, embodies the three main component parts hitherto required for the assembly of a parallel-fed transformer coupling arrangement. The primary winding of the built-in transformer has an inductance exceeding 80 henrys, and as the steady anode current is deflected through the anode resistance its value is maintained at this level under all operating conditions, a feature which is mainly responsible for the exceptionally good amplification obtained at the very low frequencies. The makers claim that from 32 cycles up to the highest audible frequency the amplification is sensibly constant.

The resistance fitted in the unit is of the wire-wound type, and will carry up to 8 mA. of D.C. It has a maximum value of 50,000 ohms, with a tapping at 30,000 ohms; the higher value to be used when the A.C. resistance of the preceding valve lies between 15,000 and 30,000 ohms, while the lower value is advised for valves of 15,000 ohms A.C. resistance and under.

By the addition of an external resistance valves of much higher impedance than those



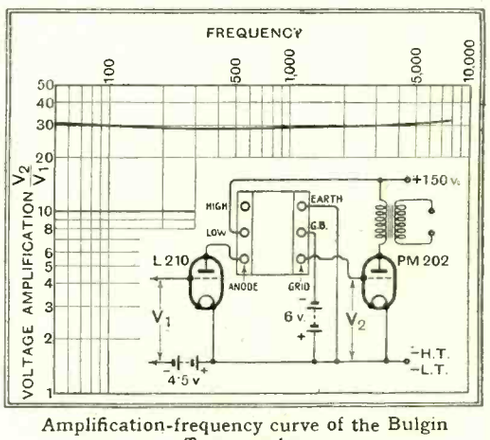
Bulgin Transcoupler; a compact parallel-fed transformer unit for L.F. coupling.

mentioned above can be used without affecting the characteristics of the unit, and the L.F. gain of the stage will be governed by the amplification factor of the valve. With low impedance valves the idle 20,000-ohm portion of the anode resistance could be utilised for decoupling purposes.

Our tests were made with a valve of 10,000 ohms A.C. resistance, so that the 30,000-ohm tapping was used.

The curve is most satisfactory, the mean amplification being a shade under 30 times for the stage, while below 100 cycles, and also above 3,000 cycles, there is actually a slight increase. This coupling unit will undoubtedly enhance the performance of any set hitherto fitted with an L.F. transformer connected in the normal manner, and will give results comparable with those expected from the very best components of this type.

Its qualities are perhaps best exemplified by the happy phrase, "High quality of reproduction at low cost," heading the instructional leaflet accompanying each unit, for the price is but 11s. 6d. This leaflet is particularly informative, indicating clearly the various alter-

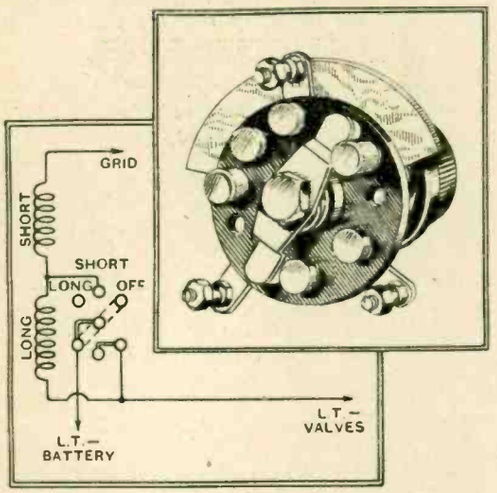


Amplification-frequency curve of the Bulgin Transcoupler.

native connections for obtaining suitable values of anode resistance to suit different valves, and shows to which terminals the external resistance must be connected when one is used. It is enclosed in a moulded bakelite case, and the makers are A. F. Bulgin and Co., Ltd., Abbey Road, Barking, Essex.

CHALGROVE ROTARY STUD SWITCHES.

A RANGE of neat and well-made rotary stud-type switches, suitable for the numerous functions switches are called upon to perform in modern wireless receivers, figure among the components made by Charles G. Chalkley, 6, Grove Street, Wellingborough. Of particular interest is a combined wave-change and battery switch which is exceedingly compact, measuring but 2in. in diameter overall and protruding ¾in. behind the panel. The body of the switch is a thin disc of bakelised material on which is mounted the single-hole fixing bush, studs and extruded terminals. This model, complete with knob and engraved indicating plate, costs 2s. 9d. and is available with knobs finished in black, brown or mahogany.



Connections for Chalgrove combined on-off and wave-change switch

B.A.T. RESISTORS FOR MONODIAL SUPER.

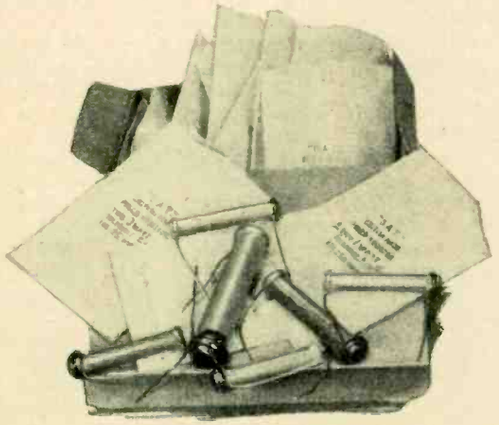
CONSTRUCTORS of the "Monodial A.C. Super" will no doubt be interested to learn that a complete set of B.A.T. resistors for this receiver is now obtainable from Claude Lyons, Ltd., 40, Buckingham Gate, London, W.1. The seventeen resistance rods required for the receiver part and the power unit are compiled into a kit set, with the resistors packed separately in small envelopes marked either "set" or "eliminator," and stating the value of the resistor enclosed, also its watt rating. Where two or more resistors of the same value and rating are employed in either portion of the apparatus they are packed in one envelope marked appropriately.

This should prove considerably helpful when building the set, for having separated the packages into their respective groups the work of construction can proceed without any possibility of fitting the wrong type of resistance in error.

B.A.T. resistors are now made in this country, and take the form of composition rods fitted with wire ends. A colour code is used to differentiate the values and they are available in 1-, 2-, 3- and 5-watt types. Prices are very reasonable, being governed not only by the watt rating, but also by the tolerance; thus a 1-watt resistance with a tolerance of ±2 per cent. costs 1s. 3d., while the same resistance, with a deviation not exceeding ±10 per cent. is available at 10½d.

The resistors supplied in the "Monodial" kit set are stated to be within ±10 per cent. of marked values, but we found on test a much closer agreement than this.

The price of the complete set of seventeen resistors is 15s. 6d.



Lyons' kit set of B.A.T. resistors for the "Monodial A.C. Super."

R.I. ANTINODAL S.W. AMPLIFIER ADAPTOR AND COIL UNIT.

SHORT-WAVE detector units are employed as a rule to replace the existing detector stage in a broadcast set, and make use only of the low-frequency amplifying stages. In the average set of to-day the output valve serves as the only L.F. amplifier, so that in the majority of cases there will be but two valves available for short-wave reception.

The new R.I. Antinodal Detector Amplifier Adaptor, however, is designed on somewhat different lines, and is in effect a complete short-wave detector circuit even to embodying a small parallel-fed intervalve transformer for coupling to the following valve. Thus, when the unit is connected to the broadcast set and the special valve adaptor plug inserted in the detector stage, after removing this valve and fitting it in the sockets provided on the top of the plug, the detector stage can be utilised as an additional amplifier.

R.I. Antinodal Short-Wave Amplifier Adaptor and the special coil embodied in this unit.

Signals, which with the usual arrangement of two valves are just audible, are brought up to good loud speaker strength by this unit.

Tests made with one of the advanced models gave most satisfactory results; reaction is smooth and progressive, being entirely free from backlash, and the circuit slides gently into oscillation without a trace of threshold howling. This smooth control is a great asset when tuning-in weak signals, for they can be brought up to good audible strength by careful manipulation of the reaction, which, incidentally, is controlled by a slow motion condenser.

Embodied in this unit is the new and recently introduced R.I. Antinodal dual-range short-wave coil. A small loading coil is included in the aerial circuit, the function of which is to alter, when the need arises, the natural wavelength of the aerial.

The effect is to shift those familiar "dead spots" which not only play havoc with the reaction control, but often impair the efficiency of the circuit at various parts of the scale. The tuned coil is in two sections, with the reaction wound in the intervening space, the aerial coil being coupled to the low potential end of the grid winding. The loading coil is accommodated at the base of the former, being well spaced from the effective portions of the aerial winding.

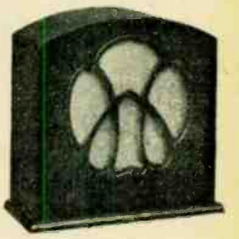
Two single-pole switches are required, the one to short circuit the aerial loading coil when not required, while the other short circuits a portion of the grid coil. As fitted in the short-wave adaptor unit the approximate tuning ranges are 13 to 40 metres and 28 to 90 metres respectively. A 0.00025 mfd. condenser is used to tune the coil.

The makers are Radio Instruments, Ltd., Purley Way, Croydon, and the price of the Short Wave Amplifier Adaptor is £4 10s., including valve. The Antinodal Coil Unit costs 6s. 9d.

CAMCO CABINETS.

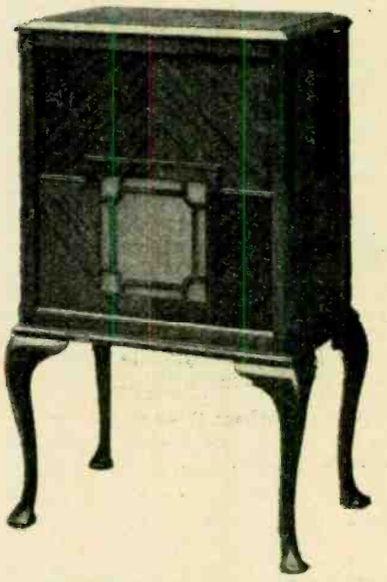
"THE WIRELESS WORLD" was given an opportunity recently to visit the showrooms of the Carrington Manufacturing Co., at 24, Hatton Garden, E.C.1, to review their range of cabinets for the new season, which includes a number of new models not previously available. The complete range of cabinets makes an extremely pleasing exhibition, and types are available for almost every wireless purpose that could be imagined, the range of prices being equally wide.

We illustrate two cabinets which particularly attracted us, the pedestal type is known as the "Carlton" and is designed to house both set and speaker, and is built of quartered mahogany. This appealed to us as a particularly attractive cabinet, departing from the more usual design.



The "Dominion" speaker cabinet.

Another cabinet illustrated is the "Dominion," designed for chassis and speaker units up to a maximum of 12in. The price of this cabinet is the remarkably low one of 12s. 6d., and it should deserve wide popularity. Any reader can obtain details of the Camco range of cabinets on enquiry from the manufacturers at the address given above.

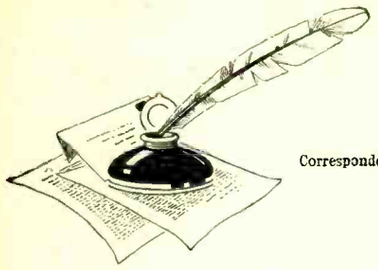


The "Carlton" pedestal model.

SERVICE NOTES.

READERS in need of technical assistance will be interested to learn that Goldsman Service, 1a, Willesden Lane, Kilburn, London, N.W.6, undertake the repair and servicing of all types of wireless receivers and accessories, a speciality being made of American and Continental receivers, for many of which spare parts are available.

The telephone number is Maida Vale 5066.



Letters to the Editor.

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

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

Foreign Programmes.

THE new feature of the foreign programmes in *The Wireless World* should appeal very strongly to your readers. It is in keeping with the general character of the paper, and foreign listening is more popular to-day than ever before.

Receivers are becoming more selective, and listeners in increasing numbers are appreciating that they need not be restricted to British stations, that they can receive foreign stations without interference and listen to them with pleasure.

It is also noteworthy that you are giving this extra information without increasing the price of the paper to the reader.

I congratulate you on your enterprise, which I believe your new venture will fully justify.

London, W.1. J. ROBINSON,
British Radiostat Corporation, Ltd.

The Monodial Super.

THOUGH quite a novice in wireless arts, I have constructed the Monodial A.C. Super with outstanding success.

Let me assure any timid novice reader of your excellent paper that he need have no fear on embarking on the construction of this set, owing to the lucid instructions contained in your journal.

I would like to give a warning not to mount the coils the wrong way round, as mine were ready mounted in reverse order when I received them. JOHN D. BYRD.

Ashton-on-Mersey.

MR. GEOFFREY E. PEACHEY'S letter as to the extremely good quality obtained from the above receiver, published in your edition of the 22nd June, did not surprise me.

It might interest you to know that we ourselves have received a very large number of letters expressing delight at the quality obtained from this receiver. On one day alone last week we received seven letters, the gist of which was that the writers had not experienced in radio this quality of output previously. I certainly cannot remember any receiver, the design of which has been published during the summer months, which has created such universal interest and which has given such all-round satisfaction as the above.

H. W. GORDON HART,
Sales Manager, The British Rola Co., Ltd.

How Many Valves ?

I AM sorry to see that *The Wireless World* is adopting the American practice of designating their sets by the total number of valves included, regardless of the purpose for which they are employed. We have recently had the "Modern Straight Five," but surely "Four" would be more descriptive, as the rectifier valve has no direct bearing on the reception properties of the receiver, and could, in fact, be replaced by other types of rectifier.

Admittedly difficulties of classification would occur, but it seems to the writer that only valves which are directly concerned with amplifying and detection should be counted in the description of the set. It might even be preferable to refer to a "Four Stage Receiver" rather than "Four Valve," "Stage" implying the complete unit for amplification or detection, and in this way ambiguities which may arise when power valves are operated in parallel or push-pull, or oscillators in superheterodyne sets, disappear. For example, a circuit employing one stage of high-frequency amplification, detector, followed by an intermediate L.F. amplifier and two parallel-connected output valves would be a "Four Stage Receiver" regardless of the method of supplying energy to the set. A. J. MADDOCK.

Northumberland.

Broadcast Reproduction.

YOUR correspondent, Mr. Tomes, has placed himself in a rather amusing position. He reminds me of certain acquaintances of mine who "murder" Beethoven's "Moonlight Sonata" every evening on a very inferior piano. This work is never played as it is written—due to careless inaccuracy. However, they must be perfectly satisfied and happy, or they wouldn't do it.

I often wonder how many people, when listening to the average pianist, realise how many notes are "skipped," or out of tune; yet, to the average ear, all is well.

Such discussions, as between Messrs. Hartley, Bonavia, and West, are extremely interesting and instructive, and the ordinary amateur may learn many things which will greatly assist him in obtaining the very best results.

An amateur, whose very letter bears the mark of the uninformed, should think twice before rushing his opinions into print; he is so likely to be misunderstood. Good-natured criticism is another matter. G. R. BRIDLE.

Liverpool.

I, and, I think, thousands of others of your readers, must disagree with the remarks of Mr. Tomes in his letter on the discussion of Broadcast Reproduction. Mr. Tomes evidently does not correctly appreciate your aims in being a little more technical than some of the other wireless journals, and although he has been a reader for some time he reads without understanding, and appears to have gathered nothing of interest from the recent letters published.

A great deal is accomplished—perhaps not directly—by these scientific discussions (since the factions often agree to disagree), but by the ideas and practical experiments which arise out of them.

We may arrive at a stalemate on one point, but other points are cleared up, *vide* the experiments at the Bell Laboratories.

A point I consider of great importance is the method and effect of reproducing the frequencies, whether high or low.

Mr. Parkinson sends an interesting letter with reference to the violin, and I would like to use this instrument from a different point of view to illustrate my remarks on reproduction.

"Strads." are sought the world over, but how many of these retain the original strings fitted by this renowned maker?

We have then the primary frequency *producing* medium lost and replaced time after time, but the *quality reproducer*, which has given fame to this name, remains with us and pleases us still.

It would appear therefore that the frequency range is not of major importance. Given a *certain* range, quality depends on the perfection of the reproducer.

I have spent a lot of time experimenting with and making M.C. speakers, and must emphasise the necessity of this high quality in receivers and reproducers alike to do justice to the B.B.C. programmes. Providing your apparatus is right you will find the B.B.C. transmit frequencies sufficient for excellent quality when the signal intensity is adequate.

This does not infer perfection, and since we cannot use this word, any qualitative expression but represents our own view of a particular condition—the difficulty remains that this is also the idea of a person whose apparatus gives an atrocity of sound.

However, some of us proceed a little farther along the path of quality, and do not worry overmuch at a little bickering in the process of travel.

Our thanks are due to those who, experimenting technically, pass on knowledge gained only by many hours of hard study and labour.

Dudley. THOS. P. PRATT.

5,000 Cycles.

I IMAGINED that for a public concert the instruments which made up the orchestra were arranged so as to give the audience the maximum pleasure, except in certain cases, when there was a "technical" audience, then the orchestra might be arranged to be interesting rather than to please the ear.

A performance by a collection of instruments all with a 5,000 cycle "cut-off" might be very interesting, but would it please the public?

If it is decided that the listening public really prefer the "Mello 'cello" tone to a more realistic radio reproduction, should not the radio set be treated as a musical instrument, and designed to include a control so that the set could be adjusted to emphasise that part of the musical scale which the listener finds most attractive? J. F. M. MELLOR.

Hyde Park, W.2.

OUTSIDE the political world, I did not know one person could hate another quite unknown to him to the extent that Mr. C. J. Tomes appears to hate me! If he cannot prove me a fool by pure reason he will never do so by abuse. I should imagine that the quality provided by the B.B.C. satisfies *all* of us, and I did not suppose that there was a single reader of *The Wireless World* so destitute of common sense as to believe I was doing anything beyond attempting to show that "5,000 cycles and no more" was not good enough.

I was glad to see Mr. Willans rise to my bait, for it seems at times almost impossible to rouse up authoritative critics; when so many people are conscientiously striving for better reproduction one hopes to see the professional designers take at least a mild interest in the subject. If I have put a wrong construction on his contribution to the I.E.E. discussion, then I apologise, but I plead that he did not make it clear that boosting of "top" by the B.B.C. was an opportunity for set designers to cut it out; I am of the opinion that the B.B.C. accentuates the top because of the deficiencies of commercial apparatus.

I agree with Mr. Willans that exact reproduction is an impossible ideal, even with binaural systems, but there is no "sound" reason why the whole broadcasting chain from microphone to loud speaker should not be treated as an amplifier. Frequency distortion caused by the acoustic properties of the listener's room is inclined to be of minor importance for this reason; the musical critic does not have to sit at the conductor's feet when listen-

ing to a concert, and one can enjoy this concert in almost any part of a decent hall, in the same way that it can be enjoyed at home in any room with reasonable acoustic properties, *provided that the reproducing apparatus has a faithful response*. I have "sweated blood" on the acoustic measurement of loud speakers, and would say that Mr. Willans' suggested test is of little value, for one cannot get any reliable indication of loud-speaker performance by an audio oscillator and a calibrated microphone; in any case, one is not listening to sine waves in broadcasting, and what holds good for pure tones does not hold good for complex tones. Until some inspired genius shows us how to measure the actual performance of a loud speaker when reproducing speech and music in given surroundings, one has to fall back on the ear. If one knows what music and speech sounds like at first hand, then one can listen to a loud speaker and say: this does or does not sound like the real thing. If, as is obvious to anyone with any knowledge of the subject at all, a range from 30 to 9,000 cycles gives very much greater realism than 100 to 5,000 cycles, why not have it, especially since this wider range will not bring in undue interference where the field strength from one transmitter is high; the B.B.C., with its demand for greater station separation, is trying to get freedom from interference?

Mr. Willans mistakes the reason for the success of broadcasting; its novelty to start with, and then its extraordinary cheapness for the varied entertainment obtained, have brought it to its present position, but I say that the time is fast approaching when the public will demand better reproduction, and the set makers will have to supply it or go under. Radio will have to progress or die, in spite of Mr. Merdler.

Mr. W. O. Russell's letter is a complete answer to Mr. Scroggie, but since he made his letter such a direct attack I cannot refrain from adding that his admission that a receiver which is to have a flat response even up to 5,000 cycles, requires design of a highly technical order, is direct support of my statement to which he takes such objection; that speed limits are only advocated by those who cannot drive quickly; that prohibition is only advocated by abstainers; that, if the gramophone broadcasts are popular, it is because of Mr. Stone and the matter broadcast, and, if the reproducer cuts off at 5,000 cycles, it is immaterial whether the original be the real thing or gramophone records; that atmospherics have no respect for wavelength, quite apart from audio frequency limits.

Isleworth. H. A. HARTLEY.

I WISH to thank you most sincerely for the very interesting and educating articles on quality by Mr. Hartley, and also for publishing letters on the controversy.

This is the only way ordinary listeners like myself, who work in a motor factory all day and know little or nothing about the technical side of radio can keep in touch with the foremost authorities and get to know the latest theories on broadcast reproduction.

Every week I eagerly look forward to *The Wireless World*, and the first part I read is the Correspondence columns. Above all, I am sure that much of the information I have gathered from your splendid journal will be beneficial to me when I have saved the £20 or so to build my quality receiver, which I hope will be good enough to convert the very musical landlady, whose flat we have just vacated owing to "wireless nuisance."

Feltham, Mddx. H. WILLIAMS.

The Scottish Regional Transmitter.

I NOTE in your recent issues of *The Wireless World* that you consistently comment on the apparent lack of enthusiasm and praise from Scotsmen on behalf of the new Scottish Regional transmitter.

I must draw your attention to the fact that thousands in the North-East and North of Scotland have regularly paid the annual ten-shilling licence for the past eight years, and not even now are they placed within the direct range of a British transmitter.

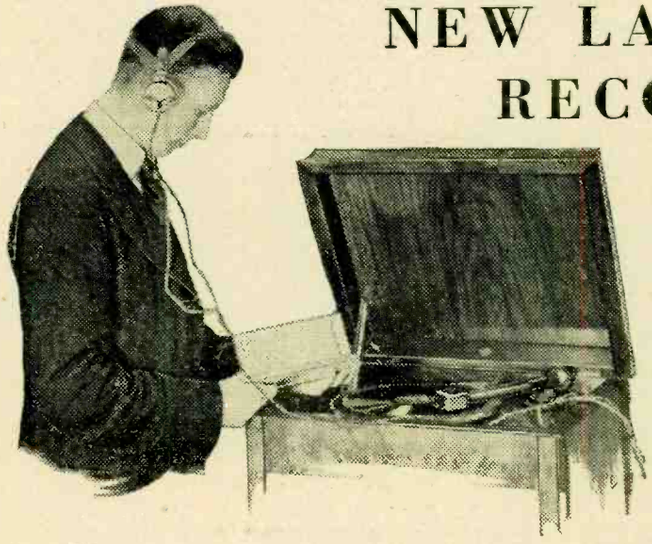
Notwithstanding this they are compelled to purchase sets employing three, four, five valves and upwards in order to receive 5XX in a satisfactory manner.

Now when we have waited most patiently for a high-power Scottish transmitter, i.e., over a period of more than three years since the promise of erection, we discover that we are still placed outside its service area. And still your correspondent sarcastically passes comment on the Scotsman's lack of eulogy.

Here we pay an average of £6 per annum to obtain good loud-speaker reception; in most parts of England £1 would suffice. Just think, what would be the result if conditions were the other way round? H. M. WATSON.

Banff.

NEW LANGUAGE RECORDS.



Learning Foreign Languages with the Aid of Records Supplemented by Direct Listening to Foreign Transmissions.

THOSE who listen to foreign programmes are almost certain to be interested in understanding the languages in which the announcements and talks are given. The fullest enjoyment of a foreign programme can scarcely be experienced until at least enough of the language is understood to be able to make out some part of the words spoken. It is of special interest to readers, therefore, to refer to a new series of language records which has recently been put out by His Master's Voice. The aim has been to give such a comprehensive selection of recordings in various languages as to cover requirements from the beginner up to those who merely need to polish up their knowledge of a language.

We have had samples of these records submitted to us, and can testify to the claim that they have been made with the utmost care. Months of study, we are told, have been devoted by leading experts in each language to the simplifying and clarifying of all the essentials, and condensing the material so as to combine with the records and text-books which are associated with them material sufficient to ensure that proficiency in any language can be attained. The user can employ these records with the confidence that from the very outset he is acquiring knowledge imparted on the right lines.

Ideal Teachers.

There is no question here of any risk of developing a bad style or pronunciation, for every speaker chosen is beyond criticism in this respect. The fact that a text-book is available to study in conjunction with the records is of very great assistance, and an unrivalled opportunity is available for acquiring a good knowledge of any modern language taken up, especially when supplemented with listening direct to broadcast transmissions from abroad. In the collection of German records there is a series of outstandingly useful records, combined with pictures, which provides an excellent method of memorising. Both in the French and German series there are dialogues with male and female voices.

The series at present covers French, German, and Spanish, whilst, in addition, a selection of Italian records is available. It is understood that other languages will be covered in due course.

Our own experience, which may perhaps be of help to students of languages from records, is that records for study are better played with headphones as the means of reproduction rather than the loud speaker. The majority of pick-ups are quite sensitive enough to permit of headphones being directly connected to the terminals of the pick-up without the necessity of any amplifier. A further merit of this method of using the record is that students can repeat a portion of the record over and over again to memorise words or pronunciation without making themselves a nuisance to other occupants of the room. But, in addition, there is the effect—probably a psychological one—which ensures far better concentration when listening on the headphones to the alternative of hearing these records through the medium of the loud speaker.

Incidentally, why is it that listening to records by means of headphones connected directly to the pick-up is not more generally adopted? Wherever records are offered for sale, elaborate sound-proof rooms are aimed at, or, alternatively, the customer trying over a record is expected to listen to it with disturbing surroundings and an audience of other customers waiting to be served. The headphone listening idea would overcome these troubles, and could be set up at very little cost in every record showroom.

READERS' PROBLEMS.

THESE columns are reserved for the publication of matter of general interest arising out of problems submitted by our readers.
Readers requiring an individual reply to their technical questions by post are referred to "The Wireless World" Information Bureau, of which full particulars, with the fee charged, are to be found on the next page.

Not Like Other Sets.

AS the "Autotone" receiver includes an L.F. tone-correcting valve, of which the function is to compensate for high-note loss deliberately introduced in the tuned circuits, it follows that the conventional methods of fitting a gramophone pick-up are not applicable to this set. If a pick-up were connected, say, across the grid circuit of the detector valve, reproduction would be excessively shrill and high-pitched, and low notes would be relatively so attenuated that they would be almost inaudible.

Thus the grid circuits of both detector and tone-corrector valves are ruled out as a possible position for the pick-up. This accessory must accordingly be inserted in the grid circuit of the first L.F. valve (the third valve in the receiver). An appropriate method of connection is shown in Fig. 1.

This is in answer to a reader who asks for information on the subject of converting his "Autotone" for gramophone reproduction.

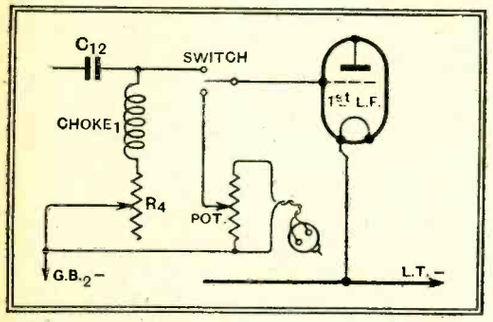


Fig. 1.—Connections of a pick-up and volume-control potentiometer to the 1st L.F. valve of the "Autotone" receiver. Component reference numbers correspond to those of the original published description.

He seems to wonder whether the special features of the "Autotone" render it unsuitable for this purpose, but it may be stated definitely that on this score the receiver is just as suitable as any other battery-fed set which is moderately economical in the matter of anode current. The amount of amplification provided by the form of connection which we have suggested will be more than enough to load the output valve, even with a relatively insensitive pick-up.

A Changing Point of View.

A FEW years ago the inclusion of automatic or "free" grid bias in a receiver was regarded almost as an experimental innovation; now it is standard practice, and hesitation is sometimes felt in using battery bias in circumstances where the alternative scheme is commonly employed.

For instance, a reader who wishes to make provision for using a pick-up with a standard H.F.-det.-L.F. A.C. receiver asks whether it would be safe to use a small battery for biasing the detector when it is converted into a gramophone amplifier. His reason for wishing to do so is that the interior of the receiver is somewhat inaccessible, and so the fitting of the conventional bias resistor and by-pass condenser would not be easy.

There should not be the slightest objection to this course, as it is comparatively rarely that auto-bias confers any basic advantage other than convenience, and perhaps that of automatic compensation for changes in H.T. voltage. But in a few rare cases free bias confers a measure of stability, due to a reversed reaction effect that is lacking when battery bias is substituted. However, this would not arise in the circumstances we are at present considering.

The "Modern Straight Five."

WE are asked to amplify the reasons given in the description of the "Modern Straight Five" for employing a simple series-connected transformer for coupling the detector and output valves. Our correspondent fails to understand why the decoupling of the succeeding stage is affected by the choice of coupling component.

This is a matter that can hardly be explained briefly, but it may be stated that difficulties in decoupling the grid circuit of the succeeding valve often arise when a parallel-fed transformer is employed; this matter was explained at length in an article entitled "Automatic Grid Bias" in our issue of April 13th, to which our correspondent is referred.

Decoupling a Superhet.

A CONSTRUCTOR of a battery-operated superheterodyne writes to tell us that his set gave admirable results when fed with H.T. and L.T. current from the sources for which it was designed, but, when supplied from a high-tension battery eliminator, there is evidence of L.F. instability in the form of "motor-boating."

The trouble is not very pronounced, and it is felt that a small amount of extra decoupling would effect a cure. It is asked which of the various anode circuits is most likely to respond to this treatment.

We recommend that a start should be made with the second detector anode circuit. Although it may not be possible to increase the value of the decoupling resistance to any great extent (for fear of reducing anode voltage), it must not be forgotten that a similar effect may be brought about by increasing the associated by-pass capacity by shunting the existing condenser with another of 2 or even 4 mfds.

If this addition fails to effect a complete cure, attention should then be transferred to the I.F. amplifier anode circuit, and finally to that of the first detector.

For the benefit of other readers, it should be added that these suggestions apply generally to the majority of modern superheterodyne receivers, and not to any one particular type.

D.C. Battery Eliminators.

A CORRESPONDENT who is planning an H.T. eliminator for operation with a direct-current supply system asks three questions with reference to this piece of apparatus.

(1) Is it advisable to change the normal position of the smoothing choke when the positive supply main is earthed, as it is believed to be in his case?

(2) How is it possible to determine definitely which pole of the supply is earthed?

(3) Information is also requested as to the simplest method of ascertaining the polarity of a pair of flex leads which are connected to a lamp socket.

With regard to the smoothing choke, this component should always be inserted in the "live" side of the circuit—i.e., the side that is not earthed. In this case it should be in the negative lead.

To determine which pole is earthed, connection should be made between either lead in turn and earth through a voltmeter of suitable range or through a high-voltage test lamp. An indication of current shows that connection is being made to the unearthed main.

An indication of polarity is provided automatically by a voltmeter which will only give a reading when the polarity of the connecting leads are as marked on the instrument. Failing this, the mains leads, with a high-voltage protective lamp or other current-limiting resistance in series, may be immersed in a glass of water; bubbles will rise from both electrodes, but more freely from the *negative* wire.

External Trimmers.

THE user of a commercial three-valve set with ganged tuning, in which the built-in trimming condensers are sealed up, and, moreover, are inaccessible, has reason to suspect that the tuning of the input circuit is incorrect. He asks us how this point can be confirmed by connecting an external trimming condenser, and then observing whether it is possible to improve signal strength or sharpness of tuning by adjustment of its capacity.

If our correspondent's suspicion is justified, the error that exists may be either in the direction of too much or too little capacity across the first tuned circuit. Either of these discrepancies may be corrected by a suitably connected external trimmer, but both of them will not be susceptible to the same form of treatment.

For instance, if there is at present too much capacity, the remedy is to insert a fairly large condenser—to be on the safe side, about 0.0005 mfd.—in series with the aerial, as shown in Fig. 2 (a).

If, on the other hand, it happens that there is too little capacity across the circuit, then

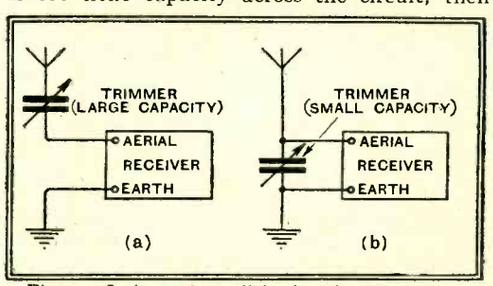


Fig. 2.—Series and parallel trimming condensers connected externally. These may be used together or separately.

it may be corrected by an external trimmer shunted across aerial and earth terminals, as in Fig. 2 (b). A maximum capacity of more than 0.0001 mfd. should be unnecessary, and even undesirable, for this method of correction.

Our querist's procedure should be to try each system, and if either the series or parallel connection improves results, it should be retained permanently. If neither has any beneficial effect, it may safely be assumed that the internal adjustment of the set is already correct for his aerial.

Almost an Antique.

A QUERIST whose four-year-old set embodies a 2-volt valve acting as an anode-bend detector, with 6-volt valves elsewhere, is in course of overhauling his apparatus, and intends to replace the valves. The detector valve was originally biased automatically by an arrangement of resistors in the negative filament lead, but the original type of valve is no longer obtainable, and so we are asked to suggest an alternative scheme, preferably including provision for variable bias.

As it will probably be desired to use ready-made components, we think that the best and simplest plan is that shown diagrammatically in Fig. 3.* Basically, this is similar to the scheme originally employed, but provision is made for picking up any desired part of the total voltage existing across the filament resistor by shunting it with a potentiometer,

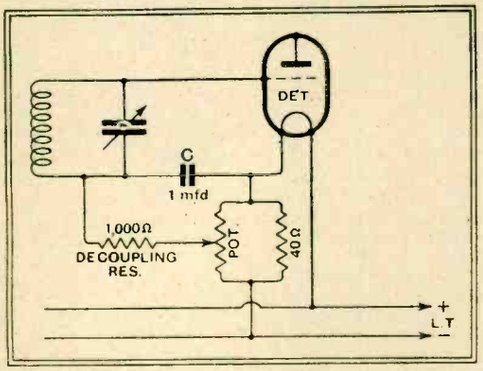


Fig. 3.—Variable "free" bias for an anode-bend detector in a battery-operated receiver. Values of the decoupling components are not critical.

to the slider to which the grid circuit is "returned" through a decoupling resistance.

The voltage-reducing filament resistance will probably have a value of 40 ohms; the parallel-connected potentiometer must have an ohmic value many times greater than this, in order that it may not reduce the effective resistance to any appreciable extent.

Superheterodyne Without Oscillation.

A BUILDER of the Monodial A.C. Super is perturbed by the fact that the removal of the oscillator valve does not always result in a complete cessation of signals, for he finds it still possible to tune in one or two stations at poor strength.

Provided that the receiver is functioning correctly, this is the phenomenon known as beat interference, in which the intermediate frequency is provided by two stations spaced by 110 kc. beating together. Its presence does not necessarily indicate any defect in the receiver, for it is improbable that will occur at sufficient strength to give rise to audible interference when the oscillator valve is functioning. It is partly the purpose of the signal-frequency tuned circuits to discriminate against it, and if the ganging be correct they perform their function efficiently.

A similar effect might be experienced, however, were the H.F. valve in an unstable condition. Should the effect be due to this cause, however, numerous whistles would be present when the oscillator valve is in circuit.

Resistance-coupled Push-pull.

READERS who have written to us on the subject of resistance-coupled push-pull amplification should realise that this system is not workable without some device that ensures that voltages applied simultaneously to the push-pull valves are in opposition. With a transformer, this is easily arranged, but without it the L.F. amplifier must be greatly complicated by the addition of a phase-reversing valve. This introduces a complication which is sufficiently serious almost to rule out of court the whole scheme for ordinary purposes.

Anode Voltage Regulation.

THE desirability of ensuring a reasonably constant anode voltage supply for A.C. variable-mu valves is generally appreciated; if the full benefit is to be derived from their special characteristics, it is important that anode voltage should not rise to any great extent when current is reduced by increasing negative grid bias for purposes of volume control.

With regard to the new battery-fed counterparts of these valves, regulation difficulties seldom arise, as the maximum voltage of the source of supply will seldom exceed the anode rating of the valves. When it happens that an H.T. battery of exceptionally high voltage is employed, it is distinctly better to feed the H.F. valve anodes from a suitable intermediate tapping, rather than from the maximum available voltage through absorbing resistances.

An H.T. eliminator as a source of current for variable-mu battery valves is bound sometimes to introduce complications, but a reader who asks for information on this subject has no real cause to worry. His eliminator, according to its manufacturers, will give 165 volts at 35 milliamps, which is the estimated total consumption of the set. This voltage is only slightly greater than the normal rating, and so there is little danger in applying it to the anodes through decoupling resistances of only a few hundred ohms. In the circumstances, care should be taken that screening-grid voltage is not in excess of the makers' recommendation, and these electrodes should be fed through a potentiometer of the lowest possible resistance.

FOREIGN BROADCAST GUIDE.

WARSAW

(Poland).

Geographical position: 52° 14′, N.: 21° 7′ E.
Approximate air line from London: 900 miles.
Wavelength: 1,412 metres. Frequency: 212.5 kcs. Power: 120 kilowatts.
Time: Central European (coincides with B.S.T.)

Standard Daily Transmissions.

10.00 B.S.T., Sacred service relayed from Poznan (Sun.); 11.58, time signal; concert (Sun.); 14.50, concert and talks; 17.00, concert or gramophone records; talks; 19.50, main evening entertainment, time signal, weather, news; 22.00, Chopin recital (Sat.); 23.10, dance music (except Mondays). Programmes are frequently relayed to Katowice, Poznan and Cracow.

Announcers: Man and woman. Call: (phon): *Hallo! Hallo! Polskie raadio Var-schavva.* Announcements are made in the Polish language, but on evenings when International concerts are broadcast, a translation is given in French, German and English

Opening and Interval Signal: First two bars of Chopin's Polonaise in A major; as under:

The Morse letter W (.--) sometimes precedes the time signal which consists of one long "hoot" followed by a number of dashes (according to hour) and three dots to indicate last seconds of last minute.

The transmissions usually close down with Clock chimes and the Polish National Anthem (Dombrowski Maxurka).

Relays: Warsaw (No. 2) 214.4 m. (1,400 kcs.), 1.9 kw.; Lodz, 235.8 m. (1,283 kcs.), 2 kw.; Lvov, 380.8 m (788 kcs.), 16 kw.

Life-saving.

WE are asked by a reader, who seems not to have been exceptionally unlucky in regard to the length of service obtained from his indirectly-heated A.C. valves, to enumerate the likely causes of an early falling-off in emission. A circuit diagram of his set is also submitted, in order that we may see if there are any obvious faults that might cause this unsatisfactory state of affairs.

Assuming that the values of components are as shown, there is nothing in the circuit arrangement that can be responsible for a reduction in valve life. The following are the most usual causes of an early decline of emission:

(*a*) Application of an excessively high voltage to the heating elements. Although it is not generally known, operation of the valve with considerably *less* than its rated heater voltage is also harmful.

(*b*) Excessive anode voltage.

(*c*) Insufficient negative bias voltage, or operation of the valve with a "zero" grid (i.e., without bias).

(*d*) Accidental application of positive instead of negative grid bias.

An excessively high heater voltage is likely to be due only to an incorrectly designed power transformer, but the use of unduly long connecting leads of thin wire may cause a deficiency.

In a modern set with automatic grid bias almost the only possible cause of grid-circuit faults is the development of a complete or partial short-circuit in a bias resistor.

The Wireless World INFORMATION BUREAU.

Conditions of the Service.

(1) THE service is intended primarily for readers meeting with difficulties in the construction, adjustment, operation, or maintenance of wireless receivers described in *The Wireless World*, or those of commercial design which from time to time are reviewed in the pages of *The Wireless World*. Every endeavour will be made to deal with queries on all wireless matters, provided that they are of such a nature that they can be dealt with satisfactorily in a letter.

(2) Communications should be addressed to *The Wireless World* Information Bureau, Dorset House, Tudor Street, E.C.4, and must be accompanied by a remittance of 5s. to cover the cost of the service. The enquirer's name and address should be written in block letters at the top of all communications.

(3) The fee of 5s. covers the reply to any wireless technical difficulty, but in special cases, where the enquiry may involve a considerable amount of investigation, an increased fee may be necessary. In such cases a special quotation will be made.

(4) Questions should be clearly written and concisely worded in order to avoid delay. Where enquiries relate to trouble experienced in receivers built to specifications in *The Wireless World* a complete account should be given of the trouble, and especially the symptoms.

(5) Where reference is made to published articles or descriptions of apparatus, the title of the article, the date of publication in *The Wireless World*, and the page reference number should be given, in order to facilitate reply.

(6) Full circuit diagrams, constructional details of apparatus, or values of components for home-designed receivers cannot normally be supplied, but circuit diagrams sent in with queries will be checked and criticised.

(7) Particular makes of components cannot, in general, be recommended, but advice will be given as to the suitability of an individual component for a particular purpose specified by the enquirer.

BROADCASTING STATIONS ABROAD.

ARRANGED IN ORDER OF WAVELENGTH.

Wavelength in Metres.	Frequency in Kilocycles.	Power in kW.	Station.	Tuning Positions.
1935	155	7	Kaunas (Kovno) (Lithuania)	
1875	160	8.5	Huizen (Holland). (*Exchanges wavelengths with Hilversum every three months.*)	
1796	167	54	Lahti (Finland)	
1724	174	75	Radio Paris	
1635	183.5	60	Zeesen (Königswusterhausen) (Germany). (*Generally relays Berlin.*)	
1600	187.5	10	Irkoutsk, RV14 (Russia)	
1554.4	193	30	Daventry National	
1538	195	7	Ankara (Angora) (Turkey)	
1481	202.5	100	Moscow, RV1 (Old Komitern) (Russia)	
1446	207.5	13	Eiffel Tower, FLE, Paris	
1412	212.5	120	Warsaw I (Poland)	
1380	217.5	100	Novosibirsk, RV6 (Russia)	
1350	222.2	0.5	Tunis-Kasbah (Tunisia)	
1348	222.5	30	Motala (Sweden). (*Relays Stockholm*)	
1304	230	100	Moscow, WZSPS (Trade Union) (Russia)	
1260	238	10	Baku, RV8 (Russia)	
1229.5	244	0.6	Boden (Sweden). (*Relays Stockholm*)	
1200	250	5	Stamboul (Turkey)	
1200	250	21	Reykjavik (Iceland)	
1170	256	25	Tashkent, RV11 (Russia)	
1154	260	7.5	Kalundborg (Denmark)	
1117	268.5	40	Moscow, Popoff RV58 (Russia)	
1100	272.7			
1105	271.5	35	Minsk Koloditschi, RV10 (Russia)	
1083	277	60	Oslo (Norway)	
1071	280	10	Tiflis, RV7 (Russia)	
1035	290	36	Kiev, RV9 (Russia)	
1000	300	100	Leningrad, Kolpino RV53 (Russia)	
968	310	10	Alma Ata, RV60 (Russia)	
938	320	20	Kharkov, RV4 (Russia)	
882	340	20	Saratov, RV3 (Russia)	
849	353.4	4	Rostov-on-Don, RV12 (Russia)	
825	363.6	50	Sverdlovsk, RV5 (Russia)	
770	389	0.6	Ostersund (Sweden). (*Relays Stockholm*)	
760	395	1.3	Geneva (Switzerland)	
720	416.6	20	Moscow, RV2 (Experimental) (Russia)	
690	434.6	1.5	Oulu (Finland)	
644	465.8	10	Kazan, RV17 (Russia)	
575	521.5	1.2	Samara, RV16 (Russia)	
574.7	522	2.5	Ljubljana (Yugoslavia)	
569	527	0.25	Freiburg-im-Breisgau (Germany). (*Relays Stuttgart.*)	
568.1	528	2	Grenoble (France)	
566	530	0.25	Hanover (Germany). (*Relays Hamburg*)	
565	531	16	Wilno (Poland). (*Relay Station*)	
560	536	0.25	Augsburg (Germany). (*Relays Munich*)	
560	536	1.5	Kaiserslauten (Germany). (*Relays Munich*)	
560	536	0.7	Hamar (Norway). (*Relays Oslo*)	
555.5	540	1	Tampere (Tammerfors) (Finland). (*Relays Helsinki.*)	
550	545	18.5	Budapest No. 1 Lakihegy (Hungary)	
542	554	10	Sundsvall (Sweden). (*Relays Stockholm*	
533	563	1.5	Munich (Germany)	
525	571	3	Palermo (Italy)	
525	571	15	Riga (Latvia)	
517	580	15	Vienna (Rosenhügel) (Austria)	
509	589	15	Brussels No. 1, Velthem (Belgium). (*French Programme.*)	
508	590	10	Astrakhan, RV35 (Russia)	
501.7	598	10	Nijni Novgorod, RV42 (Russia)	
500.8	599	20	Florence, 1FI (Italy)	
495.8	605	1.2	Trondheim (Norway)	
488.6	614	120	Prague, No. 1 (Czechoslovakia)	
486.2	617	10	Oufa, RV22 (Russia)	
480	625	50	North Regional (Manchester)	
480	625	10	Ivanovo-Voznesensk, RV33 (Russia)	
472.4	635	60	Langenberg (Germany)	
465.8	644	1.5	Lyons la Doua, PTT (France)	
459.4	653	60	Beromünster (Schweizerischer Landessender) (Switzerland).	
453.2	662	0.6	San Sebastian, EAJ8 (Spain)	
453.2	662	1	Pori (Uleaborg) (Finland)	
453.2	662	0.5	Danzig. (*Relays Königsberg*)	
453.2	662	0.5	Klagenfurt (Austria). (*Relays Vienna*)	
453.2	662	0.7	Porsgrund (Norway). (*Relays Oslo*)	
453.2	662	1	Salamanca, EAJ22 (Spain)	
453.2	662	0.1	Tromsö (Norway)	
453.2	662	0.5	Bodö (Norway)	
453.2	662	0.15	Upsala (Sweden). (*Relays Stockholm*)	
450.4	666.7	10	Odessa, RV13 (Russia)	
447.1	671	0.7	Paris, Ecole Superieure, PTT	
447.1	671	0.35	Aalesund (Norway)	
447.1	671	0.15	Rjukan (Norway). (*Relays Oslo*)	
447.1	671	0.08	Notodden (Norway)	
447.1	671	0.5	Tartu (Esthonia)	
441.2	680	50	Rome, 1RO. (*Short-wave Station, 2RO on 25.4 m.*)	
435.4	689	55	Stockholm (Sweden)	
431	696	2.5	Belgrade (Yugoslavia)	
424.3	707	3	Madrid, EAJ7 (Union Radio). (*After 7.0 p.m.*)	
424.3	707	1.3	Madrid, EAJ2 (Radio Espana). (*Up to 7.0 p.m.*)	
424.3	707	100	Moscow, Imini Stalina (Russia)	
419	716	1.5	Berlin, No. 1, Witzleben (Germany)	
416.4	720.5	2.5	Rabat (Morocco)	
413	725	1.2	Dublin (Irish Free State)	
410.9	730	1.3	Madrid, EAJ7 (Spain)	
408.7	734	16	Katowitz (Poland)	
403.8	743	25	Sottens (Radio Suisse Romande) (Switzerland)	
398.9	752	25	Midland Regional	
394.2	761	12	Bucharest (Roumania)	
389.6	770	1.5	Frankfurt-a-M. (Germany)	
389.6	770	10	Archangel, RV36 (Russia)	
385.1	779	8	Radio-Toulouse (France)	
385.1	779	10	Stalino, RV26 (Russia)	
381	788	16	Lwow (Lemburg) (Poland)	
379.7	790	1	Seville, EAJ5 (Union Radio) (Spain)	
376.4	797	50	Scottish Regional (Falkirk)	
372.2	806	1.5	Hamburg (Germany)	
370.1	810.5	0.8	Radio, LL, Paris	
368.1	815	10	Helsinki (Finland)	
368.1	815	1	Bolzano (Italy)	
368.1	815	10	Kharkov, RV20 (Russia)	
367.6	816	0.7	Fredrikstad (Norway). (*Relays Oslo*)	
364.1	824	1	Bergen (Norway)	
363.6	825	16	Algiers (Algeria)	
360.6	832	60	Mühlacker (Stuttgart) (Germany)	
355.9	843	50	London Regional (Brookmans Park)	
352.1	852	7	Graz (Austria). (*Relays Vienna*)	
348.8	860	7.6	Barcelona, EAJ1 (Spain)	
348.8	860	10	Leningrad, RV70 (Russia)	
345.2	869	11.5	Strasbourg, PTT (France)	
341.7	878	35	Brno (Brunn) (Czechoslovakia)	
337.8	888	15	Brussels II, Velthem (Belgium). (*Flemish Programme.*)	
334.4	897	1.35	Poznan (Poland)	
331.4	905	7	Milan (Italy)	
328.2	914	60	Poste Parisien (France)	
325	923	1.5	Breslau (Germany)	
321.9	932	10	Göteborg (Sweden). (*Relays Stockholm*)	
318.8	941	0.5	Sofia (Bulgaria)	
318.8	941	0.25	Dresden (Germany). (*Relays Leipzig*)	
318.8	941	1.5	Naples, 1NA (Italy)	
315.8	950	1.6	Marseilles, PTT (France)	
312.8	959	1.7	Cracow (Poland)	
312.8	959	10	Genoa, 1GE (Italy)	
309.9	968	1	Cardiff	
308.6	972	0.7	Radio Vitus (Paris)	
307	977	0.5	Falun (Sweden)	
307	977	0.75	Zagreb (Yugoslavia)	
304	986	13	Bordeaux Lafayette, PTT (France)	
301.5	995	50	North National (Manchester)	
298.8	1004	11	Tallinn (Esthonia)	
296.1	1013	7	Hilversum (Holland). (*Up to 4.40 p.m.*)	
296.1	1013	20	Hilversum (Holland). (*After 4.40 p.m.*) (*Exchanges wavelengths with Huizen every three months.*)	
293.5	1022	0.7	Limoges, PTT (France)	
293.5	1022	2.6	Kosice (Czechoslovakia)	
291	1031	10	Viipuri (Viborg) (Finland). (*Relays Helsinki*)	
288.5	1040	—	British Relay Stations	
286.8	1046	0.7	Lyons (Radio-Lyon) (France)	
286	1049	0.8	Montpellier (France)	
283.6	1058	0.5	Berlin, No. 2 (Germany)	(*Relay Stations Synchronised*)
283.6	1058	0.5	Magdebourg (Germany)	
283.6	1058	0.5	Stettin (Germany)	
283.6	1058	0.5	Innsbruck (Austria). (*Relays Vienna*)	
281.2	1067	0.75	Copenhagen (Denmark)	
278.8	1076	13.5	Bratislava (Czechoslovakia)	
276.5	1085	60	Heilsberg (Germany). (*Relays Konigsberg*)	
273.7	1096	7	Turin (Italy)	
271.5	1105	1.3	Rennes, PTT (France)	
271.5	1105	10	Minsk, RV10 (Russia)	
269.8	1112	0.25	Bremen (Germany). (*Relays Hamburg*)	
267.6	1121	8	Valencia (Spain)	
265.8	1128.5	1.3	Lille, PTT (France)	
263.8	1137	11.2	Moravska-Ostrava (Czechoslovakia)	

BROADCASTING STATIONS ABROAD (In Order of Wavelength).

