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EDITORIAL COMMENT

Price of Components

The Case for Reduction

THERE is plenty of evidence that, speaking generally, wireless is cheaper to-day than at any time since broadcasting began, and complete sets can now be bought at prices little more than the valves in them would have cost in the days when broadcasting began.

If we investigate prices at present ruling for component parts of sets, it does not take long for us to arrive at the conclusion that the price of separate parts has not come down in anything like the same proportion, and yet there are many manufacturers of components in the industry to-day who are counting upon progressive sales of component parts to meet the demands of the retail market in the future. We feel that the time has come when it is desirable to warn component manufacturers against a policy of trying to maintain the retail prices at too high a level. We have now almost reached the point when it can be profitable to buy a complete set in order to make use of the parts in constructing some new circuit employing the latest principles, and discarding the surplus material, rather than buying the components as separate items. If the sale of individual component parts is to continue and increase in the future, it is imperative that prices should at least compare favourably with the break-up value of complete sets.

We think that there is probably too much attention paid to-day to the external appearance and finish of individual components for set construction, and if retail prices can be brought down by supplying, for those who wish to construct sets, components of the same type as are used by complete receiver manufacturers, instead of increasing the cost substantially by elaborate external appearance and finish, then we think it should be done.

We have from time to time been instrumental in persuading individual manufacturers to supply, for example, condensers, with soldering tags instead of terminals and without a moulded case, at prices very much lower than was possible when these refinements were added. The constructor cares more about efficiency than the way in which the component is boxed. We do not want to see the electrical efficiency of components suffer in an attempt to bring down the retail price, but we believe that prices can be brought down by attention to economies other than reduction of the electrical efficiency.

Interference

How Individuals Can Help

ENCOURAGING progress is being made towards bringing about legislation to control electrical interference with broadcast reception. *The Wireless World* has long urged the necessity for it and real progress took place when we invited electrical organisations and the Institution of Electrical Engineers to co-operate in the task.

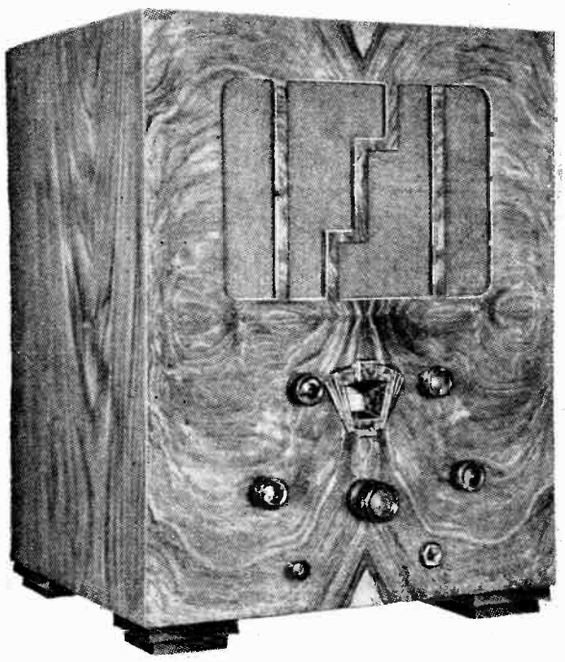
Whilst legislation is of the utmost importance, there is still an immense amount of work which individuals can do to assist in eradicating electrical radiation. Articles in this issue give a number of suggestions. It is particularly important for individual listeners to remember that their own premises may often be responsible for originating local interference.

Finally, individual buyers of electrical apparatus should insist that their purchases must be beyond reproach.

The Class "B" Ferrocart Receiver

A Highly Selective 4-valve Battery Set with 2 Watts Output

By W. I. G. PAGE, B.Sc.



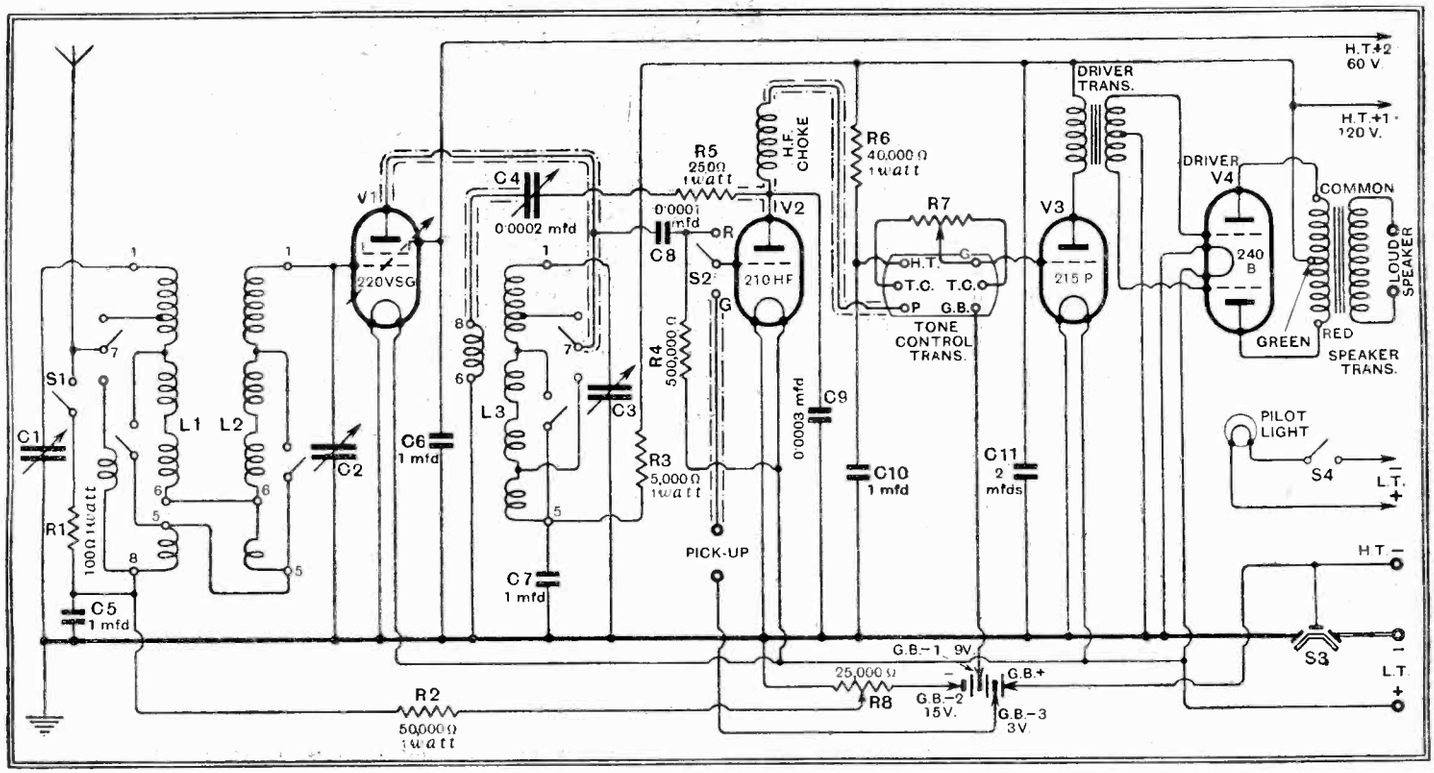
CONSTRUCTIONAL details are here given of a "straight" battery receiver combining the virtues of Class "B" amplification and Ferrocart tuning. A remarkable all-round performance is obtained, for the selectivity is such that 60 kW. stations 9 kc. apart can be separated; the sensitivity is high—some 80 stations being logged in one evening—and the undistorted output is rather more than two watts, being sufficient to fill a small hall. The total working H.T. consumption for full output is about 12 mA.

UP to a few weeks ago it was not possible with a battery set to obtain more than 250-350 milliwatts output when an H.T. battery of normal size was used, so that unless the listener was prepared to employ batteries of large capacity he had to resort to the unfortunate expedient of overloading the output stage to get anything like comfortable loud speaker strength.

The mains receiver, on the other hand, although only of comparatively recent introduction, has had a meteoric rise to fame, development after development leading to the highly specialised equipment of to-day. Now, almost overnight, after years of rather slight and painful progress, the battery set is able to put its owner in practically the same advantageous position as the man with a mains set. It is in the output stage that such progress has been made.

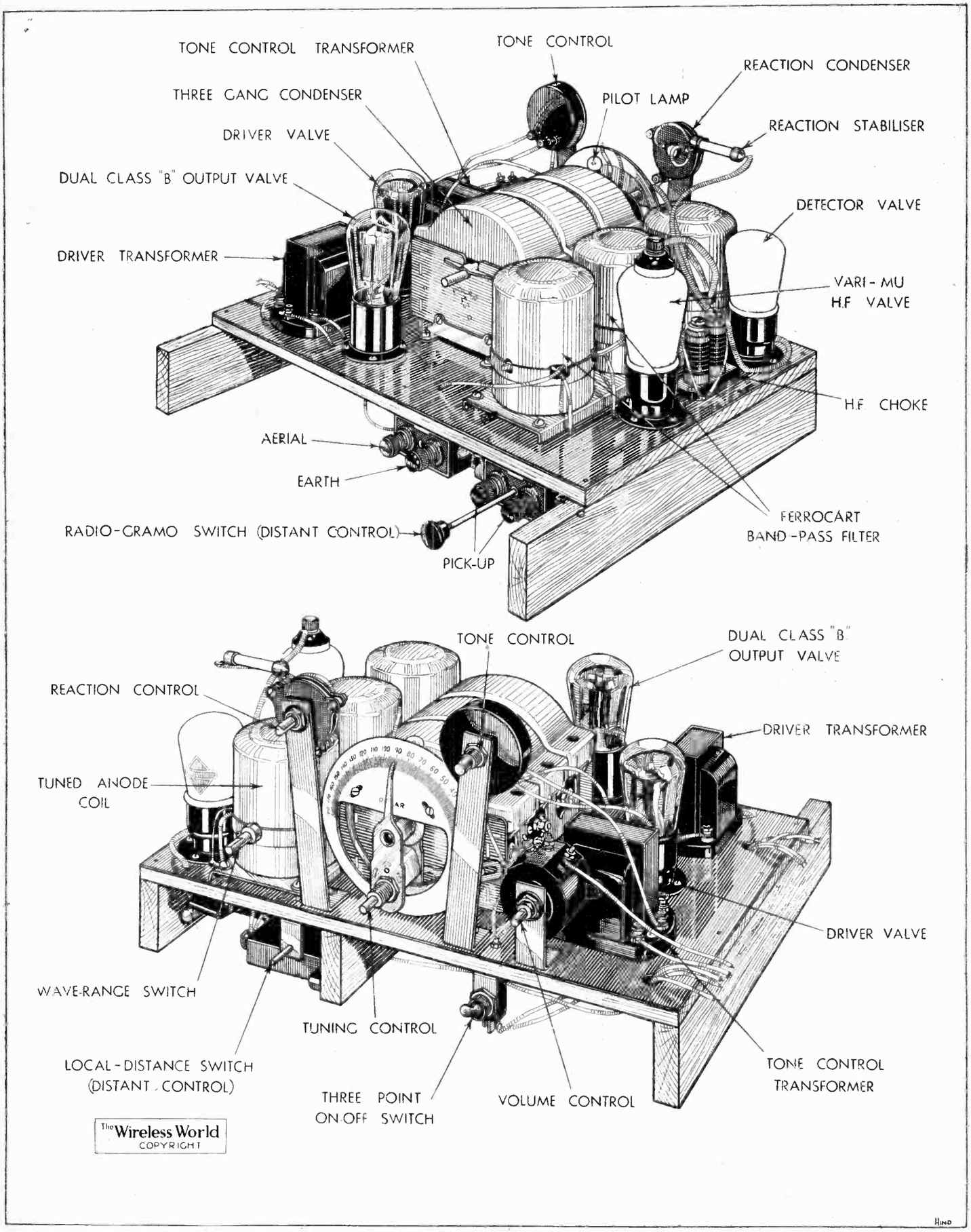
The new Class "B" amplifier, as exemplified by the Cossor 240B valve, confers the tremendous advantage of delivering over two watts output of extraordinarily good quality for a working H.T. consumption, which is within the rating of quite a modest H.T. battery.

Just as in the case of Q.P.P., the H.T. current drain with Class "B" output is proportional to the strength of the signal received, since in both cases the valves are working near the anode current cut-off point at the lower bend in the characteristic. But for the former scheme to give of its best, matched valves are desirable, and a milliammeter then becomes necessary; also with an ageing H.T. battery some sort of bias battery discharge scheme is required. With the 240B dual valve, the matching is done by the makers, and, as the working grid potential is zero volts, no bias is needed at any H.T. voltage. In addition to the merit of providing a very large power output, it will be seen, therefore, that Class "B" has important advantages over



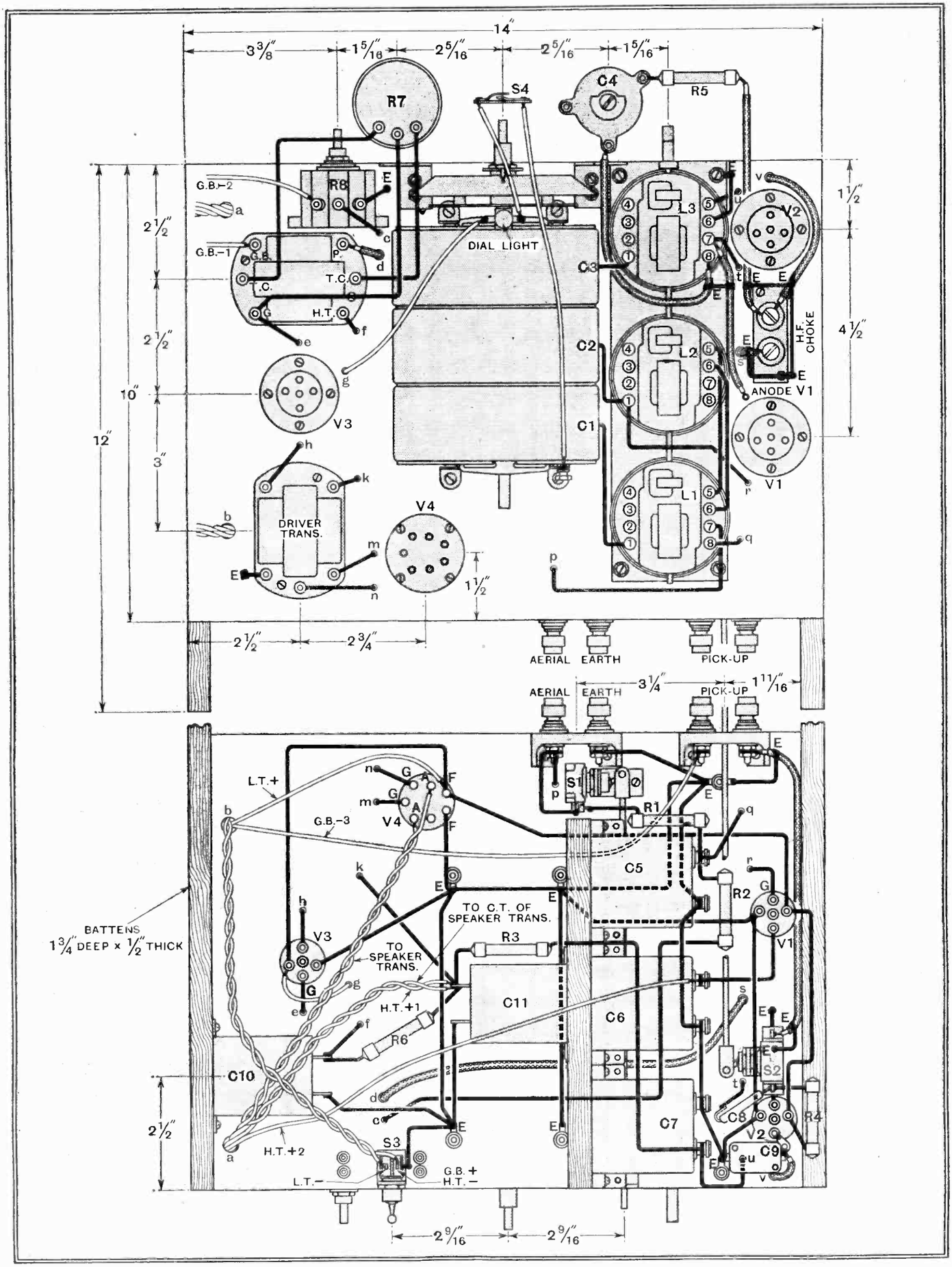
The complete circuit diagram. The switch S4 is contained within the tuning knob and connects the dial light only during the process of tuning. To prevent long leads and the risk of instability the switches S1 and S2 are distant-controlled.

New Battery Receiver Technique



Two views of the receiver chassis. It will be seen that considerable flexibility of control is given by the inclusion of reaction, volume control, tone control, local-distance and gramo-radio switches.

Dimensional Data and Complete Wiring Plan

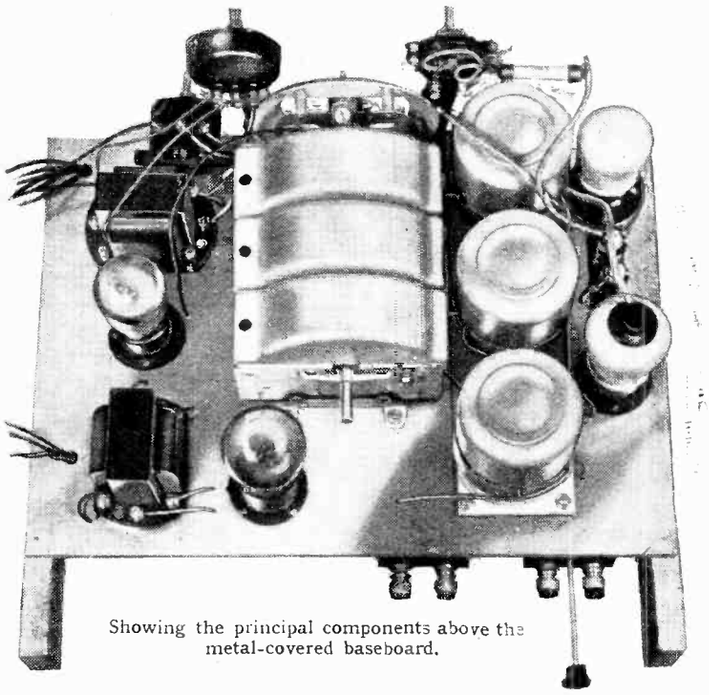


Details of the layout of components and wiring above and below the baseboard. The tone-control potentiometer and the reaction condenser, which are mounted on vertical brass strips, are here shown projected in front of the receiver.

The Class "B" Ferrocart Receiver—

other output systems, and will probably find its way into the majority of future battery sets.

It would be reasonable to ask whether a price must be paid for such sterling qualities. Is the reproduction harsh? Must we expect rather more than the usual quota of harmonics? Actually, if valves of the correct characteristic are chosen by the makers for the components of the dual valve, curvature distortion can be almost completely cancelled out. Provided that no attempt was made to extract much more than two watts from the receiver being described, the quality was beyond reproach, and was certainly equal to that of a well-designed mains set rated to give the same volume.



Showing the principal components above the metal-covered baseboard.

Almost simultaneous with the arrival of Class "B" comes the introduction of the Ferrocart coil into this country—a tuning inductance of such valuable properties that we are forced to reconsider the adequacy of the single H.F. set for modern ether-congested conditions. This type of receiver was fast becoming obsolete owing to the extreme difficulty in obtaining interference-free reception from certain stations. But with the new iron-cored tuning coils it is coming into its own again, and transmissions of 60 kW. separated by only 9 kc. can be received free from unwanted background, and the "spread" of a local station at a distance of nine miles need not occupy more than just a little over two channels each way. It was found quite easy to separate completely Poste Parisien and Breslau, Midland Regional and Sottens, also Rome and Stockholm, and to enjoy the programmes from a large number of the 80-odd stations which were logged during an evening's test. It was noteworthy that Mühlacker could be received without any background of London Regional at a point sixteen miles south of London.

For the sake of convenience, the receiver chassis has been built into a cabinet, and, excepting the need for an external aerial and earth, the equipment is entirely self-contained. The permanent-magnet moving-coil speaker is housed in the upper compartment, together with the H.T. and L.T. batteries, the latter being of 45 ampere hours, and so providing some 53 hours listening per charge for the 0.85 amp. consumption of the valves. The voltage of the H.T. battery is 135, but only 120 is needed for the various anode feeds; it is therefore necessary to put the wander plug H.T. + 1 into the appropriate tapping and to increase the potential step-by-step while the initial drop is taking place during the first two or three weeks working. The $1\frac{1}{2}$-volt tappings to be found at the positive end of the battery, although meant for Q.P.P. amplification, are thus made to serve a useful purpose.

The bias battery is part of the H.T. battery, and so is automatically renewed each time a replacement of the latter is made. This ensures that the various grid potentials are maintained at approximately correct value, and valve life is therefore increased. The wander plug marked G.B. + serves also to make a connection with H.T. −, while G.B. − 1 should be set at − 9 volts, and G.B. − 2 and G.B. − 3 should be set at − 15 and − 3 volts respectively. Screening grid volts (H.T. + 2) for V1 should be set at 60, 70 or 80 volts—whichever gives the best results.

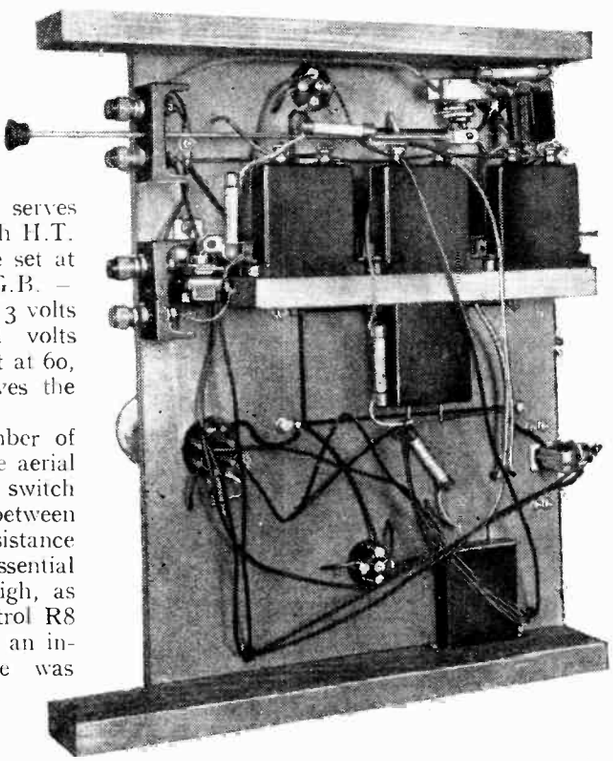
The circuit contains a number of interesting refinements. At the aerial input there is a local-distance switch S1 throwing into circuit between aerial and earth a 100-ohm resistance R1. This was found to be essential when the field strength was high, as the potentiometer volume control R8 had not sufficient range unless an inordinately large bias voltage was used. To prevent undue sideband cutting, the two Ferrocart input coils are coupled by common inductance forming a band-pass filter, and to maintain symmetry with the intervalve coupling the condensers C5 and C7 should both be non-inductive and of the same value. The anode of the variable-mu valve and the grid of the detector are joined and tapped well down the tuned anode coils for long and short waves, and the turns ratio of each auto-transformer is made equal, so that ganging shall hold throughout.

Reaction is applied to the tuned anode coupling *via* a 0.0002 mfd. condenser C4, and to prevent slight backlash on the long waves a resistance R5 of 250 ohms is interposed in series. To minimise stray fields screened leads are used for reaction, H.F. and detector anode circuits, also for the high-potential pick-up connection.

Pre-driver tone control.

With the type of push-pull circuit in which the anode current consumed is proportional to signal strength it is obviously wasteful to shunt away from the speaker any frequency band which has taken its energy from the H.T. battery. But this is what happens when the conventional pentode compensating circuit is joined across the primary of the output transformer in a Class "B" amplifier. As explained in last week's issue[1], the over-emphasis of high notes must be checked, and to effect this economically, saving some 15 to 20 per cent. of current, it is advisable to control the tone before the driver stage.

In the present receiver a transformer with a continuously variable tone control has been chosen to link the detector V2 to the driver valve V3. This is found to be very valuable in correcting the effect referred to, as well as minimising needle scratch from records and providing a means of altering the tone to suit the many moods of the listener.



The under-baseboard, where the decoupling components and the distant-controlled switches are mounted.

To compensate for the losses in the

[1] See "Practical Class 'B' Amplification."

The Class "B" Ferrocart Receiver—

grid circuit of the 240B valve (V4), a 215P driver valve, working into a transformer of a 1 to 1 overall ratio, is used to deliver the necessary 70 milliwatts. The most satisfactory bias voltage for the driver is nine.

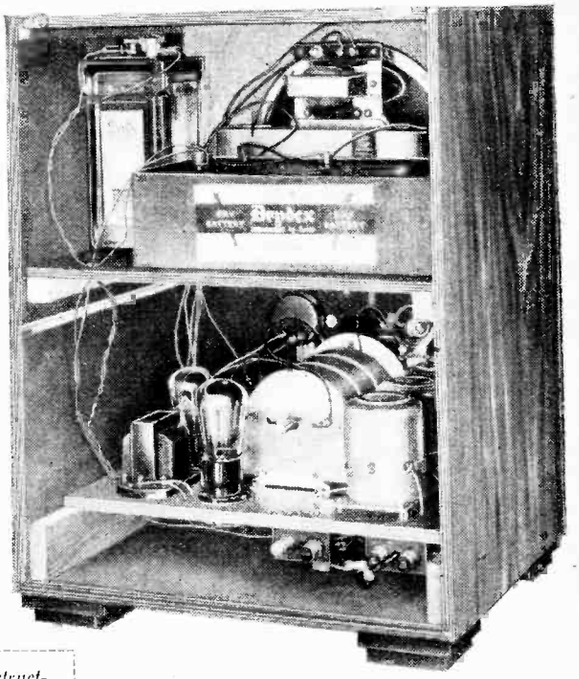
A refinement in respect of the control of switches has been introduced into this receiver. It is often found that when a local-distance switch or a radio-gramophone switch is mounted on the panel for the sake of accessibility its connecting leads may be unduly long, but it is perhaps not expedient to use screened sleeving. This may lead to instability, and the solution seems to lie in mounting the switches in their best position electrically and to arrange distant control.

The radio-gramophone switch S2 is placed so that the lead to the detector grid is only ¼in. long, and a control rod is taken to the back of the cabinet through the centre of the terminal mount. Similarly, the local-distance switch is arranged close to the aerial input circuit, but the control knob is 9in. away on the panel. In this way an efficient wiring scheme is possible.

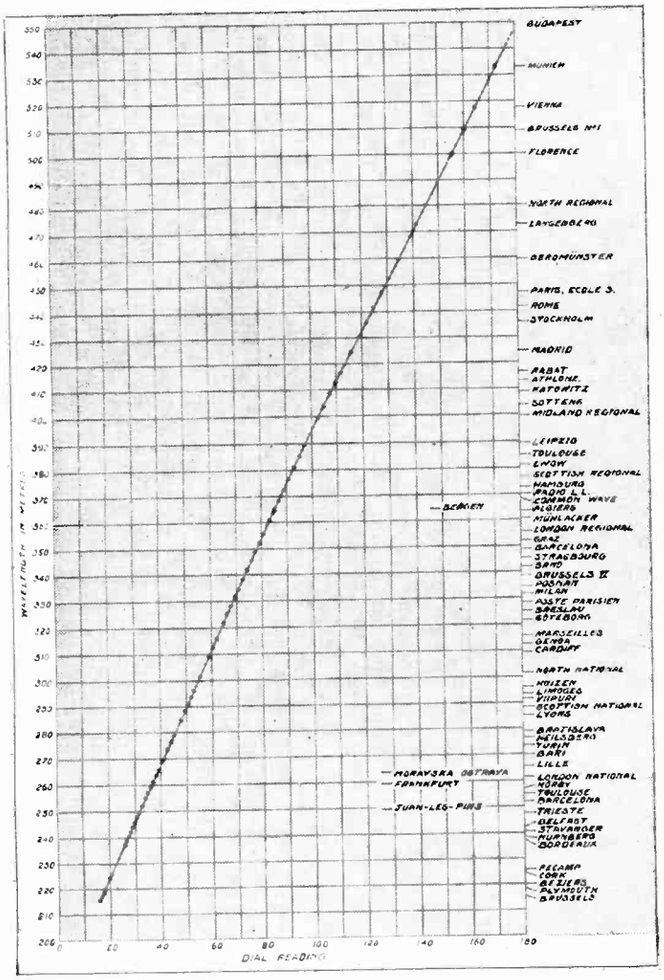
An improved appearance to the cabinet is given by the use of uniform control knobs engraved with the function which each performs. The knob controlling the ganged condenser contains a switch which connects the pilot lamp in circuit only during the process of tuning; this prevents wastage of L.T. current.

The construction of the set should present no difficulty when reference is made to the photographs and drawings which accompany the article. As soon as the set is completed and the batteries connected, the tuning knob should be rotated until some station (such as the London National) is received at the lower end of the medium waveband. The ganged condenser must now be aligned by trimming each section, using a short screwdriver. Having obtained the maximum sensitivity at a low setting of the tuning dial, it will be found that ganging holds over both wavebands. Should the tuning range not extend quite to 550 metres, the ganging should be carried out again, using more capacity in all the trimmers. For nearby transmissions the local-distance switch will have to be put into operation to prevent overloading. Gramophone reproduction is particularly effective with Class "B" amplification, especially where a tone control is embodied. Over-emphasis of any frequency band can be compensated, and needle scratch can be very considerably reduced. During the playing of records H.T. current can be conserved by turning the volume control R8 to the full negative position. The wiring of the radio-gramophone switch may not be absolutely clear from the various illustrations. There are four points on this switch, the two contacts underneath being linked together and taken to the grid terminal of the detector valve holder. Of the two upper contacts, one is joined to the grid leak and the other is taken via a screened lead to one pick-up terminal. The body of the switch is earthed.

For the convenience of readers constructing this receiver, a full-size blue print is available from the publishers at 1/6 post free.



The back of the cabinet. The top compartment contains the moving-coil speaker, the L.T. and H.T. batteries.



Calibration curve for the medium waveband only. Each of the 72 plotting points represents an identified station. The calibration of individual receivers will vary slightly, but the curve should be a useful guide.

A specimen receiver built to this design is available for inspection at 116-117, Fleet Street, London, E.C.4.

LIST OF PARTS.

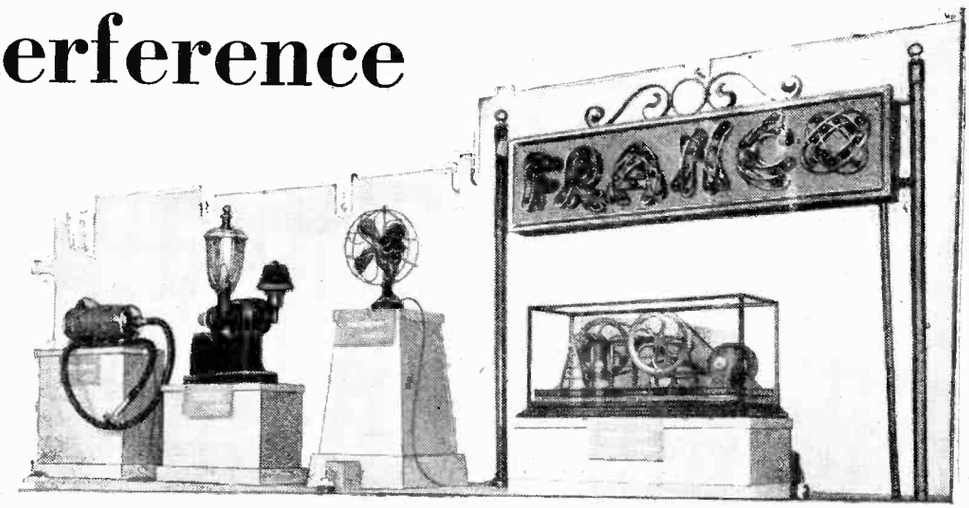
After the particular make of component used in the original model, suitable alternative products are given in some instances.

Set of Three Ferrocart tuning coils, Colvern type F1, F2, F3
1 3-gang tuning condenser and disc drive, C1, C2, C3 Polar "Star"
1 Reaction condenser, 0.0002 mfd., C4 Ormond R/504
(J.B., Utility)
1 H.F. Choke McMichael Binocular Junior
(Bulgin)
3 5-pin Valveholders Clix chassis-mounting type
1 7-pin Valveholder Clix chassis-mounting type
(Benjamin, Radiophone, W.B.)
1 4-pt. double-throw switch with distant control, S2 Radiophone type 450.X.
1 On-off switch with distant control, S1 Radiophone type 485.Y.
1 3-pt. switch with long throat, S3 Radiophone type 630
1 Volume-control potentiometer, 25,000 ohms, R8 Wearite, Q.V.C.
(Bulgin, Radiophone, Watmel)
1 Tone-control potentiometer, R7 Multitone
1 Tone-control transformer, 4 to 1 Multitone "Toco"
1 Driver transformer, 1 to 1 overall Multitone
(Benjamin, Ferranti, Lotus, R.I., Sound Sales, Trix, Varley)
1 Resistance, 100 ohms, 1 watt, R1 Dubilier
1 Resistance, 250 ohms, 1 watt, R5 Dubilier
1 Resistance, 5,000 ohms, 1 watt, R3 Dubilier
1 Resistance, 40,000 ohms, 1 watt, R6 Dubilier
1 Resistance, 50,000 ohms, 1 watt, R2 Dubilier
1 Resistance, 500,000 ohms, R4 Dubilier
(Erie, Graham Farish, Claude Lyons)
3 Non-inductive condensers, 1 mfd., 200 v. D.C. working, C5, C6, C7 T.C.C. type 50
1 Condenser, 1 mfd., 250 v. D.C. working, C10 T.C.C. type 65
1 Condenser, 2 mfd., 250 v. D.C. working, C11 T.C.C. type 65
1 Condenser, 0.0001 mfd., C8 T.C.C. type "M"
1 Condenser, 0.0003 mfd., C9 T.C.C. type "M"
(Dubilier, Hellesens, Peak)
4 Terminals, aerial, earth, pick-up, pick-up Belling-Lee type "M"
2 Terminal mounts Belling-Lee
Baseboard, Plymax, 10in. x 14in. x ¾in. Peto-Scott
With battens and brass metal strips
6 Wander plugs, G.B.+, B.T.+1, H.T.+2, G.B.−1, G.B.−2, G.B.−3 Clix type B
2 Spade terminals for L.T. Clix
1 Pilot lamp, 2 volt Bulgin
1 Tuning knob pilot light switch, S4 Wearite
1 Set of uniform engraved knobs Danipad
Screened sleeving, 1 yard Harbros
2 oz. No. 20 tinned copper wire, 4 lengths Systoflex, wood, flex, etc.
Wood Screws: 20 ¾in. No. 4 R/hd.; 12 ¼in. No. 4 R/hd. 4 ¾in. No. 6 R/hd. **Metal Screws:** 8 4B.A.; 12 6B.A., with nuts and washers.
4 Valves: 220VSG, metallised; 210.HF, metallised; 215.P, and 240.B. Cossor
1 Loud speaker with Class "B" transformer Amplion
(British Rola, Celestion, Epoch, Ormond, Sonochorde)
1 H.T. battery, 12 mA. type including bias battery, measuring 10-9/16in. x 6-9/16in. x 3¼in. Drydex H.1063
(Ever Ready, W.1210)
1 L.T. accumulator Exide D.F.G.
1 Cabinet C.A.C. Cabinets, Ltd.

Local Interference

How To Track It Down

By R. W. HALLOWS, M.A.

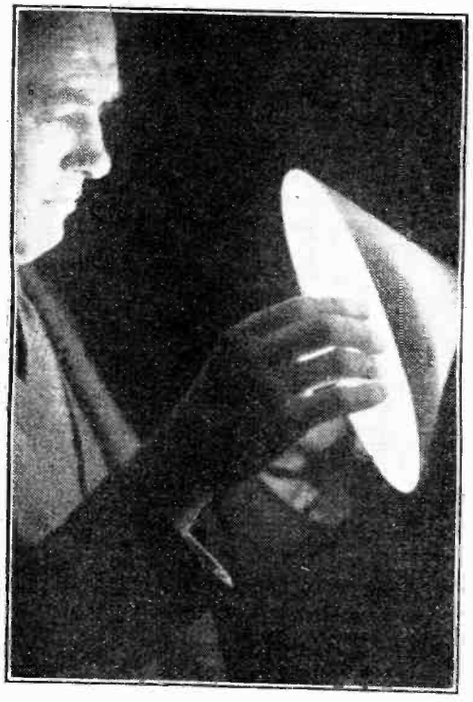


Types of local interference. The electric sweeper, coffee roaster, fan and flashing sign.

THE campaign against interference with broadcast reception inaugurated some time ago by *The Wireless World* has already had good effect in stirring up the authorities and electrical organisations. There is a vast amount of work to be done, however, by individual listeners before we are free from man-made interference, most of which is unnecessary and preventable.

Before taking any action in the matter of making reports to the authorities when interference is experienced it is always advisable to make quite sure that it is not being produced in one's own home. There are numerous ways, many of them not generally suspected, in which such a thing can occur, and a point to bear in mind is that the interference may not be confined to one's own house alone, but may also trouble those in neighbouring dwellings.