Wavelength in Metres.	Frequency in Kilocycles.	Power in kW.	Station.	Tuning Positions.
261.5	1147	50	London National (Brookmans Park)	
259.3	1157	2	Leipzig (Germany)	
257.1	1167	10	Hörby (Sweden). (*Relays Stockholm*)	
255.1	1176	0.7	Toulouse, PTT (France)	
253.1	1185	5	Gleiwitz (Germany). (*Relays Breslau*)	
251.5	1193	0.25	Trollhätten (Sweden)	
251.5	1193	1	Barcelona, EAJ15 (Assoc. Nat.) (Spain)	
251.5	1193	1	Almeria, EAJ18 (Spain)	
249.6	1202	—	Prague, No. 2 (Czechoslovakia). (*Temporary*)	
249.6	1202	0.2	Kalmar (Sweden). (*Provisional*)	
249.6	1202	0.8	Juan-les-Pins, Nice (France)	
247.7	1211	10	Trieste (Italy)	
245.9	1220	0.3	Varberg (Sweden)	
245.9	1220	0.01	Bloemendal (Holland). (*Sundays only*)	
245.9	1220	0.5	Berne (Switzerland)	
245.9	1220	0.4	Cartagena (Spain)	
245.9	1220	0.2	Eskilstuna (Sweden). (*Relays Stockholm*)	
245.9	1220	0.25	Cassel (Germany). (*Relays Frankfurt*)	
245.9	1220	0.5	Linz (Austria). (*Relays Vienna*)	
245.9	1220	0.5	Pietarsaari (Finland)	
245.9	1220	0.4	Säffle (Sweden). (*Relays Stockholm*)	
245.9	1220	0.5	Turku (Abo) (Finland). (*Relays Helsinki*)	
244.1	2229	0.5	Basle (Switzerland)	
242.3	1238	1	Belfast (N. Ireland)	
240.6	1247	0.5	Stavanger (Norway)	
238 9	1256	2	Nürnberg (Germany). (*Relays Munich*)	
237.2	1265	0.2	Orebrö (Sweden). (*Relays Stockholm*)	
236.2	1270	3	Bordeaux, Sud-Ouest (France)	
235.5	1274	0.07	Nimes (France)	
235.5	1274	0.5	Kristiansand (Norway)	
233.8	1285	1.65	Lodz (Poland). (*Relay Station*)	
232.2	1292	0.25	Kiel (Germany). (*Relays Hamburg*)	
232.2	1292	0.25	Norrköping (Sweden)	
230.6	1301	0.12	Malmö (Sweden). (*Relays Stockholm.*) — Synchronised	
230.6	1301	0.25	Karlstad (Sweden) — Synchronised	
230.6	1301	0.2	Hälsingborg (Sweden) — Synchronised	
230.6	1301	0.2	Umea (Sweden) — Synchronised	
227.4	1310	0.5	Uddevalla (Sweden)	
226	1328	0.15	Hüdiksvall (Sweden). (*Provisional*)	
224.4	1337	1	Cork (Irish Free State)	
221.7	1353	10	Fécamp, Radio-Normandie (France)	
221.4	1355	0.4	Helsinki, No. 2 (Finland)	
219.9	1364	0.3	Béziers (France)	
218.5	1373	0.5	Flensburg (Germany)	
218.5	1373	0.5	Salzburg (Austria). (*Relays Vienna*)	
217	1382	0.5	Königsburg (East Prussia) (Germany)	
215.6	1391	0.2	Halmstad (Sweden)	
215.6	1391	0.1	Brussels, Radio-Conférence	
214.4	1400	10	Warsaw, No. 2 (Poland)	
209.8	1430	—	Budapest, No. 2 (Hungary)	
207	1450	0.15	Boras (Sweden)	
206	1460	0.2	Ornsköldsvik (Sweden)	
204.1	1470	0.2	Gävle (Sweden)	
202.7	1480	0.25	Kristineham (Sweden)	
201.3	1490	0.25	Jönkoping (Sweden)	
195	1530	0.2	Karlskrona (Sweden)	

PRINCIPAL SHORT-WAVE STATIONS.

ARRANGED IN ORDER OF WAVELENGTH.

(N.B.—Times of Transmission, given in parentheses, are approximate only and represent B.S.T.)

Wavelength in Metres.	Frequency in Kilocycles.	Call Sign.	Station.	Tuning Positions.
14.28	21,018	OK1	Podebrady (Czechoslovakia)	
14.55	20,618	PMB	Malabar (Java). (*Daily* 11.00–16.00)	
15.5	19,350	—	Nancy (France). (*Daily* 21.00–22.00)	
15.93	18,830	PLE	Bandoeng (Java). (*Tues.* 14.40–16.40)	
16.3	18,400	PCK	Kootwijk (Holland). (*Daily* 16.00)	
16.32	18,380	FZA	Saigon (Fr. Indo China). (*Sun.* 19.00–21.00.)	
16.57	18,105	W9XAA	Chicago, Ill. (U.S.A.). (*Relays WCFL*)	
16.82	17,804	PCV	Kootwijk (Holland), "Voice of Holland." (*Sat.* 15.40.)	
16.9	17,750	HSP	Bangkok (Siam). (*Sun. and Tues.* 21.00)	
18.4	16,300	PCL	Kootwijk (Holland). (*League of Nations Station.*)	
19.56	15,340	W2XAD	South Schenectady, N.Y. (U.S.A.). (*Daily* 21.00.)	
19.68	15,244	FYA	Pontoise (France). (*Colonial Stn. E-W*)	
19.72	15,210	W8XK	East Pittsburg, Pa. (U.S.A.). (*Relays KDKA.*)	
19.73	15,200	DJB	Zeesen (Germany). (*Daily* 14.00–18.00)	
19.84	15,120	HVJ	Vatican State, Rome. (*Daily* 12.00)	
20.5	14,630	XDA	Chapultepec (Mexico). (*Daily* 20.30)	
21.5	13,950	—	Bucharest University (Roumania). (*Wed. and Sat.* 20.00.)	
23.38	12,820	—	Rabat (Morocco). (*Sun.* 12.30)	
24.0	12,500	CT3AQ	Funchal (Madeira). (*Tues. and Thurs.* 10.30–12.30.)	
25.2	11,900	FYA	Pontoise (France). (*Colonial Stn. N-S*)	
25.25	11,880	W8XK	East Pittsburg, Pa. (U.S.A.). (*Relays KDKA.*)	
25.27	11,870	VUC	Calcutta (India). (*Weekdays* 02.45 *and* 15.15.)	
25.34	11,840	W9XAA	Chicago, Ill. (U.S.A.). (*Relays WCFL*)	
25.4	11,810	2RO	Prato Smeraldo, Rome. (16.00 *and* 19.30)	
25.42	11,800	VE9GW	Bowmanville (Canada). (*Daily* 19.00–09.00.)	
25.46	11,777	F3ICD	Saigon (Fr. Indo China). (*Fri.* 15.30)	
25.5	11,760	XDA	Chapultepec (Mexico). (*Daily* 21.00)	
25.53	11,750	G5SW	Chelmsford. (*Relays Daventry National daily, ex. Sun.*)	
25.63	11,700	FYA	Pontoise (France). (*Colonial Stn. E-W, daily* 21.00.)	
26.22	11,440	DHA DHC	Nauen (Germany). (*Fri., Sat., Sun.* 22.00.)	
28.2	10,365	PLR	Bandoeng (Java). (*Daily* 11.00–15.00)	
28.98	10,350	LSX	Buenos Aires (Argentina). (*Daily* 21.30)	
29.3	10,238	T14NRH	Heredia (Costa Rica). (*Daily* 23.00 *and* 03.00.)	
30	10,000	—	Belgrade (Yugoslavia). (*Mon.* 21.00)	
30.4	9,869	EAQ	Aranjuez (Spain). (*Sat.* 19.00)	
31.10	9,610	HS2PJ	Bangkok (Siam). (*Mon.* 02.00–05.00)	
31.25	9,598	CT1AA	Lisbon (Portugal). (*Fri.* 23.00)	
31.28	9,590	VK2ME	Sydney (Australia). (*Sun.* 07.00, 11.00, 18.00.)	
31.3	9,582	W3XAU	Philadelphia, Pa. (U.S.A.). (*Daily ex. Thurs. and Fri.* 21.00.)	
31.35	9,570	W1XAZ	East Springfield, Mass. (U.S.A.). (*Relays WBZ.*)	
31.35	9,570	SRI	Posen (Poland). (*Tues. and Thurs.* 19.30)	
31.38	9,560	DJA	Zeesen (Germany). (*Daily* 14.00)	
31.48	9,530	W2XAF	Schenectady, N.Y. (U.S.A.). (*Relays WGY*)	
31.51	9,520	OXY	Skamlebaek (Denmark). (*Relays Copenhagen.*)	
31.55	9,510	VK3ME	Melbourne (Australia). (*Wed. and Sat.* 11.00.)	
31.75	9,450	—	Rio de Janeiro (Brazil). (*Daily* 23.30)	
31.86	9,415	PLV	Bandoeng (Java). (*Tues.* 14.40)	
32.26	9,300	—	Rabat (Morocco). (*Sun.* 19.00)	
32.85	9,130	HB9OC	Zurich (Switzerland). (*Daily* 11.30–22.00)	
34.68	8,650	W2XV	Long Island, N.Y. (U.S.A.). (*Fri.* 23.00)	
36.92	8,125	PLW	Bandoeng (Java). (*Daily* 11.00–15.00)	
37.2	8,069	OU1TH	Vienna (Techn. College). (*Mon. and Thurs.* 21.30.)	
38.0	7,890	PK3BK	Soerabaia (Java). (*Tues., Fri., Sat.* 11.40)	
39.7	7,556	HKF	Bogota (Colombia). (*Westinghouse Labs.*)	
40.7	7,370	X26A	Nuevo Laredo (Mexico). (*Thurs.* 17.00)	
41.0	7,320	HSP2	Bangkok (Siam). (*Mon.* 14.00)	
41.5	7,320	—	Budapest (Hungary). (*Tech. Sch.*) (07.30–08.10.)	
41.5	7,230	HB9D	Zurich (Radio Club) (Switzerland). (*1st and 3rd Sun.*)	
41.6	7,211	EAR58	Teneriffe (Radio Club) (Canary Islands)	
41.7	7,195	VS1AB	Singapore (Malay States). (*Sun. and Wed.* 15.30.)	
42.0	7,143	VK2HR	Sydney (Australia)	
43.0	6,970	EAR110	Madrid. (*Tues. and Sat.* 23.30)	
43.0	6,970	PK3BK	Soerabaia (Java). (*Tues. and Thurs.* 11.10)	
45.0	6,667	FM8KR	Constantine (Algeria). (*Mon. and Fri.* 23.00.)	
45.0	6,667	PL3CH	Soerabaia (Java). (*Mon., Wed.* 12.40)	
45.38	6,611	REN	Moscow	
46.69	6,425	W3XL	Bound Brook, N.J. (U.S.A.). (*Fri. and Sat.* 22.00.)	
48.0	6,250	CN8MC	Casablanca (Morocco). (*Relays Rabat*)	
48.35	6,205	HKC	Bogota (Colombia). (*Daily* 16.00)	
48.62	6,170	HRB	Tegucigalpa (Honduras). (*Daily* 01.00)	
48.65	6,167	X1F	Mexico City (Mexico)	
48.8	6,147	VE9CL	Winnipeg (Canada). (*Daily ex. Sun.* 00.30)	
48.86	6,140	W8XK	East Pittsburg, Pa. (U.S.A.). (*Relays KDKA.*)	
49.02	6,120	W2XE	Long Island, N.Y. (U.S.A.). (*Relays WABC.*)	
49.05	6,122	F3ICD	Saigon (Fr. Indo China). (*Daily* 12.30)	
49.18	6,100	W3XAL	Bound Brook, N.Y. (*Relays WJZ.*)	
49.22	6,095	VE9GW	Bowmanville, Ont. (Canada)	
49.34	6,080	W9XAA	Chicago, Ill. (U.S.A.). (*Relays WCFL*)	
49.34	6,080	W2XCX	Kearny, N.J. (U.S.A.). (*Relays WOR*)	
49.4	6,072	UOR2	Vienna. (*Tues.* 13.00, *Thurs.* 15.00, *Sat.* 23.00.)	
49.4	6,072	ZTJ	Johannesburg (S. Africa). (*Daily* 16.30)	
49.43	6,069	VE9CS	Vancouver, B.C. (Canada)	
49.46	6,065	—	Motala (Sweden). (*Relays Stockholm*)	
49.5	6,060	W3XAU	Philadelphia, Pa. (U.S.A.). (*Relays WCAU.*)	
49.5	6,060	W8XAL	Mason, Ohio (U.S.A.). (*Relays WLW*)	
49.5	6,060	VQ7LO	Nairobi (Kenya Colony). (*Daily* 16.30)	
49.59	6,050	VE9CF	Halifax (Nova Scotia). (*Relays CHNS*)	
49.67	6,042	W2XAL	Coytesville, N.J. (U.S.A.). (*Relays WRNY.*)	
49.7	6,040	PK3AN	Soerabaia (Java). (*Daily* 11.40)	
49.83	6,020	W9XF	Chicago, Ill. (U.S.A.). (*Relays WENR*)	
49.96	6,005	HRB	Tegucigalpa (Honduras). (*Daily ex. Sun.* 00.00–05.00.)	
50.0	6,000	EAR25	Barcelona Radio Club (Spain). (*Sat.* 21.00.)	
50.0	6,000	RW59	Moscow	
50.0	6,000	—	Bucharest (Roumania)	
50.0	6,000	ZL3ZC	Christchurch (New Zealand). (*Wed.* 03.00, *Sat.* 07.30.)	
50.26	5,970	HVJ	Vatican State, Rome. (*Daily* 20.00)	
51.22	5,857	XDA	Chapultepec (Mexico)	
54.52	5,502	W2XBH	Brooklyn, N.Y. (U.S.A.). (*Relays WCGU*)	
58.0	5,172	OK1MPT	Prague (Czechoslovakia). (*Tues. and Fri.* 20.30.)	
58.3	5,145	PMY	Bandoeng (Java). (*Tues.* 14.40)	
62.5	4,800	W2XV	Long Island, N.Y. (U.S.A.). (*Fri.* 23.00)	
70.2	4,273	RW15	Khabarovsk (Russia). (*Daily* 10.00–13.00)	

SUNDAY

JULY THE SEVENTEENTH.

PRINCIPAL EVENTS OF THE DAY:

AT HOME

NATIONAL	Organ recital. Instrumental concert. Military Band concert. Orchestral concert. Violin recital. Service in connection with the Wesleyan Methodist Conference, 1932, relayed from Central Hall, Manchester. Concert from Ostend.
LONDON REGIONAL	Orchestral concert. Pianoforte recital. Service from St. Mark's, North Audley Street. Band concert.
MIDLAND REGIONAL	Military Band concert. Service from St. Martin's Parish Church, Birmingham. Instrumental concert.
NORTH REGIONAL	Gardeners' Service, relayed from Wilmslow Parish Church. Vocal and instrumental concert. Roman Catholic service from St. Sebastian's Roman Catholic Church, Fairfield, Liverpool. London Regional programme.
WEST REGIONAL	Orchestral concert. Service from Crane Street Baptist Church, Pontypool. National programme.
SCOTTISH REGIONAL	National programme.
BELFAST	Service from Fisherwick Presbyterian Church, Belfast. National programme.

ABROAD

BRUSSELS No. 2	Concert from Knocke Casino.
HUIZEN	Concert by Utrecht Municipal Orchestra.
PRAGUE	Jazz compositions by Czech composers for two pianofortes.
ROME	"The Duchess of Chicago" light opera.
STRASBOURG	A day at the Nancy Exhibition.
VIENNA	Concert by the Vienna Symphony Orchestra.

BARCELONA

RADIO-BARCELONA, Call EAJ1, 349 metres; 8 kW.—12 Noon, Chimes from the Cathedral and Weather Forecast. **2.0 p.m.**, Light Music on Gramophone Records. 2.30, Concert by the Station Sextet. 3.0, Theatre Notes, Popular Music on Gramophone Records and Film Review. 3.20, Sextet Concert (contd.). 4.0, Programme for Hospitals and Benevolent Institutions with Gramophone Records. 5.0 **to** 6.30, Interval. 6.30, Light Music on Gramophone Records. 7.0, Concert by the Station Orchestra: Sevilla de mis amores (Ibarra); Waltz from A Waltz Dream (O. Strauss); Melody (Rubinstein); Mariñas (Millán). 7.30, Song Recital by Antonio Cavalliere (Tenor): Song from La Calesera (Alonso); Cançó d'amor i de guerra (Martinez Valls); Song from Los de Aragon (Serrano); Song from Carmen (Bizet). 8.0, Agricultural Talk in Catalan. 8.10, Vocal and Orchestral Concert. Soloist: Ramón Aliaga (bass). Aria from Don Giovanni (Mozart); Aria from Don Carlos (Verdi); Pièce romantique (Chaminade); Gavotte (Chaminade); Serenade from Faust (Gounod); Selections from Maruxa (Vivés); Berceuse-Rêverie (Sgambati). 9.0, Dance Music by the Melody Boys, relayed from the Excelsior Dance Hall. 10.0, Programme for Women. 10.30, Request Gramophone Concert, followed by Chess Lesson. **12 Midnight** (approx.), Close Down.

BASLE.—See **Schweizerischer Landessender.**

BELGRADE

430.4 metres; 2.5 kW.—6.55 **p.m.**, Time Signal and Programme Announcements. 7.0, Recital of Humorous Songs by Bosko Nikolic. 7.30, Concert of Waltzes by the Station Orchestra. Flower Waltz (Tchaikovsky); Valciki (Smetana); Valse triste (Sibelius); Wiener Blut (Joh. Strauss); Valse triste (Nedbal); Dorfschwalben aus Oesterreich (Josef Strauss). 8.0, Talk, followed by Sports Notes. 9.0, Gramophone Concert. La Tosca—Opera (Puccini), with Introductory Talk. In an interval at 10.0 (approx.), News. 11.0 (approx.), Dance Music on Gramophone Records.

BERLIN

KONIGS WUSTERHAUSEN, 1,635 metres; 60 kW.—11.0 **a.m.**, Talk on Music: Celebrated Contemporary Pianists. 11.30, See **Leipzig.** 12.0, See **Hamburg.** 2.0, Talk: The Poet to his Ladies—Goethe to the time of Rilke. 2.30, See **Frankfurt.** 3.35, Agricultural Talk. 4.0 **to** 6.30, See **Berlin (Witzleben).** 6.30, Ernst Keienburg reads a short story. 7.0, Report of an Andalusian Festival. 7.20, Reading. 7.30, See **Leipzig.** 7.50, See **Berlin (Witzleben).** 8.0, See **Munich.** 10.20, Weather Forecast, News Bulletin and Sports Notes. 10.35 (approx.), See **Berlin (Witzleben).** 12.30 **a.m. (Monday)**, (approx.), Close Down.

BERLIN

WITZLEBEN, 419.5 metres; 1.5 kW.—11 **a.m.**, Gramophone Concert of Classical Music. 11.30, See **Frankfurt.** 12 **Noon** See **Hamburg.** 2.0 **p.m.**, Programme for Children. 2.30, See **Frankfurt.** 3.35 (approx.), Talk: Students as International Guides. 4.0, Concert of Light Music and Dance Music, relayed from the Krollgarten. 4.35, Report of the Races for the Grand Prix of Berlin, relayed from the Grünewald Course. 4.50, Concert (cont.). 5.30, Sports Relay from the Berlin Summer Exhibition. 5.45, Concert (cont.). 6.30, Talk: The Open Air Theatre. 6.55, Pianforte Recital of Chopin's Music: Sonata in B flat, Op. 58. 7.20, Max Kretzer reads from his own works. 7.50, Sports Notes. 8.0, Concert by the German Concert Orchestra, conducted by Gustav Havemann, Soloist: Ludwig Hofmann (Bass-Baritone); Suite, Die Flöte von Sanssouci (Graener); Nocturne, Op. 13 (Trapp); Dance Suite (Hoffer); Introduction to The Mastersingers (Wagner); Elder Monologue, from The Mastersingers; Introduction to Act Three of Lohengrin (Wagner); Entry of the Gods into Valhalla from Das Rheingold (Wagner); Wotan's Farewell and the Fire Music from The Valkyries (Wagner); Overture, Tannhäuser (Wagner). In the interval, News Bulletin and Sports Notes. 10.0, Weather Forecast, News Bulletin and Sports Notes. 10.15 (approx.), Dance Music by Hans Schindler and his Orchestra. 12.30 **a.m. Monday** (approx.), Close Down.

BERNE.—See **Schweizerischer Landessender.**

BEROMUNSTER. — See **Schweizerischer Landessender.**

BODEN.—See **Stockholm.**

BODO.—See **Oslo.**

BORDEAUX-LAFAYETTE

304 metres; 13 kW.—12 **p.m.**, Relay from **Paris (Ecole Supérieure), 447.1 metres.** 2.0, Relay from **Paris** or a local Transmission. 2.30 (approx.), Running Commentary on the Cycling Tour of France. 6.15 (approx.), Radio Journal. 7.55, Talk for Ex-Servicemen. 8.10, Lottery Results. 8.15, Running Commentary on the Cycling Tour of France. 8.35, Popular Music on Gramophone Records. 9.5, Popular Concert on Gramophone Records

BRATISLAVA

279 metres; 14 kW.—4.30 **p.m.**, Concert, relayed from **Piestany.** 5.30, Talk on Bombay. 5.45, Variety Music on Gramophone Records. 6.15, Concert relayed from the Museum Café. 7.0, See **Brno.** 8.0, See **Prague.** 8.5, Wedding Waltz—Operetta in Three Acts (Pohl and Moor). 10.0, See **Prague.** 10.20, Programme Announcements. 10.25, Cigány Music relayed from **Piestany.**

BREMEN.—See **Hamburg.**

BRESLAU

325 metres; 1.5 kW.; and **GLEIWITZ, 253 metres.**—11.0 **a.m.**, Talk: Holiday Reading. 11.35, Two Talks: (a) Aquarium Lore and (b) Protection of the Forest in Summer. 12 **Noon**, See **Hamburg.** 2.0 **p.m.**, News Bulletin. 2.10, Talk for Farmers. 2.30 **to** 3.30, See **Frankfurt.** 3.30, Talk: The History of Olympic Games. 4.0, Concert by the Bad Kudowa Orchestra. 6.0, Talk on The Silesian. 6.30, Light Concert. 7.15, Weather Forecast and Sport Results. 7.30, Der Geigiefranze—Radio Play in the Silesian Dialect (Hans Rossler). 8.50, News Bulletin. 9.0, Mandoline and Guitar Recital: Weihegruss (J. Huber); Oriental March (Kolmaneck); Prelude in D Minor (Wirth); Prelude in C (Wirth); Musette (Wirth); Ballet Suite (H. Siegmund); Theme with Variations, Sarabande, German Dance (Wirth). 10.0, Time Signal, Weather Forecast, Press Review, Sports Notes and Programme Announcements. 10.30 from **Berlin** (Witzleben). Dance Music by the Hans Schindler Jazz Band. **12 Midnight**, Close Down.

BRNO

342 metres; 35 kW.—4.0 **p.m.**, Concert by a Military Band, relayed from the Josefovsky Restaurant: March (Terjung); Overture, The Kiss (Smetana); Selection (Suk-Oberthor); Tango, Juanita (Oberthor); Selection from Il Trovatore (Verdi); Slovak and Czech Dances (Novak); Polka (Voldan); Slav Dance (Dvorak); Serenade (Zita); Oriental Scene (Sebek); Selection (Pilat). 5.30, Popular Music on Gramophone Records. 6.0, German Transmission: Report on the Moravian Rowing Championship. 6.45, Political Talk. 7.0, Jazz Music. 8.0, See **Prague.** 8.5, See **Bratislava.** 10.0, See **Prague.** 10.20, News. 10.25, See **Prague.**

BRUSSELS (No. 1)

I.N.R., 509 metres; 15 kW.—5.0 **a.m.** and at hourly intervals throughout the day. Pigeon Flying Report. 12 **Noon**, Organ Recital by Louis Joos, relayed from the Carmelite Church. 12.40 **p.m.**, Edgard Souffret in his own Works. 1.0, Le Journal Parlé. 1.10, Concert of Light Music on Gramophone Records. 5.0, Orchestral Concert, conducted by A. Felleman, relayed from the Café du Grand Hotel, Antwerp. 6.30, Pianoforte Recital by Simone Haye: Preludes (Chopin) (a) in B minor, (b) in F minor, (c) in E major, (d) in B flat minor; La Fille aux cheveux de lin (Debussy); Minstrels (Debussy); Selections from Suburbio (Mompou); Preludes in F minor and G minor (Rachmaninov). 6.55, Light Music on Gramophone Records. 7.15, Religious Address. 7.30, Le Journal Parlé. 8.0, Popular Music on Gramophone Records. 8.20, Reading. 8.30, Light Music on Gramophone Records. 8.45, Talk and Readings: A Belgian Author, Albert Ghislain. 9.0, Orchestral Concert, conducted by François Rasse, relayed from the Kursaal, Ostend. Soloists: Yvonne Gall (Songs) and H. Clockers (Violin); Spanish Fantasia (Gavaert); Judex (Gounod); Violin Solo: Polonaise in A (Wieniawsky); Song: Air from Louise (Charpentier); Selection from Lohengrin (Wagner); Song: Air from Thais (Massenet); Selection from Deidamia (Rasse). 10.30, Le Journal Parlé. 10.40, Dance Music relayed from the Kursaal, Ostend.

BRUSSELS (No. 2)

N.I.R., 338.2 metres; 15 kW., Programme in Flemish.—12 **Noon**, Orchestral Concert conducted by André Felleman, relayed from the Grand Hotel, **Antwerp.** 12.40 **p.m.**, Flemish Song Recital by Q. J. van Trigt (Songs) and R. Vander Spurt (Pianoforte). 1.0, Le Journal Parlé. 1.10, Organ Recital by Louis Joos, relayed from the Carmelite Church. 1.30, Popular Gramophone Music. 5.0, Orchestral Concert conducted by Jean Kumps. 6.0, Song Recital from the Music of Robert van Tomme. Soloist: E. Walraevens, the composer, accompanying. 6.15, Light Music on Gramophone Records. 7.15, Religious Address. 7.30, Music Review by Lode Ontrop. 8.0, **Orchestral Concert** conducted by Jean Kumps. Soloist: Ria Lenssens. 8.45, Programme by Remy Angenot. 9.0, **Concert** conducted by Karel Candael, relayed from the Knocke Casino. Soloist: J. Thomas (Songs). After the Concert, Le Journal Parlé and Dance Music relayed from the Kursaal, **Ostend.** 11.0 (approx.), Close Down.

BUCHAREST

394 metres; 12 kW.—9.15 **a.m.**, Programme for Children. 9.30, Religious Address. 9.45, Choral Selections of Sacred Music. 10.0, Concert of Romanian Music by the Puciano Orchestra. 11.0, Light Music on Gramophone Records. 11.45, Time Signal and News Bulletin. 12 **Noon**, Popular Music on Gramophone Records. 3.0 **p.m.**, Programme for Peasants. 4.0, Concert of Light Music and Romanian Music by the Ionesco Orchestra. 5.0, News and Time Signal. 5.10, Concert by the Ionesco Orchestra (contd.). 6.0, Educational Talk. 6.40, Carmen—Opera in Four Acts (Bizet) on Gramophone Records. News in the intervals.

BUDAPEST

550 metres; 18.5 kW.—9.0 **a.m.**, Press Review and Beauty Culture. 10.0, Protestant Service. 11.0, Catholic Service, followed by a Concert by the Royal Hungarian Orchestra, conducted by T. Polgar: Overture, Raymond (Thomas); Petite Suite (Bizet); Le rouet d'Omphale (Saint-Saëns); Selections from Manon Lescaut (Puccini); Ballet from Sylvia (Delibes); Waltz from Eugen Onegin (Tchaikovsky); Suite from Sigurd Jorsalfar (Grieg). 2.0 **p.m.**, Popular Music on Gramophone Records. 3.0, Agricultural Talk. 3.45, Concert by the Virany Orchestra, followed by Time Signal and Weather Report. 5.0, Talk. 5.15, Concert by the Postal Officials' Orchestra, conducted by V. Roubal. 6.45, Recital of Hungarian Songs by Imre Pallo and the Farkas Czigany Orchestra. 8.0, Sports and Racing Notes. 8.15, Cabaret Programme. 10.15 (approx.), Time Signal and Sports Notes, followed by a Concert by the Mandits Orchestra, relayed from the Rajna Park.

CASSEL.—See **Frankfurt.**

COPENHAGEN

281 metres; 0.75 kW.; and **KALUNDBORG 1,153 metres; 7.5 kW.**—8.30 **a.m.**, Physical Culture Course. 10.0, Divine Service from the Garrison Church. 11.30, Weather and News. 12.0 **Noon**, Town Hall Chimes. 12.2 **p.m.**, Orchestral Concert, conducted by Walther Meyer-Radon. 2.0, Divine Service relay. 3.30, Accordion Recital by Alex and Richard. 4.0, Band Concert from the Faelledparken. Conductor, F. Hemme: Marche lorraine (Ganne); Waltz, Amélie (Lumbye); Berceuse from Jocelyn (Gounod); Russian March (Möller); Overture, 1812 (Tchaikovsky); March of the Gladiators (Sousa); Waltz, Gold and Silver (Lehar); Polka (Lumbye); Potpourri, Sang og klang. Saa ruller jig med dig (Andersen); The Parade of the Tin Soldiers (Jessel); The Match Parade (Wehle); Heinzelmännchens Wachtparade (Noack). 6.20, Talk: South American Volcanoes. 6.50, Weather and News. 7.15, Time Signal. 7.16, Sports Notes. 7.30, Radio Ball for Children. Reading in the interval. 9.30, Talk (to be announced). 10.0, News Bulletin. 10.10, Concert of Slav Music by the Station Orchestra, conducted by Walther Meyer-Radon: Overture, Ruses d'amour (Glazounov); Two Selections from the Slovak Suite (Novak); Selection from Boris Goudonov (Moussorgsky); Selections (Dvorak). (a) Slavonic Dance, in G minor, (b) Waltz in A, (c) Festival March. 11.0, Dance Music by Teddy Petersen and his Orchestra, relayed from the Wivex Restaurant. In an interval at **12 Midnight**, Chimes from the Town Hall. 12.30 **a.m. (Monday)**, Close Down.

CORK.—See **Dublin.**

DANZIG.—See **Heilsberg.**

DRESDEN.—See **Leipzig.**

DUBLIN

Call 2RN; 413 metres; 1.2 kW.; and **CORK, 224.4 metres.**—8.30 **p.m.**, Time Signal. 8.32, Mary Roughan's Instrumental Trio. 8.45, Bass-Baritone Solos by M. O'C. Magnire. 9.0, Talk, illustrated by G. Crofts (Tenor). 9.30, Pipes Selections. 9.45, Talk: The Adventures of Ellis Palmer. 10.30, 'Cello Solos. 10.50, Instrumental Trio. 11.0, Time Signal, News, Weather Report and Close Down.

FECAMP

223 metres; 10 kW.—6.0 **to** 8.0 **p.m.** Programme in English by the I.B.C. 6.0 **p.m.**, Programme for Children. 6.30, Song Recital. Vocalists: May Southern (Soprano), Hugh Merchant (Tenor), Edith Best (Contralto), and R. D. Stimpson (Baritone): Rose in the Bud (Foster); Garden of Happiness (Haydn Wood); The English Rose (German); Take a Pair of Sparkling Eyes (Sullivan); Love, Come to my Aid (Saint-Saëns); Softly awakes my Heart (Saint-Saëns); Eleanore (Coleridge-Taylor); Drink to me only (Calcott). 7.0, Symphony Concert conducted by Bernard Muir: Overture, Die Fledermaus (Strauss); Chinese Fantasy (Deppen); Air on the G String (Bach); Two Hungarian Dances (Brahms); Air de Ballet (Herbert); Rakoczy March (Berlioz); Scarf Dance (Chaminade). 7.30, Concert: Thank God for a Garden (del Riego); Little Grey Home in the West (Lohr); Mother Town (Squire); If I might come to You (Squire); Wait (d'Hardelot); In an Old-Fashioned Town (Squire); Song of the Flea (Moussorgsky); The King Went Forth (Könermann). 8.0 **to** 9.0 Programme in French. 9.0 till Close Down, Programme in English by the I.B.C. 9.0, Concert by the I.B.C. Light Orchestra conducted by John English: Morning, Noon and Night (Suppé); Dance of the Clowns (Smetana); Valse Bluette (Drigo); Intermezzo from Cavalleria Rusticana (Mascagni); Selection from The Merry Widow (Lehár); Indian Love Call (Friml); Mignonette (Friml); Down by the Old Mill Stream (Kempinsky). 9.30, The Limbey Quartet; Down in the Cornfield; Darkies in the Farmyard: The Vagabond; Swing Low; Goodbye, Brother; Nellie Gray; My Old Shako; Polka Serenade: Home, Sweet Home. 10.0, The Defence of Fort Vaux—A Chapter in the Epic of Verdun. 11.0, Concert: Get Gay; The Queen was in the Parlour; It always starts to Rain; Cuban Love Song; The Toy Town Guards; The Little old Church in the Valley; Long Ago; They never go to Bed in China. 11.30, Concert: Sweet Adeline; Ain't that too Bad; I lost my Gal again; In the Hills of old Virginia; Egyptianella; Rosalita; The Magic of a Waltz with You; In the Shade of the old Apple Tree. 12.0 **Midnight**, Dance Music by The Ibeollans: Nevertheless; Who am I? You brought a new Kind of Love to

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CONTENTS OF THIS ISSUE.

EDITORIAL COMMENT.

Frequency Modulation and Interference.

ELSEWHERE in this issue will be found an article dealing with an unpleasant form of interference which may be occasioned by frequency modulation in a transmitter. Since there is little which can be done at the receiver to relieve matters, its elimination is essentially a transmitting problem, and should receive the careful attention of those concerned.

The amount of frequency modulation, and hence of interference, appears to depend very largely upon the extent to which the normal intentional modulation is carried, and it would appear that one solution of the problem would be merely the setting of a lower limit than that now imposed for the maximum permissible modulation depth. Since this would also mean a lowering of the average modulation depth, it might be argued by those responsible for the technical side of British broadcasting that the resulting loss of signal strength would prove unacceptable to a majority of the listening public.

We do not believe that this would be the case, however, for we do not necessarily advocate that the modulation depth be reduced proportionately on all the items of the broadcast programme. From the point of view of interference it would probably be sufficient to reduce the average modulation depth only on those items in which passages of great intensity are of frequent occurrence—items such as military bands or speech.

We have previously had occasion to refer from an æsthetic viewpoint to the habit of the B.B.C. of broadcasting speech, and especially the News Bulletin, at a strength altogether incommensurate with that of a preceding musical item. Now speech is peculiar for its frequent passages of great intensity, so that the transmitter may often be deeply modulated, and a maximum of interference with other stations occurs. This is not all, however, for it is believed that this deep modulation is responsible for much of the unsatisfactory quality of speech found with even the best apparatus.

We would submit to the B.B.C., therefore, that a reduction in the average modulation depth, in particular when items such as military bands and speech are broadcast, would result in less interference of all types with other stations, better quality of reproduction, and a more natural and pleasing balance between the different programme items.

If the B.B.C. feel any doubt as to the reception by the general public of any such change, we would suggest that they try using the lower modulation level from the London Regional transmitter, while adhering to the present arrangements for the London National, for a period of, say, three months. During this time both technical and non-technical listeners would be afforded an opportunity of making a direct and rapid comparison between the two modulation depths, and it would then be possible to form a more accurate opinion than at present as to the most generally satisfactory level for modulation.

Our Thanks.

WE could not allow this issue to appear without including a message of thanks to our readers for the interest they have shown in *The Wireless World* in its new form. Ever since the announcement of the change we have been receiving day by day a large post with messages of congratulation or suggestions for future numbers, which have been sent in response to our invitation for the views of our readers. Arrangements will be made to bring together all the suggestions which have been put forward, and these will then receive very careful consideration. We are already convinced of the usefulness of many of the proposals.

We have had a few comments on the change in the size of the page, but we take this opportunity of explaining that this change was necessary in connection with technical considerations of printing, in order to accommodate the additional pages. It is gratifying to find that the majority of the letters indicate that the change of size is appreciated.

A DEFECT IN TRANSMISSIONS.

Frequency Modulation as a Little-known Source of Interference.

AN article discussing aspects of mutual interference of adjacent stations which have only become apparent since the introduction of highly selective receivers.

BY no means the least of the problems of broadcast reception is that connected with the elimination of interference. In spite of the increased knowledge of the subject, the rapid growth in both numbers and power of broadcasting stations within the last few years has so greatly increased the difficulties of the receiver designer that the improvements which have been made do not always appear obvious. The vast strides forward which have been made in selectivity since the introduction in this country of the band-pass filter by *The Wireless World* in 1929 are not readily apparent, for they have been accompanied by an even greater increase in the congestion of the ether.

The types of interference discussed in this article will be only those caused by the different broadcasting stations themselves, and no account whatever will be taken of other forms such as Morse, atmospherics, and electrical interference. Until recently, only two forms of interference were generally found, modulation interference and carrier heterodyning; but the introduction of highly selective receivers has caused sideband heterodyning to become more noticeable because it is no longer masked by other types.

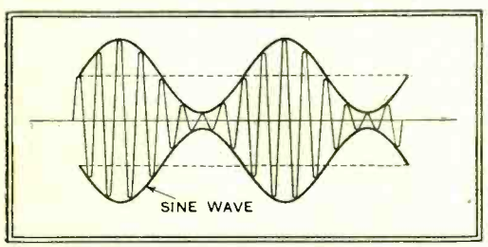


Fig. 1.—The envelope of an amplitude modulated wave, in which the amplitude of the H.F. oscillations varies in accordance with the modulation.

A fourth type of interference, which it is the purpose of this article to discuss, has also recently become apparent.

It was pointed out in a recent article in this journal[1] that modulation interference can always be eliminated, without detriment to the quality of reproduction, by using a sufficiently selective receiver. It is necessary only to use a linear detector and to arrange for the carrier of the wanted station to be sufficiently strong in comparison with that of any unwanted station, and this may be done by an arrangement of tuned circuits.

Carrier heterodyning can also be readily eliminated, but only by means which remove as well musical notes of the same frequency as the whistle. Since broadcasting stations are usually spaced by 9 kc., this may, in practice, be carried out without any great audible effect upon the quality.

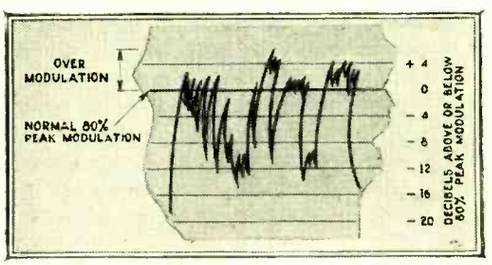
Sideband heterodyning, however, is far more serious, for it is due to the sidebands of the unwanted station beating with the carrier of the wanted station. The resulting whistles may be of quite low frequency, and, in general, cannot be eliminated without seriously affecting the quality. Fortunately, however, they are not continuous whistles but are of a momentary nature; moreover, the strongest occur at fairly high frequencies. It is possible, therefore, to strike a reasonable compromise between the conflicting requirements of quality and freedom from interference. A slight sacrifice is made in quality so that the strongest of the whistles are removed, and the feebler are tolerated. The result is by no means perfect, of course, but it is one which is pleasing and acceptable to the musical ear.

[1] "Superheterodyne Improvements," April 6th, 1932.

Frequency Modulation.

Now, the prevalent use of highly selective receivers has led to the discovery of still another type of interference, fortunately by no means so widespread, but one which is even more objectionable when it occurs. This form of interference makes itself evident as a harsh, tearing sound of no particular frequency, but generally low toned in character. It occurs at its worst when receiving a distant station working with a frequency immediately adjacent to that of the local. The reception in London of Mühlacker, for instance, is nearly always accompanied by this unpleasant sound, and it is often sufficiently strong completely to drown Mühlacker's programme.

This harsh, tearing sound is quite unlike any whistle which might be caused by the heterodyning of carriers or sidebands; it is often accompanied by whistles, but these are explainable as the normal sideband heterodyning. Observation shows, moreover, that the character of the sound does not depend to any great extent upon the modulation frequency of the interfering station. It would appear, therefore, that it cannot be accounted for by any normal heterodyning theory.



Actual record taken by the B.B.C. of depth of modulation of speech from a foreign station showing over-modulation which gives rise to frequency modulation.

It is readily observable that the effect occurs when the interfering station is modulated the most deeply, so that we must obviously seek some connection between it and the modulation depth. Over-modulation of the transmitter, of course, introduces harmonics of the normal modulation frequencies, and so gives a wider sideband spread to the transmitter. The interference due to this, however, is still of the same type as the normal sideband heterodyning, and is probably indistinguishable from it by ear.

The normal theories of interference do not offer any reasonable explanation of the observed effect, but this is not sufficient reason for concluding that they are wrong. We must conclude merely that the normal theories do not go far enough, for they are based upon the assumption that all the transmitters with which we are dealing emit only an amplitude modulated carrier.

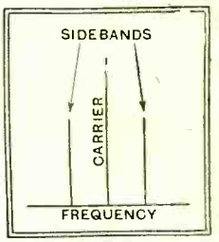


Fig. 2.—An alternative method of regarding amplitude modulation. The carrier is a pure continuous wave accompanied by a series of sidebands, which are also pure continuous waves.

Amplitude Modulation.

Amplitude modulation is a pure continuous wave the amplitude of which is varied by the modulation, as depicted in Fig. 1. Such a wave may be regarded in this way as a continuous wave whose amplitude is varying at the modulation frequency, as in Fig. 2, or as a pure continuous wave of constant amplitude accompanied by a number of other continuous waves called sidebands. The frequency separation of the sidebands from the carrier is determined by the modulation frequency, and they bear a definite relationship, both in amplitude and phase, to one another and to the carrier. Neither aspect of a modulated wave is more correct than the other, for the two theories are merely two ways of regarding the same physical entity.

There is, however, another form of modulation, known as frequency modulation. In this the carrier is always of constant amplitude, and the modulation acts by varying the frequency of the carrier. This type of modulation is considerably more difficult to visualise than the other, but for our present purposes there is, happily, no necessity for this, and it is sufficient to bear in mind a few of its chief characteristics.

The first important point is that if a station transmitting with a pure frequency modulation be received on an ordinary set no audible response will be obtained when it is tuned to resonance as usual. If we look at Fig. 3, which shows the flat-topped resonance curve of a modern receiver, we see that the carrier will merely sweep sideways along the flat top when the set is tuned to the point A, and the modulation will be responsible for no change of current or voltage in the receiver circuits.

If we tune in the station at the point B on the steeply sloping side of the resonance curve, then the sweep of the carrier will most certainly cause a rise and fall of the current in the circuit, and hence in the voltage applied to the detector. In other words, the

A Defect in Transmissions.—

circuit will act to convert frequency modulation, to which an ordinary detector cannot respond, to the usual type of amplitude modulation. The maximum audible response to a frequency-modulated signal, therefore, is obtained when the station is tuned in on the steepest part of the sloping side of the response curve.