Defects in the electric lighting or power system of a house can be responsible for intolerable cracklings, which usually resemble the worst and most violent of atmospherics. In a new or newish house the wiring should be above suspicion, but there are many homes in which the wiring was done twenty, thirty, or more years ago, and has since received little or no attention. Tests with a bridge megger in such cases often produce surprising results!



An unusual example of interference was found to be due to the vibration of a fractured filament of a 100-watt lamp. The vibration produced a high-pitched whistle.

Besides the noisiness that may come from defective wiring, electrical fittings of all kinds are capable, in certain circumstances, of indulging in unwanted broadcasting on their own account. Not long ago I traced a terrible outbreak of crackles to a loosely connected lead in a lighting switch. A friend who was tormented by appalling interference found the source eventually in a badly fitting mains fuse.

An Unusual Case

Anything in lighting or power circuits that makes a bad or intermittent contact can be responsible for such troubles. Examples that I have come across are an electric light bulb that fitted loosely into its holder, a wall plug that was wobbly in its socket, and an electric heater within whose plug a single thin strand of flex had escaped from the rest and was causing a small intermittent arc.

Perhaps the queerest case was one which concerned an electric light bulb, though the interference did not take the form of crackles, and was not caused by a loose fit between the base of the bulb and its holder. A friend, whose wireless set was in use in the evening only, complained of a piercing whistle which accompanied all transmissions, no matter what their wavelength. The whistle was heard, though much less loudly, in the houses on both sides of his, and the neighbours found that it did not begin until after his lights had been switched on.

Asked to lend a hand in locating the trouble, I took with me a miniature portable set designed for telephone reception. Experiments with this demonstrated that the whistle was at its worst in the room in which my friend's wireless set was installed. The farther one went from this room the fainter was the whistle.

There was no question that it was definitely centred in this room. A good plan in such cases is to begin by switching off (or removing from their sockets if there are no individual switches) each of the electric light bulbs in turn. There were four in this room, three of about 50 watts and one large 100-watt lamp. Putting the smaller bulbs out of action had no effect, but when the big lamp was removed from its socket the noises ceased immediately. A new one was put in to replace it and all was well.

INTERFERENCE-HUNTING should begin at home. If every wireless listener would undertake to check up all possible sources of electrical interference in his own home and eliminate the causes, we should have progressed a long way towards a solution of the interference problem. In this article the author suggests some typical sources of interference.

How could the lamp have caused the whistle? This was at first something of a mystery, but examination of its filament with a strong magnifying glass showed that there was a break at one point. The broken end had been vibrating rapidly, making and breaking connection hundreds of times a second. The result was the production of a high-pitched note by the wireless set and the loud speaker.

When Buying Electrical Apparatus

Such vibration of the filament is probably very rare; but lamps with broken filaments are often used quite unwittingly. If the ends of the wire are normally in close contact no interference takes place unless the lamp is shaken. But when someone walks across the floor of the room above or a heavy lorry passes in front of the house pseudo-atmospherics may manifest themselves. Those who install household electrical apparatus such as fans, refrigerators, hair dryers, massage machines or vacuum cleaners should remember that any of these are potential sources of interference which will in all probability not be confined to their own homes. It is the plain duty of every wireless enthusiast nowadays, in self-defence and in defence of others, to make sure that any such apparatus used in

UNBIASED

By

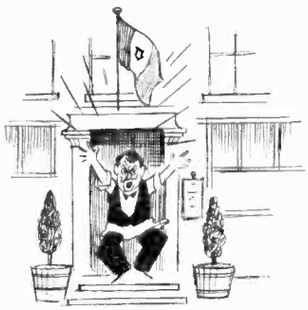
FREE GRID

Clash in Soho

IT is a frequent habit of mine to repair to Soho for dinner after the day's toil in order to get into that restful atmosphere which one associates with the Continent. I regret to say, however, that I have had to shift my dinner headquarters, temporarily at any rate, as the result of strained relations, not conducive to my peace of mind, which have arisen in the thoroughfare which I usually frequent.

Almost opposite the French restaurant which I often visit is an Italian establishment. There has never been exactly an *entente cordiale* between the two proprietors, and I fear that wireless, in spite of the B.B.C.'s motto of "Nation shall speak peace unto Nation," has caused matters to develop into open warfare.

Recently the descendant of the mighty Cæsars installed an outsize in superhets in order to listen to the emanations of his native Napoli. Unfortunately, the six-watt output of his installation penetrated across the road to the "Au Cochon Gros."



Whether it was malice aforethought or merely pure coincidence I cannot say, but not long afterwards a large neon sign, *without* interference suppressors, outlining the figure of a grossly overfed pig, appeared in glaring insolence over the French doorway.

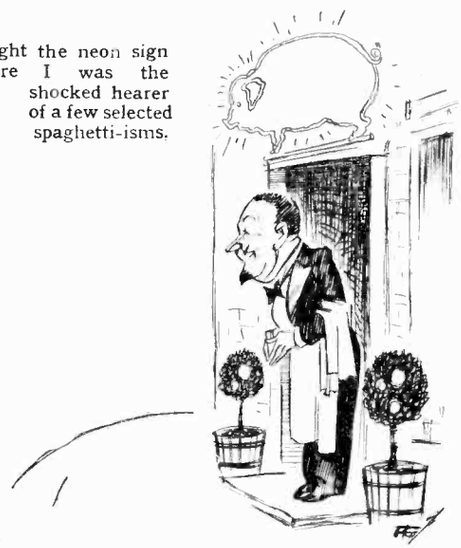
Sitting in the latter establishment on the night that the neon sign opened fire, I was the shocked hearer of the few selected spaghetti-isms forming the opening fusillade of a verbal battle which developed later in the evening. At present, therefore, you will find me in the "Retrete Castellano" round the corner.

Electric Piano Development

THE brief technical description of the "Neo-Bechstein" electrical piano given recently in *Wireless World* interested me specially, as it is so similar to the instrument which I myself described over a year ago (Feb. 24th, 1932). However, I could not help thinking that the instrument which I was privileged to see and hear is still the better one, as each individual string has its own electric-magnet, instead of there being five strings to each magnet, as in the newer instrument.

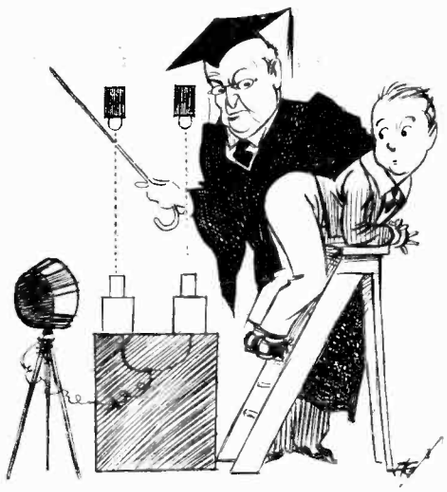
At any rate, I was sufficiently interested to write to the people in the Fatherland who are sponsoring the earlier type in order to learn of any later developments. It has, I hear, been considerably improved in many details, and advantage has been taken of an entirely novel principle to permit purchasers to have one of these pianos in their house and to hear the leading pianists playing upon it, in addition to its being used as an ordinary electrical piano.

To explain matters, I must remind readers that each string, by vibrating within the field of an electro-magnet, creates a sympathetically varying electrical current, which is fed into an amplifier. Normally, the output of the amplifier is fed into a loud speaker, but if, instead, it is connected up to a similar piano situated in the next room or the next street, then this second piano will reproduce anything played on the first one. The reason is that, in the case of the second piano, the electro-magnets, being fed with electrical energy, will obviously set their associated strings into mechanical vibration, each string vibrating at its natural frequency, and so producing its own characteristic musical sound.



On the night the neon sign opened fire I was the shocked hearer of a few selected spaghetti-isms.

It is therefore proposed to wire-up houses and supply each subscriber with an electrical piano of this type, which he can either play himself or "plug in" and hear the efforts of a leading pianist at the studio in the headquarters of the company. There is only one slight technical snag which has to be overcome before the service is put into operation. If any disgruntled subscriber is fed up with too much Bach or Irving Berlin, as the case may be, he can completely wreck the performance by playing five-finger exercises, so causing his instrument to act as a transmitter. If any reader can suggest means of overcoming this trouble there is, I feel sure, a small fortune awaiting him.



Gauging the vigour

Photo "Sell" at Science Museum

ALTHOUGH a very interested visitor the other day at the special "photo-electric" cell exhibition at the Science Museum, I was disappointed to note the omission of several quite commonplace applications of this interesting scientific device.

To mention but one, the automatic automobile speed trap was not in evidence. This device is intended for trapping lorries which do over 30 m.p.h., especially at night. It consists virtually of two photo-cell posts situated a mile apart. If less than two minutes has elapsed between the cutting of the first and second rays, a relay is operated which takes a flashlight photograph of the offending lorry, a summons being duly served at the address indicated by the motor number, while an enlarged photo of the driver is sent to the National Portrait Gallery.

The exposed films are collected from the various posts by the mobile police every day. Of course, many ordinary cars to which the speed limit does not apply are "caught," but the films are not wasted, as many instances of dangerous driving are thus revealed.

Another application not shown was the "schoolmaster's friend"—a device used to enable a master to ascertain the strength of his blows. The apparatus is so arranged that the cane cuts two photo-cell beams before reaching its destination.

Since the cane diameter is known, it is obvious that the speed of the cane—and, therefore, the force of the blow—can be calculated. Actually, of course, this calculation is done by the machine, and the results are dialed accordingly, the administrator of justice thus being able to gauge the vigour necessary for successive blows.

Screened Aerial Down-leads

How Losses are Minimised by Impedance Matching

AS electrical appliances are so widely used in America, "man-made static" is naturally a serious bar to enjoyable broadcast reception in that country. Of all the remedial measures that may be applied at the receiving end, American engineers have found that a properly screened aerial down-lead is the most efficacious. Losses normally introduced by shielding are avoided by fitting impedance-matching transformers.

ALTHOUGH locally generated interference is undoubtedly becoming more serious, due to the constant extension of electrical supply systems, the main reason why it is giving more and more trouble is that the sensitivity of our receivers is being steadily increased. Another contributory cause is the greater high-frequency response of the better-class modern set, which is more susceptible to certain types of interference than earlier types which embraced a narrower band of audio-frequencies. This can be demonstrated by reducing the high-note response of a receiver fitted with tone control; more often than not, electrical interference will be noticeably reduced by this procedure.

Very rightly, the listening public are beginning to insist upon quiet and uninterrupted reception, and the various causes of induced interference are gradually being overcome. These troubles are even more prevalent in the United States than in this country, and, according to a paper recently read before the Radio Club of America by C. E. Brigham, Chief Engineer of Kolster

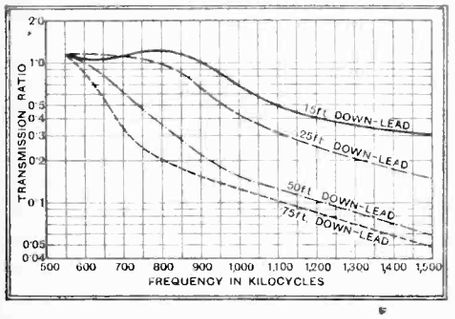


Fig. 1.—How signal strength is reduced by ordinary screened down-leads of different lengths. These curves were taken with a receiver having a low-impedance input circuit (comparable to the majority of British sets).

Radio, investigations show that the majority of noise interference is now introduced into typical sets through the aerial down-lead. Some useful and practical information is given on the subject of reducing interference by shielding these leads, and—of equal importance—means of overcoming the loss of sensitivity that is generally brought about by this form of screening are described.

It is emphasised that the partially shielded aerial must be efficient, and the unshielded portion must be erected well clear of the source of interference, and at least 30 feet above surrounding obstacles; care should be taken to see that the horizontal span is mounted at right angles to, and as far as possible from, overhead power and telephone lines.

In America it is customary to use for shielded down-leads an ordinary metal-braided cable with quite a high self-capacity, and apparently with considerable dielectric losses. The low-capacity,

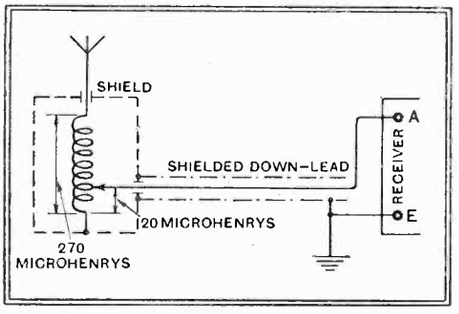


Fig. 2.—Attenuation may be reduced by fitting a step-down auto-transformer between aerial and shielded down-lead.

low-loss cable, which has been introduced for the purpose in this country and on the Continent, does not seem to be widely used. As a consequence, special precautions to avoid the losses which would normally occur have to be taken, and the down-lead is often converted into a low-impedance transmission line, which is not subject to inductive interference, and in which there is very little loss of signal strength when impedances are properly matched.

The Simplest Impedance-matching System

Without special precautions, the loss in sensitivity is found to increase more or less in proportion to the length of the down-lead, as shown in Fig. 1. This diagram shows that losses also increase with frequency; the loss is estimated as a "transmission ratio," by which is implied the ratio of the sensitivity in microvolts, as

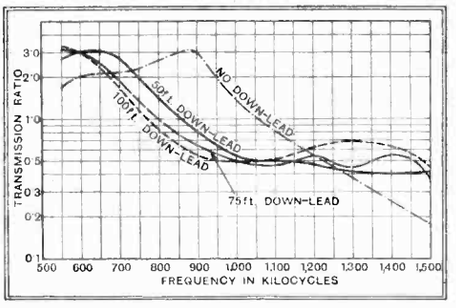


Fig. 3.—Effect of fitting a transformer as shown in Fig. 2. (Low-impedance receiver.)

measured across the aerial and earth terminals of the receiver, to the sensitivity measured across aerial and earth at the remote end of the transmission line.

The simplest method suggested for reducing these losses is shown diagrammatically in Fig. 2, where the aerial is linked to the transmission line by means of a step-down auto-transformer. This transformer is enclosed in an earthed metallic shield, which must be weather-proof, as it is mounted at the top end of the down-lead.

Where Losses Occur

As a result of adding this single impedance-matching transformer, sensitivity is improved to the extent shown graphically in Figs. 3 and 4. The first graph relates to a receiver with a low impedance input, which is defined as one having an aerial circuit coupled to the first tuned H.F. circuit by means of an inductance of 10 to 50 microhenrys, resonating above 1,500 kc. Fig. 4 relates to a receiver in which the aerial is coupled through a high-impedance inductance of some 3 millihenrys, resonat-

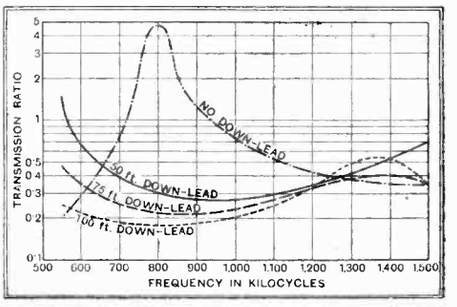


Fig. 4.—With a receiver having a high-impedance input, the arrangement shown in Fig. 2 is rather less effective.

ing considerably below the broadcast band. Loss is greatest with a high-impedance input, and is due both to the by-passing effect of the shielded lead and to mis-matching of the impedances between the low-impedance side of the auto-transformer and the high-impedance input circuit of the set.

A more ambitious and effective arrangement, employing both step-up and step-down auto-transformers for matching purposes, is shown in Fig. 5. The improvement brought about by this scheme is shown graphically in Fig. 6. It is interesting to observe that one of the curves in this figure relates to a 400ft. transmission line; this suggests the possibility of

Screened Aerial Down-leads.—erecting the aerial at a very considerable distance from the source of interference without incurring an intolerable loss.

Still another method of obtaining correct impedance matching between aerial and receiver over a transmission line is illustrated in Fig. 7. Here double-wound transformers are fitted at the input and output ends of the transmission line, and are connected together by means of twin shielded cable. The efficiency of this system is stated to be sensibly the same as that shown in Fig. 5; it would therefore appear that the need for a twin conductor is hardly justified, although it may confer more complete immunity from inductive interference.

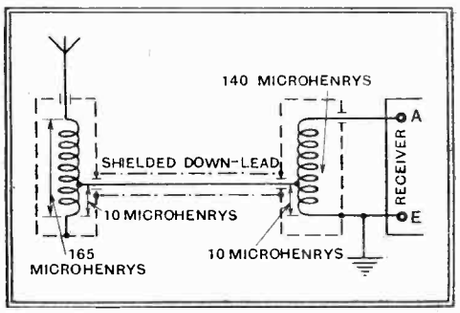


Fig. 5.—How step-down and step-up auto-transformers are fitted at each end of the screened transmission line (or down-lead) for matching purposes.

Although these systems are designed for use with high-capacity, high-loss cable, they would of course be applicable to the more efficient type of aerial down-lead; with this the need for accurate matching would not be so critical.

The terms "screened down-lead" and "transmission line" have been used indifferently, but it is worth while to point out that in certain circumstances, where the aerial is remote from the building, it is quite possible that the screened conductor will be installed more or less horizontally, the vertical down-lead being unshielded.

Two-waveband Problems

Effective earthing of the down-lead shield is found to be of great importance. A poor connection may result in failure of the screening to eliminate noises, and, generally speaking, a water-pipe "earth" has been found best. A long transmission line should be earthed at several points.

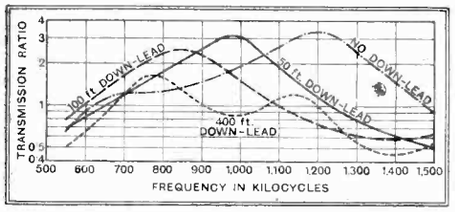


Fig. 6.—By using the impedance-matching scheme shown in Fig. 5 losses are greatly reduced.

In the matter of eliminating interference pick-up on the aerial down-lead, the American listener is particularly fortunate, for the reason that in almost every case he has to concern himself with only a single waveband. British and continental listeners who adopt the matched transmission line principle will probably find it necessary to do the same; at any rate, it is difficult to see an easy way of devising a coupling system that will be effective on both medium and long wavebands. Switching of the remote step-down transformer, which might be mounted at the top of an aerial mast, would clearly be impossible.

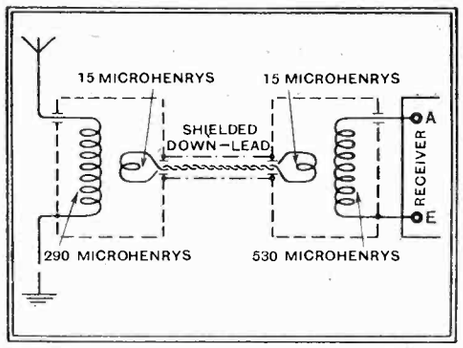


Fig. 7.—A matching circuit comparable with that of Fig. 5, but with double-wound transformers.