The process of converting frequency modulation to amplitude modulation is not necessarily accomplished without distortion. A resonance curve with straight sides would be necessary for freedom from distortion, and practical resonance curves are rarely straight. In practice, therefore, distortion is always introduced, and in some cases this may reach considerable proportions.

The Ordinary Transmitter.

Let us now suppose that a transmitter is modulated both with frequency and with amplitude modulation; this effect may be regarded as the normal amplitude modulated wave of Fig. 2, with the carrier and its associated sidebands vibrating as a whole horizontally in the frequency scale, as shown in Fig. 4. When we tune our receiver to resonance we shall obtain the normal response from the amplitude modulation, and none from the frequency modulation. When we tune off resonance, however, the response from the amplitude modulation will disappear if the set be sufficiently selective, but we shall find an audible response from the frequency modulation falling upon the side of the resonance curve. This response will normally be distorted since the side of the resonance curve is not straight.

An ordinary transmitter is designed for amplitude modulation, and, if frequency modulation occurs at all, it will be during the time of the deepest normal modulation. In practice, the frequency modulation would give only momentary audible sounds occurring with the deep amplitude modulation caused by drums and many consonants in speech. The audible response, therefore,

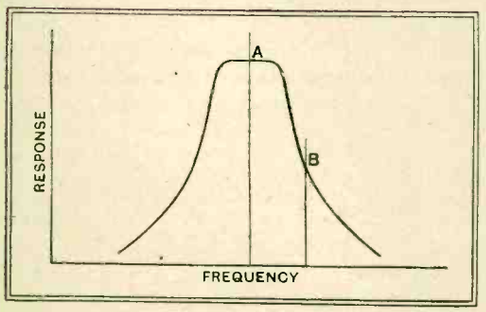


Fig. 3.—Resonance curve of a typical modern receiver. No response is given to a frequency modulated transmission tuned to the point A, since changes in its frequency cause no change in the current. The full response is obtained by tuning to the point B on the side of the curve.

would hardly be intelligible, particularly as these momentary sounds would themselves be distorted by the receiver. In general, the deepest normal modulation is caused by sounds of fairly low frequency, since in normal music the lower notes naturally give rise to a greater sound pressure than the high.

We thus arrive at the following conclusions: Since sounds which cause the audible-frequency modulation are mainly of low frequency, we should expect the audible result of frequency modulation to be mainly low toned. Because modulation occurs only on the loudest passages of the normal modulation, we should expect that the audible result of the frequency modulation would be unintelligible. Since the process of converting frequency modulation into amplitude modulation in the receiver is accompanied by distortion, we should expect that the audible result of frequency modulation would be of a harsh character.

Now, our original definition of the type of interference which we are considering was that it took the form of a harsh, low-toned tearing sound of brief duration. The three effects which theory indicates that a moderate amount of frequency modulation in a transmitter would give are thus all found in the interference. It appears very probable, therefore, that this interference is actually caused by such frequency modulation.

If this be actually the case, we should expect to find that the presence or absence of another carrier on the frequency to which the receiver is tuned would make little difference to the interference, and, further, that an alteration to the selectivity of the set would so affect the strength of the tearing noises as to give a decrease in their intensity when the selectivity is decreased. Certain experiments, therefore, were carried out to determine whether these conclusions were to be found in practice. The tests were conducted at a distance of about nine miles from Brookmans Park.

Experimental Results.

A receiver was tuned to Mülhacker, and its selectivity so adjusted that complete freedom from audible modulation interference from the London Regional transmitter was secured. The reproduction, however, was accompanied by the tearing sound, which was found to be at its worst during the reading of the News Bulletin from London, at which time it is well known that deep modulation is used. When Mülhacker closed down at the end of its programme the interference continued undiminished, although normal amplitude modulation interference was now audible owing to the absence of a demodulating carrier on the detector grid. Our first point, therefore, is satisfied, and, incidentally, we have also proved that the noise in question is not due to any heterodyning action between the wanted and unwanted stations.

In the second test, the selectivity of the receiver was lowered to a point at which amplitude modulation interference became audible in spite of the presence of Mülhacker's carrier. This resulted in some slight diminution of the tearing noises. Further reductions in selectivity gave increased modulation interference, as was to be expected, but decided reductions in the tearing noises. Our second point is also confirmed by a practical test, and there would appear to be little doubt that frequency modulation is the actual cause of this type of interference.

Having thus determined the most probable cause for the interference, we have next to consider those factors which affect its intensity. Obviously, the greater the amount of frequency modulation in the unwanted transmission, the greater the ratio of the field strength of the unwanted to the wanted carrier, and the steeper the side of the receiver resonance curve, the greafer will be the interference. Of these the first is purely a matter for the transmitter designers and operators, the second cannot be controlled except by directional methods of reception, while the third is under the control of the receiver designer. Unfortunately, little can be done in

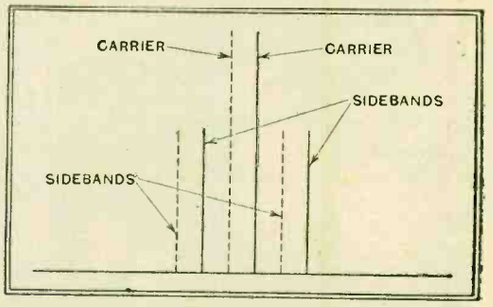


Fig. 4.—A pictorial representation of a wave modulated both in amplitude and in frequency. The carrier and sidebands of the amplitude-modulated wave can be considered as vibrating sideways along the frequency axis.

this last respect, for the reason that if we design a set so that its response to frequency modulation is small, then it is unselective, and amplitude modulation interference is prohibitive. The conditions for maximum immunity from both amplitude modulation interference and frequency modulation interference are mutually opposing.

The only hope of a real remedy, therefore, appears to lie with the transmitter, and it is to be hoped that steps will be taken to avoid all possible traces of frequency modulation.

Should it prove impossible completely to prevent frequency modulation while using present modulation depths, the situation would be greatly relieved by fixing a lower limit than that now used for the maximum permissible modulation depth. Such a limitation would be of advantage in giving improved quality of reproduction, or at least of making the design of detector stages less critical, and there is a strong possibility that sideband heterodyning would also be reduced.

The need for many studios for broadcast drama is overcome at Koenigswusterhausen, Berlin, by the use of studio "tents." The photograph shows Gretchen in a recent production of "Faust."

Broadcasting in a Train

Technical Ingenuity in an American "O.B."

By A. DINSDALE.

The dining-car "studio" on the train. Note the suspended microphone.

THE reception of broadcasting on moving trains is not only a simple matter nowadays, but a commonplace, everyday accomplishment. So far as the writer is aware, however, a musical programme had never previously been broadcast from a moving train until as recently as March 27th last, when the Columbia Broadcasting System transmitted a half-hour commercial programme from an express train running between Washington and New York, using short-wave relay transmitters to connect the train to the nearest Columbia network stations at Washington and Baltimore. From these stations the programme was forwarded to New York by land line and distributed to a nation-wide network of forty stations, extending from the Atlantic to the Pacific. The programme was also broadcast over the Columbia short-wave stations W2XE and W3XAU.

The programme, as received in New York from WABC, Columbia's New York key station, was so technically excellent that a casual listener unaware of the experiment to which he was listening might well have been excused had he declared it to be a regular studio production, with the addition of some well-timed and admirably simulated train effects. To the informed observer, however, very slight electrical interference was noticeable on a few brief occasions, and there were occasional periods of brief but slight fading, due to the passage of the train under bridges. There was no sign of unwanted noise due to the studio train or to passing trains. In fact, preliminary tests revealed that the pick-up was so excellent as to be robbed of realism! This difficulty was overcome by suspending a microphone under the train, near a set of wheels, to pick up wheel-clicks and the sound of the locomotive whistle. During the broadcast, this microphone was opened up at intervals to mix in sound effects as required. A special telephone line from the control room to the engine driver made it possible to ensure that the engine whistle would be "on tap" as and when required. The programme opened very effectively with a mighty roar from the train, which faded down under the opening announcement from the train announcer.

In collaboration with officials and engineers of the Baltimore and Ohio Railroad, engineers of the Columbia Broadcasting System spent weeks in making preparations.

An Historic Route.

A study of a map, followed by a physical survey, indicated that the best stretch of line for the purpose was just outside Washington, and the railway stations at Beltsville and Laurel, Md., were chosen as the sites for the two ground receiving stations. The latter point was selected as the "master" station for general operations. A factor which influenced the choice of locale was the fact that Samuel F. B. Morse chose this same stretch of the Baltimore and Ohio line for the initial tests of his telegraph system. These tests led to the opening of the first practical railway telegraph line in the world just eighty-eight years ago.

One of the regular B. and O. dining-cars was selected for conversion into a temporary mobile broadcasting station. This car, one of the latest type, incorporates such improvements as rubber shock absorbers and ball bearings. The windows are sealed and the car is equipped with an artificial air-conditioning system which changes and warms the air in winter, and cools it in summer. The main part of the car was stripped of chairs and tables and turned into a studio. It was treated acoustically with velour drapes which aided materially in excluding extraneous sounds. The studio portion of the car measured fifty by eight by nine feet.

All the controls, amplifiers, transmitters, and receivers were set up in the kitchen compartment. One of the new dynamic (moving-coil) microphones was used in the "studio," together with an emergency microphone, both being suspended from the roof of the car. The announcer, soloist, and twelve-piece orchestra were arranged in the studio for proper balance, which was achieved without difficulty.

THE "stunt," which is still a predominating element in American broadcasting, sometimes calls for great technical enterprise. The broadcast described in this article attracted considerable attention—as its sponsors intended that it should—and no pains were spared to make the affair sound realistic. A microphone was even placed under the train to pick up wheel clicks and rattle!

The equipment used on the car consisted of four microphones, two microphone-output amplifiers, a field amplifier, a 50-watt portable short-wave transmitter with tuning unit and associated equipment, a broadcast receiver, a short-wave receiver, two public-address amplifiers and their associated loud speakers. The public-address equipment was included so that passengers in other cars on the train could listen to the broadcast.

The field amplifier was designed and built by Columbia engineers, one of the main objects of the design being to achieve minimum weight and physical size consistent with all the necessary electrical and mechanical characteristics desirable in a portable field amplifier. The copper-lined case, when

Broadcasting in a Train.—

closed for transport, resembles a suit-case in size and appearance.

The unit includes a three-channel mixer, a three-valve amplifier, volume indicator, and the necessary switches and meters. The input is arranged to accommodate six microphones, three being available for simultaneous operation into the mixer.

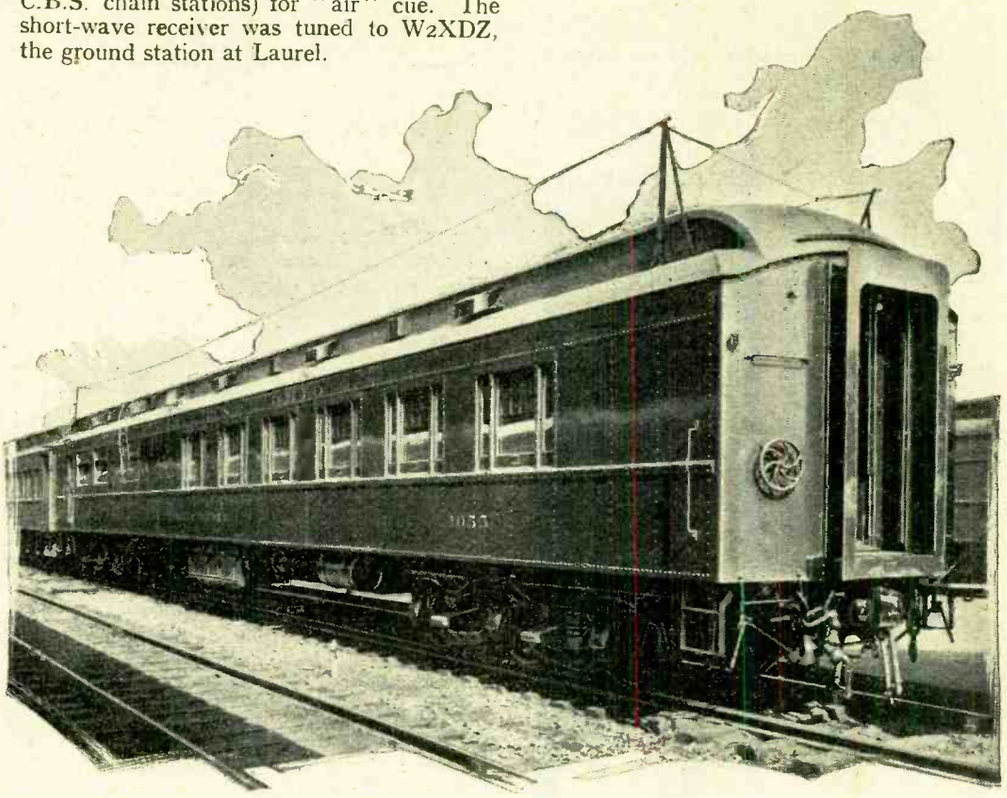
Undistorted Output.

The main "gain," instead of being connected across the grid of the first valve, is placed across the primary of the input transformer. The main gain itself consists of a General Radio modified T-type volume control, 200 : 200 ohms. The amplifier has an overall gain of approximately 55 db., and a comparatively flat characteristic from 30 to 8,000 cycles. Its good wave-shape characteristics ensure an undistorted output of plus 4 db. into a 500-ohm load. Power supply is obtained from dry-cell batteries which are carried in a separate combination battery and cable box.

The transmitter employed on the train operated on 1,542 kc., using the call W2XDY. It is a standard Western Electric 8-B, 50-watt aircraft transmitter, crystal-controlled, employing high-level, high-percentage modulation. In order to render the transmitter suitable for high-quality transmission, the input coil and modulation transformer were replaced with high-quality units, and a special aerial tuning unit, monitoring rectifier and dummy aerial were included as an integral part of the transmitter.

The power supply was taken from a heavy-duty, 12-volt accumulator, which supplied filament current, crystal heater current, and the necessary power to drive a 12-1,200-volt dynamotor. The particular dining-car chosen for the broadcast was equipped with a 32-volt, 1,000 ampere-hour accumulator, which, together with a special panel, was used for charging purposes.

The receivers used to pick up cue and instructions were a Western Electric 4-D (broadcast) and a National SW-3 (short-wave). Suitable wave-traps were employed with both receivers. The broadcast receiver was used to tune to signals from WCAO Baltimore or WMAL Washington (the nearest C.B.S. chain stations) for "air" cue. The short-wave receiver was tuned to W2XDZ, the ground station at Laurel.



The travelling broadcasting station, showing the aerial arrangements. The lead-in from each aerial wire was taken through a window of the kitchen compartment.

The transmitting and receiving aerials were erected above the roof of the dining-car at a maximum distance above it consistent with restrictions caused by bridge and tunnel clearances.

A thirty-mile stretch of copper telegraph wire was used in inductive relation to the train aerial, and properly terminated at the two receiving stations. Thus, a semi-carrier current system was made possible, but the regular short-wave system proved just as effective, and both were used.

The three short-wave receivers used at the ground points were employed as a selective system. That is to say, signals from all three were carefully monitored and mixed at Laurel, the master point, and the best signal selected for transmission to New York, via Washington, over land wires, and thence to the broadcast network.

The master control room at Laurel railway station. Mr. A. B. Chamberlain, chief engineer of the Columbia Broadcasting System, is seen operating the short-wave receiver, which picked up the train concert.

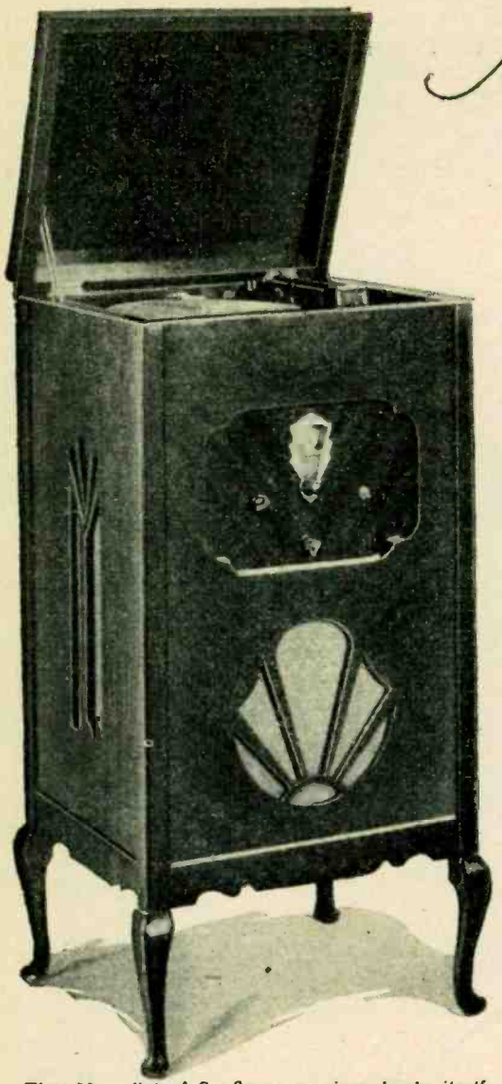
Speech, Noise and Music.

The necessary co-ordination during the actual broadcast was arranged as follows: The programme opened in the New York studio with an explanatory announcement describing what was to take place. Those in charge at Laurel listened to this speech on the broadcast receiver. On receipt of the cue words at the termination of the opening announcement, an announcer at Laurel opened his microphone and gave a brief résumé of the situation there, and how it was being handled. Those in charge on the train, in turn, listened on their broadcast receiver to these two speeches, and, on receipt of the cue words from Laurel, the engineer cut in the microphone under the train to open the programme proper with a remarkably good train effect. This, in turn, was faded down under the opening announcement by the train announcer, and the programme proceeded. Half-way through the programme, as required by the Federal Radio Commission ruling, a twenty-second break was made for station identifications, during which time train noise was again heard. Train noise was also introduced as backing for an adroitly chosen orchestral number which called for a train effect to heighten the realism of the interpretation of the composer's theme.

Notes on the MONODIAL A.C. SUPER

The New Superheterodyne as a Radio-Gramophone.

By W. T. COCKING.



The Monodial A.C. Super receiver lends itself particularly well to gramophone reproduction. It is here shown housed in a cabinet with electric gramophone motor and pick-up

BUILDERS of the Monodial A.C. Super[1] have not been slow to discover that in spite of its extreme sensitivity and selectivity it is essentially a quality receiver, and, as such, it makes a strong appeal to the music lover. It is not only an ultra-selective long-distance receiver, but, in addition, it is eminently suited for quality reception of the local station, and in consequence it is worthy of being classed as a musical instrument.

A radio set must now do more than receive broadcasting, however, for it is usually desired to employ it in the electrical reproduction of gramophone records. The Monodial A.C. Super is readily adaptable for this purpose, and, indeed, provision for the connection of a gramophone pick-up was made in the original design. It is, therefore, an ideal receiver for building in radio-gramophone form, for it will give not merely high-quality reproduction of the local station and gramophone records, but even in congested districts it will maintain that high quality on the most distant of foreign transmitters.

In order that full advantage may be taken of its inherent properties it is naturally important that the various initial adjustments be correctly carried out. So far as the operation of the radio side is concerned these adjustments have already been fully described, and it only remains to offer some suggestions for the attainment of the best quality from records. That portion of the L.F. amplifier which is used for gramophone reproduction has a substantially flat frequency characteristic over the range of frequencies met with in gramophone work, and as a result the quality of reproduction is almost entirely dependent upon the loud speaker and the pick-up.

The loud speaker will often have a series of resonances at high frequencies, which gives the effect of an abnormally strong upper register, and on radio this deficiency is turned to advantage by using it to provide additional compensation for the sideband cutting of the tuned circuits. No such compensation is necessary on gramophone, however, for many pick-ups themselves give an increased response to the higher frequencies. In general, therefore, the reproduction of gramophone records sounds too high-pitched, and in order to obtain the correct balance it is usually necessary to reduce the amplification of the higher notes.

Adjusting the Tone.

One of the simplest methods of achieving this result consists merely in shunting the pick-up by a small-capacity fixed condenser. The correct capacity must always be found by trial, since it will depend not only upon the frequency response of both the pick-up and the loud speaker, but also upon the impedance of the former. In the case of some high-impedance types of pick-up 0.0001 mfd. will prove sufficiently large to give the correct tone, whereas with others of lower impedance the capacity may have to be as large as 0.001 mfd.; in general, about 0.0003 mfd. will best suit the average pick-up.

The maximum input required by the amplifier, however, is but 0.285 volts peak, while most good pick-ups are capable of delivering an output of about 1.5 volts. A considerable reduction in the output of the pick-up is necessary, therefore, to avoid overloading, and advantage may be taken of this fact by adopting a type of tone control which consists merely of a resistance shunt to the pick-up. This resistance shunt may consist of the normal volume control potentiometer, but with a lower total resistance than usual. With the circuit of Fig. 1a, for instance, the control could be given a value of 100,000 ohms, or even 50,000 ohms, instead of the more normal value of 250,000 ohms.

THE Monodial A.C. Super receiver which has gained such widespread popularity since it was first described in April of this year is not only highly sensitive, but by virtue of tone correction is essentially a quality set. For this reason it is well adapted for the electrical reproduction of gramophone records, and notes on suitable volume and tone control circuits are given in the accompanying article.

The Compensating Resistance.

In general, however, the exact resistance value required is unknown, and it is obviously inconvenient to try different values of volume control. It is suggested, therefore, that for preference the circuit of Fig. 1b be used. In this case, the volume control potentiometer VC should have a total resistance of not less than 250,000 ohms, and the resistance R be given a value to be determined experimentally for the best quality. If desired, this resistance may also be made variable, in which case it should have a maximum value of some 500,000 ohms in order to give a sufficient range of control. The optimum value for R will vary in different circumstances, but will be most often in the neighbourhood of 100,000 ohms.

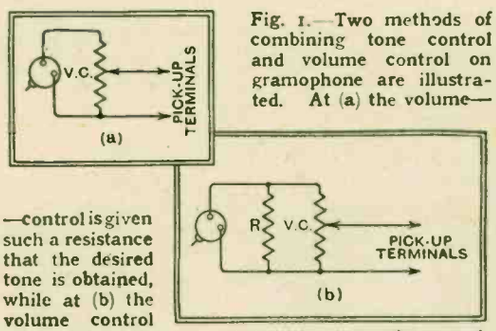


Fig. 1.—Two methods of combining tone control and volume control on gramophone are illustrated. At (a) the volume—control is given such a resistance that the desired tone is obtained, while at (b) the volume control has a high resistance, and the correct tone is secured by adjusting the value of R.

Pick-up Interference.

Although not exactly a matter connected with the quality of reproduction, a point which is worthy of mention is the possibility of hum. The set itself should give no audible hum whatever, but it is often found that on gramophone a high-pitched hum makes itself evident. This type of hum is always due to induction in the pick-up leads, and once heard is readily recognisable. It may be cured by seeing that the leads to the pick-up are as short as possible, that they are run

[1] *The Wireless World*, April 6th, 13th, 20th, and 27th, 1932.

Notes on the Monodial A.C. Super.—

with earthed screened wire, and that the pick-up frame itself, if of metal, is earthed. The volume control, furthermore, is better fitted close to the receiver, or even within it, than near the pick-up.

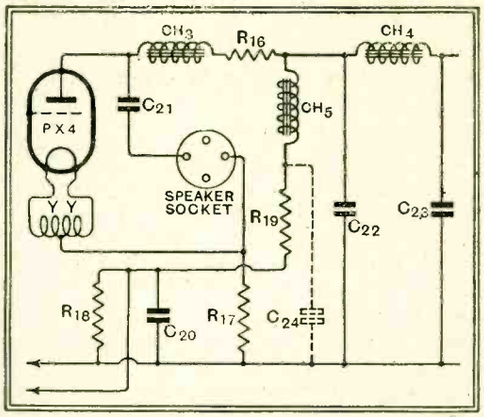


Fig. 2.—The power unit connections when a non-energised type of speaker is employed are made clear in this figure. The resistance of the choke CH_5 and R_{19} together should total 2,500 ohms, and have a current-carrying capacity of 50 mA. An extra condenser at C_{24} may be necessary if the choke is of low inductance.

Careful attention to details of this nature will enable the reproduction of gramophone records to be as hum-free as radio reception, while the quality from the records can be made to approach that given by broadcasting. The quality from records can never quite equal that of broadcasting, of course, on account of the well-known deficiencies of the recording.

The M.C. Speaker Field Supply.

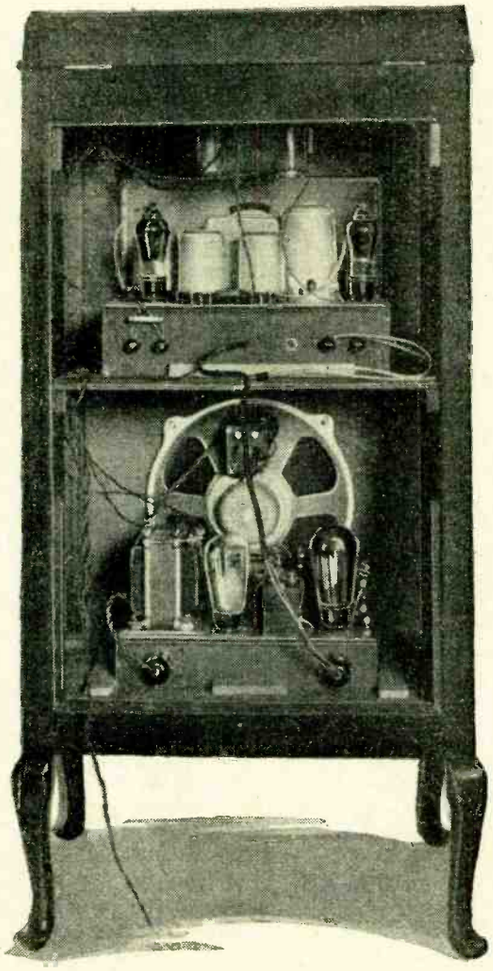
When designing the Monodial, provision was made for the field supply of a moving-coil loud speaker, and advantage was taken of the high inductance of the average field winding to reduce to a minimum the amount of smoothing equipment. The field winding of most energised types of speaker has an inductance in the neighbourhood of 50H., and when it is used for smoothing not only can a choke be eliminated, but it is permissible to reduce somewhat the amount of smoothing capacity. The resulting economy is thus quite considerable.

Some doubt has arisen, however, as to the correct procedure in cases where it is not desired to use an energised type of speaker. It may be said briefly that the field winding must then be replaced by a choke having a D.C. resistance of 2,500 ohms, a current-carrying capacity of 50 mA., and an inductance of at least 20H., and preferably greater than 30H. Most chokes have a lower resistance than 2,500 ohms, so that it must be made artificially equal to this figure by the addition of a series resistance of suitable value. The connections for a non-energised speaker are shown in Fig. 2, in which CH_3 is the extra choke and R_{19} the series resistance. A common case is a choke with a resistance of 500 ohms, and the resistance R_{19} should then be given a value of 2,000 ohms and be of the 10-watt type.

With a good high-inductance choke the results will be in no way different from those with an energised type speaker, and adequate smoothing will be obtained. Should the inductance of the choke used prove too low, however, and hum be found, it will probably prove more convenient to remove it by increasing the smoothing capacity than by changing the choke. Such extra capacity may often be connected in parallel with C_{20}, but in some cases more efficient smoothing will result by connecting it as shown dotted at C_{24}, from the junction of the choke and resistance to earth.

Increasing Power Output.

The output of the standard power stage, some 2,500 milliwatts, is ample for all normal domestic purposes, but in cases where exceptionally large volume is desired the need may be felt for a larger output. An output stage, capable of delivering some 6 watts to the loud speaker, has been prepared, therefore, and is built as a unit with its own mains equipment, and it is recommended that it be employed by those who consider the output of the standard Monodial power unit insufficient for their purpose. Although this new power unit has been built primarily for use with another receiver, it has been designed specially with a view to its being employed with the Monodial receiver unit, and when it is so used no modification to either is necessary. This power unit has been recently described in *The Wireless World* under the title of "The Modern Straight Receiver."[2]



The disposition of the moving coil loud speaker and the two units connected by flexible cable can be seen when the back of the gramophone cabinet is removed.

[2] See issues dated June 22nd and June 29th.

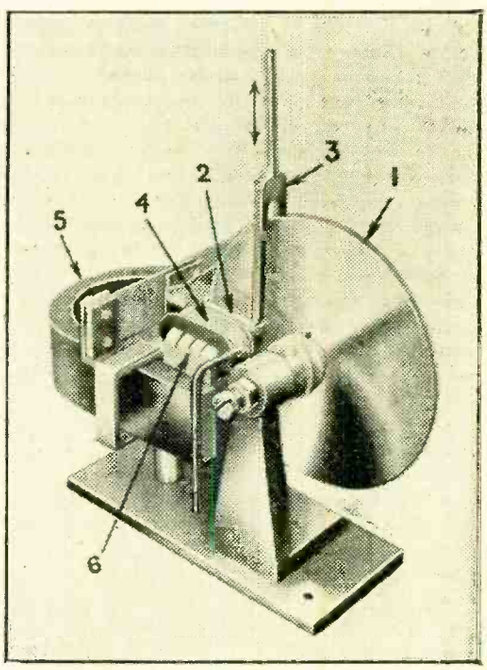
A Novel Loud-Speaker Movement.

THE underlying principle of this loud speaker is very similar to that which was used by Dr. McLachlan in the Marconi high-speed magnetic recorder. It will be recalled that in this instrument the relay was actuated by an iron shoe in contact with a rotating iron drum. Small magnetic forces generated in suitably arranged coils by the signal currents were sufficient to cause considerable forces of adhesion between the drum and shoe, the resultant drag being transmitted to the relay contacts.

The principle has already been tried in connection with sound reproduction, and a notable example was the Johnsen-Rahbek loud speaker, which relied upon electrostatic attraction to supply the "triggering" force. The difficulty in these earlier attempts was to overcome the noisy effects of friction.

In the design illustrated, the work of a German Post Office engineer named Gladenbeck, this drawback is overcome by keeping the pole shoes (2) as close as possible to the rotating iron disc (1) without at any time making actual contact. This is effected by the stirrup (3), which, in addition to holding apart the twin pole pieces, also serves to transmit vibrations to the loud speaker diaphragm. The pole pieces, together with their speech coils (4), are clamped to the permanent magnet (5), but sufficient flexibility to give the requisite movement at the extremities is provided by saw-cuts in the bend (6).

The "mechanical amplification" derived from the eddy-current drag in the disc is such that ample volume is obtained from a single-valve receiver. On the other hand, the power required to drive the disc is negligible, and a small motor running off the L.T. accumulator can be used.



Details of the movement in the Gladenbeck eddy-current loud speaker. (1) Rotating iron disc (2) pole pieces (3) driving stirrup (4) speech coils (5) permanent magnet (6) saw-cuts to increase flexibility of pole pieces.

WIRELESS ENCYCLOPEDIA

No. 22

Brief Definitions with Expanded Explanations.

FOR a thermionic valve to act as an amplifier of electrical voltage variations applied between the grid and filament some form of impedance must be connected in the anode circuit, the amplified voltage variations being set up across this impedance. These voltage variations have to be passed on to the input side of the succeeding valve, and the part of the circuit specially designed for effecting this is referred to as the intervalve coupling.

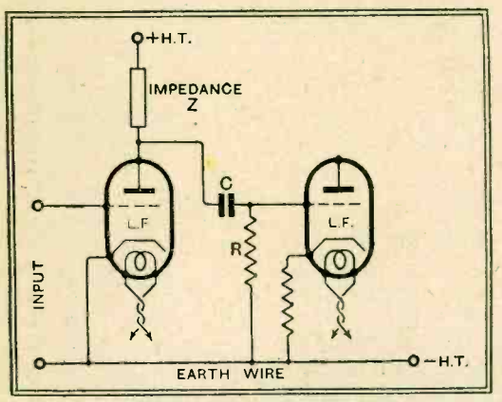


Fig. 1.—Showing arrangement of impedance-capacity coupling.

Since the mean anode potential of the first valve has to be maintained at a moderately high potential with respect to the cathode, whereas the mean grid potential of the next valve must be negative with respect to its cathode (or at the same potential as the cathode in the case of a grid detector), it follows that the high-tension voltage applied to the anode of the first valve must be entirely isolated from the grid of the second.

So whatever form the intervalve coupling may take it must possess two main properties: (*a*) there must be no conducting path between the anode and grid of the valves coupled in cascade; (*b*) the coupling circuit must allow voltage *variations* at the anode of the first valve to be freely passed on to the grid of the second. That is to say, the coupling circuit must offer an infinitely great resistance to direct currents, but a finite impedance to alternating currents.

There are two general methods of effecting this discrimination between alternating currents and direct currents. One is to include a condenser in the lead between the anode of the first valve and the grid of the second, giving a *capacity coupling* as in Fig. 1, and the other is to transfer the voltage variations through the medium of a transformer whose primary and secondary windings are insu-

INTERVALVE COUPLING. The device or circuit arrangement for connecting two valves of a valve amplifier in cascade, and through whose agency the signal voltage variations are passed on from the anode of one valve to the grid of the next. (See also No. 18: High Frequency Transformer.)

lated from each other. The second method is referred to as *transformer coupling*, the general arrangement being shown in Fig. 2.

Capacity Coupling.

The capacity type of coupling (Fig. 1) can be used in conjunction with any form of impedance in the anode circuit of the first valve. For low-frequency amplification the anode impedance Z may be either a resistance or a low-frequency choke, giving *resistance-capacity coupling* and *choke-capacity coupling* respectively. The former has been very widely used on account of its simplicity and cheapness and because uniform amplification is obtained over a very wide range of frequencies.

With either type the coupling condenser C would isolate the grid of the second valve unless a high resistance R, known as a "grid leak," were connected between the grid and the cathode circuit. This grid leak is essential to enable the mean potential of the grid to be maintained at the correct value; it is connected between the grid and a point at a suitable negative potential with respect to the cathode or filament. In Fig. 1 the grid leak is connected to the earth wire, and a resistance is included in the cathode lead to make the cathode itself positive with respect to the earth wire (self-bias). With filament valves a grid battery is commonly used to provide the necessary grid bias.

In order that the grid leak shall not shunt away too large a proportion of the voltage variations being transferred from one valve to the next, its resistance must be high compared with the reactance of the coupling

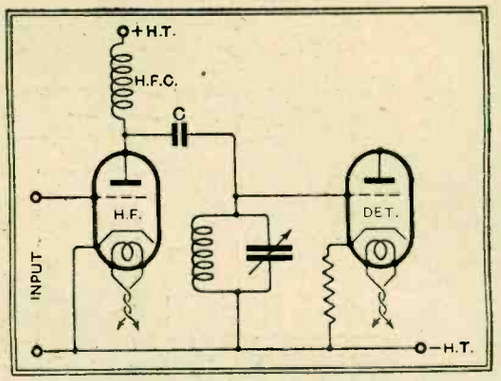


Fig. 3.—Tuned grid coupling.

condenser C at the lowest frequency to be dealt with.

For high-frequency amplification the anode impedance often comprises a coil tuned by a condenser to the frequency of the oscillations, the arrangement being known as *tuned-anode coupling*, a system which has been very widely used.

Transformer coupling is satisfactory for both L.F. and H.F. amplification, the appropriate type of transformer being necessarily employed in the respective cases. The general arrangement is shown in Fig. 2, at (*a*) for low frequencies and at (*b*) for high frequencies. The low-frequency transformer

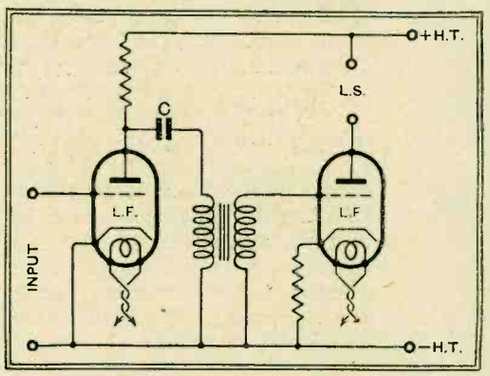


Fig. 4.—Parallel feed L.F. transformer coupling.

is iron cored and designed to give an even response over a wide range of audio-frequencies, whereas the H.F. transformer has its secondary winding tuned by a condenser to the signal frequency. In either case the H.T. is isolated from the grid of the second valve, and for this reason a grid condenser is not necessary. The required grid bias is applied through the secondary winding. Transformer coupling has the further advantage of giving a voltage step-up effect, thereby increasing the stage gain.

In recently designed receivers several modifications and combinations of the two general methods of coupling have been successfully applied, each possessing its own particular advantages. Two representative examples are the tuned-grid arrangement of Fig. 3 for high-frequency amplification, and the parallel-feed L.F. transformer circuit of Fig. 4. Of these the former has the great advantage of reducing the tendency to instability, and in the latter no D.C. passes through the primary winding of the transformer, so that the core is not polarised. The H.T. is isolated in each case by the blocking condenser C.

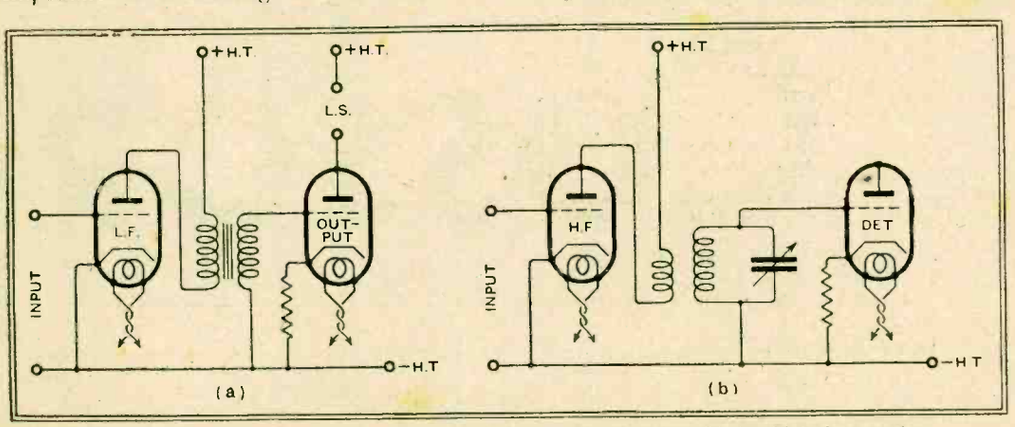


Fig. 2.—Simple transformer coupling: (a) for low frequencies, (b) for high frequencies.

Unbiased

By

FREE GRID.

The Squeak Diviner.

WONDERFUL as are the inventions of science which enable the Post Office van to detect the presence of a disused crystal set in a lumber room, I think that the mind of man can climb to still greater heights. I am moved to this profound observation by an account given by a well-known Northern journal of a Bradfordian who—but let the newspaper tell its own story: "In that street lives a man to whom in his leisure time wireless means everything, and when he is searching for other lands and the oscillator gets down to work and upsets his calculations he becomes very cross. He goes out of his house and wanders slowly down the street listening. His knowledge of wireless is such that he can soon find the house of the offender."

Listening.

I only wish that we could all achieve such a profound knowledge of wireless as this. I suppose, however, that it is a gift, like water divining.

We hear less nowadays of the people who imagine that they are being pestered with wireless messages picked up from nowhere without the aid of receiving apparatus, but I imagine that the Bradfordian belongs to the same tribe.

An Adventure in the Channel.

I WAS very hastily called to Paris the other week-end to visit a sick friend, and, as the summons came late in the evening, I had no option but to go by one of the night boats. Actually the message reached me so late that had I been in London I could not possibly have got the boat train, but by a piece of good luck I was on the South Coast, and was able to get along to the point of embarkation by car, just scrambling on board as the gangways were being drawn up.

I found to my dismay that the boat was extremely crowded, and although the journey was to be a night one there was not a berth to be had for love or money, this state of affairs being due, I was told, to the fact that it was the holiday season. Eventually I secured a rug and pillow and prepared to make myself comfortable on deck next to a bibulous fellow-countryman who, to judge by his accent, appeared to come from the more oriental part of the Metropolis. He made himself uncomfortably chummy, and after informing me that this was the first time that he had left his native land, he produced a home-made portable receiver and insisted on regaling me and other deck sleepers with programmes from both sides of the Channel.

Pointing with superstitious awe.

The set was built rather clumsily, with most of the "works" exposed instead of being hidden behind a panel in the conventional manner. It possessed the rather unusual feature of covering a waveband of 150 to 2,500 metres without a break, this being brought about by the fact that the bibulous one had copied the design of a well-known commercial set in arranging to have three overlapping wave ranges instead of the two ranges of the ordinary set, with its gap between 600 and 900 metres. Our friend finished up by giving us some Morse excerpts from various coast stations, and then subsided into slumber, using his portable to bolster up his pillow.

An Unpleasant Awakening.

I did not seem to have been sleeping very long before I was awakened by a clammy hand placed on my face. I started up and by the wan light of the moon saw my unwanted friend gibbering with fear and pointing with superstitious awe at his portable, from which the sound of Morse was emanating. After somewhat acidly pointing out to him that he had probably left it switched on before he fell into his bacchanalian sleep I prepared to resume my broken rest, but he would have none of it, and insisted that he had switched off previously. "Well," I said, somewhat testily, "why not open it and make sure?"

It was evident by the expression on his countenance that this bright thought had not occurred to him before, and, stretching out his hand somewhat gingerly, he proceeded to put it into practice. He had scarcely opened the lid, however, before he gave vent to an ear-splitting yell, dropped the set, and bolted, only to be brought to earth by tripping over a couple of sleeping passengers.

Hastily seizing the set to find out the cause of his fright, I was astonished to find sparks crackling merrily across the plates of the tuning condenser which shunted the frame aerial. The set was certainly switched off, and for a moment I was puzzled, until it occurred to me to read the Morse. Then the cause of the strange phenomenon revealed itself. Rushing in the direction of the ship's wireless cabin until I was within earshot of the spark transmitter, my suspicions were speedily confirmed.

Our friend, when switching off, had happened by mere chance to have left his set tuned to the wavelength which the fates had decreed should be used by the ship's transmitter a little later on. Naturally, the E.M.F. picked up by the frame had been sufficient to cause sparking across the tuning condenser. Detuning quickly stopped the trouble. Since untuned funnel stays in the vicinity of the aerial will often give quite large sparks, as related by me in these notes a little while ago (February 10th), it is not at all surprising that this phenomenon should have occurred in the case of a circuit tuned to the ship's wavelength, and even though, compared with a funnel stay, the frame aerial was small and relatively remote from the aerial.

Watering the Earth.

THE authorities who control our water supply *will* have their little joke. It will be remembered that some months ago they gave a solemn pronouncement about the havoc wrought to their pipes by electrolytic action when listeners use them as earth connections.

The latest effort of one of their inspectors is to warn a harmless citizen who was found watering his buried earthing tube—or, to be more precise, the earth around it—that he was liable to a heavy fine, as he paid only the ordinary household water rate and not an extra one for watering the garden.

The citizen in question has written to me asking whether the inspector's warning was strictly in accordance with the law. I have replied pointing out my lack of legal knowledge, but giving it as my opinion that as, according to his own confession, he was using a watering can and not a hose, the inspector was wrong. At the same time, it would not at all surprise me that I was wrong and the inspector was right, as I notice that a certain water-supply authority recently won its case when it sued a woman who had been guilty of washing a horse's feet without having a non-domestic licence.

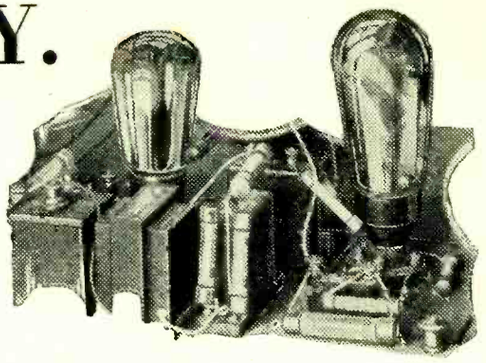
Watering the earth.

In future, I intend to be very careful to see that no inspector is loafing in the vicinity when I wash my dog, and all blinds will be drawn when my canary takes its morning bath.

IMPROVING STABILITY.

The Finer Points in Decoupling.

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



IN building up a mains set in which grid voltage is obtained by passing the anode-current through a resistance in the cathode-lead of the valve, doubt often arises as to whether the decoupling condensers should be returned to cathode or to earth.

In Fig. 1 is shown the circuit of a low-frequency amplifier followed by an output valve, making a combination of a type very frequently used for the reproduction of gramophone records. It will be observed that the last valve is choke-coupled to the speaker, in order that the bulk of the speech currents in the anode circuit of the valve shall pass through the speaker direct to cathode, without having to find their way through the eliminator section of the equipment. This output connection may be regarded as the first and most vital precaution against feed-back into earlier valves.

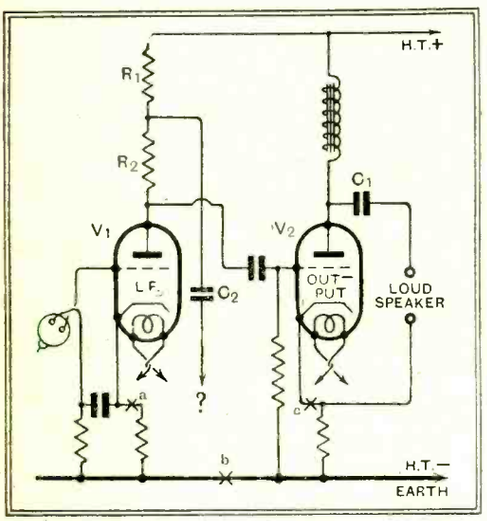


Fig. 1.—Decoupling in the anode circuit of V_1. Should C_2 be connected to *a*, to *b* or to *c*?

It is usual to return the speaker to earth at *b* and not, as shown in Fig. 1, to cathode at *c*. The latter connection, however, is preferable in that it excludes the bias resistor from the anode circuit, and so avoids the need for decoupling it.

Even when a choke-filter output circuit is used, a certain small fraction of the signal current from the last valve flows through the output choke, and so sets up a voltage across the eliminator terminals. This voltage is then superposed on the steady d.c. voltage delivered to the preceding valve, and so, through the anode circuit of this valve, passes on a voltage to the grid of the power valve. We thus have signal voltages returned from the anode of the last valve to its grid—in other words, reaction. Unless steps are taken to check this effect the usual results, distortion, motor-boating, or oscillation, will be very liable to occur.

To prevent this the decoupling resistance R_1 is inserted to block these currents, and the condenser C_2 is provided to drain away those that do succeed in passing R_1 from the H.T. end of R_2, the anode resistance proper. It is obvious that R_1 must have as high a resistance as the inevitable loss of volts will permit, while C_2, to be an effective drain, must have a large capacity. The only point that remains in doubt, therefore, is the connection of the bottom end of C_2. To what point is C_2 to drain away the unwanted signal currents?

MANY readers have probably found that although, theoretically, all decoupling condensers should be returned to the cathode terminal of an indirectly heated valve, often the receiver is more stable when the connection is made to earth. Why this is feasible is explained at some length and there follows a discussion on some of the finer points in decoupling.

Bias Resistor Currents.

It is only logical, since the currents must eventually return to the cathode of the valve in which they originate, to connect the lower end of C_2 to the point *c*, thus conducting them directly to their destination. It is more usual to return the condenser to earth at the point *b* in the circuit diagram, but it should be observed that in this case the bias resistor has quite unnecessarily to carry these stray speech currents, thereby introducing them into the grid circuit to the detriment of amplification if not of quality.

On occasions, one may insert such a combination as R_1 and C_2 to prevent speech currents from the anode circuit of V_1 from finding their way into the eliminator. In such a case the return of C_2 to the point *b* is still not strictly correct; one is attempting once again to drain away currents that are bound for the cathode of the valve that gave them birth. The bottom of C_2 must therefore be taken to point *a*, in order that the current it passes may not have to traverse the bias resistor of V_1.

Reducing Hum.

Finally the decoupling components may be used as an auxiliary smoothing circuit to lessen the hum derived from the eliminator. (Strictly speaking, they then cease to be decoupling components at all, and become a resistance-capacity filter instead.) In this last case the hum-voltage that we are trying to get rid of originates across the terminals of the eliminator; C_2 must therefore be taken down to point *b*, lest by taking it to *a* or *c* and making the hum pass through a bias resistor, the resistance filter should do more harm than good.

From the three cases discussed a general principle emerges; it is that a decoupling circuit must be regarded as a potential divider connected across the source of the unwanted voltages. The general idea is to drop as large a proportion as possible of the A.C. volts in the resistance, which is made as high as can be managed without undue loss of anode voltage, while the condenser which forms the lower arm of the potential divider has the

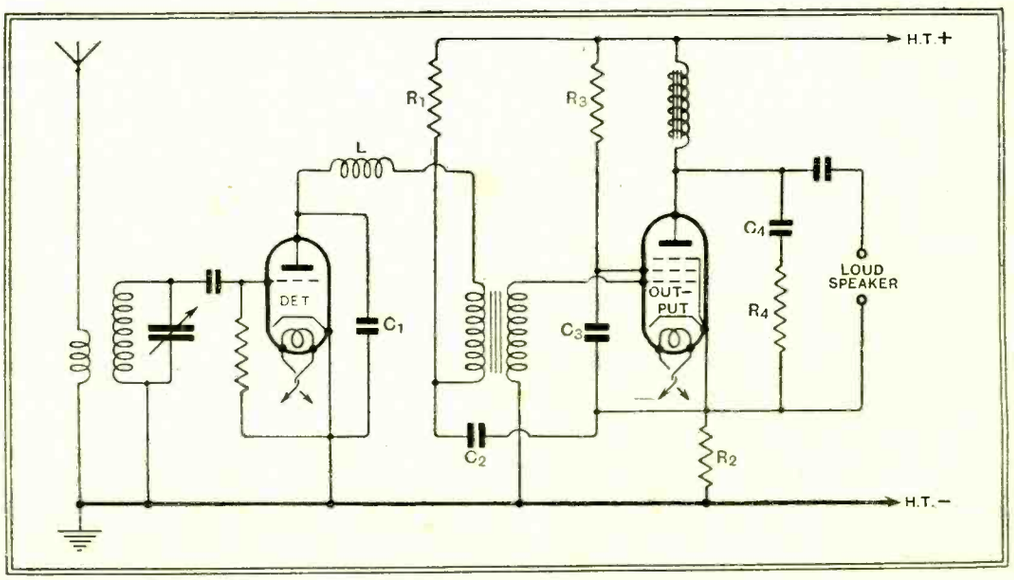


Fig. 2.—Detector-pentode set, with complete decoupling according to the principles derived from studying Fig. 1.

Improving Stability.—lowest possible impedance to the unwanted currents. If such stray oddments as bias resistors are allowed to find their way into this lower arm its impedance will be raised unnecessarily, and the decoupling efficiency will be proportionately diminished.

In all cases, therefore, the decoupling circuit is connected directly across the source of voltage it is desired to cut down; from H.T. *plus* to *c* if voltages arising from the output valve are in mind, from H.T. *plus* to *a* if the unwanted voltages arise in V_1, and from H.T. *plus* to *b* if hum-voltages from the eliminator are to be cut down.

The decoupling system of a two-valve detector-pentode set, arranged with this basic principle in mind, is shown in Fig. 2. Having discussed the general principle, it is hardly necessary to allot more than a word or two to each part of the scheme.

The high-frequency choke and its associated condenser C_1 are intended to deal with high-frequency currents derived from the detector, to whose cathode C_1 is consequently returned. In the absence of a bias resistor this point is also earth; that, however, is merely accidental.

The components R_1 and C_2 are exactly analogous to R_1 and C_2 of Fig. 1; since they are intended to protect the transformer primary from signal currents derived from the pentode, C_2 is returned to the pentode's cathode.

The condenser C_3 is also taken down to this point, because a pentode is designed to work with its screen at the same signal potential as its cathode, which is reckoned as "earth" from the point of view of the valve. Alternatively, one may justify this connection by pointing out that the signal-current flowing in the screen circuit of the pentode has to be returned direct to cathode, and should not be allowed to stray into the grid circuit by passing through the bias resistor.

The tone-corrector or impedance-limiting circuit made up of R_4 and C_4 is intended to carry the excess currents at the higher frequencies which would otherwise lead to shrill reproduction. Like the screen currents, they must eventually return to cathode, and should therefore be conducted there directly, and not be sent round by eliminator condenser and bias resistor as they would be if the tone-correcting circuit were connected directly across the output choke.

Finally, there is the main bulk of speech-current which is taken by the speaker itself; they also are bound for, and may as well go straight to, the cathode of the valve, without being allowed to set up stray voltages in other parts of the set.

VIENNA'S BUSY YEAR.

THE Vienna Broadcasting Company has computed that it transmitted for six months and eight days incessantly during the year 1931, 4,473 hours being occupied by broadcast programmes. Of these, 2,917 were devoted to music, 344 to literature, 552 to science, 443 to news, and 132 to religious services. Opera music claimed 320 hours, while musical comedies and light music had 382. No fewer than 580 hours were given over to gramophone reproduction and only 130 to dance music. Foreign programmes were relayed to the extent of 103, while 97 transmissions were relayed to foreign countries.

Distortionless Volume Control.

New Circuit for R.C. Amplifiers.

THERE is always some little difficulty in finding a low-frequency volume-control suitable for use in a gramophone amplifier, if only on the grounds that most of the methods used for disposing of the superfluous speech-voltages are inclined to have some effect on the quality of reproduction.

A potentiometer across the pick-up is perhaps the most usual method, but it is very seldom satisfactory. With the slider at the mid-point half the total resistance is in series with the grid of the valve, as Fig. 1 shows, and this resistance, acting in conjunction with the grid-earth capacity of the valve, removes a very appreciable proportion of the high-note output from the pick-up. If the total resistance of the potentiometer is reduced to avoid this defect, practically all the high notes provided by the pick-up can be made to reach the valve, but the pick-up becomes heavily shunted.

Control in the amplifier rather than on the pick-up itself is therefore required, even though this means that it becomes imperative that the first valve of the amplifier should be capable of handling the maximum output that the pick-up can deliver. If transformer coupling is used a variable resistance

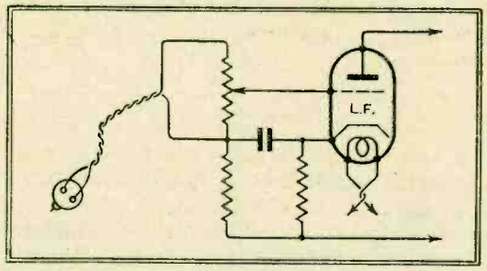


Fig. 1.—Showing that if a potentiometer across the pick-up is used as volume control, part of it is in series with the grid. This causes loss of high notes.

in parallel with the primary is usually perfectly satisfactory, but with resistance coupling matters are none too easy. A potentiometer grid-leak, as in Fig. 2, is often used, and with careful circuit-design can be made satisfactory. A high-resistance potentiometer is inclined to lead to loss of high notes, though this is very much less marked than when the potentiometer is placed across the pick-up itself. A low-resistance potentiometer, on the other hand, introduces the danger of losing a good deal of the bass if the coupling condenser C is not increased in capacity to compensate for this effect. But the main drawback to Fig. 2 is found in the fact that the lead from slider to grid is often long owing to the need for having the control in an accessible position. The long lead, unless care is taken, may introduce hum or even instability.

The obvious equivalent to a variable

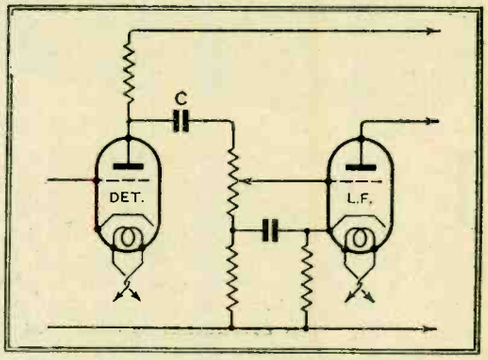


Fig. 2.—Potentiometer grid leak as volume control. A very considerable improvement over Fig. 1.

resistance across a transformer secondary is a variable anode resistance, as in Fig. 3 (*a*) which controls volume by varying the amplification derived from the valve in whose anode circuit it is situated. Since, however, this varies the anode voltage on the valve, it is not a scheme to be recommended, even apart from the fact that it is almost inevitably extremely noisy in operation owing to the changes in anode current produced by altering its value. What one requires is an anode resistance that stays constant so far as D.C. conditions are concerned, but can be made to offer high or low resistance, as required, to the signals.

By the scheme outlined in Fig. 3 (*b*) this apparent impossibility is achieved. The condenser C is given a capacity large enough to offer a negligibly low impedance to signals of all frequencies; 4 mfds. is quite large enough in most circumstances. As a general rule, R should have a resistance about equal to that of the fixed anode resistance with which it is effectively in parallel, and it will be found that a graded or tapered resistance gives the smoothest variation of volume.

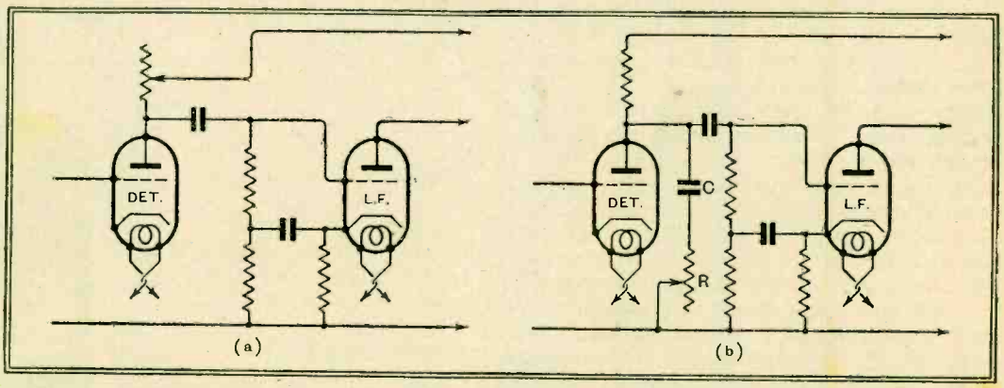


Fig. 3.—(a) A variable anode resistance controls gain, but is noisy. (b) Variation in R alters the *signal-frequency* anode resistance, but since it carries no direct current is silent in operation. Remote control is possible with this circuit.

A. L. M. S.

PYE MODEL "K" RECEIVER.

An Inexpensive A.C. Mains Set with Unusually Selective Tuning Arrangements.

IT is doubtful whether statistics have ever been prepared to show what proportion of potential listeners in this country would be adequately supplied with one or two programmes by a simple detector-L.F. set without H.F. amplification. But even if the word "adequately" be interpreted in the strictest sense, it seems probable that such a circuit arrangement would be capable of supplying really good local-station reception to at least half of their number.

If we accept this percentage as substantially correct, then it is rather surprising that, with a few notable exceptions, receivers with this circuit arrangement are looked upon almost with contempt, and few attempts are made to obtain from them the high standard of performance of which they are undoubtedly capable. More often than not, everything is subordinated to cheapness and extreme simplicity. The result is that most two-valve sets are not pleasant pieces of apparatus to handle; they lack true selectivity, and usually the quality—and quantity—of their output leave much to be desired.

Refinements in the Tuning System.

The average receiver of this class, with the simplest possible tuning arrangement, is generally capable of separating local twin stations, but, if an annoying background of interference is to be avoided, it may be necessary under unfavourable conditions to reduce aerial coupling and simultaneously to apply so much reaction that the quality of reproduction is impaired, and the set is by no means easy to handle. What is wanted is a more refined tuning system, and, if its advantages could be brought home to them, the public would doubtless be willing to pay for it.

In the new Pye Model "K" detector-L.F. set, with which we are here concerned, the feature of outstanding interest is a band-pass input filter, which confers a measure of true selectivity far beyond that afforded by the conventional single-circuit arrangement which one expects to find in such a set. It is fortunate from the point of view of the buying public that they are asked to pay practically nothing for this addition; the present set compares favourably in price with less refined types having similar pretensions in the matter of power output and quality of reproduction.

Basically, the circuit arrangement adopted is that of a regenerative grid detector, followed by a transformer-coupled pentode output valve. The component circuits of the band-pass filter are magnetically coupled, and, of course, are tuned by a ganged condenser; thus the employment of a filter is not responsible for any increased complexity in operation. As shown in the accompanying circuit diagram, connections to the high-potential points of the medium- and long-wave coils are changed over by a multiple two-way switch; in order to make it easier to follow this somewhat unusual scheme, a simplified diagram of the input circuit is given as an inset.

FEATURES.

General.—*Two-valve mains-operated receiver for operation with external aerial. For A.C. supply voltages between 200 and 250 volts.*

Circuit.—*Magnetically-coupled input band-pass filter; power grid detector with reaction. Output pentode valve coupled by resistance-fed transformer. Energised moving-coil loud speaker.*

Controls.—*(1) Ganged tuning condenser. (2) Reaction. (3) Post-detection volume control. (4) Combined wave-range and radio-gramophone switch. (5) On-off switch.*

Price.—*12 guineas.*

Makers.—*Pye Radio Ltd., Paris House, Oxford Circus, London, W.1.*

It should be noted that the coil assemblies, and also the switching system, have been simplified by the omission of a separate reaction coil; instead, a section of the aerial windings is made to serve this purpose. Otherwise, reaction control is conventional, being effected by means of a differential condenser.

The detector operates on the "power grid" principle, and normally consumes an anode current in the order of 8 milliamps. Arrangements are made to convert this valve for use as a gramophone amplifier, and to this end a bias resistance is inserted in its cathode lead. It is short-circuited by the switch when the contacts are in either the medium- or long-wave positions, and becomes effective only when the contacts are in the intermediate position.

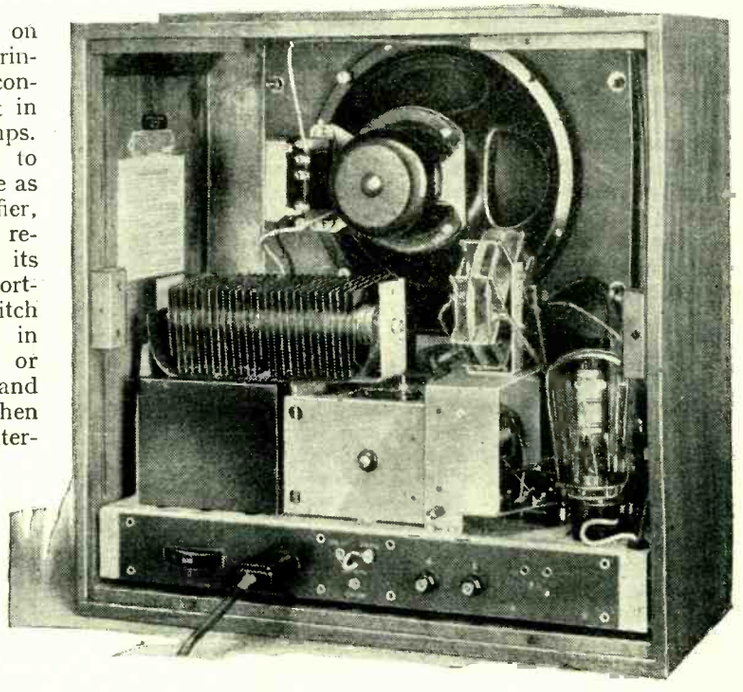
The coupling between detector and output valves is somewhat unusual. Broadly, this consists of a parallel-fed transformer, but the feed resistance is in the form of a potentiometer, and so acts as a post-detection volume control. Further, the low-potential end of the transformer primary, instead of being earthed as usual, is joined to the H.T. positive supply line, although no current flows through the winding. The detector anode circuit is decoupled in the conventional manner.

Bias for the A.C./PEN valve is obtained in the usual way by the insertion of a resistor in its cathode lead; it should be noted that both bias resistors are shunted by high-capacity dry electrolytic condensers.

Moving-coil Loud Speaker.

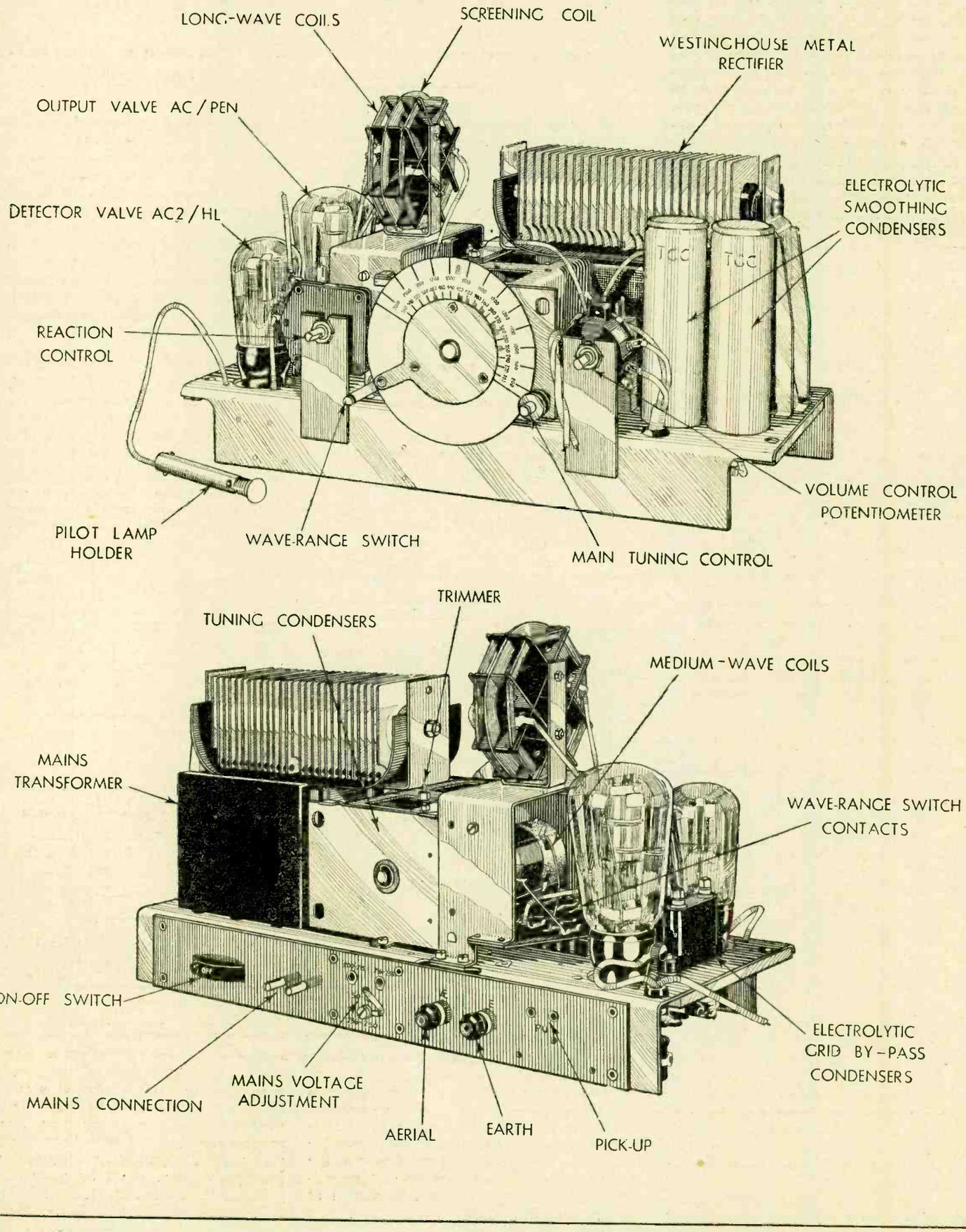
A comparatively elaborate system of tone correction is included in the output anode circuit in order to avoid the shrillness of reproduction that is too often associated with pentodes. First there is the conventional filter across the transformer primary, consisting of a condenser and resistance in series, and secondly there is a small choke in series with the speech winding of the moving-coil loud speaker. This latter instrument is of the energised type, and its field winding serves as a smoothing choke. After allowing for a voltage drop of 100 volts in this winding, there still remain about 230 volts for application to the valves. Even after subtracting grid bias voltage, it will be seen that the output valve is operated at very little under its maximum rated voltage; it actually consumes about 27 milliamps in the anode circuit, and so provides a very considerable undistorted volume.

High-tension current is supplied through a



Rear view of the Pye 2-valve receiver, with back cover removed.

A 2-VALVE SET WITH BAND-PASS INPUT CIRCUIT.



Two views of the Pye Model K receiver chassis. The power transformer is completely screened.

half-wave Westinghouse metal rectifier, and wet electrolytic condensers are employed for smoothing. This is a somewhat important point in design; as both valves are of the indirectly heated type, it follows that there would be an excessive voltage rise on first switching on were it not for the fact that these condensers tend to leak when applied voltage is increased beyond a fairly critical value. It is found that in the Pye set the initial rise does not amount to more than 20 per cent. above the normal working figure, and so the possibility of punctured condensers, etc., is remote.

Construction is on fairly conventional lines, but the high standard of workmanship that one has come to expect in all Pye sets is fully maintained, even in this relatively inexpensive model. There is no evidence of skimping, and large factors of safety are allowed everywhere, electrically and mechanically.

Filter Circuit Details.

The method of arranging the band-pass coils is naturally one of the most interesting constructional details; the medium-wave windings, of the solenoid type, are wound end-to-end on a common former, and between them is placed a vertical sheet aluminium screen, which has obviously been carefully designed, both with regard to its shape and area, so as to restrict inter-circuit coupling to the necessary extent. An entirely different system of construction has been adopted for the long-wave windings, the two coils being wound in slots on a common skeleton former. Instead of a sheet-metal screen, a coil of bare wire is wound in a third series of slots placed midway between the primary and secondary coils; adjacent turns of this screening coil are soldered together, and the whole is connected to earth.

Another unusual and very sensible feature is the mounting of the pilot lamp, which is carried on a tubular metal holder. This may easily be removed for replacements without the usual need for fumbling in an inaccessible position, and it is supported by a spring clip immediately behind the translucent tuning scale. This scale, by the way, is calibrated directly in wavelengths with an unusually high degree of accuracy, and, moreover, includes the valuable feature of markings in a contrasting colour for identification of the main British stations.

The wave-range switch, which is built as a part of the set rather than as a separate component, is unusual both with regard to its construction and—for a two-valve set—in the number of contacts. It is a three-position push-pull switch—"medium-wave," "long-wave," and "gramophone"—and would appear to be self-cleaning to an unusual extent. The main on-off switch, of the quick-acting type, is mounted at the back; a position that gives grounds for criticism, but as it is adopted on so many sets nowadays, apparently it is not objected to by the majority of users.

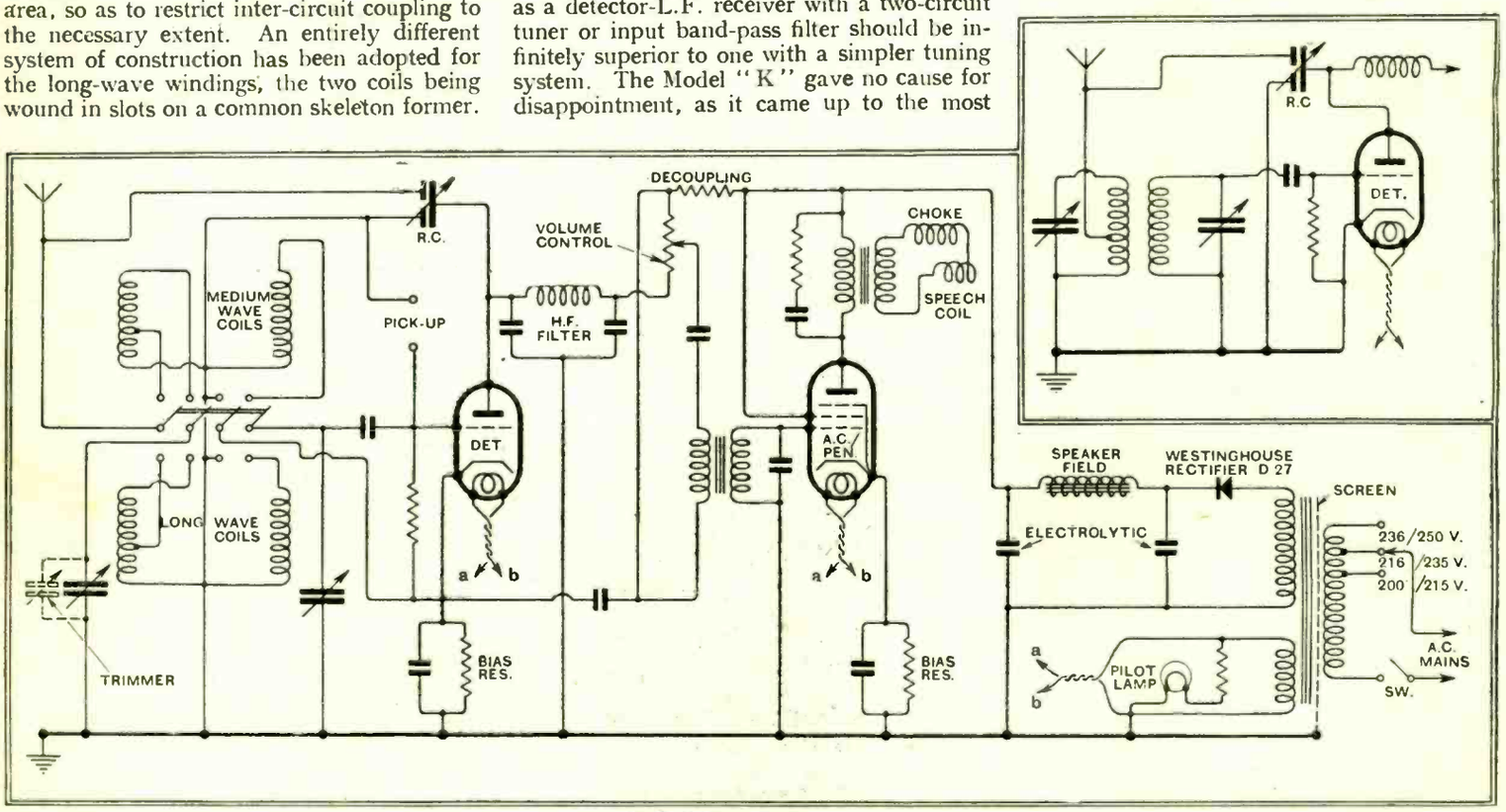
Extreme compactness, particularly with regard to the back-to-front dimensions, is a feature of the cabinet, which, like that of most other Pye sets, is of a rather light-coloured figured walnut. The chassis is flexibly mounted on rubber-insulated supports, and above it is the loud speaker, which is rigidly secured to a heavy backing board in order to prevent vibration.

When testing the performance of the tuning system, a somewhat high standard was set, as a detector-L.F. receiver with a two-circuit tuner or input band-pass filter should be infinitely superior to one with a simpler tuning system. The Model "K" gave no cause for disappointment, as it came up to the most sanguine expectations. Although tuning is broad enough to embrace the modulation side-bands, difficulties with regard to interference simply do not exist under any reasonable conditions. Due to the normal action of the detector, there is a slight trace of "spreading" when receiving a powerful station at short range, but the resonance curve appears to be exceptionally straight-sided, and the wide "skirts" of the usual regenerative detector set are entirely absent. It is a very nice set to handle, and—a matter of some importance—one that is easily tuned by the non-technical listener. Reaction control, though it might be a little smoother towards the point of actual self-oscillation, is almost ideal for a set of this class, as it has no noticeable effect on tuning.

Matters seem to have been very carefully arranged with regard to inter-circuit coupling of the band-pass filter. There is no noticeable tendency for tuning to broaden unduly towards the lower end of the wavelength scale.

Although the set is obviously intended mainly for local station work, this does not mean that good results are only obtained under the shadow of the broadcasting station; actually, ranges of thirty or forty miles from high-power medium stations are well within its capabilities, and at such distances it is not necessary to make excessive use of reaction. Its performance on the long-wave band is equally satisfactory, and the range is naturally much greater: Radio-Paris provided signals of entertainment value, and other long-wave Continental stations could be received.

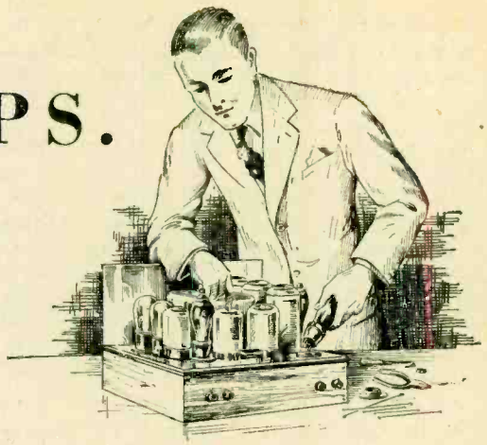
The output from the loud speaker was surprisingly good in the lower register, when one takes into account the small size of the cabinet, and consequently the small baffle area. Indeed, by pushing reaction towards the limit, it is possible to over-accentuate the bass response. But in normal circumstances the balance is good, and there is no trace of shrillness or annoying resonances. As already indicated, volume is exceptionally great for such a small set, and particularly for such an inexpensive one. At its price of twelve guineas, the set represents remarkably good value, and should be entirely capable of satisfying the needs of the large body of listeners who neither expect nor desire consistent long-distance reception.



Complete circuit diagram of the Pye 2-valve A.C. receiver and (inset) a simplified diagram showing the filter circuits and reaction control system.

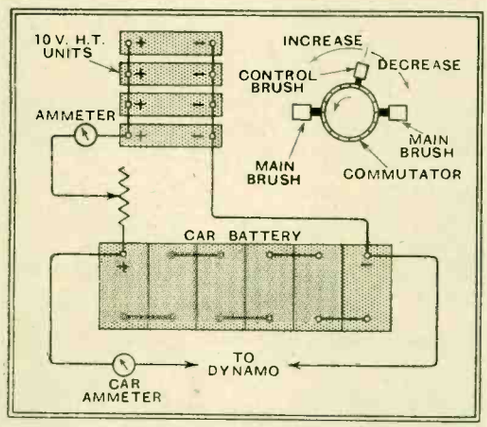
PRACTICAL HINTS AND TIPS.

AIDS TO BETTER RECEPTION.



IN the "Readers' Problems" section of *The Wireless World* some advice was recently given to an overseas correspondent who, in the absence of any local charging station, wished to recharge an L.T. accumulator from his car battery. Inspired by this paragraph, another reader has been good enough to send us some useful information, gathered from first-hand experience in Nigeria, on the subject of charging cells directly from a car dynamo.

An Improvised Charging Station.



Charging 10-volt H.T. batteries in parallel across a 12-volt car battery. Regulation of charging current is effected by an external rheostat. Inset: typical arrangement of the brushes of a car dynamo.

As is fairly well known, the generator fitted to most British cars is a shunt-wound machine, but differs from the standard type in that the field winding, instead of being connected directly across the main brushes, has one end connected to a smaller brush which bears on the commutator at a position roughly midway between the main brushes. By this arrangement practically constant-voltage regulation is obtained irrespective of speed; this is due to the fact that the third brush taps the commutator at an intermediate voltage, and this voltags falls as the speed rises. With a smaller current flowing in the field winding at high speeds the increase of output voltage which occurs in the normal type of machine is avoided.

These machines do not usually begin to charge until the engine is running at a speed of considerably over 1,000 r.p.m., which is much too fast for a stationary engine in tropical climates, and very wasteful of petrol. This trouble is overcome by moving the control brush in the direction of rotation of the armature and then cutting down the engine speed until the maximum rate of dynamo output is obtained for minimum engine speed. This may usually be attained at engine speeds of between 400 and 500 r.p.m.—no more than a rather fast "tick-over."

Under such conditions the engine may be run for hours, but it is advisable to take off the commutator cover in order that air may circulate freely through the windings. It is, of course, important to remember that the brush should be slipped back to its normal position before speeding up the engine again.

At the slow speed advocated, the engine will be running on the carburetter pilot jet, and this must be adjusted to give a considerably weaker mixture than normally; if care is taken in this respect it should be possible to obtain, with a 12 h.p. engine, between four and five hours' charging, at 12 volts 10 amps., from a single gallon of petrol.

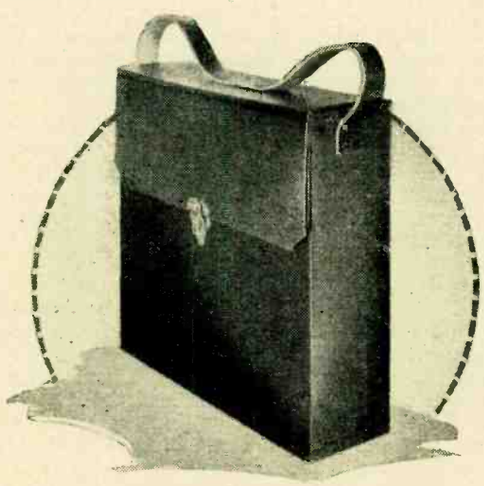
If any doubt exists as to the effectiveness of the engine-lubricating system at this slow speed a little oil may be mixed with the petrol.

This method of charging is applicable to a number of L.T. cells connected in series or series-parallel, and it is also possible to charge a large number of 10-volt H.T. accumulator units by connecting them in parallel with the car battery in the manner shown in the accompanying diagram.

THE practice of building sets in two units—the receiver proper and a combined output stage with power equipment—has proved both convenient and popular; it is exemplified in such recent *Wireless World* sets as the "Monodial Super" and "Straight Five."

Two-unit Portables.

But the possibilities of this scheme of construction, as applied to portable sets, seem to have been ignored of late. The idea is not a new one, as it was employed in a very successful transportable superheterodyne—the Igranic—in the early days of broadcasting. Portables are generally carried from place to place in a car—more often than not in a very small one—and it is an axiom that room can more readily be found for two small articles than for one large one of equivalent cubic content.



A pair of gramophone record carriers make very satisfactory (and inexpensive) containers for a two-unit portable set.

Possibly the two-unit system would not appeal to non-technical users, but there is much to commend it to those who make their own sets. A convenient scheme of subdivision is to mount the receiver and frame aerial in one case, and the loud speaker and batteries in the other. This plan may be modified to suit individual needs, and interconnection may be effected by means of a multiple cable and irreversible plugs and sockets.

EVERYONE knows that the sensitivity of a set embodying a band-pass filter or a two-circuit tuner is decreased by an excessive reduction in inter-circuit coupling. What is not so generally appreciated is that the same state of affairs is brought about by too tight a coupling.

Filter Adjustment.

The rough-and-ready rule for ascertaining experimentally the correct adjustment of all circuits of this nature is to start with a very loose coupling, which is progressively increased until signals are at maximum strength. If side-band loss is to be avoided, a further slight increase in coupling is made in order to broaden the resonance curve.

THE components of a modern factory-built set are generally more or less inaccessible, and so it becomes a matter of some difficulty to measure the individual anode currents of the various valves. At the best, convenient "break-in" points for inserting the milliammeter in each circuit will seldom be get-at-able unless the chassis be withdrawn from the cabinet.

Current Measurement by Subtraction.

But, by the exercise of a little subtlety, it is often possible to circumvent these difficulties. For instance, if measurements can be made of total current, and then of all anode currents except that of one valve, it is clear that, by a single and obvious process of addition and subtraction, the missing information can be obtained.

Total current is readily measurable at the loud speaker field-winding terminals of most present-day A.C. sets, while the output-valve current can usually be ascertained by putting the milliammeter in series with the transformer primary on the same instrument, which can nearly always be reached.

Although it is hardly good practice to do so, it is certainly convenient to measure the current of a screen-grid H.F. valve by joining one side of the meter directly to its anode terminal and completing the circuit through the flexible anode lead. Should self-oscillation be provoked by stray couplings introduced by the meter wiring, it may be stopped by short-circuiting grid and cathode terminals of the valve.

NEWS of the WEEK.

Events of the Week in Brief Review.

All-British Sundays at Luxembourg.

THE WIRELESS WORLD learns that the Luxembourg Broadcasting Company has sold the whole of its Sunday programme time for a considerable period to British concerns. It is interesting to note that money will also flow into France, *via* Luxembourg, from a number of German firms which are anxious to buy time on the air.

Vera Siewert, a young German woman, is to give the English announcements at Luxembourg, so it appears that British listeners will have to grow accustomed to a slightly Teutonic accent.

It is definitely stated that this 200-kilowatt station, will be in operation next month. The wavelength of 1,250 metres will probably be used, despite international protests.

World-wide Programmes for Jews.

WE learn that the first Hebrew broadcasting station has been inaugurated at Tal-Aviv, Palestine. The station transmits in Hebrew and English, and it is intended in the near future to include some programmes for the benefit of the Arab population. It is understood that a short-wave transmitter will soon be erected on the same site in order that Zionists all over the world may be kept in touch with the Holy Land.

Broadcasting "Holidays" in Switzerland.

LISTENERS to the Beromunster station (Schweizerischer Landessender) probably realise that the programme is a joint one, originating in more or less equal parts in the Basle, Zurich, and Berne studios. It is therefore easy for one or other of the studios to close down without interfering with the general scheme. Basle recently took a holiday for a fortnight to enable the station to get a good rest and to give the studio a thorough spring clean. Berne comes next, and then Zurich. The idea seems a good one.

HAVE YOU HEARD HER? Frau Gertrud van Eyseren, who has become Berlin's first woman announcer, succeeding the popular Karl Wessel, who died recently.

Scotland's Own.

SCOTLAND'S Third Annual National Radio Exhibition is to be held from October 12th to 22nd next, in the Exhibition Hall, Waverley Market, Edinburgh.

Special interest will be given to the event by the completion of the new high-power broadcasting station at Falkirk, and it is expected that previous attendance records will be easily eclipsed.

A School Radio Challenge.

WHEN and where was the first wireless set installed in a school? A claim was recently made on behalf of a school in Chesterfield which had a radio receiver working towards the end of 1922, but the Central School for Boys in Derby claims to have possessed a wireless installation which first worked on April 29th, 1921.

Four Great Stations for France.

A FRENCH broadcasting scheme appears to be on the move at last. M. Queuille, the new Postmaster-General, electrified those present at the recent banquet at Bordeaux of the National Broadcasting Federation by declaring that he had decided to begin immediately "the construction of four *great stations* to replace those of the P.T.T. stations at Paris, Toulouse and Lyons, and to create a new station for the Mediterranean Region." Others, he added, were to follow soon.

Our Paris correspondent states that the decision must be regarded as definite because the sites are bought and the orders given. A technical commission is now examining the tenders of the various competing firms.

This looks so much like "business" that Parisians are telling each other that some tremendous change must have overtaken the rue de Grenelle (the seat of the French Postal Administration).

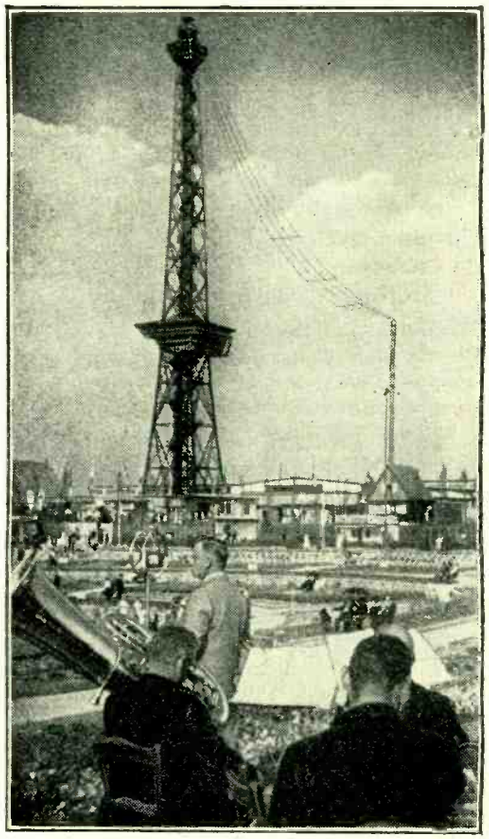
Gramophones and Broadcasting.

AMONG the items on the agenda of the Congress of Gramophone Companies to be held this month in Amsterdam is the question of the broadcasting of gramophone records. It is being suggested in some quarters that this conference will see definite steps taken to establish a united front among the gramophone companies "against" broadcasting; to us, however, it seems more likely the companies will wisely see how far they can co-operate with the broadcasting organisations without damaging their own interests. No good can come from strife between the two mediums of popular entertainment.

Death of Dr. L. W. Austin.

BY the death of Dr. Louis W. Austin, of the U.S. Bureau of Standards, wireless research has suffered a severe loss. "Physicist" was the only title borne by the scientist on the official membership rule of the Bureau at the time of his death on June 27th, but a study of the records would disclose that he had contributed perhaps as much as any other one man to the fund of knowledge on radio transmission and the conquest of interference.

Dr. Austin was a pioneer of the Marconi school, his studies in wireless going back to the beginning of the century. Together with Dr. Louis Cohen, he was responsible for the so-called Austin-Cohen formula of wave-propagation with which it is possible to determine the service areas of stations and to measure the intensity of emitted signals.



A FALLING IDOL? Our Berlin correspondent states that the opening of a new transmitter some miles from the present Berlin station may lead to the disuse of the famous Radio Tower, seen above.

Future of Berlin's Radio Tower.

BERLIN'S famous "Funkturm," or broadcasting tower may soon become a white elephant. The new high-power broadcasting station for Berlin will be erected at a considerable distance from the present transmitter in the grounds of the Tegel prison. This site has been used as an exercise ground for heavy artillery, and, according to our Berlin correspondent, it provides plenty of space and is excellently situated for broadcasting purposes. The power of the new station, which will be ready by next year, will be in the neighbourhood of 60 kW.

The Funkturm may retain its associations with radio if the authorities continue to use it as an aerial tower for the ultra-short-wave transmitter. In any case, the tower will probably pay its way as a well-patronised restaurant. The saloons half-way up the tower are a great attraction for the excursionists of Berlin.

Banana Speaks.

AT last the World's Directory of Radio Stations has a Banana, for the opening of the Belgian Congo Coast station of Banana is announced. It covers a wide gamut of wavelengths, mostly for commercial purposes, and it is interesting to note that wavelengths between 15 and 50 metres are to be used for long-distance communication with ships at sea. The 15- to 20-metre band will be used for telephony.

The Dangerous Mike.

WHILE listeners all over France were waiting in respectful homage for M. Herriot's speech at the obsequies of the late M. Aristide Briand at Cocherel, the first words to come through the treacherous microphone were: "Hand me my spectacles."

Amateurs Help the Police.

MR. HORACE LANGSTAFFE, an amateur transmitter with the call-sign G5VC, has for the past six months been co-operating with the Bradford police on a wavelength of about 160 metres, working with a police car fitted with a short-wave receiver. Now another amateur, Mr. Sydney R. Wright, with the call-sign 2DR, has joined in the experiments. The police have themselves recently obtained permission to erect a transmitter in the Bradford Town Hall, and during last week members of the police force have toured the district on motor cycles carrying wireless receivers to pick up instructions from headquarters. The strength of the signals at a number of strategic points within the city has been measured with a view to ascertaining what transmitting power and type of apparatus would be suitable for a permanent service.

The Bradford police are to be congratulated not only upon their enterprise, but for their wisdom in seeking the help of the amateur. It is well known, of course, that American amateurs have been able to render public service for many years, but this has not been the case in Great Britain.

The World's Tallest Mast.

AMERICA'S tallest wireless mast—878ft. high—has just been erected at Nashville for the new 50 kW transmitter WSM.

It is refreshing to know that Europe can beat this height by over 100ft. We believe that the Eiffel Tower remains the highest radio mast in the world.

Small Advertisements.

SLIGHT changes in our printing schedule become necessary with the approach of the August Bank Holiday. Miscellaneous advertisements intended for our issue of August 5th should be received not later than the first post on Friday, July 29th.

The Inventors' Show.

THE Rt. Hon. Lord Mayor of London, Sir Maurice Jenks, has consented to open the eighth International Exhibition of Inventions at the Central Hall, Westminster, London, on October 5th next.

How Gaby Graduated.

AN example of the "educative power of wireless" is being talked about in Paris. Our correspondent states that a little six-year-old girl named Gaby Triquet, who has never had any teacher but a wireless set, is now singing and reciting for a great gramophone recording company. One evening when she had been in the world about eighteen months, she fell asleep to "Manon," transmitted by the P.T.T. station; on awakening she astonished her relatives by reciting a considerable part of what she had heard.

Thanks to wireless, this little artiste has been enabled to commence her career at an age when others are still focusing their attention on sweets and teething rings.

Police Radio Comedy.

RECENTLY at Almelo the Dutch police seized a secret station which had been interfering with Langenberg; after the seizure, however, the Langenberg station mysteriously continued to suffer in the same way. Finally, after much searching, the Dutch authorities discovered that the police themselves had continued to work the station after its "arrest." Apparently the temptation had proved too strong, for in Holland many an amateur heart beats beneath the police tunic.

Ten Years.

TEN years packed with wireless history are entertainingly recorded in a little brochure issued by Messrs. Burne Jones and Co., Ltd., of Magnum House, 296, Borough High Street, London, S.E.1. It is available free on application to the company.

A National Repair Service.

A REPAIR service for the radio dealer, enabling him to place his customers' repairs in the hands of a company specialising in the work, offers attractive possibilities. A plan on these lines has been evolved by the National Radio Service Company, 15-16, Alfred Place, London, W.C.1. Realising that time is an important factor, they have organised a repair or conversion service by which any existing set can be dealt with in forty-eight hours. We understand that the service is also open to members of the public.

CALDWELL'S LATEST. On the right is the celebrated Mr. O. H. Caldwell, the ex-member of the U.S. Federal Radio Commission, whose radio predictions and inventions are a constant standby for American journalists. The "Voice Beautifier," shown on the right, was described in our last issue. On the extreme left is the "Applause Meter" which registers the strength of shouts and hand-clapping.

GERMAN BROADCASTING UPHEAVAL.

Scheme for State Ownership.

MOMENTOUS changes in German broadcasting are promised within the next few days. From all appearances the broadcasting organisation is shortly to be taken over by the State and used largely as a political instrument. A detailed plan for a State broadcasting system has already appeared in the Berlin newspapers, but we learn that the Cabinet has not yet decided on its adoption. It is proposed immediately to withdraw broadcasting concessions from the existing companies, a course made possible by a special clause in the agreement which would otherwise have run to 1936.

The scheme provides for nine new Regional companies, presided over by a single director of programmes, who would be responsible to a State Commission appointed by the Government of the particular State (Bavaria, Württemberg, etc.). His duty would be to see that no political matter was broadcast regionally.

Listeners complaining of the programmes would be heard, and if the complaints proved to be well founded the director of programmes would be immediately replaced.