For the experimenter, the system shown in Fig. 5 is probably the most attractive, if only for the reason that the coils used have roughly the inductance values of the ordinary screened medium-wave broadcast coil. The tapping points to suit existing conditions may be determined by trial, and will in any case be spaced only by some two to five turns from the ends of the windings.

DISTANT RECEPTION NOTES

ON several occasions in the past I have referred to the extraordinarily good reception that was obtainable from the Ecole Supérieure (PTT) station in Paris working on a wavelength of 447.1 metres. I suggested then that its transmissions were received at a strength which implied a great deal more than the mere three-quarters of a kilowatt with which the station was officially credited. Readers may have noticed that for some weeks now *The Wireless World* list of stations has correctly shown the output rating of Ecole Supérieure as 7 kilowatts, though in others it may still appear as a fraction of a kilowatt.

Except at odd times the Ecole Supérieure is no longer to be received clear of interference. The 20-kilowatt Madona station in Latvia appears to have settled down to a wavelength of 450.3 metres, which means that the frequency separation between it and the Ecole Supérieure is only 5 kilocycles. There is, therefore, as a rule a distressing heterodyne whistle on both transmissions. Madona itself is, of course, interfered with on the other side by the family of no fewer than nine stations which transmit on the common 453.2-metre wavelength which is separated from Madona's by only 4 kilocycles.

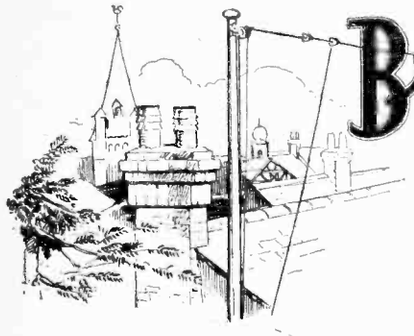
In the matter of broadcasting services Paris must be by far and away the best provided city on this side of the Atlantic. Enough is proverbially as good as a feast, and, in view of the terribly overcrowded state of the long and medium wavebands, it is difficult to see why Paris should require (1) the 75-kilowatt Radio-Paris, (2) the 13-kilowatt Eiffel Tower, (3) the now 7-kilowatt Ecole Supérieure, (4) the 0.8-kilowatt Radio LL, (5) the 60-kilowatt Poste Parisien, and (6) the 0.7-kilowatt Radio Vitus.

A week or two ago I referred to the terrible heterodyne which had completely ruined the transmissions of Huizen (Hilversum programmes) on certain occasions, and suggested tentatively that this might be due to either Kaunas or Lahti. A correspondent tells me that he identified the offending transmission as coming from Moscow; it must, therefore, have been the new 500-kilowatt station at work. I have not heard it since, and I certainly do not want to within the limits of either the medium or the long waveband, for it is sure to play havoc if it uses a wavelength in either of them.

Signal weakness has been observed on several of the long-wave stations in the daytime, those largely affected being Motala, Kalundborg, and Oslo. In the evenings these stations are well heard, whilst Huizen, Radio-Paris, and Zeesen can be received at any time when they are working.

Heterodynes are still rather troublesome on the medium waveband, though luckily it is only on occasional nights that the stations best worth hearing are affected. Recent sufferers have been Poste Parisien, Trieste, and Katowice. Nürnberg on 238.9 metres is now well worth attention. This station relays Munich, and it is an excellent stand-by for these programmes should the parent station be interfered with. Hörby is surprisingly strong just now, and Göteborg is well heard. Thoroughly reliable medium-wave stations are Munich, Stockholm, Rome, Leipzig, Toulouse, Milan, Heilsberg, Hilversum (Huizen programmes), and Brussels No. 1. Budapest and Brno should both be tried for, as on many evenings excellent reproduction is obtainable from them.

D. EXER.



Broadcast Brevities

By Our Special Correspondent

Good-bye to Gloucester

THE shutters will be put up for the last time on Sunday next at the B.B.C.'s Gloucester Repeater Station, which has served the West of England public faithfully and well for the last six years. The work will be taken over on Monday by the new Bristol H.Q. of the B.B.C. in Whiteladies' Road.

The Men in Charge

The actual job of maintaining a repeater station is unexciting, everything being practically automatic, but the man-in-charge must keep a watchful eye on the behaviour on the correction circuits and amplifying valves. The Gloucester station is in the charge of an engineer and three assistants. There is an almost similar installation at Leeds.

Public Television Programmes ?

ISN'T it time that the general public had an opportunity to see the television programmes? There are some very fine features in these nightly transmissions on 261.6 metres, and I know of many people who would gladly pay a small fee to witness a demonstration which would enable them to decide whether to purchase a televisor.

Screen in the Concert Hall

At present the B.B.C. has a special demonstration televisor in one of the Press listening rooms at Broadcasting House, but the general public are not admitted. Why not install a television screen in the Concert Hall and admit the public at cinema prices? I am sure the Hall would be thronged, even at 11 p.m. If you would like to support an appeal for such a facility, send me a postcard.

Cutting Out the Quartet

THE German political upheaval has not greatly affected the broadcast programmes so far as the British listener can observe. But conditions over there were brought home to the B.B.C. last week, when the Reichs Rundfunk was compelled to cancel the arrangement for relaying the Amar Quartet Chamber Concert. At the last minute, it appears, orders came for a Government transmission, and all previous programme arrangements went by the board.

Within the Citadel

PEOPLE have been speculating at Broadcasting House on how long the place could withstand a siege. Those who contend that the attackers would eventually give up in despair, despite the cocktail bar in the near-by Langham Hotel, point out that, among other advantages, there is a threefold lighting supply. In addition to the ordinary borough supply, the B.B.C. can use a special private power line from the generating station. Besides this there are generators in the basement capable of lighting all the studios.

Water is available from the artesian well beneath the building.

Network of Lines

If the line to Brookmans Park were cut, programmes could still go out from Daventry, which is connected to Broadcasting House by several routes.

It is a good thing that Broadcasting House is so safe, considering some of those recent variety turns.

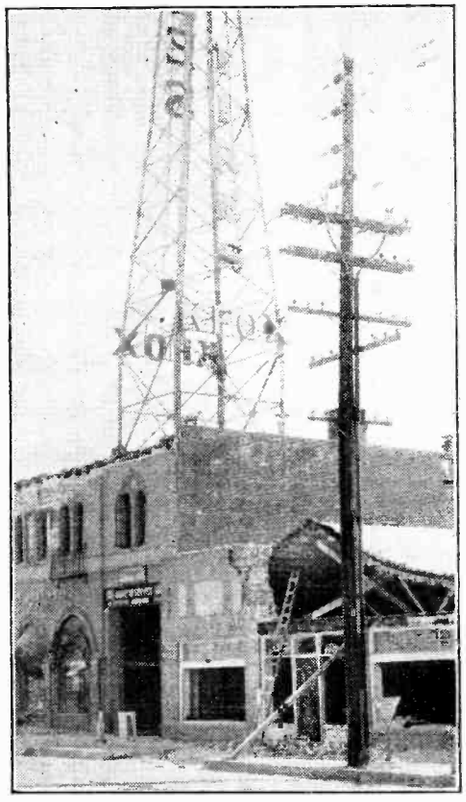
Variety and Entertainment

Talking of variety, it is now possible that Mr. Eric Maschwitz may postpone taking over the control of this feature until September, instead of May, as was originally stated. According to the latest information, there are to be two new appointments in connection with the gayer side of the Corporation's activities. Mr. Roger Eckersley may become "Director of Entertainment," and Mr. Maschwitz "Director of Variety."

I foresee some dangerous clashes if the two Chiefs fail to guard against entertainment creeping into Variety and *vice versa*. Past success must not make for overconfidence in this respect.

Recording Programmes at Home

I WONDER whether any listener, wishing to hear a special programme on a night when he had an outdoor engagement, has considered doing a little blattnerphoning or dictaphoning on his own account? One could spend many a pleasant hour planning a device which would switch on set and dictaphone simultaneously at, say, 8 p.m. for the Buggins' turn or the first movement of a Queen's Hall symphony. The record could be played over at leisure.



A REAL BREAKDOWN. B.B.C. stations are spared such calamities as befell KFOX Long Beach in the heart of the Californian earthquake zone. The photograph indicates that the mast and near-by telegraph poles withstood the shocks better than the building.

Ban on Press Records

The P.M.G. has just informed the "Newspaper World" that "the connection for Press purposes of a dictaphone with a loud speaker used for wireless reception would not be approved," but I believe that a home listener is allowed to use a dictaphone so long as no outside use is made of the record.

Broadcasting an Edgar Wallace Thriller

AN opportunity arose for the B.B.C. to secure simultaneously the rights of "The Ringer," by Edgar Wallace, and the services of Constance Cummings, the American film artist. The Productions Director has therefore decided to postpone the presentation of Horace Annesley Vachell's comedy, "Quinneys," and to substitute for it on April 19th (Regional) and 21st (National) Edgar Wallace's thriller. This will be the first broadcast performance of an Edgar Wallace play, and the first appearance in a leading part in a radio play of a film "star."

All About "Talkies"

MR. CECIL LEWIS, former programme chief of the B.B.C., returns to the studio on April 21st for the first of a series of film talks which he is to broadcast in the interval between the production of "talkies" at Elstree. Having worked for several years at picture-making, including the direction of three of his own films, he will be able to reveal to listeners the secrets of film-making.

Anticipation and . . .

STAFF arrangements at Broadcasting House and the rumours of a "general post" are still a fruitful topic of discussion in Portland Place.

Everything looked bright and happy. An increase of upwards of £150,000 over last year in respect of new licences, a magnanimous gift of another quarter of a million to the State funds, and University honours for Sir John himself, led the staff to expect something good in this month of April, which opens the B.B.C. new financial year.

. . . Realisation

BUT rises have not materialised on anything like the scale expected. Very keen disappointment is felt in many quarters. The introduction of the bonus idea has been a clever move; a rise in salary is, of course, recurrent, but a bonus equivalent to a year's rise need never recur. At the same time, the bonus need not figure on the salary sheets!

Correspondence

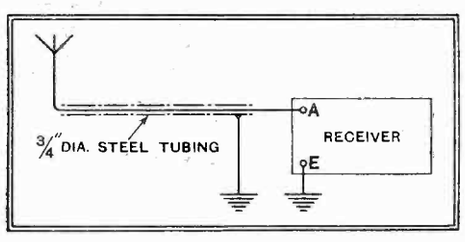
The Editor does not hold himself responsible for the opinions of his correspondents.

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.

Tubular Aerial Shield

BEING in the unenviable position of having to demonstrate highly efficient radio receivers in an area where electrical interference produced by motors, rectifiers, etc., is present, I have had to do some very serious experimental work in attempting to eliminate a great deal of this interference at the receiving end.

Perhaps your readers will be interested in an aerial system, shown in the accompanying diagram, which has enabled me to reduce interference to such a degree that I can demonstrate a highly sensitive all-mains receiver without apparent background.



The above differs from the aerial system advocated by the G.P.O.; the use of lead-sheathed wire, I find, is not so efficient at shielding as steel tubing, which does not reduce signal strength greatly.

Again, it is better to use two *good* earths, one from the receiver, the other from the shielding of the lead-in.

I am sure any reader who suffers greatly from interference will find the above well worth a trial.

King's Lynn. WM. SMURDEN.

Interference

I AM sure I am expressing the thanks of a good many listeners for your untiring efforts to bring about some sort of legislation for the suppression of interference caused by electrical machinery.

In this connection, may I just add that it is imperative for the motor car manufacturers to do something about fitting anti-interference devices to car ignition systems. The objectionable interference caused on the short and ultra short wave bands is so great that in many instances satisfactory reception is impossible.

If something is done now, we might, by the time the ultra short wave broadcasts come into general use, have interference-free reception.

LEOPOLD B. FRIEDMAN.

London, W.C.1.

I HAVE been very interested in the correspondence published some time ago on the subject of interference by Morse, and I agree with your correspondents that there is still great room for improvement.

Some years ago the Post Office very kindly investigated a complaint of mine that Midland Regional (then on 480 metres) was ruined by Morse, and I gathered that this was due to a French Coastal Station working off its allotted wavelength. But I have still to identify the individual who can cut through anywhere on the medium wave band. On Saturday, January 7th, he was plainly audible on London Regional even from 9.50 to 10.0 p.m., almost spoiling the News Bulletin.

It is exasperating to build such fine sets as the Monodial Super and then be compelled to restrict their use to the two local transmissions. I feel convinced something could be done if enough pressure were brought to bear on the offenders by the Post Office.

J. R. H. WHISTON.

Belvedere, Kent.

A.V.C. and the Monodial

WITH reference to your recent article on the conversion of the Monodial superheterodyne. As a constant reader of over ten years' standing I feel compelled to write a few words of appreciation of the article. The Monodial is unquestionably far and away the best receiver I have handled that has been described in the Press, and its unrivalled popularity is well merited. The point that appeals to me, and will, I know, appeal to a great number of readers of the article referred to, is the candid description of the conversion, the economy in cost and new parts recommended, and, finally, the straightforward manner in which the whole conversion is laid out.

The policy adopted by some of constantly suggesting to the public the advisability of constructing entirely new receivers with new apparatus in order to obtain up-to-date, efficient reception on the smallest technical grounds is open to serious criticism.

Please accept my very sincere appreciation.

H. ASHLEY-SCARLETT, Lt.-Col.,
President, Golders Green and Hendon Radio Scientific Society.

Frequency Tests

THE frequency test carried out during an evening talk some while ago from the B.B.C. emphasised the acceptability of these tests being given fairly frequently.

The B.B.C. has implied that any serious amateur should be able to construct an oscillator for his own use, but many amateurs have limited time to devote to their apparatus, to say nothing of the expense of an oscillator to give constancy.

I wonder if many of your readers are aware that, if they possess fairly sensitive sets and are situated within 15 to 20 miles of Brookmans Park, they can sometimes pick up a carrier from one of the twin transmitters upon which a frequency test is carried out? This has taken place between 9.30 a.m. and 10.0 a.m. on some mornings and apparently emanates from tests by the engineers at Brookmans Park, but not radiated by the main aerial, but from the feeders or some part of the H.F. equipment. Surely these could be radiated at full power? A. E. RUSSELL.

London, S.E.18.

Non-inductive Condensers

WE note with interest your article in the March 3rd issue on "Inductive and Non-inductive Condensers." We should like to add that it is important to use the shortest possible length of wire to the terminals of a non-inductive condenser if the circuit requires this characteristic. It is useless to use a non-inductive condenser with two or three inches of wire to the terminals, since the improved characteristics of a non-inductive condenser over the normal type would be quite lost.

During the last three years all our Type 50 condensers have been made non-inductively, and there must be a very large number of this type in the hands of constructors. Should any of your readers be in doubt as to which type they have, namely, inductive or non-inductive, we shall be very pleased to let them know how the different types may be identified.

H. W. COLE,
Assistant Manager, The Telegraph Condenser Co., Ltd.

London, W.3.

In Next Week's Issue :—

CLASS "B" ELIMINATOR

An A.C. mains H.T. unit of constant voltage output embodying the new neon stabiliser

IT is a matter of some difficulty to design an H.T. eliminator for Class "B" or Q.P.P. receivers, because the H.T. current varies between wide limits according to the signal strength. The regulation of the ordinary mains unit is such that these current variations will cause sympathetic changes in applied voltage and distortion will result. To prevent this effect a specially constructed neon stabiliser has been introduced which provides almost perfect regulation, there being not more than 7 volts change when the total load of the receiver varies between 5 and 45 mA. Without the stabiliser the voltage change would be about 200. Although the Class "B" Eliminator is designed especially for "The Class 'B' Ferrocart" receiver recently described, it can be used with the majority of sets incorporating the new push-pull output stages.

1 Neon stabiliser	Cossor
1 Metal rectifier	Westinghouse H.T.8
1 Mains transformer	Heayberd W.30
1 L.F. choke	Trix C:55
2 Fixed condensers, 4mfd., 1,500 v. D.C. test	Peak
2 Metallised resistances, 20,000 ohms, 1 watt	Dubilier
1 Resistance, 2,500 ohms, tapped at 1,800 ohms, 10 watts	Dubilier "Spirohm"
1 Valveholder, 5-pin	Clix Chassis Mounting Type
2 Fuses, 1 amp., for flexible leads	Belling Lee No. 1037
1 Grid-bias battery, 16½ volts	
1 pr. Grid-bias battery clips	Gripso
3 Mains plugs and sockets, complete with bushes	Clix
Paymax baseboard, 10in. x 7½in. x ¾in., and battens and bracket for plug sockets	Peto-Scott
1 Perforated metal box	Peto-Scott
Systoflex, wire, flex, etc.	
Wood Screws: 2d. ¾in., No. 4 R/hd.	

A.V.C. MONODIAL: A CORRECTION.

IN the under-baseboard wiring plan of the Monodial receiver with A.V.C., on page 225 of the issue for March 24th, the fixed resistors R9 and R10 were inadvertently interchanged.

One end of each of the resistors in question was correctly shown as connected to the same terminal of C7, but the connections between the other ends and condenser C8 should be changed over.

LABORATORY TESTS

New Radio Products Reviewed

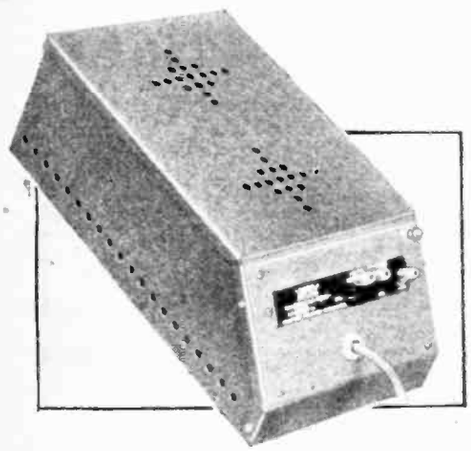
ATLAS Q.P. MAINS UNIT

A RANGE of H.T. battery eliminators designed especially for use with Q.P.P. receivers and gramophone amplifiers has just been introduced by H. Clarke and Co. (Manchester), Ltd., Atlas Works, Patricroft, Manchester. They are known as Q.P. units, there being two models for A.C. mains and one for use on D.C. supplies. The nominal output is given as 12 mA at 150 volts, but currents up to 20 mA. can be drawn from the units, as the voltage regulation is as good as it is possible to achieve with this type of power supply unit.

Each unit has two intermediate voltage tappings, one for the detector valve and one for the auxiliary grids of the pentode output valves. The first mentioned is rated at 60-80 volts with sub-tappings giving minimum and maximum voltages, which with 12 mA. drawn from the unit were 40 and 65 volts respectively in the case of the unit tested.