News Under Government Control.

In Berlin itself, the present Radio Rundfunk Gesellschaft would obtain two new directors, the present directors becoming heads of departments. One of the new directors would be appointed by the Ministry of Posts and the other by the Ministry of the Interior, the former dealing with technical, financial and general organisation, while the latter would cultivate relations with foreign broadcasting companies and control the new "Reichssender." A most important proposal is that the company responsible for the broadcasting of news bulletins would be replaced by a department of the R.R.G. functioning under the direct supervision of the director appointed by the Ministry of the Interior.

The "Reichssender," which will use the long-wave German station for its programmes, would transmit all the political matter and news which Regional stations are not allowed to handle.

The Scheme Opposed.

What is the significance of these changes? They mean (writes our Berlin correspondent) that whereas German broadcasting has hitherto been, in part, privately owned, the State intends to take over complete control. In the past broadcasters have had a certain amount of independence; in the future it will be very different. The Regional programme directors, though independent as far as entertainment and educational programmes are concerned, will be in constant fear of losing their positions, especially in those districts where listeners are well organised, as in the political associations.

In the meantime the individual States will show strong opposition to the scheme, but it is believed that the Cabinet are, in fact, determined to have the new organisation ready before the elections on July 31st. Of course, if Herr Hitler should win the day, it is quite possible that broadcasting will be once more in the melting-pot.

B.A.T. Resistors for Monodial Super.

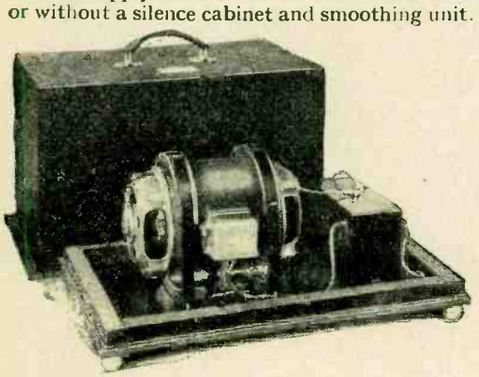
WITH reference to the kit-set of Claude Lyons B.A.T. resistors selected especially for the "Monodial A.C. Super," it should be noted that the correct price is 18s., and not 15s. 6d. as stated last week.

LABORATORY TESTS

ON NEW RADIO PRODUCTS.

WATES ROTARY CONVERTERS.

THESE small machines have been developed by the Standard Battery Co., 184-188, Shaftesbury Avenue, London, W.C.2, especially for operating A.C. receivers from the direct current supply mains, and are obtainable with or without a silence cabinet and smoothing unit.



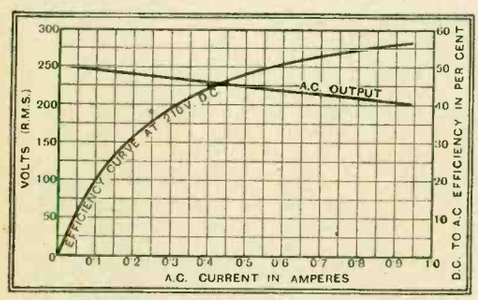
Wates D.C. to A.C. rotary converter in silence cabinet; the smoothing unit is in the small box on the right.

When used to supply power to a wireless receiver, it would be advisable to include the smoothing unit, as this has been designed especially for these machines, and are particularly effective in removing the commutator ripple and other electrical impulses from the A.C. supply.

A certain amount of mechanical noise is inevitable with any rotary mechanism, but in the case of the Wates converter this has been reduced to the lowest possible level by careful design of the bearings, the brush gear, and also by dynamically balancing the armature. The bearings are of special alloy described as the Silent Pad Lubricated Type, and give a long life with the minimum of attention. They require a little lubricant at intervals of a few months.

The brush gear is of generous proportions, being of the carbon box type, and this also has a long life, with only very occasional attention. The design of the machine is such that it will run for long periods without attention, and if the bearings are lubricated at the specified intervals a trouble-free service can be assured.

The converter tested is rated to give 180 watts output as the maximum, is intended for a 220-volt D.C. supply, and is rated to give



Output regulation curve and efficiency curve of Wates D.C. to A.C. rotary converter.

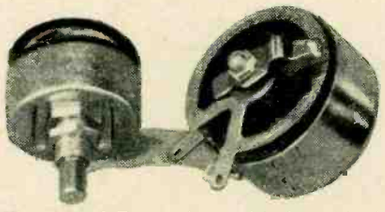
220 volts A.C. at 50 cycles on full load. The supply mains at the time of test showed 210 volts only, and on full load the A.C. output was 210 volts also. The output voltage would have been up to the rated value had the supply mains given their full voltage. The regulation is quite satisfactory, as can be seen from the curve here reproduced. The efficiency on full load, calculated as the relationship between input watts and output watts, is 56 per cent., which is quite satisfactory for a machine of this type.

Further tests were made, this time of a practical nature, and the machine behaved most satisfactorily. Using a sensitive receiver embodying high-frequency amplification, there was no more background noise than when the receiver was operated from the A.C. supply mains. A little interference was noticed with the machine in close proximity to a sensitive transportable set embodying a frame aerial, but this disappeared on removing the machine to a distance and employing a lead-covered supply lead with the casing earthed.

The machine in question was housed in one of the special portable silence cabinets supplied by the makers, and, complete with smoothing unit, is priced at £13 5s. An 80-watt outfit with silence cabinet and smoothing unit is available at £11 10s.

ROTOR-OHMS FOR VARIABLE-MU VALVES.

ROTOR-OHM wire-wound variable resistances and potentiometers are now being made in this country by Rotor Electric, Ltd., 2/3, Upper Rathbone Place, London, W.1, the new range now including certain types designed especially for use as volume controls with the variable-mu valves. These models have graded resistance elements conforming with a logarithmic law and are obtainable in two styles, viz., 3-watt and 5-watt types. In both types the resistance element is enclosed in a pressed metal case to which is attached the single-hole fixing bush.



Wire-wound Rotor-ohms with logarithmic track and rocking-disc contacts.

These special Rotor-ohms are obtainable fitted either with the rocking-disc type of contact or with plain contact arm; the former are styled the de luxe models. The 3-watt size is made in values ranging from 2,000 ohms to 25,000 ohms, and the price varies according to the style of contact and resistance. Thus, for example, a 10,000-ohm de luxe model costs 4s. 6d., while one of 5,000 ohms is obtainable at 4s. 3d. In the 5-watt range sizes go from 5,000 ohms to 250,000 ohms, the former costing 4s. 6d. with disc contact, and the largest size 7s. 6d.

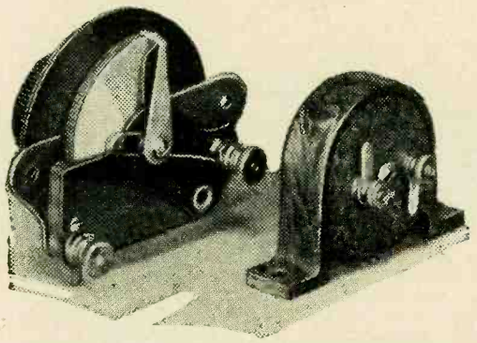
All models are obtainable fitted with plain resistances ungraded at 3d. less in each case.

TWO INTERESTING LISSEN COMPONENTS.

A PARTICULARLY vicious type of interference sometimes encountered on the long-wave band is that produced by the proximity of a powerful broadcast station. The programme from the medium-wave transmitter is audible over quite a large part of the scale, although on the medium-wave band the selectivity of the receiver is adequate to cope with the local conditions.

This trouble is usually traceable to the natural wavelength of the aerial circuit coinciding with, or falling near to, that of the local station. Raising the natural wavelength of the aerial can generally overcome this difficulty, and, incidentally, often improves the long-wave performance of the set.

The Anti-Break Through choke design by Lissen, Ltd., Worple Road, Isleworth, Middlesex, will be found particularly effective in combating this nuisance when connected in series with the aerial coil. A switch must be included to short circuit the choke when receiving on the medium-wave band.



Lissen Anti-Break Through choke and Miniature Precision variable condenser with solid dielectric.

It is very compact, takes up little baseboard space, and is enclosed in a neat moulded bakelite case. Its inductance is about 912 mH., and the price is 4s.

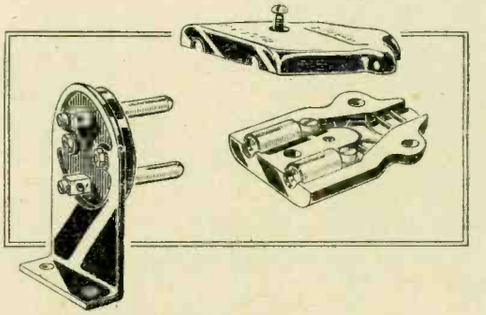
The Lissen Miniature Precision variable condenser, which is suitable either for tuning or for reaction circuits, is of the solid dielectric type. The moving vanes are rigidly supported on a ¼in. spindle, and the bearings are of generous size. Bakelised sheet is employed for both end plates, with the result that the condenser has a comparatively low minimum capacity. The maximum values of two specimens tested were found to be 0.000524 mfd. and 0.000562 mfd. respectively, while the minimum capacities were but 7 mmfds. in both cases.

A dial 2⅛in. in diameter is fitted, with the scale divided into 100 divisions, and the price is 2s. 6d.

GOLTONE MAINS CONNECTOR.

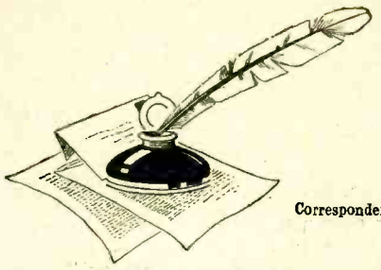
A NEAT and very practical mains connector consisting of a two-pin plug with a baseboard mounting and an insulated socket, is made by Ward & Goldstone, Ltd., Frederick Road (Pendleton), Manchester, for use in mains-operated receivers, battery eliminators, and other wireless accessories taking current from the supply mains. It is rated to carry up to 5 amps. at 250 volts.

The contacts in the socket portion are semi-floating, so that accurate alignment with the plug connector and, therefore, certain contact are always assured. A special cord grip is embodied in the socket connector to preclude any possibility of the wires coming adrift if the mains lead is given a sudden jolt or pulled by accident when removing the socket.



Goltone baseboard fitting mains connector to carry up to 5 amps.

It is made of bakelite throughout, and can be obtained finished in brown, black, or mottled brown, the price being 1s. 6d. complete.



Letters to the Editor.

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

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

Quality of Reproduction.

I HAVE been very interested to read many of the learned remarks made by your correspondents with reference to "Broadcast Reproduction and Tonal Quality."

May I, as a keen salesman of British radio, with some technical knowledge, beg manufacturers not to be guided in their receiver reproduction by the requirements of the super technician; the majority of people when listening to a receiver do not compare its reproduction with the original or consider for a moment whether it is technically correct; they desire a result that is pleasing to their ears.

My experience is that a very definite top cut-off is desirable in order to remove the various interfering noises generally present, which is not the case in a receiver more technically correct.

Undoubtedly, the incorporation of a really useful tone control enables one to cater for individual tastes.

Technicians, when criticising standard makes of receivers, must remember that they represent only a minute portion of the radio-buying public.

C. JACKSON.

Streatham, S.W.16.

Quality and Frequency Range.

MR. HARTLEY'S contributions have occupied much space in *The Wireless World* of late, and leave no room for doubt that his advocacy for retention of the higher audio frequencies is sincere to the point of fanaticism. Very grudgingly he concedes that a restriction of the range to 9,000 cycles is not only permissible from the quality standpoint but essential in view of technical limitations imposed by a crowded ether condition. This is really a most magnanimous attitude, and I feel sure that the majority of readers would feel highly gratified if Mr. Hartley would extend his magnanimity to practical considerations, since it must have been noted by many that Mr. Hartley, though most outspoken in his dictum, is singularly reticent in giving data of his receiving equipment.

Mr. Hartley, in his letter appearing in *The Wireless World* for June 1st states that for £22 he constructed a receiver conforming to his theories, which, I suppose, refers to equipment capable of giving reasonably linear response from 40 to 9,000 cycles. It would be interesting to know whether or not his reproduction is accompanied by side-band squeal, whistles, and other phenomena which contribute to mar the general effect, and if not, what steps he has taken to rid his reproduction of the extraneous noises encountered in the 5,000-9,000 spectrum *without upsetting the linearity of response at these upper frequencies.*

J. LOCKERBIE MAITLAND.

Pittington,
Co. Durham.

SURELY the question of the frequency range of radio receivers is one about which there can be no argument. If reproduction is to be faithful, then the whole system, microphone, amplifiers, transmitter, receiver, loud speaker, together with land lines and any other auxiliary apparatus through which the signal frequencies are passed should be so designed as to neither add nor subtract from the original impulses impinging on the microphone. If at any stage in the system there is attenuation or over-emphasis of certain frequencies, then the necessary tone correction should be employed to counteract this error.

That which is short of perfection is of necessity imperfect, and imperfection should not be tolerated. Unfortunately, it may have to be suffered, but this does not justify it, neither does it warrant propaganda advocating the adoption of a given standard of imperfection.

Unfortunately, a large proportion of the population have never heard, and probably never will hear, a good orchestra at first hand, and further, the travesty of music which issued from our loud speakers until comparatively recent days has educated thousands to an altogether false conception of the normal tone of any and every instrument or group of instruments.

There is the classic story of the girl, who, at the Queen's Hall, expressed her disappointment on hearing Sir Henry Wood and his merry men because it didn't sound a bit like her "wireless."

Obviously we cannot have receivers capable of perfect reproduction under existing conditions, anyway, not for a humble five or ten pounds. But, if we admit the deficiencies of such instruments and only agree to suffer them, then, surely, we can hope that the inevitable march of progress will produce us something less imperfect, and so on, till we ultimately reach perfection.

No man, going to a photographer, would be satisfied with a portrait of his *embonpoint* less head and lower extremities, why then should he be satisfied with "music" beheaded and de-tailed?

May the B.B.C. long strive to put out the best possible, and more power to the set designers who strive to utilise it, and confusion to those who would restrict the spectrum to the middle register.

H. C. RYLATT.

Ipswich.

British Apparatus Abroad.

MAY I please venture a suggestion to you *re* the advertising columns in *The Wireless World* on behalf of your numerous readers on the Continent and also to the advantage of many English firms who advertise in your periodical? The suggestion is:—

All advertisers of radio components and accessories who are selling their goods on the Continent through agencies will please publish the names and addresses of all such Continental agencies.

I think that such procedure would be of great benefit to the manufacturers, the agents, and the Continental readers of *The Wireless World*, especially at this time, when quotas are being imposed upon these goods in various European countries, making it absolutely impossible for the individual buyer to order direct from England. I personally have been greatly inconvenienced through the carelessness of one of the well-reputed firms who advertise in your columns, who shipped to France, through friends of mine here, a complete kit for a super which especially called for a non-inductive 0.01 condenser for a band-pass filter, and, even though it was especially emphasised that this condenser *must* be of the non-inductive band-pass type, they forwarded a T.C.C. Mica.

It is impossible to purchase this type of condenser from any of the French firms here; in fact, I have been ridiculed by many of them for stating that the mica type is of no use for by-passing band-pass filters. Now I am sure that various condenser manufacturers of England have agencies here in France, but where? It is only recently that I have discovered that I can buy Mullard valves here after being here for five years, and this I discovered by accident. I am of the opinion that there are thousands of pounds' worth of British goods in the Continental markets lying dormant because of lack of advertising by the agents. So I think it is up to the manufacturers to help themselves as well as their agents, and, last but by no means least, the purchaser abroad who would buy British if only these manufacturers would inform them, through their announcements in *The Wireless World*, where they sell British.

The fact that I am informed by the Customs here that the quotas for England have already been filled for the next three months proves that British goods are here, but where?

Paris, 16. R. W. HUMPHREY.

B.B.C. Transmissions.

I WOULD like heartily to endorse the timely plea for untampered transmissions voiced in your Editorial Columns for June 8th, and to express my complete agreement with the view that wilful departure from linearity in the frequency characteristic of broadcast transmitters could in the long run do nothing but harm to the art.

If we accepted the wisdom of Mr. P. W. Willans' proposal to transmit on a rising characteristic, we should, in the ideal, carry this to the logical conclusion of making our characteristic take the place of the tone-corrector in a sharply tuned receiver, so that such receivers might be designed to yield good quality and a high degree of selectivity with simplified circuits.

So far, so good; but in what case would receiver designers then find themselves? Tied to a practice arbitrarily imposed upon them, without incentive or scope for the originality essential to progress; in the necessity of matching their receivers accurately to balance the transmission characteristic under all conditions—a task virtually impossible without the re-introduction of the tone-control or other complication to serve its purpose; committed to the production of apparatus unsuitable for general reception, and therefore—until all transmitters should have followed suit—at a disadvantage in the world's markets.

The picture is perhaps exaggerated, because Mr. Willans has no intention that his proposal should be carried to its logical conclusion; but the dangers are there in their essence—and, if sound, why should not the proposal be carried to its logical conclusion?

But, when all is considered, is transmission on a rising characteristic really capable of conferring the advantages sought? It can but be agreed that such a practice must permit—in fact enforce—the use of more selective circuits at the receiver, assuming a given degree of tone-correction; but this does not exhaust the ques-

tion. Will a receiver be the more selective because tone-correction has been applied before detection rather than after it? A little reflection will show that it assuredly will not.

An important property of the linear detector is that of differential selectivity, or "filtration," whereby the weaker of two interfering signals tends to be demodulated by the stronger. Interference in telephony is due mainly to the higher audio frequencies, and in so shaping our input characteristic as to attenuate those frequencies prior to detection, as we do in receivers of the so-called "Stenode" type, we are utilising the detector to gain a valuable increase in overall selectivity. If, however, we nullify this arrangement by transmitting on a rising characteristic, the whole effect is lost, and we are forced to employ still more selective circuits, followed again by tone-correction, in order to regain it.

What is required is that the interfering signal shall be attenuated in relation to the desired one before detection, and it is manifest that this can only be done at the receiver. A rising characteristic at the desired transmitter cannot impart a falling characteristic to the interfering transmitter, but it does, on the other hand, impose a virtual necessity for it—if Mr. Willans' proposal is sound, its general adoption must be assumed, and if all transmissions are made on a rising characteristic any advantage that the plan might offer in the particular case is "hoist by its own petard" in the general case.

It is, in fact, almost, but not quite, arguable that the sounder expedient would be to transmit on a *falling* characteristic in order that the interfering frequencies might be attenuated at the source without need for acutely selective circuits; but a little reflection will show swings and roundabouts to enter into the question to the extent that there remains, on balance, nothing whatever to be gained by departure from linearity in the transmission characteristic, except as to top cut-off.

I am assuming top cut-off of the order of 6,000 Hertz to be a *sine quâ non*, since extension into the spectrum far beyond this on a rising characteristic would, far from promoting selectivity, result in a serious aggravation of interference. The rising characteristic may, in fact, be said to impose top cut-off and to determine its position in the scale, since the steeper the slope, the earlier it becomes necessary to apply it, so that, on the basis of existing station separation, an exponential characteristic would impose a cut-off of the order of 5,000 Hertz.

This is definitely too low to permit of a satisfactory standard of reproduction, or even of a standard of which present-day apparatus is capable, and any step tending in such a direction is strongly to be deprecated on both academic and æsthetic grounds.

If the purpose of the rising characteristic is, as Mr. Willans has stated it to be, to gain selectivity by enabling a falling characteristic to be used at the receiver, then it is a mare's nest for which there is little to be said. If, on the other hand, its purpose is to offset to some extent the effects of a top cut-off unavoidably imposed upon us by existing broadcasting conditions, then there is an arguable case for it, though even then, I think, a defective one. Corrections of this nature are easily applied at the receiver, which discounts any necessity for them at the transmitter; but if the designers of receivers are unable to rely upon the integrity of the broadcast characteristic, their task is not lightened, but made a thousand times more difficult, and tendencies are likely to result which can, on the whole, only be prejudicial to the best interests of the art.

Bournemouth. T. ST. C. FINLAY.

Has the Radio Trade a Bad Name?

THE heading of your editorial, "Has the Radio Trade a Bad Name?" suggests a wider field than what your remarks about manufacturers and their slow deliveries and unbusinesslike methods would imply. I think that some remarks about the wretched state of the radio trade on the retail side might be appropriate under the same heading.

I certainly think that the retail side of the radio trade has a *very* bad name, and this is principally due to the personnel of the trade being wrong. Radio is a scientific subject, and one would expect those who cater for the radio needs of the public to take a pride in their scientific knowledge of the subject, and regard themselves as belonging to a similar category as doctors, architects, actuaries, or accountants. Instead of which, they have decided to regard themselves as analogous to the ordinary type of shopkeeper who sells cigarettes, chocolates, soap or whatnot over the counter. In the early days of broadcasting, of course, it was not possible for manufacturers to decide who should sell and service their productions, but that does not apply now, and manufacturers can, if they wish, decide who are competent to give proper service to the public, and limit the distribution of their productions to these only. Yet one sees every day small shops whose principal business is the sale of confectionery, haberdashery, or groceries with a few dummy H.T. batteries in the window, along with a coil of aerial wire and a couple of valve-holders, and a card, written in blue pencil, "Accumulators Done," and these shops apparently get trade terms from the manufacturers!

Another reason that the radio trade has got such a bad name is the existence of "cut-price" shops bearing such legends as "Radio at Wholesale Prices" in letters 2ft. or more in height. Some of the prices marked up in the windows of these shops are about two-thirds of the prices in other shop windows. Sometimes it is possible to buy them at these prices, but more often they are "out of stock," and one is invited to buy something else "just as good," but foreign made. Of course, these shops cannot sell at "wholesale" prices, as they would then have no object to be in business, but one is led to the conclusion that these shops must obtain a discount of at least 50 per cent. on their purchases from manufacturers. If so, then this is proof that the advertised prices of wireless goods are fictitious, and should be brought down to a more reasonable level, and the same trade terms allowed to all traders. We might then expect to see more technical men in the retail radio trade and better public service as a result.

Forest Gate, E.7. EDW. J. GUNN.

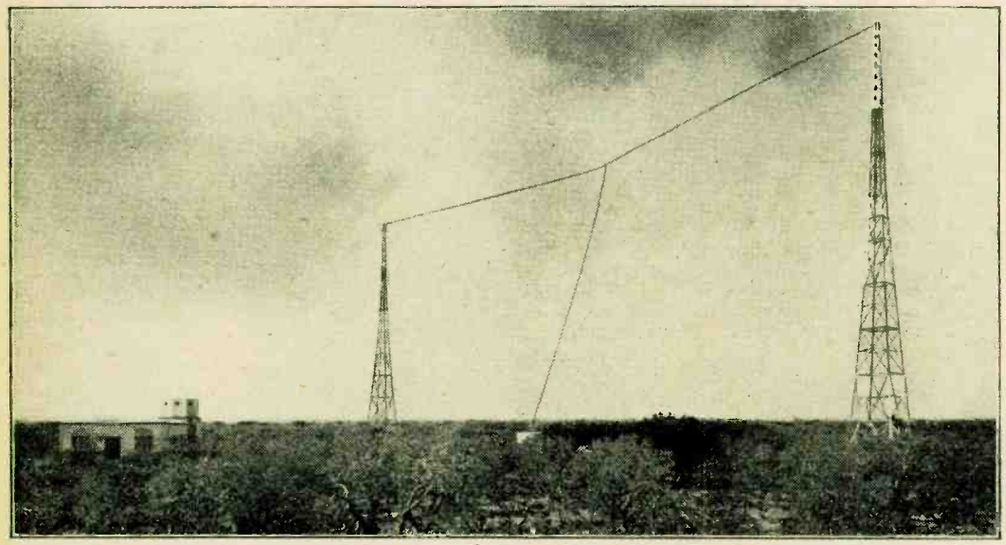
HOW heartily I endorse your recent leading article "Has the Radio Trade a Bad name." It has with me. In the last eighteen months I have constructed three of the biggest "W.W." receivers. The delay in delivery of components is a disgrace, and quite a few are far from right when they do arrive. Coils with a variation of three to four turns on the medium wave-band when they are supposed to be "matched." Coils with tappings connected to the wrong terminals and dual switches shorted together are a few of the troubles I have met. These, from a different maker in each case, have given me hours of work to get right. Potentiometers with a broken turn here and there are another grouse. Last, but not least, valves are most unreliable. Either the current consumption is nothing like the stated figure or they are definitely defective in some way. I never put anything into a set without a careful test first, but what about the constructor with practically no facilities for such tests? I admit the manufacturers replace these bad articles when returned, but I never expect a reply sooner than a week after writing! J. PARKES.

Ham Common, Surrey.

Power-handling Capacity of Loud Speakers.

IN connection with the letter from the Gramophone Company, Ltd., in your issue of June 15th, on the above subject, I would point out that to state the capacity of a loud speaker as so many watts without saying at what frequency this holds good is insufficient. To take an instance: With a moving-coil loud speaker having a 7-inch cone, with a flux density in the gap of 10,000 lines per sq. cm., a free movement of the cone and coil of approximately three-quarters of an inch at 50 cycles with 5 watts input is required, otherwise the frequency will be doubled or trebled in reproduction. It is necessary, therefore, that a loud-speaker maker should state that his product will handle so many watts down to x cycles without frequency doubling. It will be found in practice that very few loud speakers are capable of reproducing frequencies below 100 cycles if the applied A.C. power is in excess of about 500 milliwatts. H. A. HARTLEY.

Isleworth.



ITALY'S NEWEST BROADCASTING STATION. The Marconi-built transmitter at Bari, seen in the picture, is still testing on about 280 metres. The official opening will probably take place in October, when a power of 20 kW will be used.

BROADCAST BREVITIES

By Our Special Correspondent.

Dr. Adrian Boult.

IT is rather astonishing that Dr. Adrian Boult, who is virtually responsible for 70 per cent. of the programme material transmitted by the B.B.C., should not occupy a more prominent place in the councils of that august body. I am glad that a move is on foot to secure greater recognition for the Director of Music. There is a distinct possibility that Dr. Boult may soon become an Assistant Controller; at present he is only head of one of the four main sections, which comprise music, drama, musical comedy and revue, and talks.

Restrictions.

Dr. Boult is quite capable of controlling the musical policy of the B.B.C., and it seems a pity that a man of his originality and international reputation should be answerable on even small questions to persons whose abilities, however great in administrative directions, could by no stretch of imagination be said to extend to the realm of music.

Royal Incident at "B.H."

THE Royal visits to Broadcasting House passed off very happily. I fancy, however, that the broadcasting authorities were inclined to forget that palaces and noble buildings are not uncommon spectacles to kings and queens.

I am thinking of an incident during a rehearsal when King Alfonso, on his visit on July 8th, was obviously more interested in the human spectacle than in the finest friezes and mural designs that the B.B.C. officials were so anxious to show him. And yet, I believe, the officials were surprised!

Broadcasting House in Miniature.

I AM intrigued by the question now going the rounds as to whether the model of Broadcasting House at the Olympia Show will actually work. In what sense can anyone imagine it to work? It is true that the lifts could travel up and down quite convincingly, and some juicy little sparks could be created on the roof aerial, but here surely a sane imagination stops.

A Cross-section.

The model will be on a scale of ¼in. to a foot, and will be approximately 5ft. long and 3ft. wide. The exterior of the front and west side will be shown. At the back visitors will see a cross section down the centre of the interior.

Programme for the "Proms."

THE prospectus for the coming season Promenade Concerts makes good reading.

Several composers will be conducting their own works. On August 11th, two composers wield the baton, Frank Bridge conducting his "Blow out, you bugles," and Edgar Bainton conducting his "Epithalamion"—a first concert performance in London.

Among notable "first performances in England" are Ravel's pianoforte concerto for left-hand only, on August 16th; and the Konzertstuck for violin and orchestra (Beethoven-Manen). Delius's "Song of the High Hills" will be given for the first time at the "Proms" on September 20th.

Songs from Sussex.

LISTENERS who sigh for a breath of fresh air in the programmes should listen to the National transmitter on August 8th, when a special singsong will be broadcast from the Sussex Boys' Camp at Plashett Park, Isfield.

A Lesson from Munich.

HAVING more than once urged the B.B.C. to co-operate with the film industry, I am interested to hear that the Bavarian Broadcasting Company has permitted the filming of a complete day's programme from Munich under the alliterative title "Film von Funk." The pictures were taken in the studios and the sound was picked up and carried *via* telephone cable to the studios of the film company some distance from the town, there to be recorded on film. All the actual performers, announcers, orchestra, etc., figure in the film, and even the much-maligned studio audience appears.

Let Listeners See for Themselves.

Why not let British listeners see what happens behind the scenes at Broadcasting House? As things are at present a vast number of people in the provinces will never have an opportunity of seeing such impressive scenes as the National orchestra in the Concert Hall or the Wireless Military Band in 8A.

Bank Holiday.

ON Bank Holiday, August 1st, the National programme will be of special interest. In the afternoon a relay will be given from Thiepval, where H.R.H. the Prince of Wales will be present, with the French President, at the unveiling of the Somme Memorial.

A Varied Evening.

At tea-time we shall listen to the declarations of connubial bliss delivered at the trial for the Dunmow Flitch, to be relayed from Dunmow, Essex. Early in the evening a star vaudeville programme will be given from a studio, and this will be followed, as mentioned in these columns a fortnight ago, by a Promenade Concert comprising the material which made up the first "Prom" at Queen's Hall on Saturday, August 10th, 1895, which was conducted by the then Mr. Henry J. Wood. Sir Henry will himself conduct this reminiscent programme. The soloists will be May Huxley, soprano; Margaret Balfour, contralto, and Thorpe Bates, baritone.

THE BROADCAST INTERVIEWER. A specially slung double-faced microphone used for radio interviews in Germany. The little black cross above the microphone face indicates that the circuit is "alive."

HAL-L-L-L-L-O! An early morning bather broadcasts his sensations to Melbourne listeners.

Why Seaside Programmes are Rare.

"WHY can't we have some broadcast programmes from the seaside?" asks a perspiring correspondent, who imagines that he can recall many happy occasions when his loud speaker has brought him the sounds from the beach and the parade.

I can tell him that the B.B.C. has a very cogent reason for reducing the number of seaside programmes. In previous years the tendency has been for each coastal resort to spend more time in establishing its claim to be the "Queen of Watering Places" or the "Lido of the North" than in entertaining listeners.

Better than the Real Thing.

Again, it is felt that the seaside atmosphere can be manufactured much more easily and much more realistically in the Effects Department than at the seaside itself.

A few years ago the B.B.C., in order to heighten the realism of a radio play, went to the expense of chartering land lines from London to Plymouth to pick up the actual sounds of the sea and superimpose them in the play. No sooner had the play started than a listener rang up saying, "If you must give us the sound of the sea, give us the real thing and not an imitation!"

Scottish Regional Next Month.

THE tumult and the shouting over the opening of the Scottish National transmitter have already died down sufficiently to enable the engineers to consider proceeding with the Regional transmitter. I hear that the first tests, which will be given on 376 metres, can be expected about the third week in August. Thus the first tests will coincide with the opening of the Olympia Radio Show, but I do not imagine that they will keep any Scottish radio enthusiasts in their native land who can possibly get an excursion ticket south.

More Opera from the Fatherland.

ANOTHER opera performed in Germany will be heard by Regional listeners on July 27th. It comes from the Residence Theatre, Munich, and will consist of Act II of "Don Giovanni." The conductor will be Professor Hans Knappertsbusch. On August 12th Act II of "Oberon" will be relayed from Salzburg.

Amazing a Maskelyne.

TO amaze a member of the Maskelyne family must be uphill work, and therefore I feel that special congratulations are due to John Macdonell, of "Surprise Item" fame. For Mr. Jasper Maskelyne confessed to me last week that he was amazed when approached by "Mac" to undertake a programme of magic at the B.B.C. microphone.

I thought "Magic in the Air" was very skilfully contrived, but as Mr. Maskelyne admitted to me, the real chance to mystify the radio audience will come with television.

Even the Maskelynes cannot make ladies vanish before they have appeared.

READERS' PROBLEMS.

"Free" Bias System.

"WHICH is the best automatic grid-bias system?" is a question that is constantly recurring, but we fear it is hardly possible to answer it briefly and in general terms without some risk of being misleading. After all, the various methods advocated are very similar in principle, and each has its own particular advantages and disadvantages.

There can be little doubt that the principle of true "self-bias," in which each valve obtains its negative grid voltage from the "drop" across the resistor in its own cathode lead, is generally the safest to employ when in doubt. The tracing of faults is always easiest with this system, and there is the further advantage that the bias voltage applied to any one valve is independent of the operating conditions of other valves.

Metal Rectifiers and Safety.

INFORMATION is requested as to the correct method of connecting a delay-action switch when one of the new high-voltage Westinghouse metal rectifiers is employed. Our querist is familiar with the normal manner of using this device with a valve rectifier, but asks whether any modification would be necessary in his own particular case.

An automatic delay-action switch confers the same benefits when used in conjunction with a metal rectifier as with valve rectification, and the only precaution to be observed is the avoidance of a considerable difference of potential between the heating elements of the switch and its contacts. This may easily be done by inserting the safety contacts in the negative H.T. lead in the manner shown in Fig. 1. It will be observed that current for operating the switch is derived from the L.T. secondary of

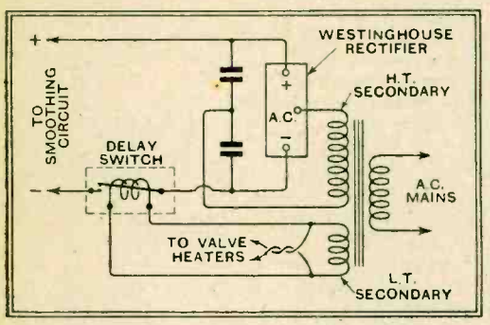


Fig. 1.—A delay-action switch interposed in the output of a metal rectifier. Note that the contacts are inserted in the negative H.T. lead.

the power transformer; in cases where more than one of these secondaries is provided, the switch winding will naturally be connected across the one which has the greatest surplus output.

Power Unit Limitations.

IT should be emphasised that when a designer sets out to plan the power supply equipment for a receiver, he does not normally allow any very great amount of surplus current and voltage output in the H.T. supply system. To do so would manifestly be extravagant, and totally unnecessary; it is sufficient that enough current and voltage for the various valves in the receiver should be available.

Several readers seem to imagine that the H.F.-detector unit of the "Modern Straight Five," for example, could be operated without any substantial alteration in conjunction with existing high-power amplifier units; they forget that, to ensure good voltage regulation for the variable-mu valves, the H.F.-detector portion of the set requires an H.T. supply in the order of 50 milliamperes at 200 volts. Very few amplifiers have the surplus H.T. wattage which this represents.

Volume Control and Quality.

THE user of a set that is admittedly out of date is puzzled because the operation of his post-detection volume control has a noticeable effect on quality. Regulation of intensity is effected by a 100,000-ohm resistance, which is shunted across the primary winding of the L.F. transformer: it is observed that quality is definitely improved by a slight reduction in volume, but is impaired when the value of the controlling resistance is still further reduced.

THESE columns are reserved for the publication of matter of general interest arising out of problems submitted by our readers.

Readers requiring an individual reply to their technical questions by post are referred to "The Wireless World" Information Bureau, of which full particulars, with the fee charged, are to be found on this page.

We think that the effects observed are fairly normal. It is probable that as a result of reducing the primary shunting resistance a slight increase in bass amplification is introduced; the effect is practically the same as would be a reduction in the A.C. resistance of the preceding valve. Similarly, with some transformers the connection of a shunt with fairly low resistance will be responsible for accentuation of the higher frequencies as well.

As a net result of these alterations it seems probable that side band cutting of the H.F. amplifier is being compensated for, to some extent, and this, plus a very slight increase in bass response to offset possible shortcomings in the loud-speaker, may well be accountable for more pleasing reproduction.

Potentiometer Resistance Values.

STATING that he wishes to use it for a "special grid-bias arrangement" in a D.C. mains receiver, a reader asks us to tell him where he can obtain a rotary potentiometer with a resistance of 40 ohms.

So far as we are aware, no manufacturer produces a component with exactly this ohmic value. But it is probable that our correspondent could obtain a wire-wound filament resistance of 40 ohms, and, if so, it would be an easy matter to convert it for use as a potentiometer by making connection to that end of the resistance winding which is normally "free."

For the benefit of this reader, and for that of others who may need potentiometers of values that are not readily available, it may be pointed out that for most radio purposes a fixed resistance of the desired value, shunted by a potentiometer with a resistance many times greater, may be considered as the precise equivalent. If the ohmic value of the potentiometer be much higher than that of the resistance, the latter will not be affected, and any proportion of the voltage that is "dropped" across it may be "taken off" from the sliding contact.

This is illustrated diagrammatically in Fig. 2, in which we have assumed that the pressure across the potentiometer will amount to 10 volts. A resistance of 5,000 ohms has been assigned to the potentiometer merely because

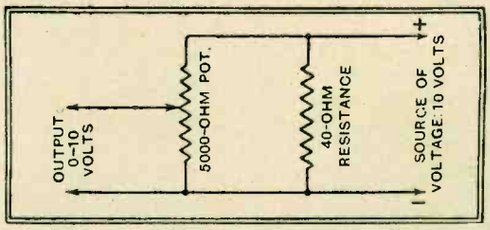


Fig. 2.—For variable grid-bias purposes: failing a potentiometer of the required value, a plain resistor shunted by a high-resistance potentiometer may be substituted.

it happens to be a common value; ten times, or even one-tenth of that figure, would do equally well in most cases.

This method is quite practicable in grid-bias circuits, and complications are only likely to arise when an appreciable amount of current is taken from the potentiometer.

Choked Grid Circuit.

WHEN a receiver develops a marked falling-off in sensitivity, which can be restored momentarily by touching any point on the grid-circuit wiring or any of the grid-circuit terminals, it is almost invariably safe to assume that a condenser in this circuit is accumulating a charge, due to an interruption in the leakage path which should exist.

It is well known that the detector grid condenser must have its leak, but it is sometimes forgotten that a direct current path must *always* be provided between the grid of every valve, whatever its function, and its filament or cathode. Failing this, the valve will become paralysed, unless there are stray leakages of sufficient magnitude.

A reader, who sends us a circuit diagram of his three-valve set (one H.F. stage), complains that no station other than the local transmitter is audible unless he touches one of the terminals on the input band-pass coil assembly. This filter is of the "mixed" type, with a large coupling condenser common to both circuits; the conductive grid-circuit is completed through a 5,000-ohm decoupling resistance and a volume-control potentiometer. We are confident that the fault will be found in one of these components or their connections.

The Wireless World

INFORMATION BUREAU.

Conditions of the Service.

THE service is intended primarily for readers meeting with difficulties in the construction, adjustment, operation, or maintenance of wireless receivers described in *The Wireless World*, or those of commercial design which from time to time are reviewed in the pages of *The Wireless World*. Every endeavour will be made to deal with queries on all wireless matters, provided that they are of such a nature that they can be dealt with satisfactorily in a letter.

Communications should be addressed to *The Wireless World* Information Bureau, Dorset House, Tudor Street, E.C.4, and must be accompanied by a remittance of 5s. to cover the cost of the service. The enquirer's name and address should be written in block letters at the top of all communications.

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EDITORIAL COMMENT.

Is Wireless Dearer?

THE Olympia Radio Show will open this year on Friday, August 19th, approximately a month earlier than in previous years, so that we find discussions already taking place on the subject of what surprises the Show may have to offer in the way of new sets and components, but perhaps the most discussed subject of all is the question of price. We have found that amongst the public there is a tendency to consider that prices in wireless remain at too high a level by comparison with the all-round reduction in cost which has taken place with most other commodities. There may be a good deal of evidence to justify this view, and we may anticipate that standard commodities in wireless will show a substantial reduction in price this season so as to come into line with other articles, but when we come to discuss prices in detail we have to take into consideration changes in general conditions of reception which have taken place recently. A year or two ago there was little or no need to concern ourselves with selectivity to any serious extent for reception conditions in this country; designers of receivers could employ the simplest tuning arrangements and yet give complete satisfaction to the user. If we try to use such a set to-day we find that it is unsuitable, even for reception of the local transmitter, because other stations come in around the same tuning positions.

The need for increased selectivity has grown steadily, but it is only within the last twelve months that the position has become so acute that sets, to be satisfactory for general reception purposes, have had to be designed to give a degree of selectivity not hitherto contemplated. Not only have stations increased in number but their power has been put up so enormously that many of the Continental transmitters are equal in strength of reception to the home stations. These changing conditions have naturally had to be taken care of in the design of the modern receiver. Far greater precision of tuning is required and this, in itself, tends to make the task of securing quality harder, so that technical skill, not to mention workmanship and general complication of construction, has added largely to the cost of the receiver. If the price of a receiver of to-day suitable for general reception has not come down substantially by comparison with a receiver of three or four years ago, at least we have the knowledge that to-day's receiver is a very different article from the one of older type, and in terms of actual value there is no comparison between the two. These comments which apply to the complete receiver hold good equally in proportion in the case of a large number of modern component parts.

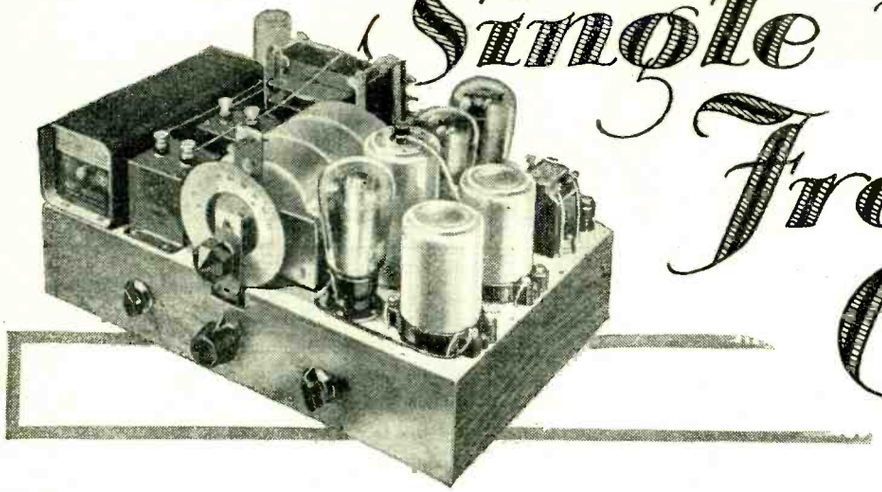
We have only to cite as one example the ganged condenser, where to-day the accuracy and the degree to which it is capable of being matched with coils for tuning circuits put it into an altogether different class of instrument from the condenser with which we were familiar a year or two ago.

When, therefore, we discuss price in relation to the new season's products, let us be careful that we are being fair to the products and taking into account the exacting requirements of apparatus to-day rendered necessary as the result of the change in reception conditions.

Historical Instruments.

SOME time ago certain pieces of wireless apparatus of outstanding historical interest were only by chance saved from the dustbin, and, having been rescued, these are now carefully preserved in the Science Museum at South Kensington.

This incident served to stimulate interest in trying to recover for preservation examples of pieces of physical apparatus with which fundamental research has been carried out. Lord Rutherford has recently appealed for co-operation in tracing such apparatus. Any readers who may know of instruments coming within this category are invited to communicate with the Secretary of the Institute of Physics, 1, Lowther Gardens, Exhibition Road, S.W.7.



Single Valve Frequency Changers

Part I.—A New Development in Superheterodynes.

By W. T. COCKING.

FOR some years, the straight combination of three valves, as H.F., detector, and pentode, has formed one of the most popular types of receiver. Its popularity is well merited for the reason that it is inexpensive, and it will provide good quality reproduction, and, furthermore, its sensitivity is adequate for satisfactory continental reception under normal conditions.

The chief drawback of this type of set is its lack of selectivity, and in this respect it is often inadequate for the reception of stations the wavelengths of which are close to those of a powerful transmission. Even if mutual interference between stations adjacent in frequency be avoided, a strong local station may spread over the tuning dial and will often cause interference over a band of frequencies perhaps not less than 100 kc.

ALTHOUGH the superheterodyne gives the extreme selectivity necessary to cope with modern listening conditions, a number of constructors probably hesitate to build this type of set on the score that the first cost and running costs are high. In the process of frequency changing it has hitherto been almost imperative to use two valves, but as pointed out in this article a single valve can be made to function perfectly satisfactorily thus making possible a four-valve superheterodyne.

It is obvious, therefore, that if the listener lives in an area of high field strength from the "local," some alternative type of receiver is badly needed. This alternative is undoubtedly the superheterodyne, and it is the extreme selectivity which can be so readily secured with it which is responsible for its rapidly growing popularity.

The superheterodyne is usually considered expensive, however, for few satisfactory designs have appeared which legislate for less than five valves. Both first cost and running costs, therefore, are likely to be higher than those of a straight set of equal sensitivity and giving the same quality, and this represents the price to be paid for the extra selectivity.

Now it is the process of frequency changing which demands that the superheterodyne shall have more valves than a straight set, and in the usual design two valves, acting as a detector and as an oscillator, are required to effect this process. The obvious course, therefore, is to make a single valve fulfil both these functions, for a four-valve superheteroyne then becomes a possibility. As regards sensitivity and quality of reproduction, such a receiver would compare favourably with the three-valve straight set, and it would be *infinitely superior in its selectivity.*

It is obvious that such an arrangement would represent a big stride forward in economical receiver design, and until recently the only thing standing in the way of the production of such a receiver has been the lack of a satisfactory single-valve frequency changer. As there is no inherent reason why a valve should not act efficiently as both an oscillator and a detector, it was felt that the subject was one meriting detailed attention.

The American Circuit.

A single-valve frequency changer, employing an ordinary screen-grid valve, is used in a number of American commercial receivers, and experience with these showed that it was capable of a satisfactory performance. A circuit which is satisfactory in a commercially constructed receiver, however, is not necessarily so in a home-constructed set, where special facilities for ganging and adjustment are not usually available. A detailed investigation into its properties was, therefore, necessary in order to determine its suitability.

The circuit is shown in Fig. 1, and it will be seen that a screen-grid valve is employed, and that the screening grid is connected normally to its positive source of supply. The signal-frequency input is applied to the control grid from the usual tuned circuit L_4C_2, and the valve is biased negatively by a resistance in its cathode lead. The tuned oscillator circuit LC is connected to the anode circuit, and is shunt fed with the primary L_2 of the I.F. transformer acting as an H.F. choke to the oscillator frequency, and the I.F. trimming condenser acting as the feed condenser. The reaction coil L_1 is included in the cathode lead of the valve where it is, of course, in series with the path between the cathode and the control grid and so is effectively in the grid circuit.

So far as efficiency is concerned, the circuit is extremely satisfactory and compares well

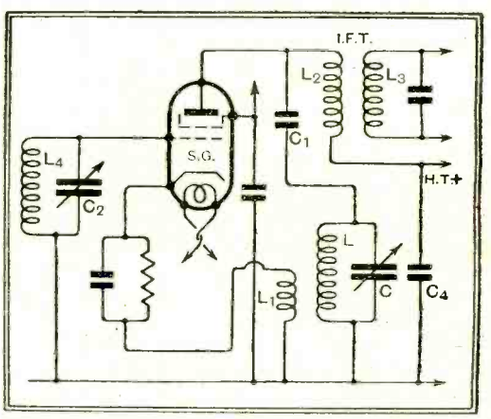


Fig. 1.—A screen-grid frequency changer commonly used in America; oscillation takes place between the anode and control grid circuits, although the reaction coil is included in the cathode lead.

with the usual two-valve arrangement; moreover, when the circuit constants are given their correct values, and the various adjustments are correctly carried out, its general operation is good. The circuit suffers from two serious faults, however, which make its use impracticable in a home-constructed receiver; there is interaction between the oscillator and signal-frequency circuits, and there is a risk of radiation from the aerial.