Provision is made for matching within sufficiently close limits the operating conditions of the two pentodes in the Q.P.P. output stage. The auxiliary grid supply for these valves can be taken from one of three sockets marked 130-140 volts. They permit of variation between 8 and 10 volts, according to the load on the unit. With a total load of 12 mA. the measured outputs from these sockets were 140, 150 and 160 volts. At a load of 18 mA. the voltages dropped to 128, 136, and 142 respectively.

The output from the 150-volt tapping measured 180 volts at 9 mA., 169 volts at 12 mA., 150 volts at 16 mA., and 135 volts at 20 mA.



Clarke's Atlas Q.P.24 A.C. mains unit for use with Q.P.P. receivers.

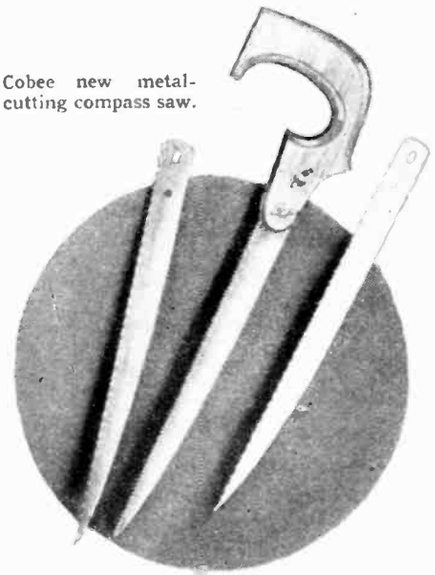
Both A.C. models include Westinghouse rectifiers, and the price is 72s. 6d. for the Q.P.24, and 100s. for the Q.P.26. This has the addition of an L.T. trickle charger. The D.C. version, model D.Q.P., costs 45s.

COBEE COMPASS SAW

MADE by A. Barson and Co., Ltd., 53, Truro Road, Wood Green, London, N.22, the Cobee metal-cutting saw is an ideal tool for the wireless home constructor, as it can be used for cutting metal sheet, metal-backed wood such as "Plymax," and ordinary ply-wood with equal facility. The orthodox hack saw has definite limitations owing to the presence of the frame, whereas in the Cobee saw the blades are sufficiently rigid to render a frame unnecessary.

The blades are 13in. long and $\frac{1}{16}$in. thick, and are easily interchanged, a coarse-toothed blade being recommended for cutting wood, whilst one with fine teeth similar to those of an ordinary hack-saw blade is available for use with metal. We found the coarse-toothed blade particularly efficacious in cutting aluminium-backed plywood, a material that is often used in the construction of chassis for *Wireless World* receivers. The Cobee saw should find a place in every home

Cobee new metal-cutting compass saw.

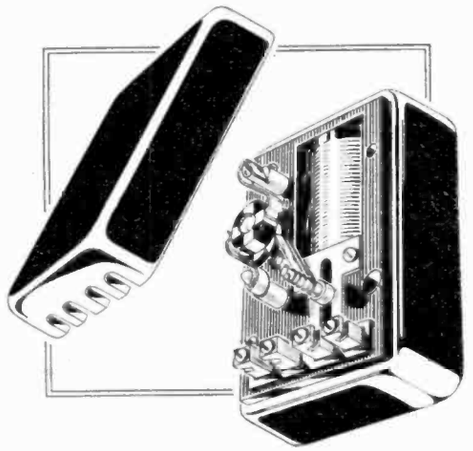


constructor's workshop, in view of its undoubted usefulness, and the price is 5s. 3d. complete with three blades.

WATES DISTANT SWITCH

THIS is a remote control unit for switching on and off the receiver from any distant point, and would be an exceedingly useful addition where loud speaker extensions are provided. It operates from a small $4\frac{1}{2}$-volt flash-lamp battery and a standard bell push-button switch. Current is taken only for a few seconds at a time, so that a battery of this type will serve for many months.

The mechanism is simple, robust and rapid in its action. It consists of a small solenoid, in the centre of which is a plunger of soft iron. When the battery circuit is closed the plunger is drawn into the solenoid and carries with it a ratchet. This engages with a toothed wheel, causing it to rotate one-eighth of a revolution. Metal segments, arranged in the form of a cross, come into contact with two spring leaves and so close the filament or mains circuit of the receiver. As the plunger mechanism



Wates distant switch with cover removed.

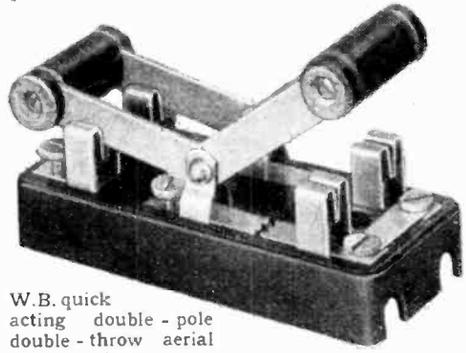
is returned to the "ready" position by gravitation, it is essential to mount the switch vertically and as explained in the descriptive literature.

The switch is quite reliable, and operates immediately the bell-push is pressed. However, if the leads are much in excess of about 20 yards, or have a resistance greater than one ohm, a six-volt battery becomes necessary, but it would be quite in order to use two flash-lamp batteries wired in series. Incidentally, the switch will operate on A.C., and one of the small bell-ringing transformers giving 5 or 8 volts output at one amp. could be used in place of batteries.

The makers are Wates Radio, Ltd., 184-188, Shaftesbury Avenue, London, W.C.2, and the price is 9s. 6d.

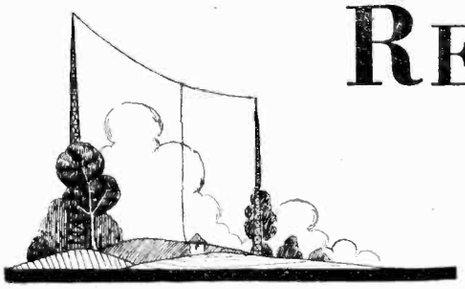
W.B. EARTHING SWITCH

MOUNTED on a moulded bakelite base measuring $3\frac{1}{8}$in. × $1\frac{3}{8}$in., this new W.B. aerial switch, which is a double-pole double-throw type, entirely isolates the receiver from both the aerial and the earth when in the "safety" position. It is fitted with V-shaped knife contacts and has a handle at each end, thus ensuring perfect rigidity, quickness and ease of manipulation.



W.B. quick acting double-pole double-throw aerial switch.

The makers are Whitely Electrical Radio Co., Ltd., Radio Works, Victoria Street, Mansfield, Notts, and the price is 1s.



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 brief particulars, with the fee charged, are to be found at the foot of this page.

Checking Condenser Sections

TO ascertain whether all the various sections of a ganged condenser have the same capacity at any given angular setting is not a difficult matter. The regenerative detector circuits of an existing receiver—even of the receiver for which the condenser forms a part—and a milliammeter are practically all that is needed if one adopts the plan shown diagrammatically in Fig. 1.

This scheme is recommended to a reader who believes that his failure to obtain accurate ganging is due to a defective condenser. The testing apparatus should be wired up in the manner shown, in such a way that any section of the ganged condenser may be employed to tune the grid circuit; an absorption circuit, consisting of another coil, a condenser, and preferably a "vernier" condenser as well, should be placed in inductive relationship with the tuned circuit. The procedure is to make the testing circuit oscillate by increasing reaction coupling, and then to adjust the trimmers on the ganged condenser sections so that when they are set at zero any section will tune the circuit to precisely the same wavelength.

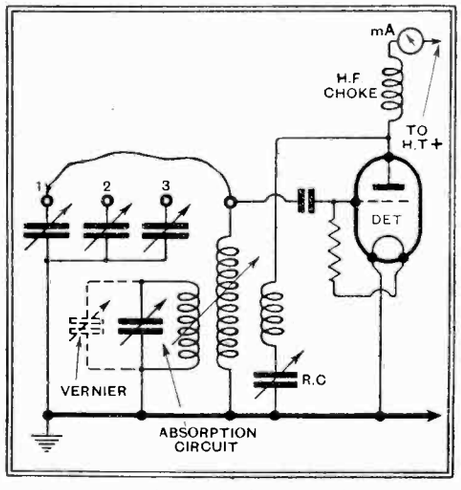


Fig. 1.—Tracing misalignment in ganged condensers: an improvised test circuit operating on the absorption principle.

A state of resonance between the absorption circuit and the oscillating circuit is indicated by a "kick" of the milliammeter reading as the former is brought into tune; coupling should be so loose that this "kick" is only just perceptible. If the reading of the absorption tuning condenser (or better, its parallel vernier) remains unchanged, irrespective of which ganged condenser section is in circuit, it can be assumed that all have the same capacity.

Having made the preliminary adjustment of trimming capacity, the sections of the ganged condenser should be checked at a number of other settings, no subsequent adjustment of the trimmers being permissible. Again, the absorption condenser setting should be the same for each condenser unit, and any discrepancy is a measure of the amount by which individual units are out of alignment.

Voltage Measurements : A Precaution

ALTHOUGH not entirely accurate, a direct measurement of the voltage applied to a high-power output valve, if taken by a good high-resistance voltmeter, is accurate enough for most practical purposes. In making measurements of this kind it is common practice to connect the negative terminal of the meter to the earth line or metal chassis, and then to join the positive meter terminal to the valve anode, or some other convenient point in that circuit.

This procedure is apt to introduce a serious error when dealing with heavily biased mains-operated valves, and we think it is responsible for an effect noticed by a correspondent. By connecting the meter in the manner described he is reading the sum of the anode and grid bias voltages applied to the valve; this would account for the fact that the voltage appears to be higher than it should.

It would be correct in the circumstances to connect the negative terminal of the meter directly to the cathode terminal of the output valve, and not to the earth line. With a directly-heated A.C. output valve connection should be made to the centre tap of the filament transformer, or even to either of the filament terminals.

Loud Speaker Changes

THE Modern A.C. Quality Amplifier (*The Wireless World*, February 17th) is a somewhat specialised piece of apparatus, and consequently its power supply and smoothing circuits do not follow conventional practice. The amplifier was primarily designed for use with a pair of matched loud speakers, both having field windings of 2,500 ohms resistance; provided that the specification is followed implicitly in this matter, everything is straightforward, but a number of readers who propose to use single loud speakers, or other loud speaker combinations, seem to be uncertain as to the right method of procedure.

These uncertainties may be cleared up by saying that, with obvious limitations as to power handling capacity and suitability of the built-in coupling transformer, any loud speaker or pair of loud speakers may be employed; permanent magnet, energised, or these types in combination.

As a result of departing from the specification certain changes may become necessary, and as a guide in making these a simplified diagram of the power supply circuits is given in Fig. 2. Referring to the original design, the first (series-connected) loud speaker field is employed for smoothing purposes, and so it can only be replaced by a choke or a choke-resistance combination having a total resistance of 2,500 ohms.

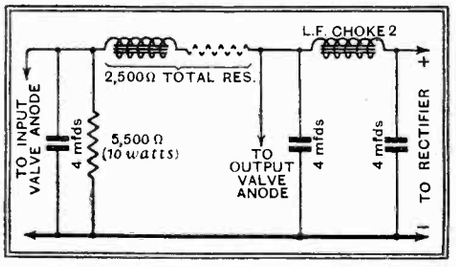


Fig. 2.—A special system of progressive smoothing is used in the "Modern A.C. Quality Amplifier." This simplified diagram of the power supply circuits shows how the parallel-connected field winding may be replaced by a loading resistance.

The second (parallel-connected) loud speaker field, in conjunction with resistance R5, acts as a load, and its presence ensures that sufficient energising current shall flow through the other field winding. Consequently, for the second field, a plain resistance of 5,500 ohms (10 watts rating) may be substituted for these two components if desired.

An Out-of-date Arrangement

A NOISY background, and especially a background of hiss, was a serious shortcoming of the earlier superheterodynes. This disadvantage has now been almost completely overcome, largely by methods of control made possible by the introduction of the variable-mu valve.

These remarks are prompted by a letter from a reader who has improvised a superheterodyne receiver largely from existing parts; except for background noises, the set works satisfactorily.

A circuit diagram submitted for criticism shows that no form of volume control is fitted other than provision for regulating input from the aerial. This means that all the valves—and particularly the I.F. amplifier—are always working at full magnification irrespective of the strength of incoming signals. Consequently, the background hiss will be as bad when dealing with strong signals as with weak ones. To improve the average ratio between signal strength and background noise, we strongly recommend the fitting of some form of volume control which will allow regulation of I.F. amplification.

The Wireless World INFORMATION BUREAU

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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CONTENTS

EDITORIAL COMMENT

Television and the B.B.C.

A Responsibility to the Public

IN the early days before broadcasting in this country began the Postmaster-General made a public statement that he would not be prepared to grant facilities for regular broadcast transmissions until he was satisfied that there would be nothing in the nature of a monopoly for the supply of wireless receiving sets, but that equal facilities would be available to manufacturers. There is no doubt that at that time the Postmaster-General envisaged the possibility of a patent situation which might give to one company exclusive rights to supply sets for broadcast reception. We have always believed that it was because of this attitude adopted by the Postmaster-General that the Marconi Company, then owning most of the patents of importance, granted licences subject to the payment of royalties under their patents, without discrimination, to any *bona fide* manufacturer.

Television is not yet to be regarded as of more than great experimental interest, but progress has been made and it seems probable that before long sufficient development will have taken place for the B.B.C. to treat television as a part of their regular programme service. There are several rival systems for television transmission, most of which require the employment of distinctive apparatus at the receiving end, that is to say, the receiver and transmitting system are interdependent and are not universal in application, as is the case with sound broadcast apparatus. Television transmissions, irrespective of the system employed, could be "coded" in most cases in such a way that only apparatus using a particular patented arrangement could receive them. The B.B.C. ought not to countenance a monopoly which might be created in this way unless the coding system is in itself a technical essential, in which case a general licence to manufacturers should be granted on reasonable terms for the construction of receiving apparatus. When the time comes, therefore, for the B.B.C. to select one or more systems for regular broadcasting transmissions, we hope that the Postmaster-General will again recognise the importance of guarding against an exclusive monopoly in the hands of any one manufacturer. The principle which was fair in application when broadcasting began will be found equally just when television reaches the stage where it becomes a public service.

Summer Time

Effect on Distant Reception

SUMMER Time is with us again, but whereas in the past we have become accustomed to expect to have to forgo the enjoyment of foreign listening, in general, until a later hour in the evening. But to-day, although after dark, the smaller stations come in at much greater strength, good reception is obtainable in daylight with quite unambitious receivers, and programmes of most of the bigger Continental stations can be enjoyed.

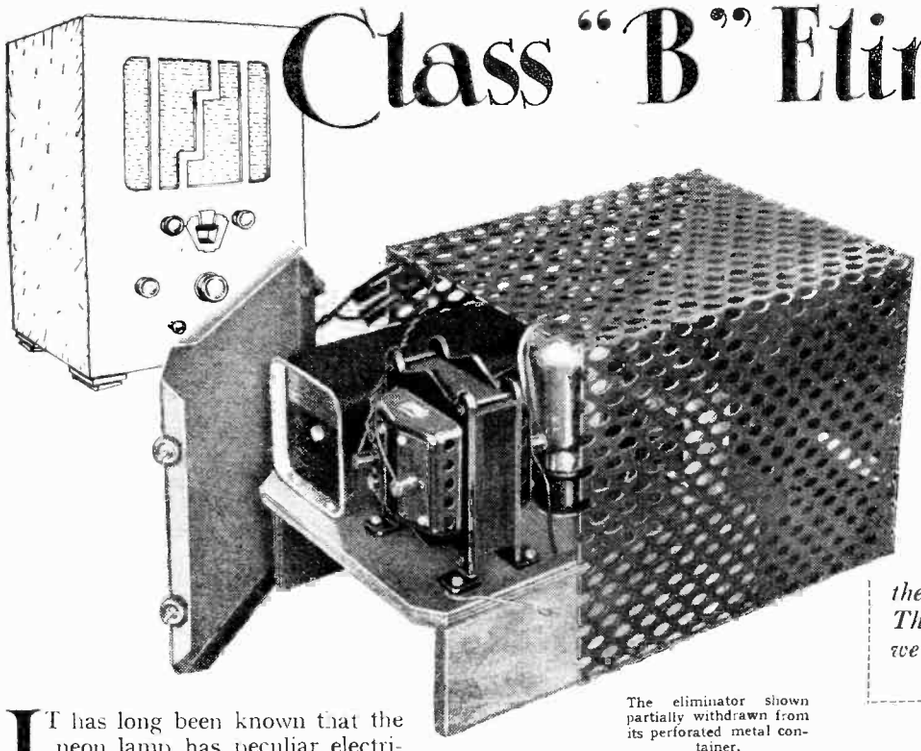
Two factors have contributed to bring about this change; the power of many of the Continental stations has increased so substantially during the past twelve months that they have become comparable to local stations, and the average efficiency of receivers is much higher. It would seem, therefore, that we can look forward to satisfactory reception throughout the summer of a wide selection of foreign programmes.

Class "B" Eliminator

H.T. Unit with Constant Voltage Output Embodying the New Neon Stabiliser

By W. I. G. PAGE, B.Sc.

CONSTRUCTIONAL details are given in the accompanying article of an H.T. eliminator for A.C. mains for use with receivers embodying the new Class "B" amplifier. Almost perfect voltage regulation is obtained by the employment of a new neon stabiliser with which there is a voltage change of only seven when the total load of the receiver varies between 5 and 45 mA. The stabiliser used is an advanced sample, but we understand that the production model gives an even better regulation curve.



The eliminator shown partially withdrawn from its perforated metal container.

IT has long been known that the neon lamp has peculiar electrical properties. Its apparent variation of resistance when different voltages are applied to it has prompted scientists to use it as a stabiliser in wireless circuits. As long ago as August, 1929, S. O. Pearson[1] showed that considerable liberties could be taken with the decoupling scheme of an ambitious receiver if a neon tube were shunted across the output of the mains supply unit. Meanwhile, however, great improvements have been made in all-mains equipment, and very little attention has been paid to stabilisers until to-day.

With the advent of Class "B" and Q.P.P. amplification it is a matter of some difficulty to design an eliminator which will give anything like a constant applied voltage to the anode of the valves when the total anode current varies according to the signal strength—between, say, 5 and 45 mA. It is only necessary to look at the regulation curves of the smoothed outputs of various mains rectifiers available at the present time. When the D.C. milliampere load is changed between the above limits the D.C. volts output may vary as much as 200, and it is only by using a small portion of the regulation curve of a heavy duty rectifier—a somewhat wasteful process—that this figure can be appreciably reduced.

Class "B" amplification has so far been applied only to battery sets, but there is already a demand for a suitable A.C. eliminator, and it has been left to A. C. Cossor, Limited, to produce a special neon stabiliser, which causes the regulation of any of the standard rectifiers to become almost perfect. With the stabiliser in circuit in the eliminator about to be described, the voltage output changes only by 7 with a load variation between 5 and 45 mA.; without the stabiliser the voltage change is about 200. The designer thus has at his disposal a means of providing an almost constant voltage from a comparatively high resistance source irrespective of the load.

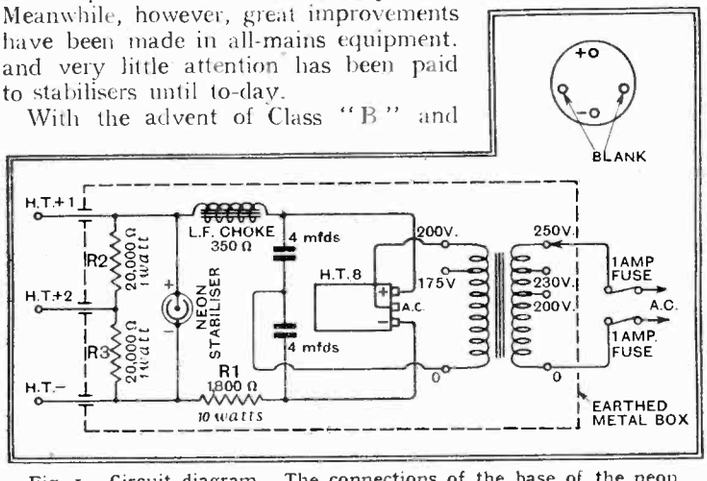
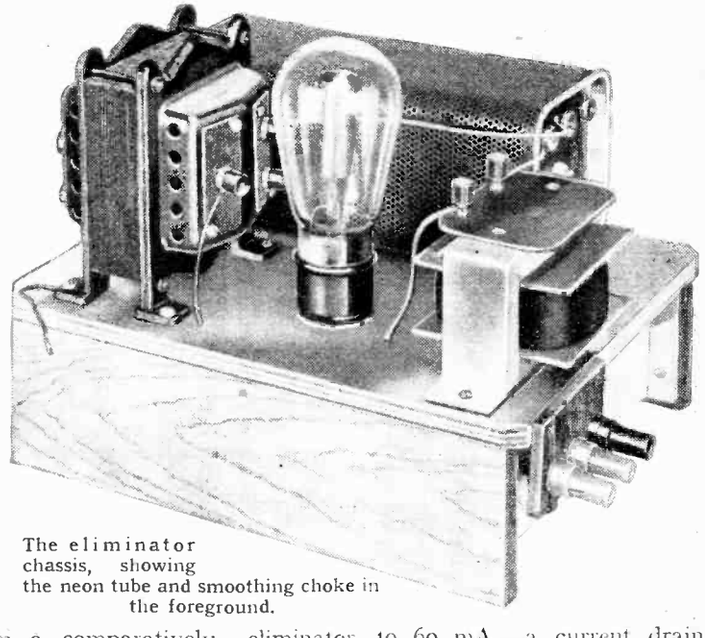


Fig. 1.—Circuit diagram. The connections of the base of the neon stabiliser are shown inset.

The action of the neon tube is interesting, for to all intents and purposes it behaves as a floating battery of high resistance. Now it is well known that a floating battery acts as an excellent smoothing device; we can, therefore, replace the usual 4 mfd. condenser after the smoothing choke by the neon lamp, and we shall be rewarded with an equivalent of some 20 mfds. Apart, therefore, from its propensities as a voltage regulator, the stabiliser assists tremendously in giving a hum-free supply. The equivalent voltage of the fictitious battery representing the neon tube is about 100 and its resistance about 270 ohms, so that when the regulation of the circuit is plotted it will be seen why the voltage output is almost constant for varying loads.

To restrict the total output of the eliminator to 60 mA.—a current drain which is not likely to be reached during the peaks in any battery Class "B" receiver—a resistance R1 or 1,800 ohms must be included in the smoothing circuit.



The eliminator chassis, showing the neon tube and smoothing choke in the foreground.

[1] "The Neon Lamp as a Stabiliser," August 28th and September 4th, 1929.

Class "B" Eliminator—

Together with the D.C. resistance of the choke, the added resistance to the smoothing circuit is, therefore, 2,100 to 2,200 ohms.

It will be assumed that the eliminator is to be used with "The Class 'B' Ferrocart" Receiver described in last week's issue, although with minor changes it could be used with almost any Class "B" or Q.P.P. set. Terminal H.T.+1 will deliver about 130 volts to the anodes of the valves, irrespective of whether the current being drawn is 5 or 45 mA., and from H.T.+2 the screening grid of the variable-mu valve will receive 60-70 volts. When the set requires only 10 mA. for a weak signal the neon stabiliser takes 50 mA., and when a current of 45 mA. for the maximum signal is wanted the stabiliser takes but 15mA. Thus the sum of the currents from stabiliser and set is always 60 mA. It is interesting to watch the needle of a milliammeter joined in circuit at X (see Fig. 2), which, of course, registers the total current taken by the receiver, the potentiometer for H.T.+2 and the stabiliser. The reading remains almost steady at 60 mA., the greatest deviation from this figure being 59 to 61 mA. from no signal to full volume.

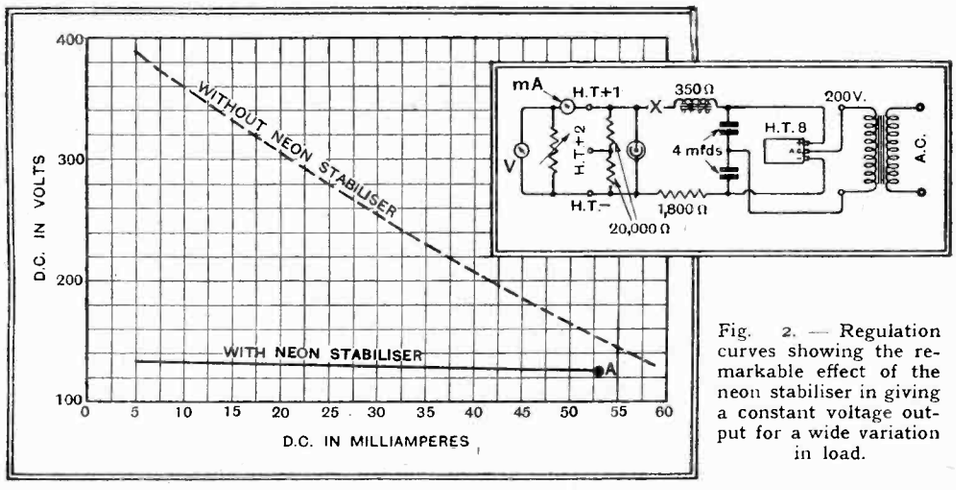
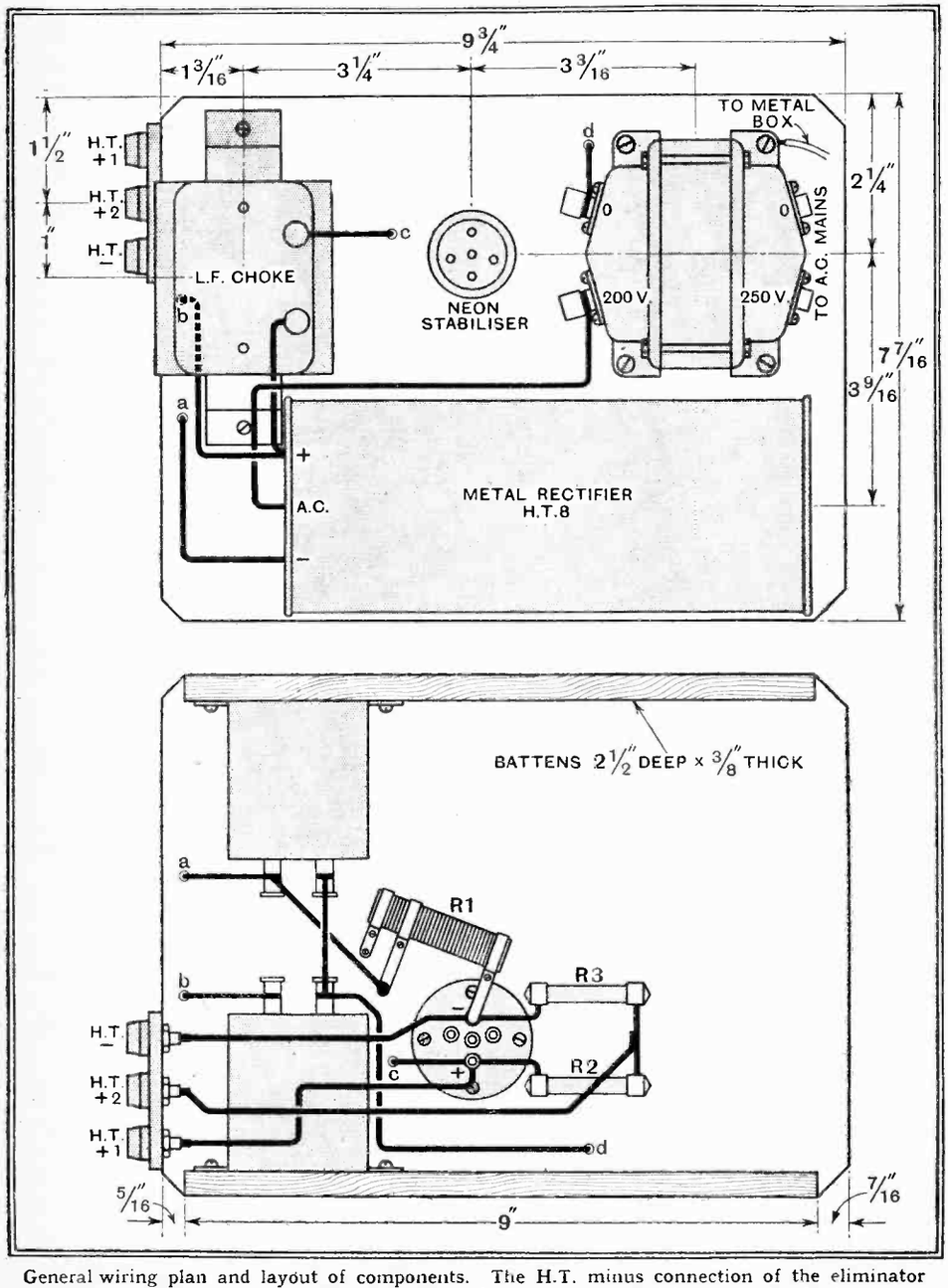


Fig. 2. — Regulation curves showing the remarkable effect of the neon stabiliser in giving a constant voltage output for a wide variation in load.

Regulation curves of the eliminator, with and without the neon tube, using the circuit shown inset, have been taken, and are given in Fig. 2. The effect of the stabiliser is remarkable, and it is only with a device of this kind that a receiver imposing widely varying loads can hope to give really distortionless results. It is interesting to note that should the receiver load exceed 53 mA. (the point A) —which only results from gross overloading—the neon tube is extinguished and the stabilising effect ceases.

It must not be inferred that the regulation of the rectifier used in the eliminator is poor; this is far from the case, for the characteristic compares favourably with other rectifiers, and is entirely satisfactory for the type of receiver for which it was designed—that in which the mean current hardly varies at all with the signal. Moreover, it is fair to point out that the steepness of the curve, in the case without the neon lamp, is somewhat aggravated by the presence of R1.

The eliminator is built upon a metal-covered baseboard, and the whole is housed inside a perforated-metal container which fits snugly into the space occupied by the H.T. battery in "The Class 'B' Ferrocart" Receiver. The container and the covering to the baseboard are earthed to the receiver "earth" terminal, and the H.T.– wander plug of the receiver is taken to H.T.– of the eliminator. A separate bias battery will be needed, which can be held in clips under the central wooden partition in the receiver cabinet. The positive terminal of this battery must be connected to the contact of S3 (in the receiver) to which H.T.– is already joined.



General wiring plan and layout of components. The H.T. minus connection of the eliminator must not be earthed. Two one-ampere fuses are connected in the mains leads.

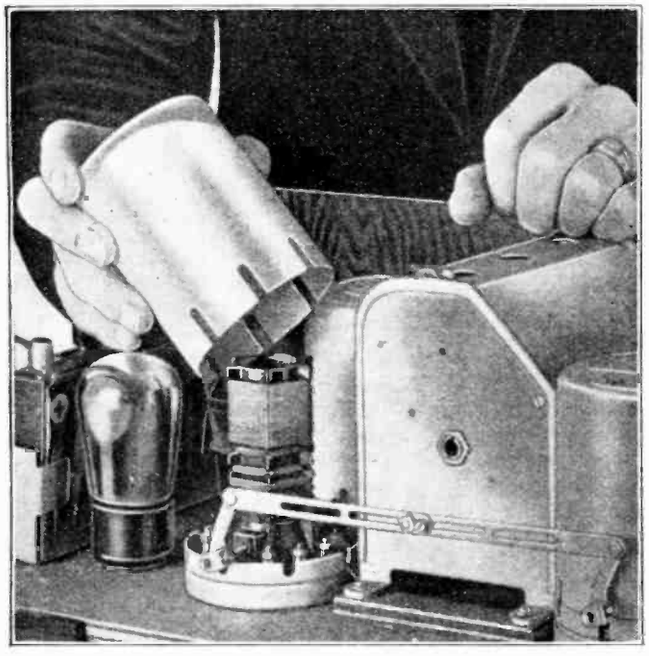
LIST OF PARTS

1 Neon stabiliser	Cossor Type S.13C
1 Metal rectifier	Westinghouse H.T.8
1 Mains transformer	Heayberd W.30
1 L.F. choke	Trix C.55
2 Fixed condensers, 4mfd., 1,500 v. D.C. test	Peak
2 Metallised resistances, 20,000 ohms, 1 watt, R2, R3	Dubilier
1 Resistance, 2,500 ohms, tapped at 1,800 ohms, 10 watts, R1	Dubilier "Spirohm"
1 Valveholder, 5-pin	Clix Chassis Mounting Type
2 Fuses, 1 amp., for flexible leads	Belling Lee No. 1037
1 Grid-bias battery, 10½ volts	
1 pr. Grid-bias battery clips	Gripso
3 Mains plugs and sockets, complete with bushes	Clix
Plymax baseboard, 10in. x 7½in. x ⅜in., and battens and bracket for plug sockets	Peto-Scott
1 Perforated metal box	Peto-Scott
Systoflex, wire, flex, etc.	
Wood Screws: ¾in., No. 4 R/hd.	

SCREENING—*Effective and Ineffective*

How to Obtain Stable High-Frequency Amplification

By M. G. SCROGGIE, B.Sc., A.M.I.E.E.



A typical modern screened H.F. stage.

THE receiver which has the greatest mass of metal bestowed on it and around it is not necessarily the best screened. The necessity for some kind of screening grows increasingly important with developments in high-frequency amplification. There are always electric and magnetic fields to be considered, and the ineffective results of indiscriminate methods of screening are explained.

THE most manifest difference between a receiver of to-day and one of the past is that each part of the former is encased in metal, a characteristic almost totally lacking in the latter. Even an unmechanically minded person is probably capable of perceiving that this selection of material is not in all cases based upon considerations of mechanical strength (although it is true that the transport systems of the country are such as to justify the choice for chassis and supporting parts). Most of the metal is wholly or partly for "screening." Why is screening necessary?

If an amplifier has an amplification of 10, and one tenth of the output finds its way back to the input, it upsets it very badly and may cause continuous oscillation. This is the process when a reaction coil is used to couple the anode circuit of a valve to the grid circuit to get intentional oscillation. If the amplification is very large, coupling between the components at a considerable distance is enough to cause oscillation.

In a modern set the power amplification from aerial to loud speaker may run into billions, and distance alone is not sufficient to prevent coupling between parts carrying high power and those of low power, for it is not practicable to build sets with all the components spaced many yards from one another.

Fortunately coupling does not necessarily cause undesired oscillation; by changing the frequency of amplification it may be possible to stop off one section of the set from another; this is done once in a "straight" set, and twice in the usual type of superhet. In spite of this restriction, any modern sensitive receiver would burst into uncontrollable oscillation if a certain amount of electrical screening were not resorted to in order to prevent adjacent parts from coupling.

The Invisible Link

Further inspection of our modern receiver might lead to the conclusion that in order to screen one part from another it is enough to enclose it in metal. Judging from things that one sees from time to time, this certainly seems to be the impression of some designers. But such a golden rule is too simple to be true, and is liable to lead one badly astray.

To begin with, it is necessary to discriminate very clearly between electric and magnetic screening. As both electric and magnetic fields exist together they are liable to be confused. (The *field* is the invisible link that constitutes the coupling; a fire may be said to have a thermal field which reaches across space between the flames and the cat on the hearthrug, and is detected by the latter.) It is convenient to remember that the electric field is associated with volts, and the magnetic with amps.

A coil of any sort depends for its action on the current flowing round it, and there is an intense magnetic field within it which decreases in strength at greater distances. Anything brought near an unscreened coil or condenser tends to change the distribution of the field and so alter the inductance or capacity, and hence the tuning. Leads from one part to another carry current and also vary periodically in voltage, and so are surrounded by both magnetic and electric fields. In fact, every part forming a high- or low-frequency circuit sets up both kinds of field, but in some components one may predominate and the other be negligible.

Fig. 1 (a) shows diagrammatically the electric field between the plates of a condenser at an instant when the upper plate is positive and the lower earthed plate negative. Most of it lies directly between the plates, but a few "lines of force" extend outwards, and a hand brought near disturbs the distribution, which determines

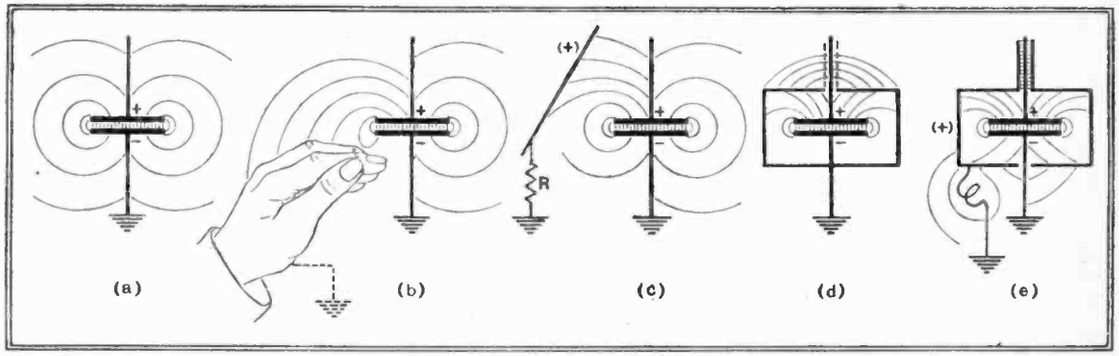


Fig. 1.—(a) The lines indicate the invisible "field" set up between the plates of a condenser when a difference of voltage exists. (b) Effect of proximity of a hand. (c) A stray lead produces a pronounced effect. (d) A condenser with a metal screen reduces stray field. (e) An inductive path from screen to earth may cause the screen to become ineffective.