The Effects of Interaction.

That interaction is inevitable can readily be seen, for the signal frequency circuit L_4C_2 is in series with the reaction coil L_1. As a result, any alteration in the setting of C_2 will affect the oscillator current in this circuit, and this change in circuit constants will be reflected into the oscillator circuit LC, since this is coupled to the grid circuit through L_1. A

Single Valve Frequency Changers.—

change in the setting of the signal-frequency tuning condenser C_2, therefore, affects the oscillator frequency.

This is not necessarily a matter of great importance in a ganged set, however, since the variable condensers are all operated together, and it is for this reason that satisfactory results can be obtained, *when the proper initial adjustments have been carried out.* During the process of ganging, however, the stray circuit capacities have to be adjusted, by means of the trimmers, to the correct values, and while this operation is being carried out, the set is effectively one with separate tuning controls. Although interaction may not seriously affect the performance of the set when it is correctly ganged, therefore, it renders the process of ganging almost prohibitively difficult, unless special apparatus be available.

Value of Intermediate Frequency.

The amount of interaction experienced, however, depends to some extent upon the value of the intermediate frequency employed, and is greater the lower the frequency. One would expect, therefore, that interaction would be more serious in a set built with the standard British frequency of 110 kc. than with the standard American frequency of 175 kc.

It has been found further that radiation may occur with this type of frequency changer, for the oscillator voltage must of necessity be applied between the grid and cathode of the valve. As a consequence, some proportion of this voltage must be set up across the circuit L_1C_2 and be transferred to the primary circuit, and thence to the aerial. This transference is by no means efficient, of course, for these circuits are tuned to a frequency differing from that of the oscillator by the intermediate frequency. The amount of radiation found, therefore, will depend largely upon the value of the intermediate frequency used, and will be at its greatest with a low intermediate frequency. Radiation will be greater with the standard British frequency, therefore, than with the standard American.

It will thus be seen that although the circuit may prove satisfactorily free from the effects of circuit interaction and radiation when the American I.F. of 175 kc. is used,

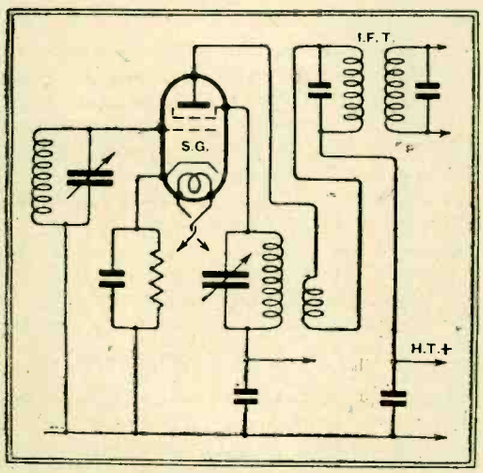


Fig. 2.—A modified form of screen-grid circuit, in which the anode and screen-grid circuits are coupled together to produce oscillation. The same faults of circuit interaction are present as in the American arrangement.

it will not necessarily be so when the lower frequency of 110 kc. is employed, and this frequency is about the highest which can be used in this country on account of the necessity for reception on the long waveband.

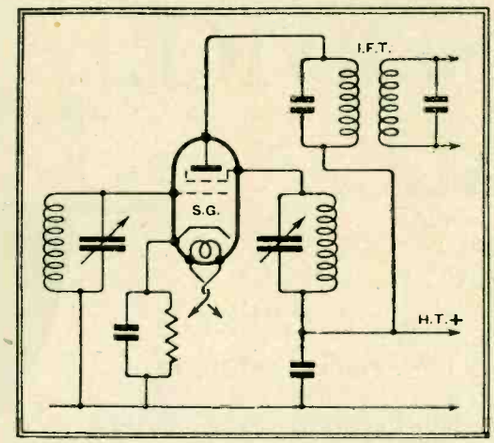


Fig. 3.—The screen dynatron circuit is unsatisfactory on account of circuit interaction and its low efficiency; the I.F. circuit is also heavily damped.

The writer's experiments, in fact, have tended to show that under these conditions it is quite unsuitable, and the whole cause of its unsuitability is circuit interaction.

The Screen-grid Oscillator.

If freedom from circuit interaction is to be obtained, then it is obvious that the control grid cannot be employed as an agent in securing oscillation, and the possibility of reacting between the anode and screen-grid circuits comes up for consideration. A circuit of this type is shown in Fig. 2, and its action is self-evident; as a variant, the tuned oscillator coil may be in the anode circuit, and the reaction coil in the screen-grid circuit, but the results are little different.

Circuits of this type, which may conveniently be called screen-grid oscillators, are perfectly satisfactory as regards efficiency, and they give results little different from those with the American circuit. Experience shows, however, that exactly the same faults of circuit interaction are present. Obviously, therefore, the oscillator and signal-frequency circuits must be coupled, although no intentional coupling is provided.

Apart from stray circuit couplings, which can be kept at a low level by careful design and screening, the only unavoidable coupling is that given by the valve-control grid—screen-grid interelectrode capacity. The capacity present in a few typical valves, therefore, was measured, and found to vary between 9 mmfd. and 13 mmfd., a value which is sufficient to couple the oscillator and pre-selector circuits very tightly indeed.

The Screen Dynatron.

Although it was realised that this high valve capacity would prohibit any use being made of the screening grid for oscillating purposes, a further circuit of a different type was tried out as a check, and is of interest on account of its simplicity. This is shown in Fig. 3, and may be called the screen dynatron. The input circuit is normal, and the I.F. transformer is connected in the anode circuit. The oscillator coil and condenser are in the screen-grid circuit, and no reaction coupling is required. Both screen-grid and anode are operated at the same potential of about 60 volts to 80 volts, and under these conditions the screen-grid volts—screen-grid current curve of the valve shows a negative resistance slope, so that oscillation can be maintained without reaction coupling.

The circuit functions, but has all the faults of the American and screen-grid oscillator circuits, with the added disadvantages of being inefficient and imposing considerable damping on the I.F. circuit, thus reducing the selectivity. This, of course, is due to the low anode voltage of the valve, which results in an anode A.C. resistance of the order of 3,000 ohms, and an amplification factor which is proportionately low.

The Anode Dynatron.

By this time it was abundantly clear that if a screen-grid valve were to be employed, neither the control grid nor the screen-grid could be used for the process of generating oscillations. There remained, therefore, only the possibility of producing oscillation through a dynatron action in the anode circuit, and this was accordingly tried. The circuit is shown in Fig. 4; the screen-grid is given its normal voltage, but the anode has a potential of about 12 volts only. A tuned circuit connected in the anode circuit will cause oscillations to be maintained at a frequency determined chiefly by its inductance and capacity. Some doubt was felt with these particular connections as to whether the valve would oscillate at its correct frequency or at the intermediate frequency, for the primary of the I.F. transformer was also in the anode circuit. No difficulty was experienced on this score, however, and satisfactory oscillation at the correct frequency could be readily secured.

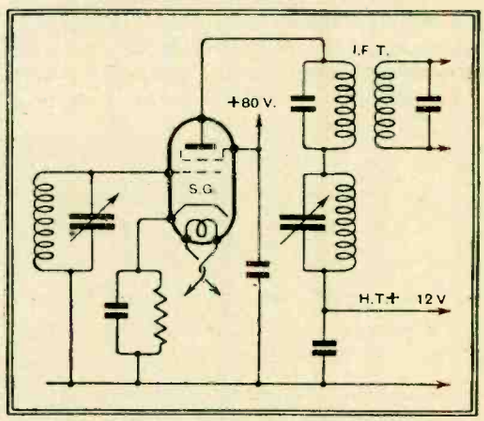


Fig. 4.—The anode dynatron frequency changer functions well, but the efficiency is low and the operating conditions are critical.

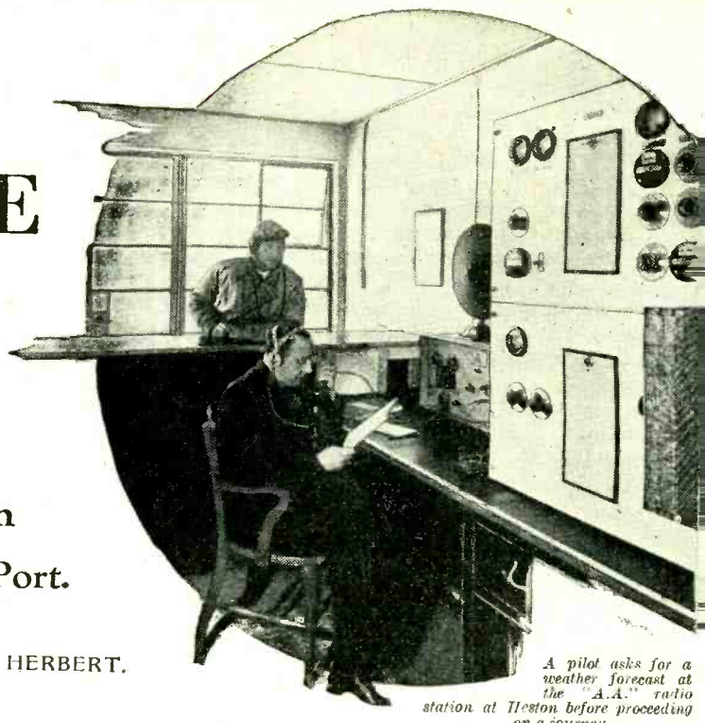
This circuit was found to be free from the interaction effects of the others, but its efficiency was low. It is possible that this might have been raised to some extent had not other drawbacks associated with it given rise to a doubt as to its reliability for general use. The anode voltage for satisfactory oscillation is critical, and may vary with different valves of the same type; moreover, past experience with this type of oscillator has indicated that it might prove necessary to employ only picked valves. Obviously, therefore, with present-day valves a dynatron oscillator should not be used if it can be avoided.

(To be concluded.)

WEATHER SERVICE FOR ALL.

The "A.A." Station at Heston Air Port.

By FLYING-OFFICER T. HERBERT.



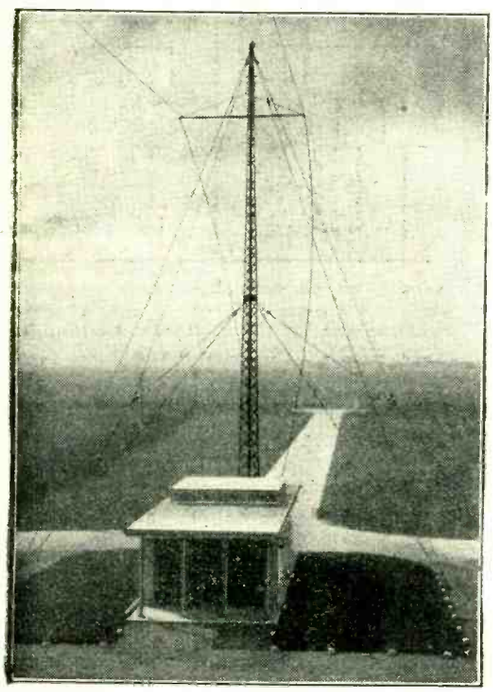
A pilot asks for a weather forecast at the "A.A." radio station at Heston before proceeding on a journey.

"HALLO, this is the Automobile Association calling from Heston Air Port, and here are the Air Ministry weather reports for England!" Many readers must often have heard such an announcement when tuning-in on the long waveband, and many must have profited by the advice following it.

The real importance of the service, however, may not be fully realised, and a description of how the Heston Air Port station was started and of the work it performs may be of interest. The credit is due primarily to the Automobile Association, who realised that there was a growing need for weather forecasts for "the man in the air." After much preparation, the radio station at Heston Air Port was born last autumn, the inaugural date being September 15th. On paper the scheme seemed difficult to justify, but since its birth it has proved itself of tremendous value not only to airmen, but to all classes of listeners. Before giving any technical information regarding the station I should like to say something about the service it renders.

Heston Air Port station receives all its weather information in code figures from the Air Ministry, which is the official Meteorological Department of this country; the messages are decoded at Heston and broadcast in plain language. When I say plain language I mean it. High-sounding words and phrases are purposely omitted, our aim being to make the messages intelligible to whoever picks them up, whether he be flying above the clouds or hiking through the countryside. Such words as "A depression is sweeping over England" and "Anti-cyclones are gathering strength" are never used, nor do we mention the word "millibar."

HOW many listeners realise that the weather forecasts transmitted on 833 metres from Heston are valuable to airman and landsman alike? Every hour throughout the day, the station gives the weather conditions at observation points dotted all over England. The half-kilowatt transmitter is heard at distances up to 150 miles on the smallest plane sets.



The little transmitting station wears a trim appearance. The "T" aerial runs north and south, and is about 70 ft. high.

How the Messages are Given.

The weather messages to aviators are broadcast nine times per day on a wavelength of 833 metres (frequency 360.1 kc.), and, as far as possible, a definite form of announcement is followed. For example, one hears first the name of the place to which the weather report refers; secondly, the time when the observation was taken; thirdly, the state of the weather; fourthly, the amount of visibility; fifthly, the amount of low cloud (this specially for the benefit of the pilot). The amount of low cloud is given in tenths, assuming the sky to be ten-tenths for the purpose of observation. Therefore, if the sky were about a quarter covered with low cloud at, say, 600ft., the observation would be: "three- to four-tenths of low cloud at 600ft." Lastly, the message gives the wind direction at the surface of the ground, and its speed. This last-mentioned information can be of immense importance to a pilot who wishes to land but can see no wind indicator or smoke. It is also useful to pilots over recognised aerodromes who, although they can see a wind indicator, are still without the knowledge as to the speed of the wind.

In addition to these weather reports, Heston broadcasts three Air Ministry weather forecasts each day. As these services are extremely valuable to all classes of listener, I give a time-table below:

0930	Forecast for the day, and Air Ministry Weather Reports for England.
1030	Forecast for the day, and Air Ministry Weather Reports for England and latest for S.E. England.
1130	Reports for S.E. England.
1230	Reports for England.
1330	Air Ministry Forecast until dusk.
1530	Reports for England.
1530	Repetition of reports for England with S.E. route amendments.
1730	Forecast for to-morrow.
1830	Reports for England.

Weather conditions at Heston are included in all these reports, but readers may be interested to know the various other places which are mentioned. For instance, pilots on what is known as the Eastern route to the North will wish to know the weather conditions at Bedford, Cranwell, Harrogate, and Newcastle. These are mentioned regularly. Mention is made, too, of Oxford, Birmingham, Chester, Holyhead, Liverpool, and Renfrew, these places being on the Western route to the North. Travellers on the West route will listen specially to mention of Ross-on-Wye and Pembroke; and those travelling South-west will be interested in what is happening at Farnborough, Winchester, Southampton, Amesbury, Portland Bill, Plymouth. Strategical points on some of the other routes are as follows: South-east—Croydon, Biggin Hill, Lympne, and Dungeness; East Anglian—Felixstowe and Yarmouth; London area—Heston, Stag Lane, and Brooklands. There are a number of supplementary weather stations, including

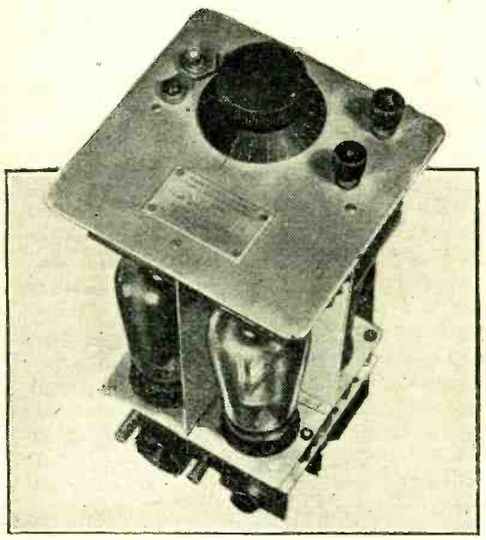
A Weather Service for All.—

Catterick, Lizard, Southport, and Coventry. The majority of the places mentioned are included in each broadcast.

Seeing that this list practically covers England and Wales, it is easy to understand why these broadcasts have become popular all over the country and that letters of congratulation pour into the post-box at Heston. The public gratitude is the more understandable when it is noted that, prior to the inauguration of the "new direct weather service" from Heston, the ordinary man in the street had only three ways of getting a weather forecast. He could (*a*) telephone to the Air Ministry; (*b*) wait for the B.B.C. forecasts, which in some cases were too late to be of any use; and (*c*) glean what he could from the daily newspapers.

Help for the Ordinary Man.

Now,, so to speak, the latest about the weather is put on every listener's doorstep. Every hour almost, by twiddling a knob, he can find out what the weather is doing at different spots all over Great Britain. The service benefits not only aviators, but motorists, market gardeners, farmers, charabanc owners, and many others. Nevertheless, it is, of course, primarily intended for aeroplane pilots, professional and private, flying all over the country and in Western Europe.



The smallest of its type in the world, this miniature aircraft receiver is made by Standard Telephones and Cables, Ltd., specially for use in light aeroplanes. Although it measures only 9¼" × 4¼" four standard-size valves are included.

The transmitter at Heston has been equipped and installed for the A.A. by Messrs. Standard Telephones and Cables, Ltd. It is of the M4 type, with a power rating of half a kilowatt, and is designed for radio-telegraphy, modulated c.w. telegraphy, and c.w. telegraphy. The power output on telephony is 300 watts (with 75 per cent. distortionless modulation) and on telegraphy 500 watts. The wavelength range is from 400 to 1,600 metres or from 600 to 2,600 metres, or any 3-1 wavelength ratio between 100 and 2,600 metres. The system is low-power self-excited oscillator and amplifier. The operation of the entire equipment is remarkably simple. Exide batteries are used for the valve electrodes.

The Air Port receiver, known as the type RSI, is capable of reception on wavelengths between 40 and 20,000 metres. A great feature of this receiver is that it is unnecessary to change any coils, all the transfers from one waveband to another being carried out by means of plugs and sockets. The aerial is of the "T" type, running north and south, and is about 70ft. high.

Of special interest is the Standard Telephones and Cables' special light aircraft receiver used by many 'planes for reception of the forecasts from Heston. The equipment comprises the complete receiving apparatus operated in conjunction with fixed aerials on the machine. Without doubt, the receiver is the smallest commercial aircraft set in the world, its overall dimensions being only 9¼in. × 4¼in. It houses four standard valves, and weighs only 4 lb. 8 oz. While the guaranteed range of the receiver in the air is 100 miles, this seems to be a very conservative figure, for reports are frequently received at Heston from distances of from 130 to 150 miles. The tuning is single dial and absolutely foolproof, and the receiver can be operated by the pilot without having to remove his gloves.

The author would like to conclude this article by inviting readers to send in their reports of the station's transmissions, with any criticisms which they may have to offer. Letters should be addressed to Flying Officer T. Herbert, R.A.F.O., Wireless Officer-in-Charge, Heston Air Port Radio Station, Heston, Hounslow, Middlesex. Moreover, anyone calling at Heston Radio and mentioning *The Wireless World* will be assured of a welcome, and the author will be pleased to show him over the station.

NEWS FROM THE CLUBS.

Ancient and Modern.

SOME of the earliest crystal sets were demonstrated by Mr. L. E. Newnham, B.Sc., lecturing recently before the Portsmouth and District Wireless and Television Society. His subject was "Wireless—Ancient and Modern" and the description applied to the apparatus on view, which included some of the earliest broadcast receivers.

The Society holds its meetings monthly at Pinks Lecture Room, Commercial Road, Portsmouth.

All wireless enthusiasts are welcome and full particulars of membership can be obtained from the Hon. Secretary, Miss E. Maclean, 106, St. James' Road, Southsea.

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Transmitter in Two Rôles.

THE mobile transmitter of the North Middlesex Radio Society was in operation during the recent direction-finding competition, and bearings on its various positions were recorded by the receiving groups, all equipped with portable D.F. apparatus. During the afternoon the positions were reversed, i.e., the transmitter became stationary and the D.F. groups were galvanised into activity as they tracked the transmitter to its lair. This task was accomplished in a comparatively short space of time. The winning group was that under the direction of Mr. Alexander Black, representing the Golders Green and Hendon Radio Society, and the judges complimented him on his accurate and careful work. Mr. T. H. Tagent's group (North Middlesex) secured second place.

Hon. secretary: Mr. E. H. Laister, "Windflowers," Church Hill, N.21.

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Mathematics Made Simple.

"FIGURES Without Tears" was the title of a talk recently given by Mr. J. W. Walker at a meeting of Slade Radio, Birmingham. Mr. Walker explained simple formulæ in the inimitable way which has won him a reputation as a happy exponent of radio mathematics. A number of well-known but tricky formulæ were fully explained, and many members obtained an insight into wireless calculations which they had never possessed before.

The hon. secretary of the Society, whose address is 110, Hillaries Road, Gravelly Hill, Birmingham, will be pleased to hear from local enthusiasts who care to join the Society.

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The Ferranti Jubilee Show.

A VISIT to the Ferranti Jubilee Exhibition at Bush House, London, W.C.1, provided a high light in the programme of the Tottenham Wireless Society. A party journeyed to Bush House on July 2nd. Perhaps the greatest interest was shown in the newest Ferranti receiver, a seven-valve "superhet." Mr. Hall, of Messrs. Ferranti, very lucidly explained the working of the receiver, dealing in particular with the necessity of an efficient band pass filter between aerial and the first stage; he also stressed the importance of good screening.

Hon. Secretary: Mr. W. B. Bodemeaid, 29, Pendennis Road, Tottenham, N.17.

Club Transmitter at Slough.

THE transmitting and receiving installation which the Slough Radio Society hopes to build in the near future was the subject of a lecture given by Mr. L. H. Fitzgibbon on Tuesday, July 19th. Mr. Fitzgibbon is already well known to Slough radio enthusiasts, having recently lectured before the Society on the Belex Short-wave Converter.

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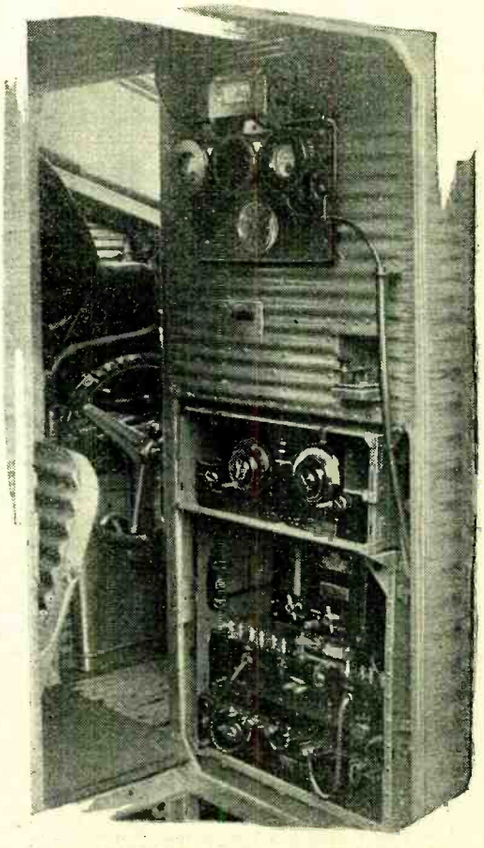
A Round of Visits.

SUMMER tours of an interesting nature are being carried out by members of the Kentish Town and District Radio Society. The Brookmans Park broadcasting station, the Science Museum, Kensington, and the Ferranti Jubilee Exhibition at Bush House have been visited.

Hon. Secretary: Mr. Eric A. C. Jones, 46, Lady Margaret Road, Kentish Town, N.W.5.



ON A PRINCE'S AIR "YACHT." This Marconi A.D. 18a transmitter and receiver, installed on the new private passenger plane of Prince Bibescu of Roumania, covers a wave-range of 300 to 1,600 metres. The transmitter output is 350 watts.

THE ear is a peculiar structure which is not equally sensitive to all frequencies. At low volume levels music sounds thin, but at greater volume the bass returns. These phenomena of hearing, which have an important bearing on the volume level to be aimed at in broadcast reproduction, are here dealt with by a recognised authority on acoustics.

The LOUDNESS of SOUND

The Sensitivity Limits of the Human Ear.

By N. W. McLACHLAN, D.Sc.

IN every branch of applied science it is necessary to make measurements to discover how much we have of this thing or that thing. If we want to know the bore of a cylinder we take a pair of inside calipers and then measure the distance between the points on a rule calibrated in inches or centimetres. Where sound is concerned the measurements are much more difficult and elusive, but they have to be made, nevertheless, to obtain a proper knowledge of acoustic effects. Before attempting to describe measurements on the loudness of sounds, suppose we try to understand some of the principles involved.

It is common experience that the ear is not equally sensitive to all frequencies. For example, if we hear a band at a distance it is high-pitched instruments like the cornet which come through first. If we listen to broadcast reproduction at a low loudness level it sounds thin because low-pitched instruments like the double bass and drums are almost inaudible. As the intensity is increased by manipulating a volume control, a point is reached when the loudness of the low frequencies increases at a greater rate than that of the upper frequencies. If the reader is not familiar with these important facts concerning audition he ought to make the simple experiment we have outlined above.

Threshold of Audibility.

When the intensity is decreased the reverse effect occurs, so that the low frequencies become weaker more rapidly than the high frequencies. At low intensities the important tones of various instruments (bass drum, 'cello, double bass, pipe organ piano) are below the threshold of audibility. That is to say, the tiny variations in air pressure which correspond to these particular tones do not stimulate the nerve mechanism of the ear to an adequate degree. The effect is somewhat similar to that encountered in the operation of household electricity meters. When the current passing through the meter falls below a certain value, the force which it creates in the driving mechanism is inadequate to overcome the inherent friction. Consequently the meter fails to register the current—i.e., it is inoperative. There is, therefore, a threshold value below which the mechanism fails to respond. Another example is to be found in connection with automobiles. If it is necessary to push a motor car in a garage the local boy takes off the brakes and heaves to. But a heavy car refuses to move until another person, usually the owner, lends a hand. In other words, there is a threshold value of motive force below which nothing happens.

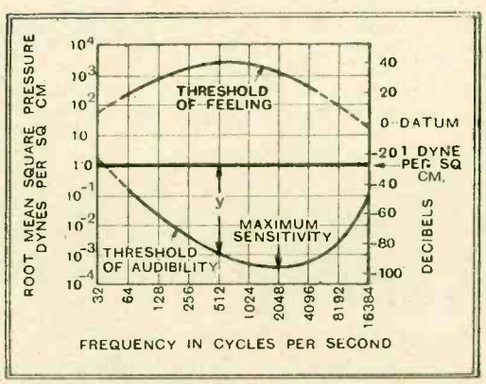


Fig. 1.—Diagram showing threshold of audibility and of feeling for normal ears at various frequencies. The area enclosed is known as the "Auditory Sensation Area" and represents "hearing" of 100 per cent. efficiency. The distance above the Threshold of Audibility is the *sensation* level.

After this preamble, suppose we try to understand the inner meaning of measurements and data obtained during experiments on the properties and sensitivity of the human ear. We all have ears (to hear) in various states of repair, so that the results of the tests not being confined to any particular section of the community should be of wide interest and use.

Concert Pitch.

In Fig. 1 there are two curves. The lower refers to the threshold of hearing, and the upper to the threshold of feeling. The area enclosed by these curves when produced to meet at both ends of the frequency scale is known as the "Auditory Sensation Area." All persons with normal average hearing can detect sounds whose intensity and frequency reside within this area. The horizontal axis refers to frequency or pitch, this being given in piano octaves where middle C is taken as 256 cycles per second. This is the pitch figure usually adopted by physicists, although concert pitch is slightly higher and gives a more brilliant tone to musical instruments. Hence its use for concert purposes.

There are two scales for the vertical axis. One is in decibels and the other in dynes per square centimetre. The decibel is, of course, the well-known sensation unit used so much in telephonic work. Actually it is a power unit. The dyne per square centimetre is the fluctuation in air pressure above and below the ordinary barometric pressure whose mean value is about 760 mm. of mercury or approximately one million dynes per square centimetre. A dyne is the unit of force in the system of units of the centimetre, gram, second variety. A force of one pound measured on a spring balance, say, is equal to that of about 4.45×10^5 dynes. Consequently a dyne is a rather small force. The pressure exerted by the atmosphere on every square centimetre is equal to the weight of a column of mercury 76 cm. high and 1 square centimetre in cross-section. The

The Loudness of Sound.—

density of mercury is 13.6, so that the weight amounts to $13.6 \times 76 = 1{,}033$ grams. Now 1 gram is equivalent to 981 dynes, so that the pressure of the atmosphere is $1{,}033 \times 981$, or about one million dynes per square centimetre. It is usually known to meteorologists as a "bar"—not a wet one! Thus 1 dyne per square centimetre is approximately one-millionth part of the ordinary atmospheric pressure. A sound of any frequency from 40 to 10,000 cycles whose air-pressure variation corresponds to 1 dyne per square centimetre is audible. The loudness of the sound, however, depends upon the frequency.

Normal Hearing.

In obtaining the curves in Fig. 1, the apparatus shown schematically in Fig. 2 was employed. A known voltage was applied by the microphone to the amplifier. The volume control was adjusted to such a value that the observer listening at the telephone ear piece in a highly damped enclosure could hear nothing. The control was varied until the sound just became audible. From the setting or value of the attenuator control and the input voltage to the amplifier, the air-pressure variation causing sound in the observer's ear was calculated. Several readings were taken at each frequency, and the process was repeated by different observers. The air-pressure variation required to produce a sound which is just audible varies from individual to individual, so that the lower curve in Fig. 1 is an average one for persons having what can be regarded as normal hearing.

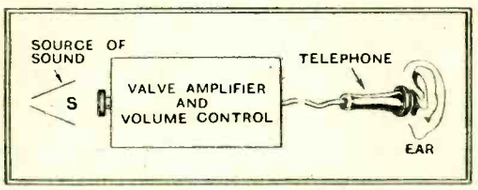


Fig. 2.—Diagrammatic representation of apparatus used in tests for finding the acoustic properties of the ear.

Any serious departure from that curve can be considered as abnormal. For example, if we consider 256 cycles, the threshold pressure is 4×10^{-3} (four-thousandths) dyne per square centimetre. If on testing a person it is found that the threshold is, say, $\frac{1}{10}$th dyne per sq. cm., his hearing loss at this frequency depends upon the difference between the two. Thus, if the middle curve (Fig. 3) represents the threshold of audibility for an individual, his hearing loss is represented by the shaded area. As an example of this, Fig. 3 represents the curve for a person whose hearing loss was 42 per cent., and this would be the aural condition of a fairly deaf person—the kind of person at whom one has to shout, thereby wasting much vocal energy and soon becoming hoarse—here the aforementioned "bar" might become handy! The upper curve in Fig. 1 was found in a similar manner, excepting that the sound emanating from the telephone receiver was very loud indeed. If the loudness is steadily increased from the threshold of audibility, a point is reached when the sensation of feeling is created. Beyond this stage the effect of the sound is to cause actual pain due to over-stimulation of the nervous system. The feeling sensation at low frequencies is sensed as a flutter, whilst in the middle register it resembles tickling, as though a few small insects had taken refuge in the aural organs.

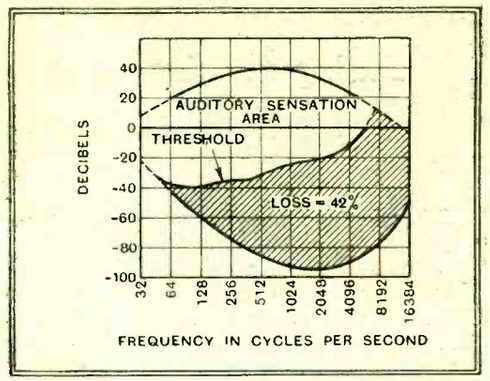


Fig. 3.—Diagram indicating the large rise in the threshold of audibility in a deaf person. The ratio of the shaded area to the "Auditory Sensation Area" in this case is 0.42, which represents a loss in hearing of 42 per cent.

If we draw a horizontal line across Fig. 1 at 1 dyne per square centimetre, it is above the threshold of audibility over the range 40 to 10,000 cycles. Suppose the input to the telephone ear piece in Fig. 2 is adjusted to give an acoustic pressure of 1 dyne per square centimetre over the above frequency scale, then the difference between the threshold curve and the line (see y) is the intensity above the threshold. At 40 cycles it is not very far from the threshold, whilst at 2,000 cycles, where the ear is most sensitive, it is quite a long way from the threshold. Consequently the sound appears to be much louder at 2,000 cycles than at 40 cycles.

Ear's Response to Bass Register.

The question which now arises is this: What must be the intensity level of the 40-cycle note to appear as loud as the 2,000-cycle note? This point was also settled by aid of the apparatus in Fig. 2. A note of 700 cycles was chosen as a standard of reference. Now suppose this is set at a certain level above the threshold of audition equal to 10 db. Then a series of other notes—e.g., 100, 400 cycles—are sounded and their intensity is altered until the loudness is equal to that of the 700-cycle note. In this way the curve marked 10 in Fig. 4 was

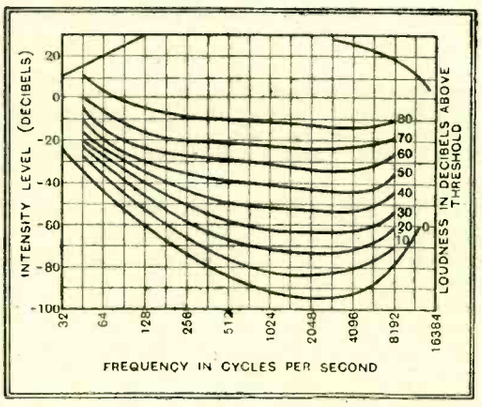


Fig. 4.—Diagram showing curves where the loudness is the same at all frequencies, i.e., contour lines of equal loudness. These can be regarded as "Isobels."

obtained. The level is raised to 20, 30, etc., decibels above the threshold and the process repeated, the comparison always being made with the 700-cycle note. The result of these tests is given in the curves of Fig. 4. Since the loudness (bels or decibels) above the threshold is identical for each curve, the curves can be termed "Isobels" (equal bels, but the gender is neuter). Selecting the curve marked 50 db. (this represents a loudness which occurs in ordinary conversational speech), the air pressure corresponding to 40 cycles is about 5 dynes per sq. cm., whilst that at 2,000 cycles is only $0.125 = \frac{1}{8}$ dyne per sq. cm. when the two notes are equally loud. This corresponds to a power ratio of $40^2 = 1{,}600$, and indicates quite forcibly the much lower sensitivity of the ear in the bass register, as we pointed out at the beginning of the article.

The curves of Fig. 4 show very clearly why much more power is required from low-pitched instruments, etc., like the double bass, 'cello, bass male voice, to give a degree of loudness equal to that of the flute, violin, and soprano voice. It is easy to understand that the energy is greater, for one has only to see and feel the long, thick strings of a double bass vibrating, to see and hear the

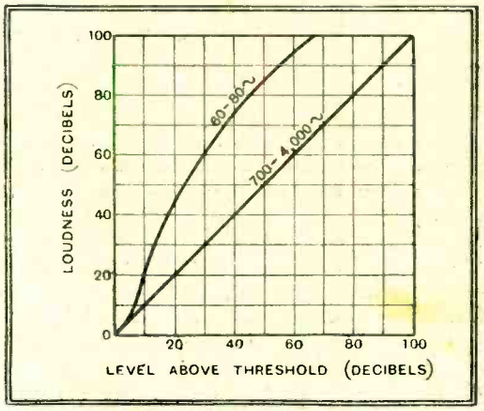


Fig. 5.—Curves showing that the loudness in the lower register increases much more quickly than that in the upper register for equal increments above the threshold of audibility. The loudness from 700 to 4,000 cycles is proportional to the increase in intensity.

long pipes of a great organ, or to take stock of a regimental drummer laying in to a drum some two feet diameter with a force which if delivered on one's head would produce loss of consciousness. On the other hand, if one draws a bow lightly across or plucks a violin string, the loudness of the sound is quite appreciable. The same argument applies to the piano, where the bass strings are thicker and longer, and the hammers are heavier than those in the upper register.

Loudness and Corresponding Air Pressure.

At the beginning of this article it was stated that when the low frequencies became audible as the intensity level was augmented the loudness increased more rapidly than that of the upper frequencies. This can be seen from Fig. 4, where the curves for equal loudness crowd together in the low-frequency region. To make the point quite clear, some of the data in Fig. 4 have been plotted in a different way in Fig. 5. Two curves are given. One refers to frequencies from 60 to 80 cycles, whilst the other involves the

The Loudness of Sound.—
range 700 to 4,000 cycles. The horizontal axis represents the level in decibels above the normal threshold of audibility of the average ear. The vertical scale represents the loudness of the sound compared with that of the 700-cycle note. The 700-4,000-cycle line is straight, showing that a definite increase in intensity or air pressure produces the same increase in loudness at all frequencies in this band. For example, when the sensation level is raised from the threshold (zero) to a normal value of 50 db. the loudness is also 50 db. As a contrast we take the 60-80-cycle range, where for the same rise in sensation level the loudness is 86 db. This shows quite clearly that the loudness in the lower register increases much more quickly than that in the upper and middle registers. We must be very careful to realise, however, that for any given degree of loudness the corresponding air-pressure variations are much greater at low than at high frequencies.

Reference.—"Speech and Hearing," by H. Fletcher.

CATALOGUES RECEIVED.

A small booklet just issued by the Dubilier Condenser Co. (1925), Ltd., Ducon Works, Victoria Road, North Acton, London, W.3, and obtainable on application, contains some useful information relating to their metallised resistances. Curves are given showing the effect of temperature, humidity, radio frequency characteristics, and mention is made of tests carried out to ascertain the stresses required to tear off the end caps, also to fracture the porcelain tube.

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F. C. Hill and Co., 154, Compton Road, Wolverhampton.—Leaflet giving particulars of mains transformers and L.F. chokes.

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Edison Swan Electric Co., Ltd., 123-5, Queen Victoria Street, London, E.C.4, have issued a leaflet giving particulars and operating data relating to two new low-voltage gas-discharge rectifiers, the types U.235 and U.600.

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The Radio Components Catalogue, No. 31-32, issued by the Loewe Radio Co., Ltd., Fountayne Road, Tottenham, London, N.15, in addition to giving particulars of their wide range of small components now contains full details of the latest Multiple valves designed for A.C. operation.

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A leaflet received from Kenwell Radio, Ltd., 200, City Road, London, E.C.1, contains full details of an interesting power pack with which is embodied an energised moving-coil loud speaker.

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Epoch Radio Manufacturing Co., Ltd., Exmouth House, Exmouth Street, London, E.C.1—an illustrated leaflet dealing with the model 20c. permanent-magnet moving-coil loud speaker.

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General Electric Co., Ltd., Magnet House, Kingsway, London, W.C.2—publication M.6160 dealing with measuring instruments designed especially for tracing faults in wireless receivers.

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Rotax, Ltd., Willesden Junction, London, N.W.10—20-page booklet illustrating and describing the range of M-L anode converters and rotary transformers, machines for obtaining a high D.C. voltage from L.T. accumulators, also A.C. from D.C. mains are available in various sizes.

CHANGE OF ADDRESS.

The Electrical Devices Co., 12, Great James Street, Bedford Row, London, W.C.1, have acquired new premises at 62, Conduit Street, London, W.1, the offices being at New Burlington Place, Regent Street, London, W.1. The telephone number is Regent 5119.

D.C. GRAMOPHONE AMPLIFIER.

Push-pull Circuit with Large Power Output.

By R. A. FEREDAY, B.Sc., A.Inst.P.

IT has become customary to design amplifiers intended to give high power output almost exclusively for A.C. mains operation, and it is common for a D.C. amplifier to consist of such a set provided with a D.C.-to-A.C. converter. For an amplifier of moderate size this represents unnecessary complication; the following description applies to a gramophone amplifier recently constructed by the writer which derives all its power (H.T., L.T., and G.B.) directly from 240-volt D.C. lighting mains, and which will give an audio-frequency power output of nearly five watts—sufficient for a fair-sized hall.

The output stage consists of two PX4s in push-pull, coupled by a Varley split-secondary transformer to a single AC/HL. Referring to the circuit diagram, it will be seen that anode current for this first valve is smoothed by the choke and condenser C_2; grid bias is derived from the potential drop across R_2.

Series-connected Filaments.

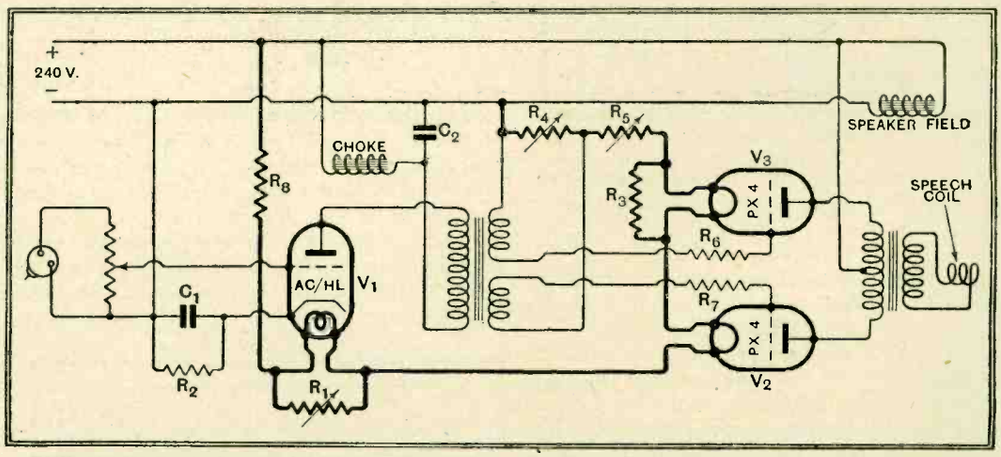
The filament circuit comprises the three filaments wired in series, the two grid-bias resistors R_4, R_5, and the resistance mat R_8. A resistance R_3 prevents overheating of the filament of V_3 by the anode current of V_2, and the resistance R_1 is included, since the heater current of the AC/HL was found to be less than the nominal one ampere. This series connection of the filaments reduces the filament consumption to 240 watts, of which approximately 200 watts have to be dissipated as heat from the mat. By mounting this in a vertical plane close to the back of the cabinet, which is perforated by a number of large openings and covered by a protective metal grille, adequate ventilation is secured, and the amplifier, although totally enclosed below the motor board of the gramophone, runs very cool.

Balanced Output Valves.

Grid bias for V_2 is obtained from the voltage drop across R_5 and the filament of V_3; that for V_3 from the drop across R_4 and R_5. These latter are actually Igranic preset resistors, two ten-ohm resistors in series being used for R_5 in order to provide the necessary current-carrying capacity. Thus the output valves are balanced but for a four-volt difference in anode voltage; used on a reasonably "clean" D.C. supply, no smoothing has been found necessary in the output stage. These valves will accept a grid swing of some twenty-five volts, which can be provided comfortably by the preceding stage.

The anti-parasitic resistance R_6, R_7, are of the wire-wound (spaghetti) class, but are of different types in order to destroy the symmetry of the circuit with respect to H.F. currents. The adoption of a push-pull output, and the avoidance of a grid-biasing scheme using components common to each stage, reduces dangers of unwanted inter-stage coupling to a minimum; none of the available H.T. voltage is wasted in decoupling resistances, and, in spite of a small drop across the smoothing choke, the first valve receives rather more than its rated maximum anode voltage.

The installation is completed by a Marconiphone pick-up and Epoch "Domino" speaker; the quality provided is quite pleasing, and very large volume is obtained before overloading commences.



THE CIRCUIT DIAGRAM OF THE AMPLIFIER. The filament connections are shown in thick lines. R_1 50 ohms; R_2 600 ohms; R_3 100 ohms; R_4 6 ohms; R_5 20 ohms; R_6 20,000 ohms; R_7 25,000 ohms; R_8 207 ohms resistance mat, Cressall, Type 1527; Choke: Varley Nichoke II; C_1, C_2 2 mfd.

Frivolous, querulous or—

UNBIASED

By

FREE GRID.

The Simplest Set on Earth.

NOW that the electrostatic loud speaker is available in this country in a really practical form, it is interesting to reflect that over a dozen years have passed since one of our pioneer wireless firms, namely, the Marconi Co., commenced experimenting with electrostatic headphones. It is true that the experiments were not very successful.

One scheme which was mooted at that time would have given us a perfect and fool-proof local-station headphone set which we could have put into the hands of our maiden aunt—or any other woman for that matter—with absolute certainty that, short of using a coal hammer, she could not have put it out of order.

In its most elementary form it consisted simply of a special pair of telephones with two diaphragms—one fixed and one moving—set very closely together but insulated from each other. One diaphragm was connected to earth, and the other to the aerial. The principles underlying the way in which it was *supposed* to work were perfectly straightforward, but for the benefit of those who may have inadvertently skipped Chapter I of their elementary text-books on electricity and magnetism I give a brief explanation here.

The oscillations due to an incoming wave train would cause one diaphragm to be positively charged and the other negatively, and the charges on the diaphragms would change their sign every half-cycle, which, in the case of a wavelength of 600 metres, represents one million times a second. The result of this would be that the two diaphragms would be mutually attracted and the moving one would be pulled over towards the fixed one to a greater or lesser extent, depending upon the amplitude of the incoming carrier wave.

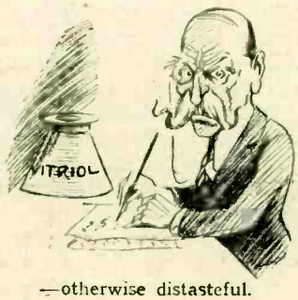
Not According to Plan.

Naturally, the changes of sign would not affect the attracting power, nor would the fact that the charges on each diaphragm were equal and opposite twice during each cycle release the diaphragm owing to the fact that the changes were, of course, at radio frequency. Any chopping-up or varying of the incoming energy, such as a series of wave trains due to a spark transmitter or the modulation associated with a telephony transmitter, would naturally waggle the diaphragm in sympathy, and, heigh presto! we have the simplest set on earth!

No attempt was made at tuning, and presumably the arrangement would have received several stations at once, like certain commercial broadcast receivers on the market to-day; but, unfortunately, like ideas for perpetual motion or making a fortune by backing horses, it did not work quite according to plan when tested, although it must be acknowledged that weak signals *were* heard when the arrangement was tried near to a powerful spark station. Later on attempts were made to add a tuned circuit, but, unfortunately, the capacity of the phones, being in shunt with the tuning condenser, completely swamped it. What this capacity was I do not know, but it would be something less than 0.02 mfd., which is roughly the capacity—it varies with the value of polarising voltage, of course—of the electrostatic loud speaker which I am at present trying out.

The Chance of a Lifetime.

THE Editor, in his infinite wisdom, having seen fit to enlarge the pages of this journal without having the common courtesy to consult me on the point, I find that I have room for several hundred more words in my allotted space than hitherto.*



—otherwise distasteful.

I am, therefore, hoping shortly to offer the hospitality of one column of my page to all those unfortunate writers of letters to the Editor who, because their letters have been abusive, frivolous, querulous, carping, dull or otherwise distasteful to the Editorial mind, have hitherto been classified under the heading of "Also wrote." I propose to have the letters printed in the smallest known type in order to get the maximum number in each week.