Screening—Effective and Ineffective—

the capacity, and so the tuning is upset in the manner familiar to those having experience of short-wave sets, where "hand capacity" is a serious fault unless screening is adopted (Fig. 1 (b)).

But the more important effect of the stray field is that referred to at the commencement—the induction of electric charges on surrounding objects. In Fig. 1 (c) we have a lead belonging to some other part of a set passing close to the high-potential end of the condenser. It becomes entangled with some of the stray lines of force and receives electric charges corresponding to those on the condenser—of course, weaker. But if there is much amplification between the lead and the condenser a complete oscillating system may result, and the set is "unstable."

Screened Leads

A high impedance, R, is shown between the lead and the earth, because if it were directly connected to earth the charges would instantly leak to earth, and no appreciable voltage could be obtained. That gives us our cue for confining the troublesome lines of force within bounds where they cannot interfere with other business. By enclosing the condenser within a metal

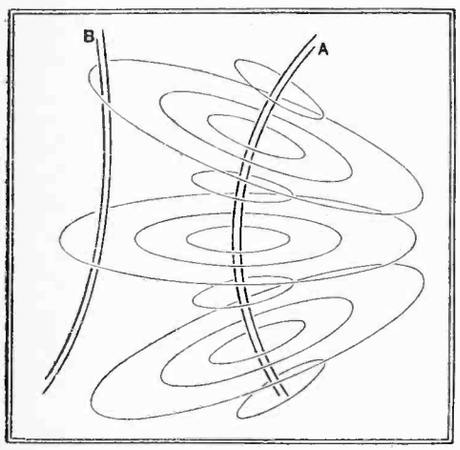


Fig. 2.—The magnetic lines of force form rings of various diameters around a wire (A) carrying current, and a few of them may link or couple another wire (B) at a distance.

case, and earthing the case, lines of force from the high-potential parts inside the case can have no appreciable effect on things outside, because the charges induced on the case dash straight away to earth through the delightfully easy metallic path. But, of course, the lead to the condenser outside the case is still capable of doing damage, and, to be thorough, the screen should be extended as shown dotted (Fig. 1 (d)).

It should be clear from the above statement of affairs that the conditions for effective screening from an *electric* field are, first, that all stray lines of force shall be intercepted by the screen, and, secondly, that the screen shall everywhere have a low-impedance path to earth ("earth" being the low-potential part of the set). With regard to the latter, it may be accepted that in ordinary radio receiving circuits any metal—even if quite thin, such as tin-foil—is low enough in resistance, for the path to earth is usually only a few inches long. But one must not forget the *inductance* of the path, particularly at such short wavelengths as are now used. A foot of straight wire, strip, or sheet, or a few inches bent into a coil, has enough inductance to allow quite an appreciable potential to be set up across it. So it is desirable to avoid long leads joining up various earthed portions of a short-wave receiver. At high frequencies (short waves) every tendency is in the direction of increased harmfulness of stray capacity. The higher the frequency being received the more exacting the screening requirements.

As regards the intercepting power of the screen, a continuous sheet of metal may be considered to be perfect and much to be desired for the purpose wherever practicable. But if it were used, for example, for the screen grid of a valve, the flow of electrons from cathode to anode would be blocked and the valve would not work. So there is nothing for it but to use a piece of gauze or similar material.

It might be supposed that the holes provided to let the electrons through would equally offer an outlet for the lines of force, but this is not so. It is as if at the entrance to an exhibition a number of refreshment houses were installed, so that thirsty visitors, even though originally aiming between the stands, are drawn aside and prevented from passing on to the interior. But the electrons are made of such stern stuff that only those that accidentally bump into the stands near the entrance are appreciably detained from going farther.

So it would be possible to screen the condenser perhaps 99 per cent. by erecting a sort of bird cage around it, provided the wires are reasonably close and lead straight to earth.

Magnetic Field

It will be noticed, of course, that the presence of the screen increases the total number of lines of force; in other words, increases the capacity. This increase may be in itself undesirable, such as in a tuning condenser, by increasing the minimum wavelength, and if the screen is supported from the condenser by high-loss material, such as a poor insulator, it makes the condenser a bad one. It is not always necessary to screen the condenser, which is the source of the leakage; it is enough to screen from it those parts that are particularly affected by it, and this sometimes offers a choice of method. The most effective thing is to screen both, but this is very seldom necessary in normal design. What about the magnetic field? This is not associated exclusively with horseshoe or other magnets, but exists whenever electricity is *in motion*, i.e., *current* (Latin: *curro*, I run).

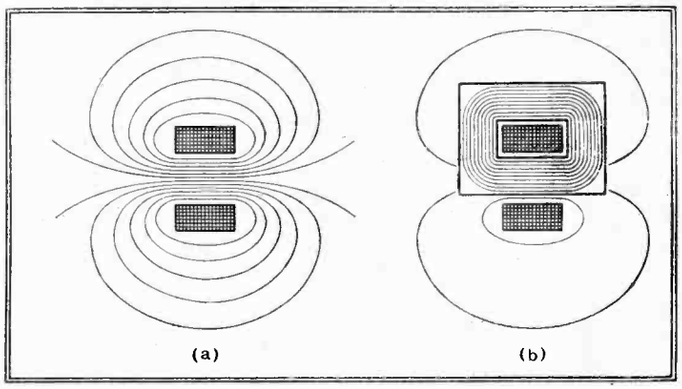


Fig. 3.—(a) The field inside a coil (seen in section) is intense, but weakens at increasing distances. (b) If the coil is provided with a closed iron core the field is restricted almost entirely to the iron.

Every condenser which is receiving an alternating charge requires that the charge shall run in and out of it, and therefore possesses a magnetic field—in other words, has inductance. But in the best condensers this effect is of little account compared with that due to the electric field. Similarly, while a tuning, choke, or transformer coil has a difference of potential (voltage) between various parts of it, and so creates an electric field, giving rise to the objectionable self-capacity, it is noted chiefly for the magnetic effect due to the current round the turns of wire (Fig. 2).

This is most intense inside the coil, but spreads out in all directions, being weaker the farther is spreads (Fig. 3 (a)). If a piece of magnetic material (chiefly iron in its fifty-seven and more varieties) is brought into the sphere of influence, it has the interesting power of gathering to itself numerous lines of force, just as

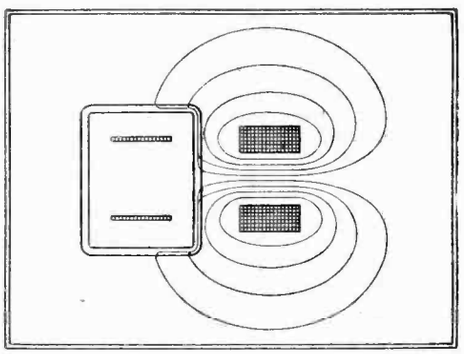


Fig. 4.—If a coil is screened by a thick iron box the disturbing field passes through the iron in preference to the air within, and coupling is prevented.

Arnold von Winkelried saved his country from the Austrians by piercing himself with as many of their spears as his arms could reach. So a closed path of iron where the lines of force pass around has the effect not only of concentrating and multiplying lines, and so augmenting the inductance of the coil, but also of offering such an

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easy path as to discourage the spare lines from straying into the wider pastures.

Therefore a coil with a closed iron core, even though very highly inductive, has little to do with its neighbours (Fig. 3 (b)).

But the moment a gap is introduced in the core, this condition of affairs largely ceases to exist, so a smoothing choke, for example, is far more prone to induce hum into surrounding circuits than a well-constructed transformer of comparable inductance.

Moreover, the above remarks apply primarily to very low frequencies such as those supplied to our houses by the corporation. The higher audible frequencies tend to make themselves felt in the surrounding space to a greater extent, and at radio frequencies ordinary iron [1] is almost completely ineffective. Tuning coils spaced a yard apart can couple intimately enough to give rise to instability in a high-amplification set.

Much can be done to mitigate this by setting the coils so that the direction of the field is such as to cause either no coupling,

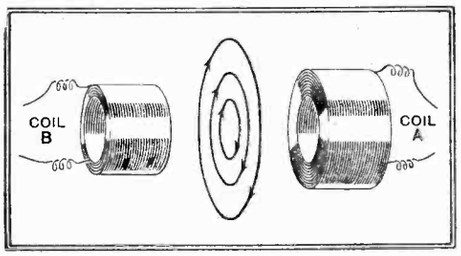

Fig. 5.—In certain circumstances closed metal loops interposed between the coils have currents generated in them which oppose the field due to the generating coil.

or mutually opposing coupling. But there is a limit to this, for the orientation of the coils must be very precise to be any good, and may have to be altered for different frequencies, and, furthermore, the problem of setting four or more coils all at right angles to every other one would be a good subject for a prize competition offered by a Scotsman.

Closed Loops

Hence screening. There are really two methods of screening a magnetic field. One is to enclose the coil to be screened in a box of highly magnetic material (or, more accurately, material of high permeability) (Fig. 4). This brings the danger nearer by attracting lines of force, but if the box is sufficiently permeable, the magnetic path is so easy that there is negligible difference of magnetic potential set up. The thin covers put on transformers are practically useless, for they are not nearly thick enough or continuous enough. The slightest gap renders such a screen ineffective. At low frequencies it must be made of ¼in. nickel-iron to be much good, and at high frequencies the permeability even of this alloy fades away. So the magnetic screen is of very limited application.

It is an elementary piece of common sense that a push in one direction is ineffective so long as there is a precisely equal pull in the opposite direction. The

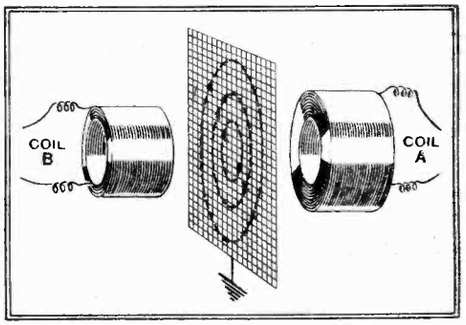

Fig. 6.—A wire gauze or mesh screen is a poor magnetic, although quite satisfactory, electric screen.

tug-of-war is indecisive. There is no objection to letting the magnetic field roam at will if it is accompanied everywhere by an exactly opposing field. One way of approximating to this is to wind the coil in two opposing halves. But if the halves are close enough together to neutralise exactly, the total inductance is zero, and it would be just as useful and a lot less expensive to abolish the coil entirely. There is a clever way out of the difficulty by making use of the very coupling effect that we want to avoid.

We know, of course, that coupling from a coil carrying alternating current causes currents to flow in any other coil that forms a closed circuit. That is how every transformer works. Now the induced current is just like any other current, and therefore it sets up a field of its own. Luckily enough, this field is in exact opposition to the field that created it (provided that the current flows through resistance only). So all we have to do is to put closed loops everywhere between the coil and the outer world, taking care that the loops are oriented so as to couple properly (Fig. 5).

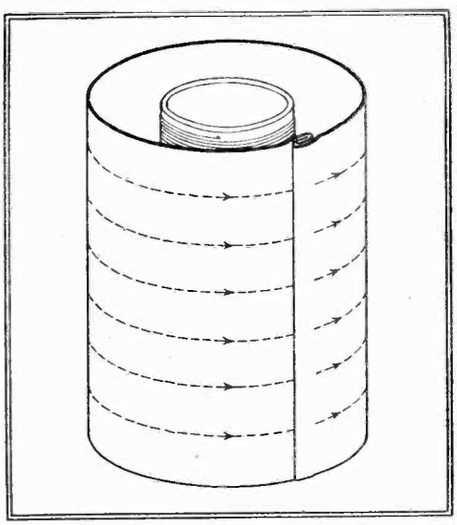

Fig. 7.—A cylindrical aluminium screen with a pressed seam may open-circuit the loop paths, owing to the high contact resistance, and so largely destroy the screening effect.

These loops are completely effective only if they form a dead short circuit—no impedance at all. This extreme ideal is impossible of attainment, and the best that can be done is a continuous enclosure of pure copper (silver is a shade better still, but is uneconomical). There is then no question of setting the loops exactly in the right relation to the coil, because a continuous sheet provides conducting loops in every direction.

Metal Gauze

The higher the frequency the more effectively the field is cancelled by a given thickness of screen, so that very short wave coils can be screened by thin foil, but coils carrying currents of domestic-supply frequencies require absurdly thick screens. In fact, although iron is higher in resistance than copper, and therefore worse in neutralising the field, it wins on points because of its greater permeability. But somewhere in the region of low radio frequencies copper takes the honour and holds it over the whole band of wavelengths in which we are interested.

There is another point to consider when providing a coil screen. The induced currents in the screen react back on to the coil that caused them, and add to the losses of the coil. If the screen fits closely

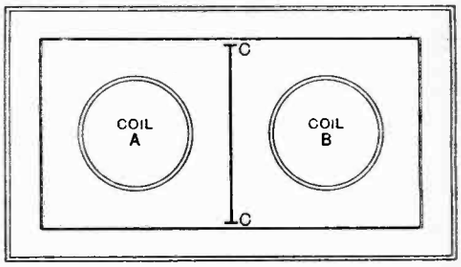

Fig. 8.—Two coils in built-up screening compartments may couple strongly if the partition makes bad contact at CC.

around the coil, the effect is almost to short-circuit the coil, besides adding greatly to its self-capacity. In addition, the screen carries heavy currents which are likely to lead to imperfectly distributed field neutralisation. So the screen should be as large as possible and well away; at least double the diameter of the coil.

The thicker and more conductive the screen, the more perfect the screening and the less the resistance thrown back into the coil.

In this respect it differs from an electric screen. It differs also in requiring no earth, though it usually is earthed in order to perform the dual rôle. Not only is greater thickness of metal desirable for magnetic screening, but the metal gauze construction is quite hopeless. The reason is that while a path to earth in a gauze screen may be reasonably low-resistance, as it can follow a single wire all the way, the closed loops include numerous poor contacts in series and are far from being short circuits (Fig. 6). There is enough conductivity to ruin the efficiency of the coil within, and not enough to do any

[1] "Ferrocart" coils promise to break away from this limitation.

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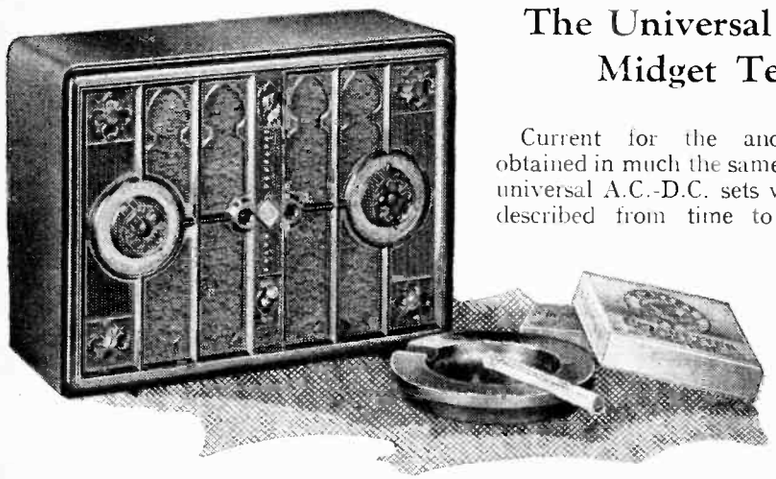
screening worth mentioning. So it is quite possible (and sometimes useful) to have a screen which shuts off the electric field and passes the magnetic, or vice versa.

A coil screen may have a very brave appearance and yet conceal an unsoldered seam that cuts across all the loops running parallel to the turns of the coil (Fig. 7). A screen is even capable of coupling two coils more intensely than if it were absent altogether (see Fig. 8). The spiral wire, or strip screen, which is sometimes seen, is supremely useless for both magnetic or high-frequency electric purposes, for it offers an inductive path to earth and fails in the main essential, having no closed loops at all.

There are many other subtleties of screens, but perhaps enough has been said to show that the receiver which has the greatest mass of metal bestowed on and around it is not necessarily the best screened.

An American A.C.-D.C. Set

The Universal Kadette Midget Tested



IN *The Wireless World* of March 24th some technical details of the latest American Midget "universal" sets were given. These tiny receivers, which work interchangeably on either A.C. or D.C. mains, have enjoyed extraordinary popularity in the country of their origin, and are now available on the British market. One of the Kadette receivers—a typical example of the "cigar-box" type—has been submitted for test by Anglo Auto Accessories Co., Ltd., 11, Great Queen Street, London, W.C.2.

With the addition of a barretter resistance when necessary, the set may be operated on any type of mains supply between 100 and 250 volts, A.C. or D.C., and of any standard periodicity. The extra resistance, which is built into a special form of plug adaptor, and is extremely compact, is only needed for voltages above 110.

Straightforward 1-v-1 Circuit

The circuit arrangement is that of an H.F. amplifier, detector, and output pentode; input and output circuits of the H.F. valve are of the single-tuned type, volume being controlled by adjustment of bias in the conventional way. Anode bend detection is employed, the valve being linked to the pentode by means of resistance-capacity coupling.

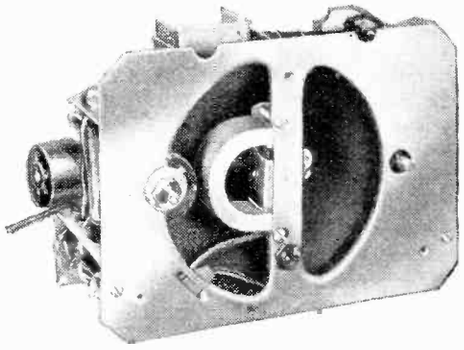
All valves are of the indirectly heated type, their heating elements being wired in series. Self-bias is obtained for each valve by the usual expedient of inserting a cathode resistor.

Current for the anode circuits is obtained in much the same way as in other universal A.C.-D.C. sets which have been described from time to time in these pages. In the Kadette set, the half-wave rectifying valve is of the mercury vapour type.

Receiving and rectifying valves are naturally rather smaller than their British counterparts. This is not surprising, in view of the fact that the set is a marvel of compactness, measuring externally about 8½ ins. by 6½ ins. by 4 ins. back-to-front.

The ganged condenser is of the air dielectric type, complete with segmented end vanes. Tuning coils are perhaps a shade smaller than usual, but, due to the fact that they are not enclosed in screening covers, their efficiency is probably about normal.