All disappointed correspondents who feel that their past letters have come under the heading mentioned would be invited to contribute.

The Cannibals of Cape Town.

WHEN I was very young I used to imagine that the Australians spent their time playing with boomerangs and calling "coo-ee," and that the inhabitants of South Africa divided their time between devouring missionaries and endeavouring to avoid being devoured in their turn by lions. In fact, when I first went to Cape Town I half expected to meet a lion at each street corner, and it was some days before I became acclimatised.

It is evident that similar primitive ideas and fears concerning the other end of the so-called "dark" continent still haunt the mind of at least one journalist, as he expresses considerable astonishment at the fact that the schools in Algiers are provided by the municipality with wireless sets for the reception of special school broadcasts; in fact, he appears to be rather surprised to hear that there are schools there at all; this, mark you, in a journal which devotes itself to education.

Let me assure him from personal experience that Adderly Street, Cape Town, at the sharp end of Africa, and the Rue d'Isley, Algiers, at the blunt end, are as civilised as his native Piccadilly.

* "Free Grid" really has no "grouse" as contribution rates are not calculated "per page."—ED.

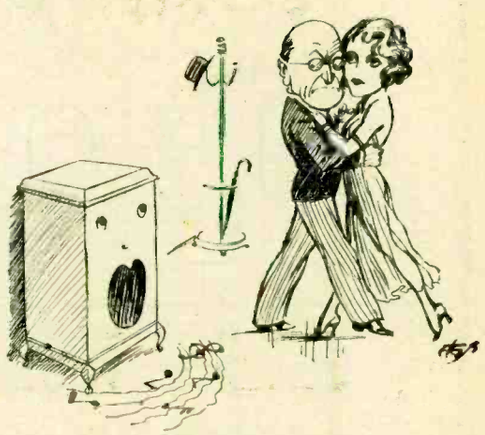
To Stop or Not to Stop.

THERE are things in this life which at times tempt the most good-humoured of us to indulge in language not permitted within the precincts of a Young Ladies' Seminary. In my particular case one of the things is the sudden stopping of a gramophone before the record is quite finished, or, alternatively, the refusal of the motor to stop when the record *is* finished, due to the too early functioning or to the non-functioning of the automatic stop.

I believe I am right in saying that I have tried every known electric motor and every known automatic stop, but none of them fulfils the claim to be universal in the sense that it will function on *any* type of record. Nor can I see how the wit of man could devise such an arrangement.

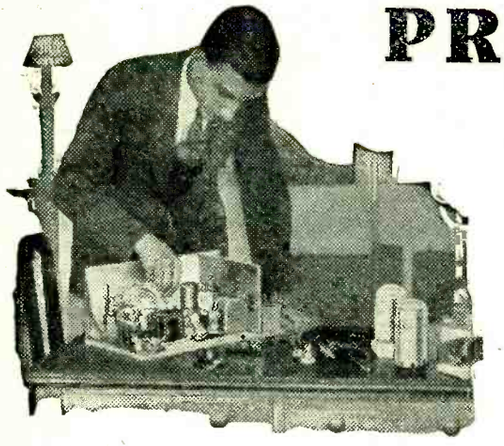
My collection of records ranges from the most expensive twelve-inchers to the original Woolworth sixpenny touches (not their latest plutocratic eight-inch type), and I defy any manufacturer to get his automatic stop to work properly on my whole collection. I will make things easier for him by not requiring the instrument to function on my "home-recorder" records, which lack any kind of "run off" track; nay, I will go even farther, as Shakespeare said, and rule out all but the 10 in. or 12 in. records. Even then I will warrant that no manufacturer could do it.

Of course, it is not really the fault of the maker of motors or automatic stops, but of the various recording companies who all seem to have different ideas on the question of the design of a "run off" track and where recording shall end, just as thirty years ago they all had different ideas about the speed of recordings. Why can't something be done about it?



The Great Unfinished.

By the way, if any maker of motors fitted with an automatic stop still thinks he can do the impossible, will he kindly send a specimen along for the attention of *The Wireless World* laboratricians?



PRACTICAL HINTS AND TIPS.

AIDS TO BETTER RECEPTION.

IT is sometimes forgotten that every D.C. mains-operated set is automatically "earthed" by its connection to the supply system. Admittedly, this form of earth connection is often lacking in efficiency from the "H.F." point of view, but when an unduly noisy background of hum is present it is at least worth while to try the effect of taking off the normal earth wire.

Without an Earth.

When a marked improvement is noticeable as a result of working with a "mains earth" only, it will generally be found that there is an appreciable difference of potential between the "set earth" and the "mains earth." This provides a clue as to how disturbing hum voltages are introduced into the receiver.

AS has already been inferred, the H.F. stopping choke, which forms an important part of the conventional diode detector circuit, has a difficult task to perform. It is necessary that it should be capable of restricting the applied H.F. energy to the detector circuit, and, if good sensitivity is to be obtained, it should not introduce appreciable losses into the tuning system. Further, there is the question of effective self-capacity; that of the choke winding is practically in parallel with the tuned input circuit, and if it has a high value will tend to restrict the wave-range of the receiver. Naturally, of these considerations that of self-capacity is by far the least important. The component to which we are referring here is indicated by "H.F. Choke 2" in Fig. 1.

Diode Circuits.
Practical Considerations.

Some measurements have recently been carried out in order to determine the suitability of various commercial chokes for this special purpose, and some interesting results have been obtained. It has emerged from these tests that some chokes which are admirably suited for ordinary uses are far from satisfactory in diode circuits, and, conversely, that others for which no special claims for efficiency are made are reasonably satisfactory for our present somewhat exacting requirements.

Choice of H.F. Choke.

But it must not be thought that a choke which is generally held to be of indifferent design is bound to make a good H.F. stopper for a diode. On the contrary, the tests that have been made show clearly that the large-size Lewcos choke, which enjoys a reputation second to none for all-round efficiency, is also the best of the various specimens that have been tested for our present purpose. In the matter of restricting the application of H.F. voltages to the succeeding L.F. amplifier, it is outstandingly good, and from the point of view of losses it is not excelled by any of the other specimens. Similarly, only one other choke was found to have a lower effective self-capacity at the wave-lengths at which measurements were made.

The only drawback to this particular component is its relatively large size, but this, of course, accounts partly for its good performance. It is not always that space can be found for such a large choke, and so tests were made of alternative components of more compact dimensions. One of the smallest of those tested, which, nevertheless, proved to be extremely satisfactory, was the McMichael Junior Binocular type, which was found to be much more effective as an H.F. stopper than many larger components, and, in view of its small size, to be responsible for surprisingly low losses. Its effective self-capacity was also practically as low as that of any other component.

With regard to chokes of average size, the R.I. "Quad" proved to be the most suitable of those tested for use in diode circuits, being highly efficient both for H.F. stopping and in the matter of losses. It is interesting that for this particular purpose it is definitely better than the larger and more expensive component produced by the same firm.

When there is any doubt as to the effectiveness of the H.F. stopping arrangements included in a diode set, it is a good plan to include some simple form of H.F. filter in the anode circuit of the L.F. valve which immediately succeeds the detector. If wandering H.F. energy can be stopped at this point, it is unlikely to do much harm. A suggested form of filter has been added to the circuit diagram already mentioned (Fig. 1); the associated by-pass condensers may have a capacity of 0.0002 or 0.0003 mfd.

For the sakes of completenes, the diagram shows in skeleton form the general circuit arrangement of a very satisfactory medium-range set in which diode rectification is employed. The semi-variable condensers of 0.0001 mfd. capacity are usually set to about half their maximum value. Finally, it should perhaps be pointed out that the remarks made above with regard to H.F. chokes apply only to the component directly associated with the diode. Choice of the remaining chokes (Nos. 1 and 3) is governed by the usual considerations.

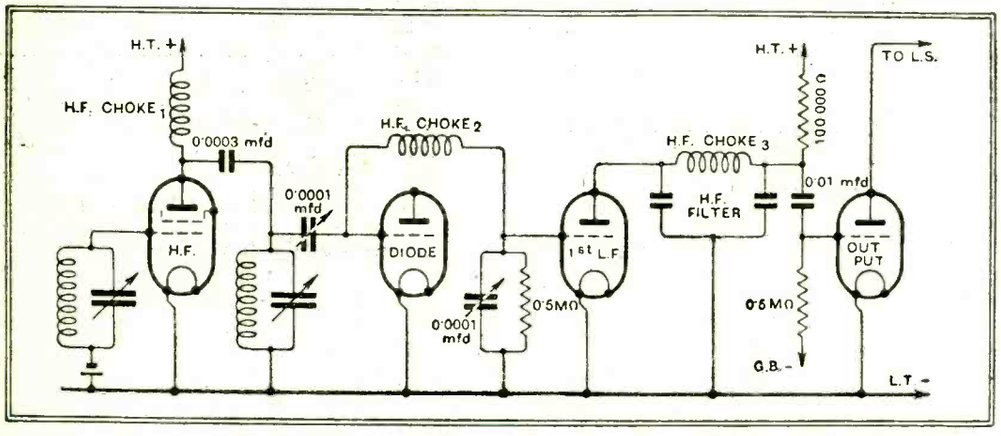


Fig. 1.—Skeleton diagram showing the essentials of a practical receiver with diode detection. The effectiveness of H.F. choke No. 2 has an important bearing on the operation of the detector.

WHEN a receiver fails to function "according to plan," almost the first thing that the wise amateur does is to measure the anode and screening-grid currents consumed by each individual valve. When dealing with a modern superheterodyne which employs an S.G. valve operating as an anode bend first detector, he often encounters a minor difficulty: the current consumed by this valve may be so small that it will hardly give an indication on a milliammeter of average current range.

First Detector Current.

In many receivers the detector anode current amounts to no more than between 0.1 and 0.4 milliamps., and if this cannot conveniently be read on the meter, a test should be made by short-circuiting the bias resistance—or in the case of a battery set by returning the grid circuit directly to the earth line. As a result of doing this, anode current should rise to several milliamperes; if it does, we have a fairly certain indication that everything is well in the associated circuits.

THE unfortunate use of the word "free" in connection with grid bias and the field current of moving-coil loud speakers has, in the past, misled many people into imagining that the laws of nature could be successfully circumvented by the wireless engineer. It has long ago been made clear that "free" grid bias volts are merely filched from the H.T. voltage, which has to be correspondingly increased in order to make good the deficit; many people are, however, still somewhat hazy concerning the question

Is Field Current Ever "Free"?

Practical Hints and Tips.—

of field current supply in the case of a moving-coil loud speaker, which is certainly more entitled to the term "free" than any system of obtaining grid bias.

An "energised" type of loud speaker requires a certain value of current to pass through its field winding before it will function properly, and a certain number of volts—usually in the neighbourhood of 100—are needed to overcome the resistance of the winding and force the current through.

The plate current of a modern mains receiver is usually sufficient for the purpose, but if the field winding is connected in the common H.T. positive supply lead it will at once, according to its resistance value, appropriate a certain number of the volts which rightly belong to the anodes of the valves in the receiver. The net result is that neither valves nor loud speaker are adequately provided for. Fortunately, the loud speaker field serves as an excellent smoothing choke, and can be substituted in place of an ordinary inductance, and the volts hitherto absorbed by the latter will be available for loud speaker and set.

The voltage demand of the field winding, however, is usually in excess of that absorbed by any ordinary smoothing choke, and the deficit will therefore have to be made up by increasing the voltage of the H.T. supply. However, the modern tendency to use a generous output valve which usually requires a much greater anode voltage than preceding valves in the set *does* enable the loud speaker winding to be used to absorb the excess voltage, which normally would have to be wasted in a resistor. In this latter case, therefore, the field current is really free, apart from the fact that its winding serves also as a smoothing choke.

Strengthening Low Notes.

A VALVE of fairly high magnification factor, and consequently of relatively high A.C. resistance, is generally the most sensitive type to choose as a grid detector, but its use may introduce an appreciable attenuation of the lower audio-frequencies. This applies when the succeeding output valve is connected by means of a transformer, of which the primary winding is directly in the anode circuit.

A simple remedy for this state of affairs is to be found in the use of resistance feed for the transformer primary. The effect of this alteration is always to reduce the effective resistance of the valve, as the feed resistance is, for all practical purposes, in parallel with it. All other things being equal, the bass response of a resistance-fed transformer is bound to be better than with the direct form of connection.

Cathode-circuit Measurements.

IT is usual, when making a measurement of anode current, to insert the milliammeter at any accessible point between the plate terminal of the valve concerned and the positive terminal of the source of H.T. supply. But, when it is more convenient to do so, there is not the slightest objection, on technical grounds, to connecting the instrument in the cathode lead of an indirectly heated three-electrode valve. The resistance of the meter will usually be negligibly low in comparison with that of the bias resistor which is customarily included in the cathode circuit.

The anode current of a directly heated output valve, of which the filament is supplied with A.C. from a step-down transformer, may be ascertained in a similar manner by inserting the milliammeter in the lead which joins the L.T.-transformer secondary to earth—generally through a self-bias resistor.

This method offers the slight advantage of additional safety; no considerable voltage difference exists between the meter leads and the metal chassis of the set, and so the result of an accidental short-circuit is not likely to be serious.

When dealing with a screen-grid or pentode valve in this manner it should be remembered that the meter will indicate the sum of anode and screen currents—also possibly that consumed by the feed potentiometer.

MURPHY "A3 PEDESTAL" RECEIVER.

A De Luxe Model Incorporating Many Detail Refinements.

THIS latest addition to the range of Murphy receivers is a development from the well-known A3 model. It in no way supersedes the latter receiver, which is being continued as a table model at 17 guineas, but may be regarded as a de luxe version incorporating a number of detail refinements emanating from the experience of more than a year's manufacture and servicing of the original design.

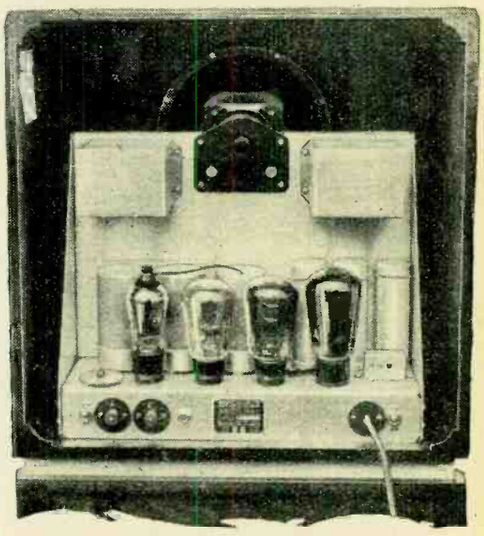
The Murphy "A3 Pedestal" receiver has a slightly wider cabinet, and is provided with a stand of strikingly original design.

The cabinet of the pedestal model is several inches wider than that of the standard A3, and the general appearance in conjunction with the solid-based stand is distinctive. The set is readily detachable from the stand, but cannot be purchased separately.

Perhaps the most important difference is to be found in the tuning coils. In the original design these were of the flat, basket-wound type, but the new model employs single-layer cylindrical coils in vertical screening cases. The coupling inductances in the band-pass input circuit have also been reduced in value. A test carried out within five miles of Brookmans Park, under precisely the same conditions as those under which the original model was tested (*The Wireless World*, July 29th, 1931), revealed a distinct improvement in selectivity without any apparent diminution of the excellent range and sensitivity.

A further reduction has also been effected in the level of mains hum, and this is now quite inaudible outside a radius of two or three feet from the loud speaker fret. This improvement is attributable to the use of an 8-mfd. and two 4-mfd. electrolytic condensers in the smoothing circuit in place of the paper condensers in the original model, and to the fact that the L.F. transformer is orientated to reduce coupling with components associated with the supply mains.

An alteration has also been made to the volume control, and the input volume-control resistance is no longer ganged with the reaction knob on the front panel. It is now mounted at the back of the set, and may be pre-set to local requirements by a metal star wheel near the "Local-Distance" switch.



No back is fitted to the "A3 Pedestal" receiver. Note the new cylindrical coil screens and electrolytic condensers behind the valves. The auxiliary volume control star wheel is on the left of the screen-grid valve holder.

The volume and quality of reproduction maintain the high standard of the original A3, but the sphere of usefulness of the "Pedestal" model has been extended by the incorporation of a gramophone pick-up jack.

The price of the "A3 Pedestal" receiver is 19 guineas, and the makers are Murphy Radio, Ltd., Welwyn Garden City, Herts.

News of the Week

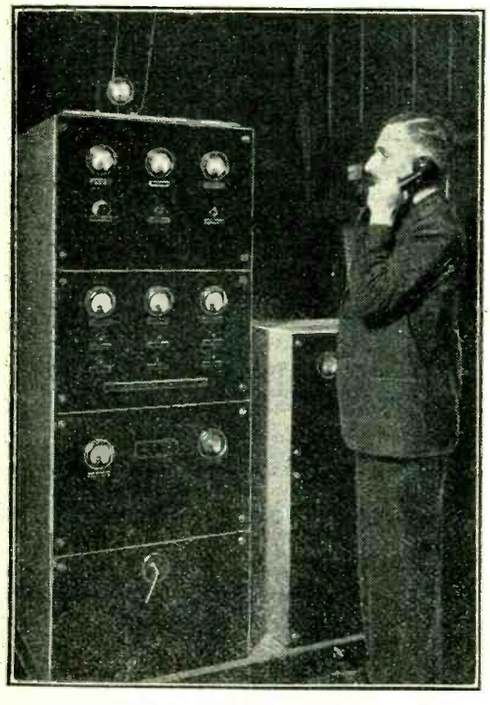
Current Events in Brief Review.

August 19th.

ONLY three weeks remain before the opening of the National Radio Exhibition at Olympia on August 19th. For the first time in its history, the Exhibition will occupy the Grand Hall. It will be just twice the size of last year's show, with an area of 200,000 square feet. Some 250 stands have already been leased by manufacturers. Sound-proof demonstration rooms, which have been a valued feature of the last two years, will again be in evidence in the gallery.

The authorities have wisely decided to maintain the traditional arrangement that the loud speakers on the stands shall diffuse music from a common source; as in the past, the B.B.C. will handle the programme material, both wireless and gramophone.

Besides offering the latest ideas in commercial radio technique, this year's Olympia Show will prove to be a magnificent spectacle which no listener can afford to miss.



THE LATEST IN POLICE RADIO. An official calling up a motor cycle patrol by means of the 100-watt transmitter installed at the Bradford police headquarters.

Automatic Radio Tuner.

NEWEST amongst the "radio period selecting devices" accepted by the U.S. Patent Office is one by Emile Brugger, a Swiss watchmaker, of New York. According to a correspondent, the device enables the listener to pre-select the station whose programme he wishes to hear over a 24-hour period, the tuning being held for 15 minutes or multiples thereof.

Ten-day Weather Forecasts.

EVERY Tuesday and Friday evening, Berlin and certain other German stations now broadcast a long-term weather forecast over a period of ten days. It is interesting to learn that the service is experimental!

"Ultra-Shorts" for Aircraft Guidance.

WAVES between three and five metres are being used in some interesting tests now being conducted by the German aircraft experimental station to devise a means of guiding aeroplanes when landing in the foggy weather. The directional properties of the ultra-short waves are employed, a transmitter on the landing ground being used to send out a continuous note, while an ultra-short wave receiver on the 'plane enables the pilot to determine his direction and height by the strength of its signal.

If the tests prove successful, a commercial equipment may shortly be put on the market.

A Radio "Lausanne."

SEPTEMBER 3rd has now been definitely chosen as the date on which the world's wireless troubles are to be tackled at Madrid, which is the venue of the International Radio Telegraph Convention. The last conference of the kind was held at Washington in 1927, since which year radio complications, particularly in regard to wavelengths, have increased at an alarming rate.

The primary object of the conference is to settle questions regarding commercial and maritime wireless communication, but it is hoped that many pressing questions relating to broadcasting will be found a place on the agenda.

Bradford's Radio Flying Squad.

LAST week we drew attention to the enterprising wireless tests now being conducted by the Bradford police. One of the most interesting features of the tests is the use of wireless telephony by motor cycle patrols. Of special note is the device used on the patrol machines by which the rider's attention is called to the fact that headquarters are seeking to get into touch with him by wireless.

A small electric lamp attached to the top of the headlamp and in full view of the driver is lighted by relay in the receiver actuated by a carrier wave from a transmitter. When the lamp lights up the relay is switched off and the 'phones are brought into circuit.

A four-valve receiver is carried in the sidecar, to the rear of which is attached a metal tube aerial. To avoid ignition interference the magneto, leads and sparking plug have all been screened.

The transmitter, which has been installed at police headquarters by Standard Telephones and Cables, Ltd., is run from mercury vapour rectifying valves. It operates on 157 metres with a power of 100 watts, and strong telephony signals have been audible up to 25 miles on headphones.

France Holds the Record.

FRANCE relies on gramophone programmes more than any other country in Europe, according to figures just published by the Union International de Radio Diffusion. No less than 25.6 per cent. of the total French transmissions consist of mechanical music. Belgium follows with 20.5 per cent.

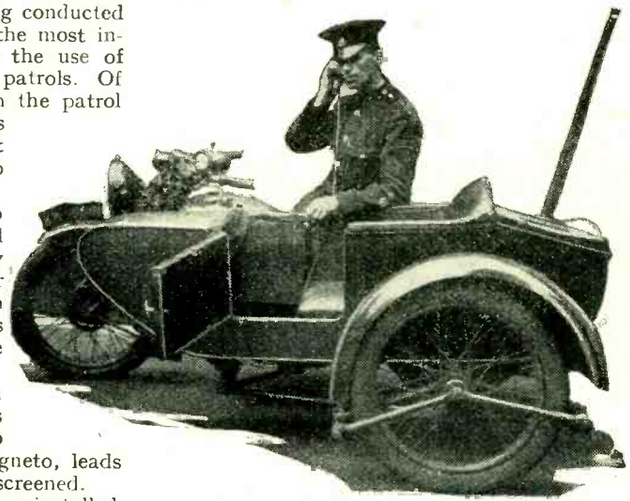
Oratory Let Loose.

"THE greatest piece of radio news reporting in the history of broadcasting" is the theme of the story which comes to us from Washington concerning the sixty-hour programme which was offered to the radio audience of America during the recently adjourned Democratic National Convention and the Republican Convention which preceded it.

Of the sixty hours at speech at the microphone, fifteen were rejected by the broadcasting authorities, but, nevertheless, there were times during the Conventions when the two major networks were engaged in the fiercest rivalry.

The scene of the event was the Chicago Stadium, the platform of which was plastered with microphones which picked up many remarks and "asides" which escaped the audience of 20,000 in the hall. Each of the rival radio broadcasting concerns scored "scoops" when, apparently, influential persons addressed the microphone at short notice.

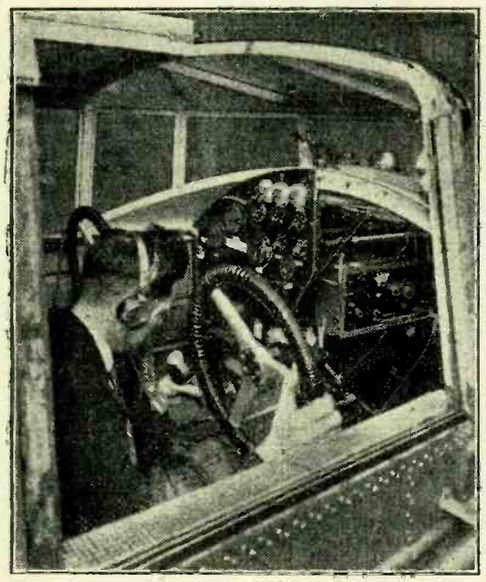
On the N.B.C. network there were at times as many as eighty-eight stations, while the Columbia system once carried ninety-six. From a radio point of view a great success was scored by the new Lapel microphones, which enabled the orators to "ramp around the platform" and forget all about the "raddio."



WITHOUT LEAVING THE SADDLE. A relay-actuated light device indicates to the patrolman that the headquarters transmitter is in operation.

Broadcasting Dispute in Belgium.

BELGIAN broadcasting has long been in an unhappy state due to conflicts between the various political associations. The managing counsel of the Belgian National Broadcasting Institute has now decided to increase the time allotted to recognised radio associations to one-half of the total time occupied by the Institute's own transmissions. Unhappily, this decision has provoked more protests. The only organisation profiting by the new time schedule appears to be the Liberal Association, which finds its time quadrupled in Flanders and doubled in the French-speaking area. The other parties, including the Catholic Socialists and the Nationalist Flemish, declare that the concession is out of proportion to the importance of the party. "Prompt action" is expected in the near future. Let us hope this will not take the same form as on a previous occasion, when the detonation of a bomb in the Brussels studio completely overshadowed the efforts of the "effects" department.



A MONTH IN THE AIR. A view of the cockpit in the Hon. Mrs. Victor Bruce's 'plane in which she hopes to establish a world record for flight duration. A Marconi A.D. 22B light 'plane transmitter is installed.

Gramophone Amplifiers in Church.

IT seems that St. Asaph Cathedral can claim the distinction of being the first important church to employ "canned" music in the absence of the organ.

In the course of recent repair work the organ had to be dismantled, but soon afterwards it was desired to provide music for a wedding ceremony. The cathedral authorities turned to the British Radio Manufacturing Company (Liverpool), Ltd., who installed a gramophone amplifier giving an undistorted output power of 25 watts. On each side of the chancel a concealed moving coil loud speaker was mounted, one being of the cone and baffle type, the other being a 12ft. exponential horn. The former was attenuated in the upper register, while the latter was less responsive below 150 cycles.

Throughout the ceremony, which was attended by a congregation of 800, bridal music was effectively rendered from the standard gramophone recordings.

According to a correspondent the pedal notes set up vibrations in the choir screen and other furnishings. Later on, the output from the amplifier was transferred to an exponential horn in the cathedral roof, and excellent reproduction was given of a wedding peal played on the bells of St. Margaret's, Westminster.

Nearing the Five Million Mark.

ANY doubt as to whether the receiving licence figure in this country will reach the five million mark before Christmas are dispelled by the news that on June 30th the figure was 4,764,188. Great Britain, which was once "runner-up" to Germany in the European licence race, is now definitely in the lead; the German total actually dropped by 100,000 in June, and is now not much in excess of four million.

Official Opening Eight Years After.

FRANCE'S silent broadcasting station is at last to make itself heard. Our Paris correspondent reports that the new Postmaster-General, M. Queuille, has signed the necessary permit for the start of transmissions from the new PTT transmitter in Paris which will have a power of from 7 to 8 kW.

This gesture is much more impressive than appears at first glance, for it is made eight years after the birth of the long-awaited station! The plant was ready so far back as 1924, and had been approved by the Finance law of 1925. For various reasons, not unconnected with the rivalries of conflicting interests, it has "rusted in a vile repose."

The Silly Season.

IT is always in the summer months that one hears of such claims as that of eighteen-year-old Dino di Corbetaldo, an Italian youth, who boasts that he has built the smallest wireless set in the world. Moreover, such claims nearly always originate in hot countries. Dino, to show his good faith, gives us the number of his instrument, viz., 10,222, together with a certificate (origin unstated) assuring him that no other wireless set on the earth is so small.

But, as our contemporary, *The Western Evening Herald*, points out: "It may be recalled that during the early days of popular radio, a Plymouth man made a tiny set which was probably little larger than that reported from Italy."

A FIVE-METRE FIELD DAY.

Forty-one Miles on Telephony with 8 Watts Output.

By a Special Correspondent.

EARLY one recent Sunday morning three cars equipped with 5-metre apparatus might have been observed leaving Croydon, each bound for a different location. One, driven by H. E. Smith, part owner and operator of G6UH, made for a hill close to Haslemere, Surrey; another, containing G6SM and John Ferguson of G6UH, proceeded to a hill just outside Dorking, whilst the third, piloted by G5BY and accompanied by the junior operator of G2BM, was bound for a lofty spot on the Sussex Downs just behind Eastbourne.

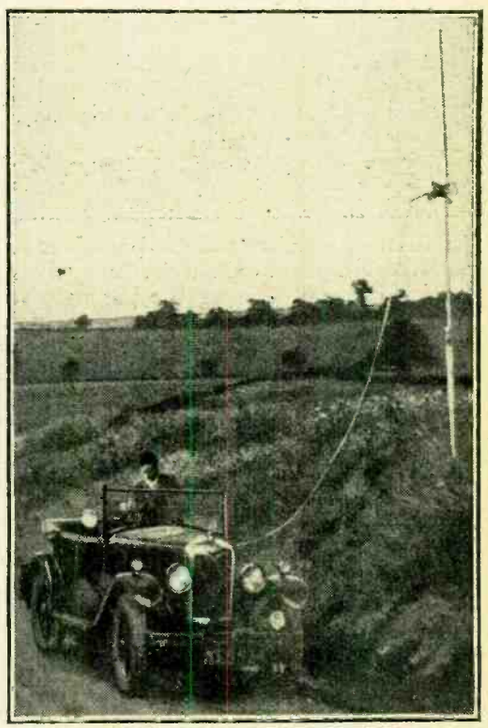
The latter car, after a hectic three miles up roads little better than cart tracks, and having a gradient of 1 in 5 or thereabouts, reached a sufficiently elevated position for the portable 56 megacycle transmitter and power supply to be unladen and put into operation.

Meanwhile, the other two cars having arrived at their destinations, receiving aerials were erected and three receivers went into action. Of these two were located about a quarter of a mile apart on the same hill near Dorking; the other, as already mentioned, was at Haslemere. The former location had already proved its worth on previous occasions, signals from both G5BY's and G6SM's stations at Croydon, about twenty miles away, having been received there.

At the prearranged time the portable 56mc. transmitter went on the air, and for a solid ten minutes G5BY kept up continuous voice modulation. This, however, on an extremely hot day, proving such an effort, the remainder of the period of transmission was completed by placing the microphone on top of an alarm clock. The transmission was picked up by the receivers at Dorking—thirty-six "air" miles away—at such strength that the voice modulation could be heard some fifteen yards from the 'phones, while the tick of the clock was audible at a distance of five yards—this, of course, being in the open air! Speech was 100 per cent. understandable all the time.

On G6UH's receiver, forty-one miles from the transmitter, the voice signals were R6-7, the clock tick being, of course, somewhat weaker. This result was particularly satisfactory, as the location chosen was not an ideal one for 56mc. work, and proves that this distance should be easy to exceed in further tests.

G5BY's H.T. was derived from the 12-volt car battery by means of one of the Electro Dynamic Company's dynamotors, which delivered 30 watts at 300 volts. The transmitter employed the same circuit as that described in *The Wireless World* of June 8th last, and was placed at, and coupled to the centre of, an aerial eight feet in length. Transmitter and aerial were erected in one piece and fed from a distance with L.T. and modulated H.T. via a three-wire cable.



FIVE-METRE FIELD SET IN ACTION. G5BY as it was rigged up on the South Downs for communication with Dorking, 36 miles away.

The modulation unit consisted of a PM4DX transformer-coupled to a PM24D (a 25-watt pentode), the latter, in turn, being choke-coupled to the plates of the oscillators through a 2,000-ohm resistance, bypassed by a 1 mfd. condenser. The PM24D drew just over 40ma. at 300 volts, and the transmitter input was 35ma. at approximately 230 volts—a shade over 8 watts.

All three receivers were of the type described in *The Wireless World*.

As soon as the necessary permit is obtained from the P.M.G. (probably before these words are in print), two-way communication between these and perhaps more distant locations will be attempted, and should, from the results already obtained, be easy of attainment.

SAVAGE PORTABLE A.C. AMPLIFIER. MODEL C/8W.

Self-contained Public-address Amplifier, Embodying an Electric Gramophone.

RARELY is a sporting event of any importance held to-day but that some provision is made to keep all those present notified of the progress of the event, of imminent developments, and of other matters appertaining to the occasion. Amplifiers and loud speakers are now the accepted medium for broadcasting information, and this practice has been extended to most of the venues of outdoor entertainment, even though the spectators have uninterrupted views of the proceedings. Between times the apparatus serves to relay musical items to all parts, thereby affording a little diversion and assisting also to sustain interest.

Consequent upon this, a number of specially designed amplifiers are now available, of which those made by W. Bryan Savage, 292, Bishopsgate, London, E.C.2, are of particular interest, for they are compact, self-contained, and designed for ready transportation from place to place. The model C/8W gives an undistorted output of 8 watts, and embodies a two-stage amplifier, a gramophone-motor, electric pick-up, and can be obtained with or without a small microphone. The whole is contained in a substantially made portable-type oak case measuring 20in. × 15½in. × 10in., and it is operated entirely from A.C. For field work, such as at sports meetings, fêtes, and other outdoor functions where A.C. is not readily available, the amplifier can be operated from a small rotary converter driven by a car battery or by a 24-volt accumulator if the last mentioned is available.

So far as we are aware, this is the only amplifier of its kind in which a screen-grid valve is employed, and in the present case its use is made possible only by a somewhat unusual arrangement of resistances in the auxiliary grid circuit, this being the subject of a recent patent. Resistance-capacity inter-valve coupling is used, for with the high amplification afforded by the first stage a voltage step-up in the coupling unit is quite unnecessary. Indeed, it has been found desirable to restrict the output from the gramophone pick-up by inserting a resistance in series with it to avoid overloading. This precaution is very necessary, for, although the pentode gives an output of some 8 watts, it operates with a negative grid bias of −35 volts only, and, as a consequence, the maximum signal potential its grid will handle without overloading is a shade less than 25 volts R.M.S.

FEATURES.

General.—*Portable-type two-valve amplifier embodying an electric gramophone and a microphone. Operates on 40-100 cycles, 100-250 volts A.C., and gives an output of 8 watts.*

Circuit.—*Screen-grid first stage amplifier, resistance-capacity coupled to power pentode. H.T. from full-wave valve rectifier. Filter-fed output transformer designed for 8- or 16-ohm loud speakers.*

Controls.—*(1) Volume adjustment. (2) Tone control. (3) Gramophone-microphone switch.*

Price.—*£27 10 0, complete with microphone. (Chassis only, £9 10 0.)*

Makers.—*W. B. Savage, 292, Bishopsgate, London, E.C.2.*

Interesting Tone Control.

An output transformer with a step-down ratio is fitted, the secondary winding having two tappings, the one for loud speakers of 8 ohms impedance, while the other gives the correct matching for 16-ohm models. When the amplifier is required to operate two or more loud speakers they must be so connected that their combined impedances amount either to 16 ohms or to 8 ohms. A filter circuit feeds the transformer, and a small resistance has been included in the anode circuit of the output valve to suppress incipient oscillation.

Decoupling is applied to the grid circuit of the output stage only, and this appears to suffice with the particular circuit arrangement adopted, for there is no trace of instability. One other point of interest is the positioning of the tone control included to compensate for the tendency of the pentode to emphasise the higher frequencies. It takes the form, familiar to most readers, of a variable resistance connected in series with a condenser and, although it is customary to apply the compensator to the output stage, here we find it included in the grid circuit of the first valve.

In this position it is particularly effective, and affords a very wide range of control. Its effect is to depress the amplification of the higher frequencies. Turned to the extreme position in one direction, the upper register is almost entirely suppressed, while turned to the limit in the other direction the accentuation of the higher frequencies is most marked. Between these two extremes will be found a position where the output is well balanced.

The response curves perhaps show best the effect of the tone control. Curve A is the overall characteristic of the amplifier without

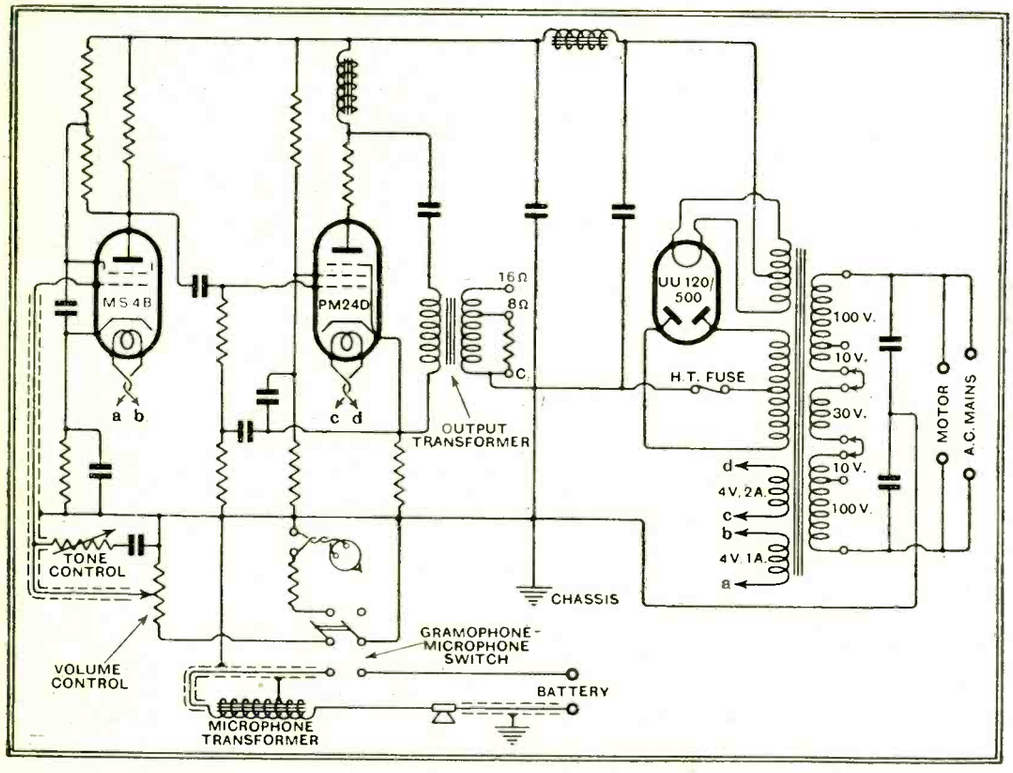


Fig. 1.—Circuit arrangement of the Savage public-address amplifier, Model C/8W.

Savage Portable A.C. Amplifier.—

correction, the input voltage being injected at the point where the pick-up connects, while the output is measured across the secondary of the output transformer. Curve B was obtained with the tone-control resistance set to approximately its mid position. The broken-line curve shows the effect of maximum correction. It is interesting to note in passing that one effect of applying correction is to raise slightly the amplification below 100 cycles. The reason of this is rather obscure, but it is connected in some way with the complicated network of resistances and a capacity in the input circuit.

The Microphone Circuit.

These curves do not take into account the characteristics of the pick-up, as this component was not included in the circuit at the time the measurements were made. Since the step-down ratio to the 16-ohm tapping on the output transformer is 22.4:1 approximately, the mean overall amplification from the point of connection of the pick-up to the anode of the output valve is 448 times. As a matter of interest, this figure does not represent the true maximum amplification available from the two-valve arrangement, as the resistance in series with the pick-up has a limiting effect, and was retained in position when making our measurements. The maximum amplification, which is considerably greater, is taken advantage of, however, when the microphone is used, but the volume control must be turned down considerably to avoid overloading.

In the models embodying the microphone there is a two-pole change-over switch which brings the gramophone or microphone into operation as required. When the microphone is inoperative, it is housed in a special fitting attached to the recessed lid, but is transferred to a more convenient position near the front of the motor board when in use. Although it is a comparatively inexpensive component, its characteristics are

Fig. 2.—Illustrating the compact and portable design of the Savage 8-watt amplifier.

quite good judged aurally, speech being not only perfectly intelligible, but quite clear and crisp. The input transformer is housed in the top left-hand corner of the lid, and two sockets for connecting the small 4½-volt battery required to supply the microphone current are located at the back of the valve platform.

Background Noises Avoided.

A universal-type mains transformer, having some eight tappings, being fitted, the amplifier can be adapted quickly for use on any standard supply of from 100 to 250 volts, 40 to 100 cycles, A.C. The Collaro electric motor is provided with a voltage adjuster also, and this will be found below the turntable. There are two positions only in this case; the one serves for supplies between 100 and 130 volts, while the other makes suitable adjustment for mains ranging from 200 to 260 volts, 40-100 cycles, A.C. An automatic stop is included which switches off the motor at the end of the record.

Although the amplification curves give the best indication of the performance of the amplifier, a few additional comments may not be out of place here, since these do not include the response characteristic of the Marconiphone pick-up or that of the loud speaker. With a good loud speaker the out-

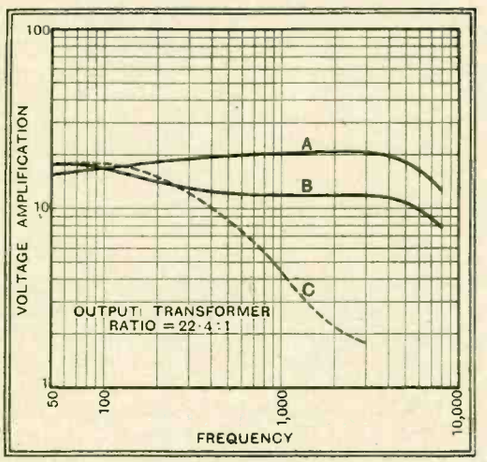


Fig. 3.—Overall response curves of the amplifier. (A) Without tone correction, (B) partial correction, (C) maximum correction.

put is inclined to be a little rich in high notes before tone correction is applied. However, the bass is well in evidence, and quite a small adjustment of the compensator serves to produce a very nice balance. The slight reduction in amplification above 5,000 cycles is barely noticeable; indeed, in some respects it is an advantage, since needle-scratch noises become less apparent. This particular amplifier is singularly free from background noises, mains hum has been reduced to negligible proportions, and the electric motor is so well screened that it is incapable of causing the slightest interference. Even with the microphone in circuit, the hiss characteristic of all carbon-type components of this nature is only just perceptible indoors, and in the open air would be entirely obscured by external noises.

To sum up, the Savage Model C/8W amplifier, having been designed to provide a certain service connected with public entertainment, performs its allotted function in a perfectly straightforward and satisfactory manner, and, in addition, embodies most of those features essential to equipment of this type. It is self-contained so far as practical considerations deem desirable, is comparatively simple to handle, and, being housed in a substantially made case of portable design, is readily transported from place to place, and can be brought into operation in a very short space of time. Of no less importance is its very reasonable price. Complete with microphone and valves the

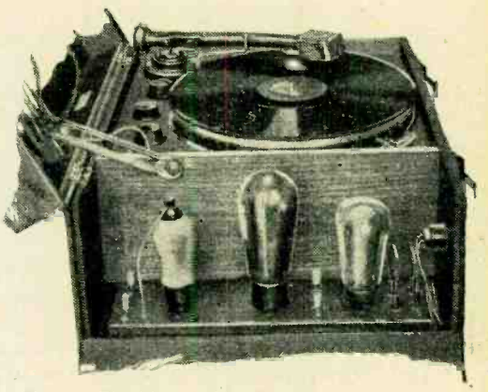


Fig. 4.—The hinged side gives easy access to the valves, output sockets and mains adjustment.

amplifier costs £27 10s. Without microphone and its switching the price is £2 10s. less, while the chassis only, less valves, gramophone motor, and other accessories, is obtainable at £9 10s.

A larger model, designed on somewhat similar lines but having two pentodes in parallel, with an output rating of 16 watts, and designated the 2/16W model, is obtainable at £32 10s., complete with all the accessories provided with the amplifier here described.

"BREAK-THROUGH" INTERFERENCE.

IN a long experience of trouble-tracing in all types of receivers, one not infrequently comes across cases where a medium wavelength station "breaks through" when the receiver is tuned to a long wavelength. Various methods of checking this nuisance have been successfully used, but occasionally stubborn cases have been encountered in which all attempts at tracing the trouble have proved abortive, more especially in the case of receivers employing two stages of amplification.

Wave-range Switch at Fault.

Careful analysis of many stubborn cases in which the fault was eventually traced has revealed the surprising fact that in no fewer than 50 per cent. of them it was due to a faulty contact in a wave-change switch. It is well known that in order to receive long waves the practice of using loading coils—which are short circuited when on medium wavelengths—is almost universal nowadays.

In a receiver of the type mentioned above there may be four tuned circuits, and if the long wave section of one of them fails to be "opened" by the wave-change switch it is easy for this trouble to occur. The fault is probably due to a defective switch contact as already indicated, but in a number of cases it has been traceable to an undue amount of "whip" in the rod actuating the various switch contacts.

NUTS TO CRACK.

Instructive Problems and their Solution.

THE present series has been started by *The Wireless World* for the benefit of readers who like to work out little problems for themselves and be sure that the results they obtain are correct. At frequent intervals wireless problems are presented, and in the following instalment the answers are given with the methods of working them out, and hints on possible points of difficulty. Problems 56, 57, and 58 have already been given, and below the answers appear, whilst another set of problems is included this week for treatment in the next instalment.

QUESTION 56.—**A power valve whose nominal A.C. resistance and optimum load are quoted as 1,400 ohms and 3,500 ohms is coupled by a choke-filter to an output transformer. If the moving-coil speaker used has an impedance of 2,100 ohms at 256 cycles, what should be the turns ratio of the transformer? If an additional similar loud speaker were connected in parallel with the first, what should be the transformer ratio?**

Answer—1.29 *to* 1 *step-down;* 1,82 *to* 1 *step-down.*

It is a safe working rule that, in the absence of special information regarding the best working load for an output valve, this should be chosen in the neighbourhood of twice (or even more times) the value of the A.C. resistance of the valve. Very often, however, the optimum value of load is specially quoted for output valves, following the lead given by *The Wireless World*, which publishes this information in its annual Valve Data Sheet. In the present instance this optimum load is expressly given as 3,500 ohms, which is thus a little more than twice the A.C. resistance of the valve. The precise value is not, however, critical.

The correct transformer ratio for "matching" the actual loud speaker impedance to this optimum load is given approximately by the expression:—

$$\text{Ratio of primary to secondary turns} = \sqrt{\frac{\text{Optimum anode load}}{\text{Speaker impedance}}}$$

Substituting numerical values, this becomes

$$\sqrt{\frac{3,500}{2,100}} = \sqrt{1.667} = 1.29$$

The transformer ratio required is thus 1.29 to 1 step-down.

When the second similar loud speaker is connected in parallel across the transformer secondary, the equivalent impedance of the two instruments becomes half its former load value, or 1,050 ohms. In this case the best turns ratio will therefore be

$$\sqrt{\frac{3,500}{1,050}} = \sqrt{3.333} = 1.82.$$

QUESTION 57.—**A loud speaker whose inductance is 1.15 henrys is coupled to a power valve through a condenser of 2 mfds. To what frequency will the combination be resonant?**

Answer—104.9 *cycles per second.*

This is obviously a simple exercise in finding the resonant frequency of a series tuning circuit, and the only point calling for any remark lies in the treatment of the units involved. When the inductance L and capacity C of a series circuit are both expressed in the fundamental units, viz., henrys and farads, the resonant frequency in cycles per second is given by the well-known formula

$$f = 1/2\pi\sqrt{LC}$$

In the present instance, the condenser is of 2 microfarads capacity; we must therefore express this in terms of farads before applying our formula: evidently it is 2×10^{-6} F. Substituting numerical values in the formula, we now have,

$$f = \frac{1}{2 \times 3.1416 \times \sqrt{1.15 \times 2 \times 10^{-6}}}$$

and, after a little "slogging," the intrepid arithmetician will arrive at the desired result, viz.,

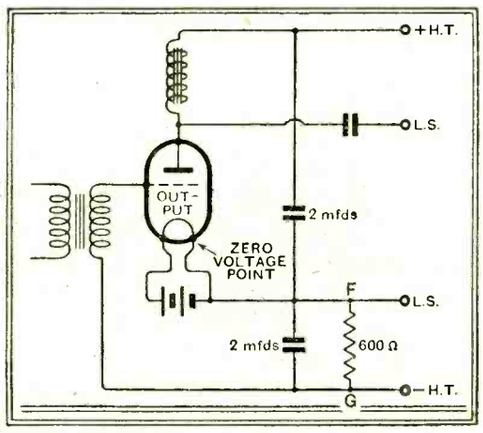
$$f = 104.9 \text{ cycles per second.}$$

With most people, however, arithmetic is a form of light recreation seldom indulged in, and the majority of wireless enthusiasts are now accustomed to solve such problems as this by the popular abacs published in *The Wireless World*. The issue of February 17th last contained a useful chart by means of which approximate solutions to the above and many other allied problems may be obtained at sight with sufficient accuracy for all practical requirements.

QUESTION 58.—**A two-valve portable set obtains "free" grid bias on the output valve by means of a 600-ohm resistor between the H.T.—and L.T.—leads. With a valve of 6,500 ohms A.C. resistance the grid bias is 7 volts negative. With another valve of 8,000 ohms A.C. resistance it is only 4.5 volts negative. The H.T. supply being 120 volts, what is the steady anode current in each case?**

Answer—11.7 *mA., and* 7.5 *mA.*

When filament current is provided by an accumulator, it is customary to measure the grid bias voltage from the negative end of the filament, which is thus reckoned to have zero potential. The accompanying figure shows the essentials of the grid biasing scheme here adopted, in which the steady part of the anode current provided by the H.T. battery flows through the biasing resistance of 600 ohms, while the speech component follows the low-impedance path of the shunting condenser. The filament end of the resistance, F, has evidently a more positive potential than the grid end, G, which is connected directly to the negative terminal of the battery. G is thus biased negatively with regard to F, and, since this last has zero potential, we may properly regard G as being "so many volts negative" to F.



Practical biasing scheme for output stage. Note the decoupling condenser across the bias resistance.

By Ohm's Law the steady current I in amps, is given by the quotient E/R where E is the P.D. or bias voltage and R is the resistance in ohms.

In the case of the first valve, therefore,

$$I = 7/600 = 0.0117 \text{ A.} = 11.7 \text{ mA.}$$

With the second valve,

$$I = 4.5/600 = 0.0075 \text{ A.} = 7.5 \text{ mA.}$$

In neither case has the A.C. anode resistance of the valve anything to do with the problem.

The importance of adequate decoupling arrangements with this form of grid biasing should be emphasised.

NEXT SERIES OF PROBLEMS.

QUESTION 59.—**If 10 kilocycles be taken as the necessary frequency "spread" of a broadcasting station, how many stations could be operated on wavelengths between (a) 100 and 600 metres; (b) 3 and 8 metres?**

QUESTION 60.—**In order to measure the resistance of a grid leak, a 200-volt meter of 980 ohms per volt resistance is employed in conjunction with a dry battery. The direct voltage reading of the battery is 144 volts, but if the grid leak be included in the circuit the reading drops to 24 volts. What is the value of the leak?**

QUESTION 61.—**A transformer-coupled stage of L.F. amplification incorporates a device for tone-control by the use of which the effective amplification of the stage may be varied between 3 times and 0.15 times the magnification factor of the valve. What is the amplification range of the tone-control in decibels?** NUTCRACKER.

NEW BOOKS.

The Mathematics of Wireless. By Ralph Stranger. pp. xi+193. (George Newnes, Ltd., London. Price 5s.)

Although some may disagree with the author's methods of presenting his subject, all will have sympathy with the end in view. This is, as stated in the Introduction, to "explain to 'the man in the street' the mathematics of wireless." There is undoubtedly a need for a book explaining simple mathematics in simple language for people who wish to get the most out of wireless as a hobby. The difficulty is to provide good, plain instructional fare with just enough sugar-coating to make it palatable. This book errs somewhat in the direction of too much sugar-coating in proportion to solid matter.

Mr. Stranger has endeavoured to gain the confidence of the reader by carefully excluding matter which he considers "difficult." This, of course, makes for easy reading, but the inevitable fact remains that the book will provide only an introduction to whet the appetite of the novice for more complete knowledge.

Gramophones, Acoustic and Radio.—The official handbook of "The Gramophone." Advice on buying, maintaining, and overhauling acoustic and radio gramophones, with notes on storing and cataloguing records, and general hints and tips. Pp. 122, with 63 diagrams and illustrations. Price 1s.

BROADCAST BREVITIES

By Our Special Correspondent.

Programme Canning in Portland Place.

THE B.B.C. is making full atonement for its early indifference to the Empire broadcasting question. Following upon the establishment of a station at Daventry with a world-wide range, the Corporation now proposes to make assurance doubly sure by entering the programme canning industry.

Finding a Market.

If Daventry should fail to make itself heard everywhere (and this is what the new arrangement suggests may happen), our brothers in the Dominions and Colonies will still hear us and our programmes on recording discs, which are to be sold in whatever market they will fetch a price.

Pity the Local Artists.

The sufferers from the scheme will be the broadcasting artistes. Despite assurances that these selections from the world's best programme entertainment will not compete with local talent, I am convinced that broadcast artistes up and down the Empire will soon begin to feel the draught.

What Australian listener, for example, would want to listen to a Bush soprano when Gracie Fields is available in her latest B.B.C. triumph?

Smashing Records.

Copyright complications, too, are bound to follow.

And what will happen when the records get smashed half-way across the Pacific?

Developments at Daventry.

In the meantime the B.B.C.'s field at Daventry begins to look like a Druid circle; in fact, there seem to be almost as many masts as on the famous Post Office site at Rugby.

No short-wave plant has yet been installed, but I understand that it is nearly completed in the works of Standard Telephones and Cables, Ltd., so that the first tests may be made very much sooner than was expected.

I hear, by the way, that even when 5XX and Midland Regional are transferred to Droitwich, the old aerial masts are likely to remain as part of the short-wave system.

Doubts in Droitwich.

The Droitwich Municipal authorities are still on tenterhooks regarding the B.B.C.'s recent survey of the district. After all that has been said, it would be a tragedy if Droitwich were not chosen for the new transmitters; the townsfolk know full well that broadcasting can give the place more fame in a night than the celebrated mineral springs have brought in a thousand years.

While the World Listens.

IT looks as if the relay of the unveiling ceremony at the Thiepval memorial on August 1st will provide the biggest simultaneous broadcasting event in the world's history. Besides being broadcast throughout the United Kingdom, the service will be relayed via Rugby to Canada, America, and Australia. India and Ceylon will also pick up the relay from Daventry 5SW, which will be specially opened for the occasion.

It is said that some of the German stations will also relay the service, but I cannot vouch for the truth of these statements. It is a fact, however, that German stations did tune in the relay from the Menin Gate, Ypres, when this memorial was opened in 1929.

A B.B.C. Vesper.

AND now we are to have a special B.B.C. Vesper Verse. At the conclusion of the Epilogue on Sunday week (August 7th) listeners will hear a short verse sung to the music of Cyril C. Dalmaine, in which the general sentiment is summed up in the words: "Grant that the Nations shall speak peace to the Nations one and all." The author of the hymn is Paul Askew.

A Better Pamphlet.

AT last the B.B.C. have produced a pamphlet with a cover illustration which positively pleases. The new programme pamphlet "Broadcasts to Schools," with its graceful sketch of Broadcasting House, could actually be left lying in a classroom, whereas the cover designs of some earlier pamphlets were enough to give a sensitive child melancholia.

The new pamphlet covers the school programme from September, 1932, to June, 1933. Although each course is complete in itself, many of those outlined continue previous work.

Sir Walford Davies Again.

Miss Rhoda Power, whose dramatic and literary interludes are now a special feature of broadcast history, will again take part. Commander Stephen King Hall will specialise in modern affairs. This year's travel talks will cover many corners of Europe, beginning with Brittany and the forests of Finland.

Everyone will be glad that Sir Walford Davies is providing two courses. The first is intended for schools which are without adequate resources for the teaching of music; the second will be for those which already have their own musical curriculum.

"Outside" Band in the Studio.

ONE of the best of the present outside dance bands will fill the late dance music period from a studio at Broadcasting House on August Bank Holiday. This is Billy Cotton's Band, which at one time was heard regularly from Ciro's Club, but has not been much "on the air" recently by reason of other engagements which could not be made to fit in with broadcasting.

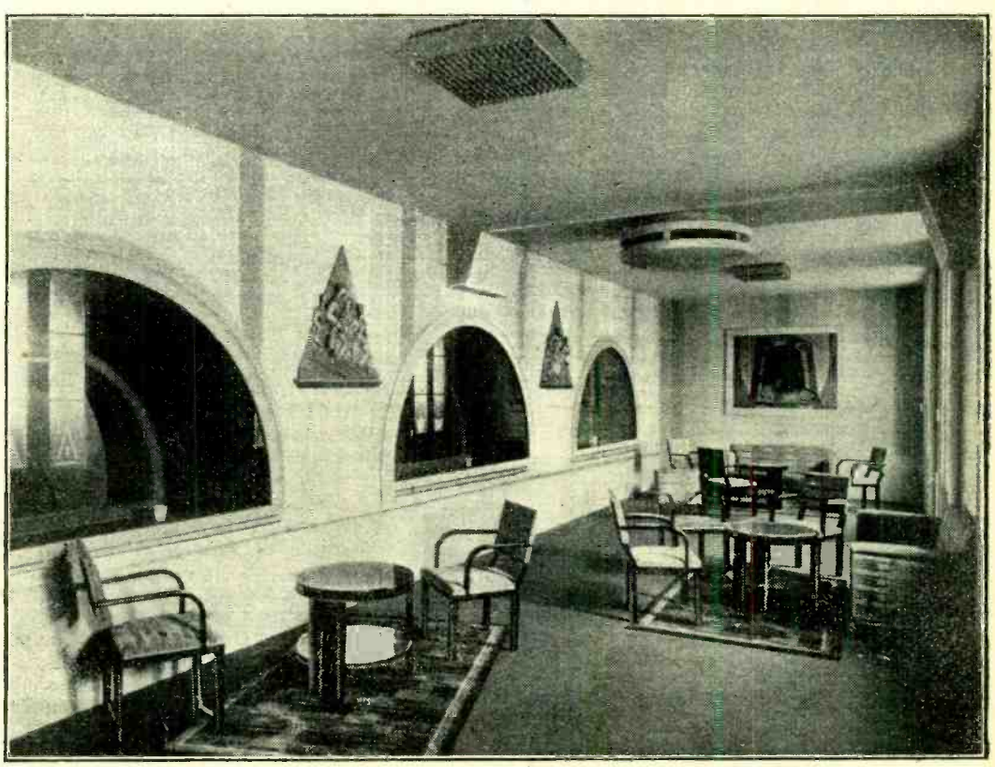
Planning the Anti-pirate Campaigns.

IT is impossible not to admire the persistency of the Post Office in their campaign against "pirates." I was at Portland Place the other day when notification was received from St. Martin's le Grand that "special investigations" were to be conducted in a certain area.

In most cases, by means of skilful propaganda, the battle has been won before the much-dreaded van appears. Last week the campaign ranged over the Manchester, Crewe, and Trent areas, and I am told that the P.O. engineers are still very busy.

How the Press Helps.

By the way, I wonder whether the work of the Press is fully recognised by the Post Office mandarins; at most, all the local newspaper gets out of the business is a good "story," whereas both the Post Office and the B.B.C. stand to win hard cash.

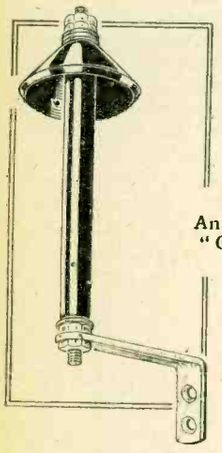


"RADIO HOUSE," ROME. Restrained luxury in a modern setting characterises the new headquarters of Italian broadcasting. The photograph shows one of the artistes' waiting rooms. Most of the studios being below ground level, artificial ventilation is necessary.

LABORATORY TESTS ON NEW RADIO PRODUCTS.

"GAP" LIGHTNING ARRESTER.

THIS aerial safety device consists of an ebonite tube to the lower end of which is attached a wall bracket, while at the upper end is an ebonite cowl above which is located a terminal for attachment of the aerial down lead. The earth connection and the lead to the earth terminal on the receiver join to the fixing screw holding the wall bracket.



An aerial safety device, the "Gap" lightning arrester.

Down the centre of the ebonite tube are two metal rods, extensions of the aerial and earth connections, and the inside ends are separated by a small air gap. In the event of lightning striking the aerial the charge jumps the spark gap and is carried to earth.

It would seem advisable to include a small fixed condenser in series with the aerial coil in the set, for without this interruption of the alternative course the aerial charge might prefer the path of lower D.C. resistance.

The "Gap" safety device is made by Ward's Radio, Railway Terrace, Rugby, and the price is 2s. 6d.

TRIX MAINS COMPONENTS.

ERIC J. LEVER (TRIX), LTD., 8-9, Clerkenwell Green, London, E.C. 1, have for long specialised in the manufacture of components designed especially for mains use, and their latest range of transformers now includes over twenty different standard types. Tests made with a few representative specimens confirmed the makers' claim that in every case the component is capable of considerable overload, thus pointing to a generous margin of safety. These models run perfectly cool under full load conditions, and the output voltages are well regulated.

The model V350/75A is a typical example of a general purpose transformer suitable for use in a 4-valve receiver. It is intended to supply up to 75mA. of D.C., and on full load about 370 volts will be available after smoothing. The model has three secondary windings rated at 350+350 volts, 4 volts at 2.5 amps. for the rectifier, and a 4-volt L.T. winding giving 4 amps. respectively. With four A.C. valves connected to the L.T. winding the potential across their heaters was approximately 3.9 volts when 50 mA. are taken from the rectifier. Under these conditions the filament supply for the rectifying valve, which required 2.5 amps., was 3.94 volts. Results quite as satisfactory as this were obtainable from the other specimens tested.

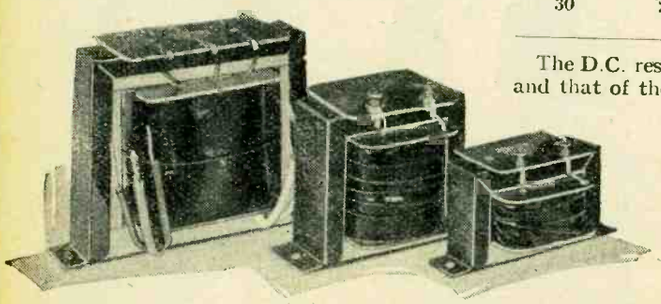


Fig. 1.—Trix mains transformer Type V.350/75A and L.F. chokes C.30P and C.55.

Chokes intended for H.T. smoothing and for use in output circuits are available in various sizes; the smallest is capable of carrying 20mA. of D.C., while the largest standard model has a D.C. carrying capacity of some 300 mA. A special low resistance model has been designed for use as an output choke with D.C. pentode valves. Its resistance is of the order of 120 ohms so that when passing its maximum current of 30 mA. 3.6 volts only are dropped across the choke.

Two specimen chokes were tested; this special model, the C.30P, and a general purpose smoothing choke designated the model C.55. Their respective inductances when passing various amounts of D.C. were found to be as follows:—

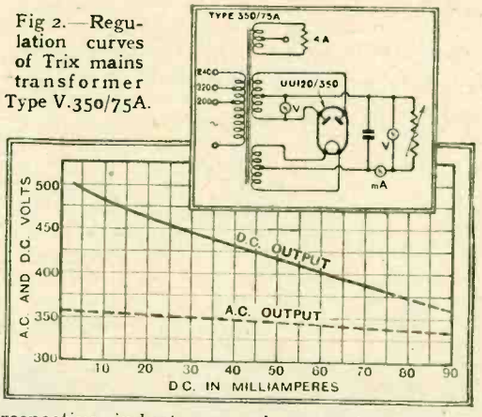


Fig 2.—Regulation curves of Trix mains transformer Type V.350/75A.

Model C.30P.		Model C.55.	
D.C. in mA.	Inductance in Henrys.	D.C. in mA.	Inductance in Henrys.
0	41	0	32
5	36	10	28
10	33	20	26.5
15	31	30	25.3
20	30	40	24
25	29	50	23
30	28.5	55	22.7

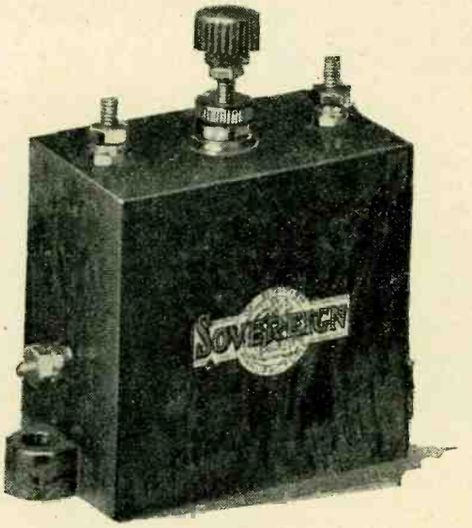
The D.C. resistance of the C.30P is 133 ohms, and that of the C.55 model 350 ohms.

The above measurements were made under conditions as close as possible simulating those obtaining in a practical case. For example, about 100 volts A.C. were applied across the pentode model, but 6 volts A.C. only were used in the case of the smoothing choke.

The prices of the components here illustrated are: mains transformer, Type V350/75A, 37s. 6d., with or without terminals as desired; L.F. chokes model C.30P, 19s., and model C.55, 14s. 6d.

SOVEREIGN VARI-CHOKE.

WHENEVER an H.F. choke figures in the circuit a condenser is invariably associated with it either in the form of a by-pass condenser or as a medium for coupling to a valve or a tuned circuit. These two components thus lend themselves admirably for embodying in one unit, but so far the Sovereign Vari-Choke is the first example of this practice we have seen.



Sovereign Vari-Choke, consisting of an H.F. choke and variable condenser.

The H.F. choke has a comparatively high inductance so that this component is interchangeable with any standard model and can be employed wherever a component of this type is specified. It includes a variable condenser of the pre-set variety, the maximum capacity of which was found to be 0.00037 mfd., a value quite adequate for most purposes.

Three terminals are provided, of which the top pair join to the condenser while the H.F. choke is connected to the side terminal and its adjacent top terminal. It is housed in a neat bakelite moulded case measuring 3 ins. × 3 ins. × 1⅜ ins. overall.

The makers are Sovereign Products, Ltd., 52-54, Rosebery Avenue, Clerkenwell, London, E.C. 1, and the price is 3s. 6d.

JUNIT S.G. LOLOS VALVE HOLDER.

A PARTICULARLY neat 5-pin valve holder for horizontal mounting, and intended primarily for use where the screen-grid valve passes through a hole in a vertical screen, is obtainable from the Junit Manufacturing Co., Ltd., 2, Ravenscourt Square, London, W.6. The body, which is a bakelite moulding, consists of a hollow shell with the socket springs anchored by their respective terminals, but not coming in contact at any any other point with the bakelite.

Junit 5-pin valve holder for horizontal mounting.

Since the springs are mainly air-spaced, the losses in the valve holder are extremely small. An aluminium stamping is riveted to the bakelite shell, and serves to support the valve holder in a horizontal position. The price is 1s. complete.

Letters to the Editor.

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

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

Frequency Range.

WITH reference to the controversy as to frequency range at present being aired in your columns, may I venture to approach the matter from an entirely different aspect?

To begin with, it is impossible with the present frequency band allowable to give the fundamentals of over two octaves of the pipes included in a Wurlitzer organ, the frequency of the highest pipe note being in the region of 20,000 cycles.

Again, to turn to another instrument, the 'cello. Any player will agree with me that the stable harmonics that can be played on a stringed instrument give a reliable indication of the general tone quality of the instrument. I myself have a nice copy of a Stradivarius 'cello, and can easily play a sixteenth harmonic of A, which has a frequency of 3,250 cycles, and to maintain the quality which this indicates when playing notes up to A one must go up to 6,300 cycles. As a matter of fact, quite a lot of 'cello parts are written an octave higher (requiring 12,000 cycles), so that our quart (12,000 cycles) has to fit our pint pot of 4,500 hertz.

But this is not all; I have, since Mr. Hartley first started by publishing his frequency chart, taken several opportunities of listening to commercial receivers within the means of the average man's pocket, and the results have surprised me.

At one time in the dark ages one got from a speaker a plethora of middle with no ends. Later, one got a cone speaker and said, "What d'you think of that bass." Still later, someone discovered high notes, and an attempt was made to put the top on the music (?) to which we had been accustomed. But what has become of the middle register?

I have serviced practically every make of set yet produced, and I can think of only one reasonably priced commercial receiver which does not give ends and no middle. I forbear to mention names.

Is there any reason why the response curves of these receivers should not be "cooked" to put back the middle? I have not experimented with the problem, but suitably tuning a transformer secondary in connection with a resistance to damp out undue sharpness of the response at resonance should do the boosting required by the middle, and, if suitably arranged, should not unduly reduce either the top or the bottom.

In case anyone should ask me where I get my ideas of balance, I will add that I have had some years of playing in a good orchestra.

Salford. H. MOORBY.

Mr. Tomes Replies.

WILL you please allow me space to reply to Messrs. Cross, Turner and Young, who replied in the issue of July 8th to my letter on "Broadcast Reproduction"?

In the first place, my letter was not published in full by *The Wireless World*,* part of which was omitted for some reason, which I suspect hit the nail on the head!

I referred the Editor to an issue wherein no less than a page and a half out of some two pages was given to the discussion. This part was not published, and does not give full colour to my letter.

Replying to Mr. Cross, it may interest him to know I have one of the latest seven-valve all-electric radio-gramophones designed for quality, so am in no need for his so-called "educating." I believe in buying a good set. He would not buy a £10 car and expect Rolls-Royce running out of it by fiddling about; he should make sure of facts before he rushes into print.

Mr. Turner is under the impression that as his letter of May 11th was not attacked, it was correct—far from it, the letter was not interesting enough to read, apparently!

He says the pages of *The Wireless World* are a suitable place to discuss "Reproduction." I agree, but let us have Dr. McLachlan or Bonavia Hunt to discuss the subject, not Mr. Hartley, whose figures were wrong. [*Our correspondent has produced no evidence in support of this statement.*—ED.]

Mr. Turner's contention that the "Purists" are satisfied with the B.B.C. transmission is pitiful; seeing that on the same page as his letter is a "moan" from a Mr. Rampton, who complains that the B.B.C. interfere with the transmitter, he slips up badly in his statement of being satisfied; perhaps this is his idea of "reasoned discussion"!

Mr. Young's letter is nearer the mark when he states that "Reproduction" can be debated to a certain extent. Just so, but this has been going on for the last two months, and can anyone say they have progressed one iota? It is exactly as I say—a waste of space, and boring. I have noticed that the "Purist" brigade are the people who are never satisfied, always pulling their sets to pieces. A complete programme to them or their families is unknown; or, if you hear their set, you are told, "It's not quite right, when I get so and so it will be finished," etc.

Half the oscillation caused is by these people, who plead that this is progress.

Let the "Purists" get it into their heads once and for all that reputable makers of sets keep a special department for research, and can spend money in doing so—far more than any experimenter can afford to do; and remember the old saying: "You cannot get something for nothing." If you want quality you must pay for it, not waste time and space in "bickering."

In conclusion may I thank the Editor for allowing me to reply to the above gentlemen?

London, S.W.12. C. J. TOMES.

* The only omission was a sentence reading: "No less than a page and a half is given in this week's *Wireless World*."—ED.

How Many Valves?

MR. A. J. MADDOCK'S letter in the issue of July 15th seems much to the point. Why not follow the prevailing fashion of compromise, however, and combine the two notations? The example quoted by Mr. Maddock would become a "four stage-five valve receiver," or in contracted form a "4S/5V" set. One might even carry this to its logical conclusion and refer to a "4S/5V/R" set, the "R" indicating a power rectifier of any type incorporated in the receiver. (I think it most undesirable that a rectifier "bottle" should be classed as a "valve" in such a notation, as it only leads to misunderstandings.) In the above example the 5V/R portion gives *some* indication to a prospective purchaser of the class of receiver—highbrow, lowbrow, or just common-or-garden—and also (should he hail from Aberdeen) of its value for the money. Of course, as a Scot he would call it a "1-v-2S/5V/R"!

May I add to the congratulations on your enterprise in the new make-up of the paper?

Belfast. JOHN A. SANG.

What the Ear Hears.

YOUR summary of the Bell Laboratories' tests on the frequency-bands required for the reproduction of specified sounds published in your issue of June 15, "What the Ear Hears," is opportune, and should satisfy disputants for a while. It is important, however, to emphasise that only one issue was in hand, i.e., what extensions of the frequency-band do add something to the reproduction. Having obtained an answer, it is a matter of commercial engineering to see if adherence to the answer is practicable in particular sound-reproducing systems.

It is obviously useless to strive unnecessarily to satisfy the criteria thus set up when one is faced with a general inadequacy of response in the sound-reproducer. On the other hand, the cost of extending the transmitted frequency range is comparatively a small matter for broadcasting administrations, and they should therefore lead the way for attaining the ultimate ideal by placing no hindrance in the way of anyone desirous of taking the trouble to do his share of the work.

An important point arose in a recent letter, whether the frequency-response between the modulation in the radio-transmitter and the sound-intensity in the studio should have any particular arbitrary form. This can only be settled on an engineering basis, depending on the nature of the transmitting medium. As adjacent transmitters are liable to carrier interference, and that the actual power in speech and music is associated with low frequencies rather than high, it appears that a tilt up in the response before transmission, with subsequent correction in the receiver, is justified. Needless to say, whatever is done in the transmitter must be maintained, otherwise listeners would never know what to do.

It follows that broadcasting administrations are likely to come to widely differing conclusions about the response curve between the modulation and the sound-intensity in the studio, with the result that the exploring listener, with a set giving a fixed response, is likely to arrive at unfavourable opinions of a particular administration's quality of transmission, forgetting that the latter is, or ought to be, based on a policy and not lack of knowledge.

This brings me to the most important point in the study of sound-reproduction, how may the quality of reproduced sound be judged? As it is practically impossible to make useful comparisons between original sounds and their reproduction, a more useful criteria must be adopted. The most serviceable is that adopted in acoustic research and exemplified by the Bell Laboratories' tests. In a reproducing system the defects were examined and measured, and bearing these in mind tests are devised to see how important these known defects are in reproducing sounds. It is quite

idle to make a lot of tests without previous measurements to indicate what one is looking for; this is mere guess-work and of no real value, except possibly in the very beginning of a study; certainly not in this year of grace where the reproduction of sound is concerned.

What, therefore, happens to the man who, for various reasons, has not the tools to investigate the individual defects and to control them? The answer must be that he must depend on guessing. As we are only considering frequency distortion at the moment, it follows that he can use whatever frequency-response curve he fancies, and no one can deny him the right. Mr. Willans' letter, on page 609, is apposite, and is couched in sufficiently forcible terms to need no amplification from me. His remarks are fundamental to the problem of tone-control, most particularly to those schemes of tone-control which are continuously variable over a wide range. The science of sound-reproduction has arrived at a stage where the adjustment of the tone of reproduction over a fairly wide range can be defended on the grounds of personal preference. I am, of course, begging the question regarding the meaning of overall reproduction.

As a step towards arriving at some conclusions regarding the measurement of overall reproduction, perhaps a few remarks relating to a form of distortion, which has not been thoroughly examined yet, may be useful. For want of a better name, I call it *acoustic distortion*, because it is only concerned with sound-waves and their effect upon the ear. When we listen to a sound the received impression is made up partly from the reception of the direct radiation from the source and the reception of reverberant sound, the latter being determined by the surroundings. If the ratio of the *direct-intensity* to the *reverberant-intensity* is high, the sound is acoustically *hard*; if the ratio is low, the sound is *mellow*; if very low, the sound becomes *echoy*. This ratio is alterable by the polar response-curves of both the microphone and the sound-reproducer, in a way that can be simply calculated, as well as by the distance of the listener from the source of sound and the reverberant properties of the enclosure.

If the microphone and sound-reproducer are directive, the sound is hardened for some orientations, particularly along the axes, and the more so for high frequencies, because the polar response-curves of most microphones and sound-reproducers become very concentrated as the frequency is increased. It follows that inadequate reverberation and exposed sound-reproducers at a short distance, as obtains in most domestic reception, tend to harden up the reproduced sounds so as to become intolerable.

Now most people profess to prefer a mellow tone on reproduction, and they proceed to get it by shunting their reproducer with condensers to cut off the high frequencies. What they are really doing is to reduce the contribution of high-frequency hardening to the general mass of sound, and on the whole they gain more in general reproduction by cutting down the high frequencies to increase mellowness than they lose on frequency response.

Radio research workers on the Continent are paying special attention to the problems of microphone and loud speaker design. The "soup-ladle" reflector on the right is a modification of the design which has become so popular in America. The microphone is a new condenser type which can be tested in conjunction with the various loud speakers seen on the left.

An analogous condition arises in phase-distortion in very long telephone lines, in which the high frequencies get left behind the lower frequencies. The hang-over of the high frequency components gives rise to a tinny ring on reproduction, but in reducing the high frequency components on reception, more is gained in articulation than is lost by their removal on a frequency basis.

Please remind your readers that side-bands still exist, but that it is open to anyone to change the system of modulation from a linear response to an inverted frequency response by the use of a very sharply tuned circuit if they feel that they have a real reason for doing so. Also that a sound-reproducer is not a musical instrument.

L. E. C. HUGHES, Ph.D.

London, W.1.

Next Week's Set Review:—

MARCONIPHONE 2 VALVE BATTERY RECEIVER

MODEL 248

100 Divisions or 180 Degree Scales?

THE arrival of receivers such as your Monodial Super, having exceptionally sharp tuning, raises in an acute form the question of graduation and size of dial scales. The table of condenser dial readings in your issue of the 27th of last month shows several readings to a tenth of a division on a 100 divisions scale, otherwise readings of one two-thousandth part of the circle. With my own receiver, an H.F. Det. Pentode with no claims to exceptional range or selectivity, my table of readings shows several readings of half degrees with an 180 degrees scale.

Such considerations seem to rule out the hundred divisions scale. It is quite easy to halve a division by bringing a hair line or other index midway between two divisions; tests show that the eye does this readily and remarkably accurately even when the divisions are close together. It is a very different matter when the eye has to estimate a distance of a quarter of a division away from a line.

But if scales of 180 degrees are to be easily read and used, dials must be of adequate diameter to permit of useful spacing between graduations. The back-of-panel type of dial enables a large diameter scale to be used, the only limitation being the necessity of clearing the bottom, or lid, of the cabinet. I consider a six-inch diameter scale the least size of any real use in a modern receiver. Here one degree subtends about one-twentieth of an inch. Alternatively, a two-to-one gear can be used to enable the whole circumference of the dial disc to carry a scale instead of one-half as at present. The gears need not be machine cut. It is not essential that the dial disc doubles the movement of the condenser drive with mathematical accuracy; all that is required is that dial disc and drive move together without backlash. This can be ensured by simple and well-tried methods. Toothed gears are essential, cords or chains will not do.

The following point is perhaps of interest more to manufacturers and users of manufactured sets than to the home constructor, but it is pertinent to the subject of this letter. Where scales are graduated in wavelengths there should be an additional scale in ordinary divisions. I can recollect only one commercial receiver whose manufacturer has realised this need. Wavelength scales are useful as a help to finding stations with a new receiver, after which recorded readings suffice.

In the absence of such a supplementary scale the wavelength scales of mass-production receivers are usually more trouble than they are worth. In the case of closely graduated scales one has often to record or remember that to get a station, say, on 450 metres, one has to set to 460 for example. Some manufacturers dodge this trouble by providing a scale with few and very open graduations. One commercial receiver, capable of receiving a large number of stations on the medium waveband under favourable conditions, has about a dozen graduations to cover the whole of this waveband, and at the lower end of the band there is a space of over half an inch between graduations. As a means of enabling "the user to tune in to stations he requires readily and with certainty" [Editorial Comment, January 6th, 1932], such a scale is practically useless.

W. A. B.

Edgware.

EPOCH DUAL LOUD SPEAKERS.

We are informed by the Epoch Radio Manufacturing Co., Ltd., Exmouth Street, London, E.C.1, that on and after August 1st the following Epoch moving-coil units will be available in matched pairs for dual operation: Types 20C, J1, A2, B5, and E8. The units will be mounted on a small baffle with a single output transformer, and no additional charge will be made for matching.

READERS' PROBLEMS.

THESE columns are reserved for the publication of matter of general interest arising out of problems submitted by our readers. Readers requiring an individual reply to their technical questions by post are referred to "The Wireless World" Information Bureau, of which full particulars, with the fee charged, are to be found on the next page.

Ganging Frame-aerial Circuits.

WHEN a frame aerial is used as a collector for a receiver in which all tuned circuits are controlled by a ganged tuning condenser, it may be taken as an almost invariable rule that a frame aerial must form part of the set, or at any rate must be permanently fixed with relation to the other components. If it were not, it would be almost impossible to ensure that the stray capacity across it, and also to some extent its inductance, remain unchanged in all positions. Unless this state of affairs can be achieved, the alignment of the ganged tuning system is bound to be affected adversely.

Incidentally, the reader who raises this point appears to have fallen into a common and quite understandable error with regard to the self-capacity of a frame aerial winding. In practice, this is almost invariably much greater than that of a compact coil of similar inductance; indeed, it is often so high that real difficulty is encountered in covering a reasonably wide wave-range when a frame aerial is employed in a receiver with ganged tuning.

Compensating Condenser Adjustments.

NOT the least of the advantages of variable-mu valves is that they make possible the use of an almost perfect input volume control; as is well known, this is effected by varying the efficiency of the valve by altering its grid bias voltage. The great advantage of this method is that it brings about practically no alteration in tuning, and cross modulation troubles are not provoked.

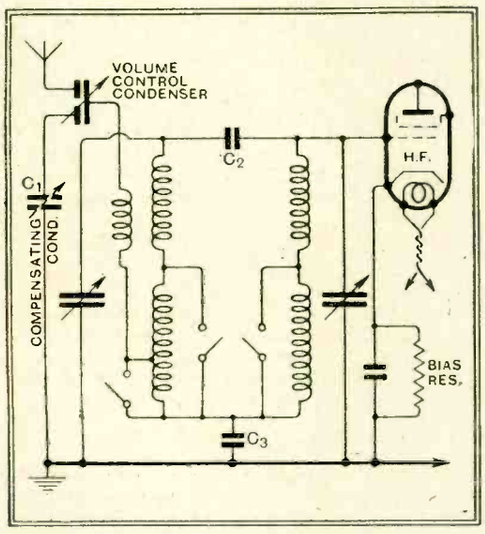


Fig. 1.—Controlling aerial input without serious disturbance of tuning by means of a differential condenser; adjustment of the compensating capacity C_1 is described in the text. Condensers C_2 and C_3 act as the combined couplings of a double-capacity band-pass filter.

When the first valve of the receiver is an ordinary screen grid valve, a compromise has to be effected, and probably the most satisfactory arrangement for average conditions is that illustrated in Fig. 1. Here input from the aerial is controlled by a differential condenser, which operates in such a way that a reduction in transferred aerial capacity, brought about by decreasing the value of the series condenser, is compensated for to some extent by simultaneously increasing the capacity shunted across the aerial coil.

The functioning of this device is not difficult to follow if it is realised that (referring to the diagram) the rotor meshes more closely with the earthed stator as its engagement with the aerial-connected stator is reduced.

Unfortunately, capacity compensation is not exact, as the reduction in transferred aerial capacity is not entirely balanced by all settings of the volume-control condenser. Matters may be greatly improved in this respect by fitting a semi-variable condenser of about 0.0005 mfds. in the earthing lead of the "balancing" stator. Again, perfect compensation can hardly be attained, but a precise adjustment can be effected for the setting of the volume control condenser at which signal intensity is controlled most effectively.

This information is repeated for the benefit of a reader who has built a set in which this method of control is employed. He is in difficulties over the adjustment of the compensating condenser, and asks for instructions as to how it should be set.

The best procedure is to tune in accurately a fairly strong signal, with the input control at maximum, and then gradually to reduce intensity until a comparatively sudden and well-marked falling-off is observed. Next, without touching any other control, the compensating condenser (of which the adjustment is not very critical) is adjusted until signals are again at maximum strength.

This having been done, one can rest assured that, at this particular setting of the volume control condenser, the reduction of transferred aerial capacity which has been introduced by the operation of the volume control condenser is exactly balanced, and therefore that the tuning of the input circuit remains unaffected.

The Dividing Line.

ONE of the functions of the Information Department is to examine and criticise circuit diagrams of proposed receivers that are submitted by readers. It is noticed that in a surprisingly large number of cases an error is made with regard to the detector anode circuit, particularly when the succeeding L.F. stage is coupled to this valve by a plain resistance or by a resistance-fed transformer.

Diagrams that are otherwise beyond criticism often contain the fault shown in Fig. 2 (a); the feed lead for the L.F. amplifier is taken directly from the detector anode. With this form of connection, the usual H.F. filtering devices—H.F. choke and by-pass condensers in conjunction—become almost totally ineffective, and as a result the receiver is certain to suffer from troubles associated with the action of H.F. currents in the amplifier.

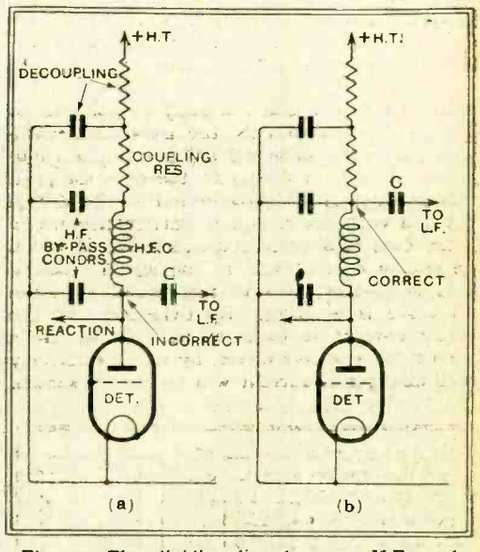


Fig. 2.—The dividing line between H.F. and L.F. The H.F. filtering devices are rendered ineffective by connecting the L.F. coupling condenser as in diagram (a).

The correct position for the L.F. feed lead is on the "dead" side of the H.F. choke and by-pass condenser system, as indicated in diagram (b).

Misleading Measurements.

A READER describes his method of measuring the voltage applied to the anode of a variable-mu A.C. valve under various conditions; he has used a good meter of exceptionally high resistance, and has further reduced the current consumption of the instrument by fitting a series resistance. So far, so good; this method should enable reasonably accurate measurements to be made, even in a circuit where the normal current consumption is fairly low.

But, in spite of these precautions, the results obtained by our reader are somewhat inconsistent and misleading. This, we consider, is entirely due to the fact that measurements have been made between the anode terminal of the valve and the metal chassis of the receiver; in effect, what he has measured is the sum of the anode and bias voltages. Instead of connecting the negative terminal of the meter to the chassis, it should be joined directly to the cathode of the valve.

This point is generally of small importance unless one is dealing with an output valve. But the same risk of an appreciable error exists in the case of a variable-mu valve which requires a relatively large bias voltage.

"Monodial Super" and Hum.

PROSPECTIVE builders of the "Monodial Super" have already been told that, failing the use of a 2,500-ohm loudspeaker field winding for smoothing purposes, a choke with a resistance in series, of a total ohmic value of 2,500 ohms, must be inserted in place of the speaker field. Two or three readers who have employed this scheme say that the resulting background of hum, though not excessive, is somewhat greater than is desirable, and have asked for advice as to how it may be eliminated.

The most obvious cause of this shortcoming is the use of a choke which is less efficient as a smoothing device than the field winding which it replaces. But provided the discrepancy is not too great, it should be possible to dispose of the residue of ripple by connecting an extra by-pass condenser between the junction point of choke and resistance and earth in the manner suggested in the "Hints and Tips" section of our issue for July 8th. If this fails, a better choke, and/or extra smoothing capacity will be needed.

Balancing Out Anode Current.

WHEN a meter is inserted in series with the detector anode as an indication of the general behaviour of the "H.F." portion of the set, it is an advantage to balance out the steady current which normally flows, and to arrange matters so that the instrument indicates only *changes* in current due to the application of signal voltages to the detector grid. This practice is widely adopted in the design of valve voltmeters, and is particularly useful in the case of a grid-circuit rectifier, of which the steady current under "no signal" conditions is greater than that which flows when the valve is working. By balancing out the steady current it becomes possible to use a much more sensitive meter, by which relatively small changes of current will be clearly shown.

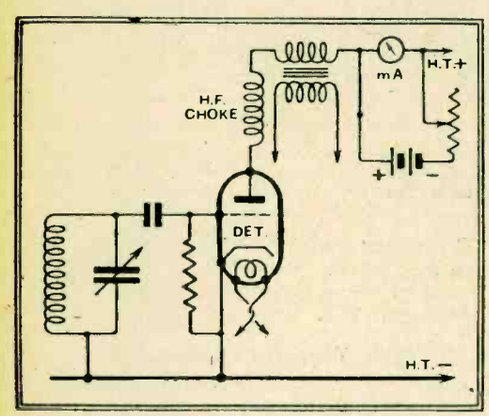


Fig. 3.—By careful adjustment, current from a local battery (of which the polarity must be reversed) may be made to balance out the steady current which flows in the detector anode circuit.

We are asked by a reader, who evidently appreciates these points, to give a hint as to how steady anode current may be balanced out when dealing with a straightforward A.C. receiver. He gives no further details of the set or of his requirements, but we think that the matter will best be understood by reference to Fig. 3. By applying to the meter a suitable voltage from a local source which is in opposition to the pressure derived from the H.T. eliminator, it is possible to pass through the instrument a value of current that exactly balances out that which is normally flowing in the anode circuit. If this be done accurately the meter will indicate zero until a change in current (brought about by the action of rectification) is produced by a signal.

Still referring to Fig. 3, it is desirable that the value of the variable resistance by which a balance is effected should be many times greater than the resistance of the meter itself, and it will be obvious that the battery must be of such a voltage that it will drive the required current through both resistance and meter.

To take a practical case, we will assume that the detector normally passes 5 milliamps. and that the meter has an internal resistance of 100 ohms. A local battery of 4½ volts would be convenient to use, and, in series with a fixed resistor of slightly under 900 ohms would supply the correct value of balancing current. In practice, one would choose a variable resistance of 1,000 ohms, which is a commercially obtainable value, and which would probably give sufficient latitude. If there is any uncertainty a higher value should be used.

The use of a battery may be avoided by adopting the arrangement shown in Fig. 4. The values of the potentiometer and of the resistance R may need alteration if the meter is to read practically the full change.

There are other methods of balancing out "standing" anode current, but this will be sufficient to explain the basic principles of carrying out the operation.

Something for Nothing.

TO judge by several letters recently received from readers, it is not fully realised that most systems of tone control are inefficient, from the quantitative point of view of amplification. Most of the methods commonly advocated give full magnification only at one end of the frequency scale; impulses corresponding to other frequencies receive much less than normal magnification, and at the reverse end of the scale to that being deliberately accentuated there is often no magnification at all. It is for this reason that, in receivers which embody tone control as an important part of their design, an extra valve is generally needed to make good the loss.

An exception exists when correction is effected by introducing a resonance, by means of which a band of frequencies can be given a considerable increase in amplification without affecting the amplification of other frequencies. But it is true to say that this method, applied without full knowledge on the subject and with great care, is apt to lead to disappointing results; the resonance peak of a single stage may be so sharp that it makes little obvious difference to the quality of reproduction; or, at the worst, it may introduce a marked and unpleasant over-accentuation to a narrow band of frequencies.

As a general rule, it is best to apply the principle of L.F. tuning to an amplifier in more than one L.F. stage. Very successful results have been obtained by introducing resonances of a slightly different frequency in two separate coupling circuits.

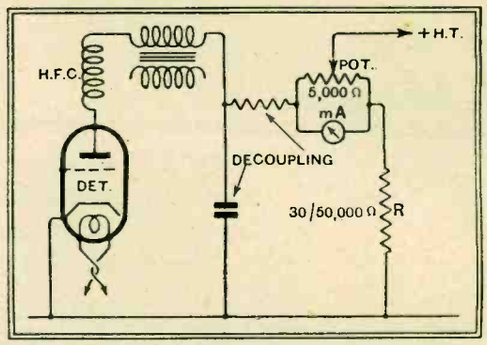


Fig. 4.—A battery-less arrangement similar in its effects to that shown in Fig. 3. With grid detection, the normal connections of the meter must be reversed in order that changes in current may be indicated. Values of the resistance R and of the potentiometer may need modification.

No Saving.

A CORRESPONDENT, who proposes to install a mains-operated receiver, is unfortunate enough to have to pay for his current at what would appear to be an excessively high rate. The supply is D.C. at 220 volts for lighting, and he tells us that arrangements may be made with the supply company to wire his house for "power." Current for this latter purpose is supplied at 440 volts, and at a much lower rate—actually about one-third the price charged for lighting purposes. Our advice is asked as to whether this high voltage would be suitable for operating a wireless receiver.

All D.C. sets are normally designed for voltages between 200 and 250, but matters can be arranged so that they may be operated on a higher voltage. The point is, however, that exactly twice as much wattage will be dissipated if our correspondent uses the power mains for his set, and so the saving in cost will be almost negligible, in spite of the lower rate charged for current. On this score it would certainly not be worth while to have any alteration made. The cost of having power mains connected would probably not be recovered in several years' operation of a receiver.

But from other aspects the possibility of having a high voltage supply is distinctly attractive. A receiver could be designed for a 440-volt system, which would not suffer from the ordinary limitations of D.C. sets.

The Wireless World INFORMATION BUREAU.

Conditions of the Service.

(1) THE service is intended primarily for readers meeting with difficulties in the construction, adjustment, operation, or maintenance of wireless receivers described in *The Wireless World*, or those of commercial design which from time to time are reviewed in the pages of *The Wireless World*. Every endeavour will be made to deal with queries on all wireless matters, provided that they are of such a nature that they can be dealt with satisfactorily in a letter.

(2) Communications should be addressed to *The Wireless World* Information Bureau, Dorset House, Tudor Street, E.C.4, and must be accompanied by a remittance of 5s. to cover the cost of the service. The enquirer's name and address should be written in block letters at the top of all communications.

(3) The fee of 5s. covers the reply to any wireless technical difficulty, but in special cases, where the enquiry may involve a considerable amount of investigation, an increased fee may be necessary. In such cases a special quotation will be made.

(4) Questions should be clearly written and concisely worded in order to avoid delay. Where enquiries relate to trouble experienced in receivers built to specifications in *The Wireless World* a complete account should be given of the trouble, and especially the symptoms.

(5) Where reference is made to published articles or descriptions of apparatus, the title of the article, the date of publication in *The Wireless World*, and the page reference number should be given, in order to facilitate reply.

(6) Full circuit diagrams, constructional details of apparatus, or values of components for home-designed receivers cannot normally be supplied, but circuit diagrams sent in with queries will be checked and criticised.

(7) Particular makes of components cannot, in general, be recommended, but advice will be given as to the suitability of an individual component for a particular purpose specified by the enquirer.