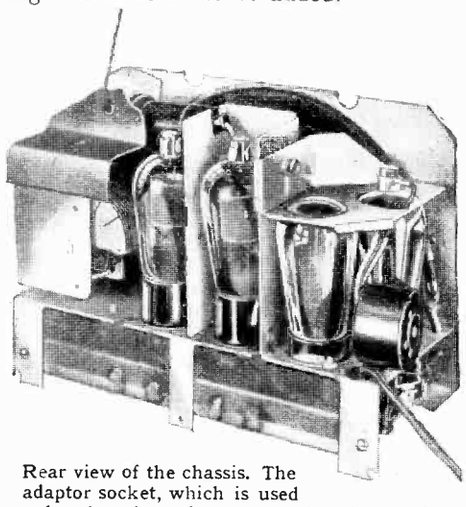
An insulated aerial wire of about 25 feet in length, which may be coiled up and tucked into a compartment at the back, forms a permanent part of the set; a similar recess is provided for the mains connector.



Although only 6 in. in diameter, the cone loud speaker occupies a large proportion of the chassis space.

The built-in loud speaker is of the moving-iron type, with a cone about 6 ins. in diameter; small as it is, it naturally occupies a good deal of the chassis space.

Total current consumption amounts to about a quarter-ampere, and so the power dissipated in the set amounts to less than 30 watts. Of course, when working on voltages above 110, the amount of energy dissipated in the external voltage-absorbing resistance must be added.



Rear view of the chassis. The adaptor socket, which is used only when batteries are employed, can be seen on the extreme right.

Although primarily designed for mains operation, the Kadette is an extraordinarily versatile little set, as provision has been made for working it from external batteries.

It can also be used as a motor car set, and with this object in view an adaptor socket is included as part of the receiver. This socket is normally out of the way inside the set, but it may be withdrawn and connected to the corresponding multiple plug to which the car accumulator and an H.T. battery are connected. A special conversion "kit" for car work, complete with interference suppressors, etc., is available.

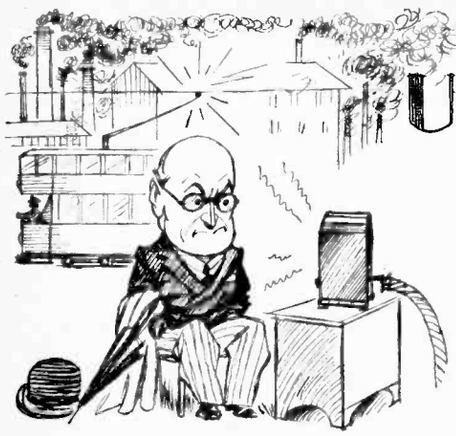
Compact but Sensitive

In the matter of sensitivity and selectivity, this set behaves very much like other comparable types with which we are familiar, having the same number of valves and tuned circuits. Of course, in making this comparison, the length of the aerial is taken into account. Control is extremely simple, and the volume adjustment works exceptionally well. Under difficult conditions, the inherent selectivity of the set is hardly enough to ensure immunity from interference, but the general performance of the receiver is distinctly useful.

Volume is surprisingly great, and quality of reproduction is much more pleasing than one might expect. Most of the output is confined to the band between 500 to 2,000 cycles, but, for the purpose for which the set is intended, this is satisfactory enough.

The price of the standard model is ten guineas, complete with external resistance.

Kadette receivers are also being shown on Stand No. 442a at the Ideal Home Exhibition by the Homeaids Radio Company.



UNBIASED

by

Free Grid

Move our aerials into—

Loud Squeakers

It was only the other day that I was discussing the problem of compact and suitably shaped radiogramophones for the modern super dolls'-houses which are springing up overnight in the suburbs of all large towns. It is quite evident that the radio industry has been faced with a similar difficulty in America, and so has designed the set to suit the house. At any rate, I can think of no other valid reason for the production of the midget sets which are now trickling over to this country.

I had the opportunity of examining and testing several of them the other day, and I fully agree that their compactness is a marvel of ingenuity, and that the sensitivity and selectivity is remarkably good. There is very little of the lower musical register in them, however, and one could hardly expect otherwise.

I do hope that as a result of the complaint I made the other day about the unwieldiness of British receivers, manufacturers in this country won't rush to this other extreme. If they do, let them leave out the loud squeaker and make the set smaller still. I defy any man to get decent quality if he stuffs his loud speaker into a Lilliputian cabinet.

The Limit

I WAS very interested in a "W.W." article the other week in which we were urged to jettison our humble twenty-foot downleads in favour of monstrosities several hundred feet in length. The idea is that we should move our aerials into the peace of the countryside to dodge electrical interference and then link them up to our sets by means of the "transmission line" type of downlead.

It is quite evident that the good gentleman who advocates this sort of thing is more used to the great open spaces of the land of liberty than he is to the pettifogging restrictions of this parasites' paradise, for he quite forgets that by the terms of our receiving licences officialdom limits us to an aerial of 100 feet in length, including the downlead.

In fairness to this misguided scribe, it must be said that he frankly admits that his information is of American origin. Nevertheless, the fact remains that, no matter whether you call it a downlead or a transmission line, it is counted as part of the aerial within the meaning of the Act. On this point a Post Office friend whom I consulted seemed very emphatic.

It is high time that we all got together in order to get this archaic prohibition removed. The reason why it was originally adopted—and I defy anybody associated with the G.P.O. to contradict me—was to prevent listeners in this country hooking a pirate transmitter to their aerial and communicating with foreign countries.

At the time when this rule was made, it was thought that if the aerial were limited to a 100 feet, communication beyond the confines of the realm would be a technical impossibility. Amateur transmitters exploded such an idea years ago, of course, and such a regulation merely irks the citizen in these days, when it would be possible to communicate with the enemy with a bent pin as aerial and a school globe as earth.

Nor Iron Bars a Cage

IF credence can be placed in the report of a Scottish journal, the P.M.G. secured a truly magnificent scoop the other day with his detector van.

It is well known that if you keep a lodger (sorry, I mean paying guest) in your house, he is required to take out a separate licence if he uses even a humble crystal set in his room. I did not know, however, that the same ruling applies if your aunt or any other wretched relatives foist themselves upon you. At any rate, the other day a worthy Scot who is a properly licensed listener received an unexpected and uninvited visitor in the form of a maiden aunt.

Scarcely had the good lady's tin trunk been carted upstairs than there came a peremptory knock at the door and a wireless inspector presented himself, demanding to see the wireless licence and to inspect the gear of the "guid man of the hoose." These were duly produced, and it was thought that the inquisition was over, when the martinet of the P.O. demanded to inspect the second radio set in the house. In vain did the householder protest that none such existed, and it would probably have meant application at the local police court for a search warrant, had not the newly arrived visitor announced that she had brought her small portable with her.

It appeared that the P.O. van had been in the vicinity at the time with the special object of searching out unlicensed lodgers' sets, and the good lady had been the first victim; this, mark you, in spite of the fact that her receiver was completely shielded by being in the tin trunk.

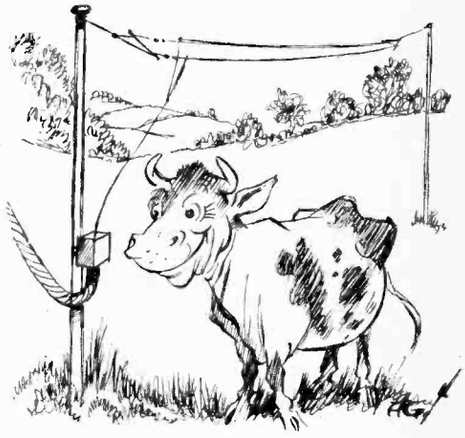
Truly this is an amazing piece of technical progress, for at one fell scoop it does away with the blind spot bugbear caused by steel structures. The modesty of the Post Office engineers with regard to their remarkable invention is highly commendable.

Impatient Patients

MY denunciations of hospital wireless, both in the matter of electrical interference and the early switching off of programmes in the evening, have brought me several fresh complaints from patients and ex-patients.

One correspondent specially pleads that the B.B.C. should radiate hospital programmes in the early morning. "Anybody who has ever been in a hospital," he writes, "will be acquainted with the ghastly and barbarous practice of waking patients and washing them in the wee small hours at a time when all good Christian folk are asleep. Not even in Wormwood Scrubs, and similar places, is such Spartan treatment meted out to the inmates, as I can personally vouch for. I suggest that special cheery programmes suited to the hour and the occasion be prepared by the B.B.C."

Yet another reader complains of the monotony of being compelled to receive only one programme. "I realise that half-a-dozen wall plugs, giving an equal number of programmes, is rather too much to ask for," he states, "although according to a recent *Wireless World* article this service is available in a New York hotel,



—the peace of the countryside.

but I *do* think that wiring might be carried out so that at least two programmes were available."

I have received such a large number of letters offering suggestions and detailing complaints that I am thinking of starting a "Hospital Listeners' Association," so that all these things can be demanded and a united front presented to the powers-that-be.

NEWS *of the* WEEK

Current Events in Brief Review

Closing Down

THE new "Deutschlandsender" (Konigswusterhausen) now closes down with the National Socialist song followed by the National Anthem. It is expected that all other German stations will shortly follow suit.

Jewish Programmes from Holland

TO the many religious and political broadcasting associations in Holland is now added the Israeliete Vereeniging Radio Omroep, consisting of unemployed Jewish musicians who, we understand, will shortly give concerts from either Hilversum or Huizen.

The "Lucerne Plan"

THE Lucerne Conference, the most important meeting of its kind since the Prague Conference of 1929, is to open on May 15th or 16th next. Shortly before that date the International Broadcasting Union will meet to complete its proposals for a new wavelength plan.

We understand that it is hoped to publish the new "Lucerne Plan" before Whitsuntide.

Nipped in the Bud

POLITICIANS who have been banned from the German microphone on account of anti-Hitler views have been seeking facilities for broadcasting in Holland. The Minister of Public Works, however, has notified the Dutch Control Commission that talks on politics cannot be authorised if there are reasons to believe that the talks would not be permitted in the country for which they are intended.

Changing Their Tune

FRENCH listeners, who have recently been complaining against the amount of British publicity in the programme from French stations, have suddenly changed their attitude as the result of the formation of an advertising company to exploit the high-power Irish station at Athlone, writes our Paris correspondent. It is now realised that the moneys so badly needed by French broadcasting are likely to cease as a result of the new competition, so that freedom from British trade propaganda will not be an unmixed blessing.

Finding Running Commentators

AN ingenious new method for discovering budding talent among prospective radio reporters has been evolved by Herr Richard Kolb, of the Berlin Witzleben station. News films are projected in the main hall of Berlin Broadcasting House and the candidates for microphone appointments are required to give as vivid a word picture as possible of what they see.

When Listeners "See Red"

TRAFFIC signals are causing interference to wireless reception in Belfast, and the postal authorities have had to forward a batch of complaints to the City Council. Experiments are now being carried out to see if the trouble can be overcome.

Fire at Radio Toulouse

DISASTER overtook Radio Toulouse on April 6th, when fire broke out at the studio buildings near the city and did considerable damage. Fortunately, the new high-power transmitter at the Chateau d'Agnan is not affected, but we understand that the lack of a suitable studio makes transmission impossible for the next few days.

The actual fire occurred at Villa Schmit, where the studios and the original 8 kW. transmitter were completely destroyed.

Singapore Leads

THE possibility that the Empire may be dotted with relay stations, especially for the reception and distribution of the B.B.C. short-wave transmissions, is suggested by the project for the establishment of a relay station at Singapore. The original station closed down several years ago.

A Vocal Clock

THE Paris Observatory now has a "speaking clock" which, as one radio journal puts it, announces the hours with a "hoarse and hollow voice." One critic likens the clock's speech to the sound of a worn-out gramophone record made by a sufferer from catarrh.

Elettra at Olympia

WIRELESS enthusiasts visiting the Ideal Home Exhibition at Olympia make a bee-line for the "Rooms of the Scientists," more especially to see the reproduction of part of the wireless room in Marchese Marconi's famous yacht *Elettra*. The cabin has been furnished with a Marconi short-wave transmitter, Type SWB.4, as used in early experiments in long-distance ship-to-shore wireless telephony. There is also an example of the new micro-wave apparatus as well as a direction finder and a marine receiver designed for loud speaker reception on telegraph or telephone signals. Working demonstrations are given.

Included in a "Museum" display next to the "Rooms of the Scientists" is a selection of coherers used by the young inventor in Italy in 1895.

The Marchese and Marchesa Marconi visited the Exhibition on the opening day.

Wireless in Welsh

A CORRESPONDENT of the *Western Mail* has compiled a wireless vocabulary in Welsh. Among the suggested terms are the following: Gwerchyr (valve), torch annog-dorch (coil), cynwyseddur (condenser), gorwasg (high tension), bychanwasg (low tension), Wybrell (aerial), cyfanell (set).

Anti-interference Campaign

THE firm of Ward and Goldstone, of Manchester, has recently organised a special department to deal with technical problems involved in the use of their Screened Down-leads and other devices for minimising the effects of "man-made static." The new service is free, and questionnaire forms are available for distribution to sufferers from interference.

Trolley Buses at Bay

AT last the trolley bus seems to be turning on its tracks to hit out at those who would blame it for every crackle and splutter in their radio receivers. According to the *Trolley Bus Gazette*, issued by the British Electrical Development Association, trolley buses "are blamed for every click, splutter or squeal on wireless sets of whatever age or design, although the buses may not have been running at the time."

Apparently recent cases which were investigated revealed that the disturbance was being caused by the ignition system of a gas engine half a mile away and an electric bakery.

British manufacturers of trolley buses are fitting stopper coils as part of the standard equipment.

Wireless Music in Public

ON April 5th Mr. Justice Maugham gave an important decision in the Chancery Court to the effect that loud speaker reproductions in public places of the B.B.C. broadcasts constituted new performances entitling the copyright owners to royalties.

The test action was brought by the Performing Rights Society, who asked for an injunction restraining Hammond's Bradford Brewery Company from permitting the George Hotel, Brighouse, to be used for the performance in public of any musical work of which the right of performance was in the plaintiffs, and for damages for alleged infringement of copyright by the unauthorised reproduction of three musical pieces broadcast by the B.B.C. His Lordship decided in favour of the plaintiffs. The case will probably be taken to the Court of Appeal.

The Performing Right Society has subsequently stated that it does not contemplate any departure from its policy of making no claim in respect of the performance of music by dealers in the course of their business on their business premises, by wireless sets or musical instruments, provided such performance is confined solely to the department dealing in such articles.

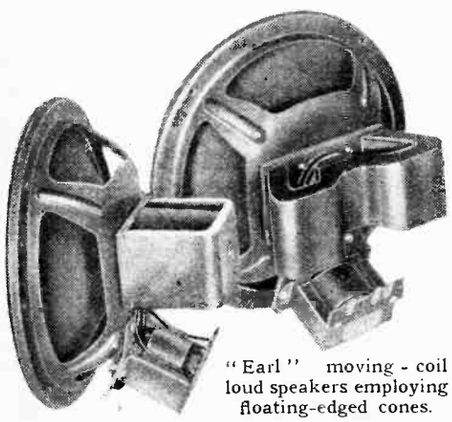
LABORATORY TESTS

"EARL" LOUD SPEAKERS

SUPERFICIALLY these units appear to follow conventional practice in design, but a closer examination reveals several points of divergence.

Instead of rigidly clamping the periphery of the diaphragm it is allowed to float between felt rings so that not only is it to a certain extent self-aligning, but considerably greater movement is permitted to the diaphragm and the restoring force is much less than in the majority of small moving-coil units. As a result the bass response is fuller and altogether more pleasant to listen to. The usual strong resonance at 100 cycles is absent, and instead the slightly enhanced bass response is spread over an octave from 75 to 150 cycles.

The middle and upper middle registers from 150 to 2,000 cycles are unusually free from minor resonances and the top is strengthened by an increase of output between 2,500 and 4,000 cycles—again without any definite resonant frequency. The junction of the apex of the cone with the moving-coil former has been given a slight radius and this, in conjunction with the material chosen for the diaphragm, probably accounts for the absence of any sharp resonance in the higher frequencies. The output falls off gradually above 4,000 cycles, but there is still a useful response at 8,000 cycles with inputs of the order of 750 mW.



"Earl" moving-coil loud speakers employing floating-edged cones.

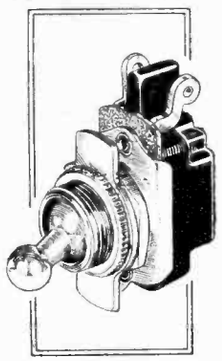
The efficiency of the permanent magnet model is exceptionally good, and is, in fact, very little different from the mains-energised model. The latter, incidentally, is fitted with a hum-bucking coil, and both models are equipped with dual-ratio output transformers giving alternative load impedances of 3,000 and 11,000 ohms.

The price of the permanent magnet model is 35s., and of the mains model 25s. The makers are Electriclocks and Radio, Ltd., Avenue Works, Hanover Park, London, S.E.15.

BRITISH RADIOPHONE Q.M.B. SWITCHES

COMPACT, robust, and as reliable as any house lighting switch, despite their diminutive size, these toggle-type switches will handle with perfect safety and freedom from arcing currents up to 3 amps. at 250 volts. The metal frame with its single-hole fixing bush is completely insulated from the electrical contacts, which, with the exception of the small terminal tags, are enclosed in a neat moulded bakelite body.

Two models of the single-pole on-off type are available. Known respectively as the type 406 and type 485, they differ in that the first mentioned is fitted with a slotted lever for incorporating in a composite unit comprising two or more component parts, such as volume control with mains switch, or combined waveband and mains switch. The price of either style is 1s. 3d.



British radiophone on-off Q.M.B. switch.

A three-point switch is available for 1s. 6d., while there is also a four-point double-throw model made, the price of this being 1s. 9d. The makers are the British Radiophone, Ltd., Aldwych House, Aldwych, London, W.C.2.

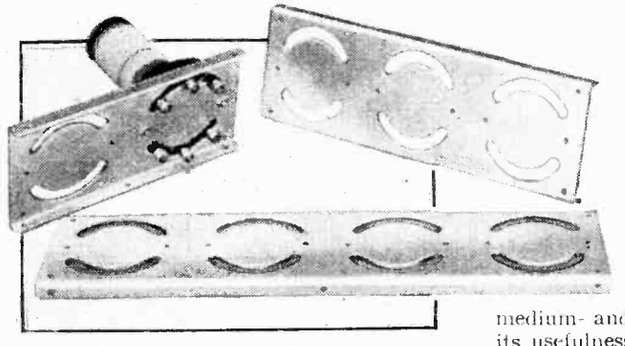
NEW RADIO PRODUCTS REVIEWED

GOLTONE COIL CHASSIS

A RANGE of stout aluminium chassis for mounting Goltone Screened Dual Range Coils are now obtainable from Ward and Goldstone, Ltd., Frederick Road (Pendleton), Manchester. They are made to accommodate two, three, or four coils, each coil being fixed by two screws, the correct number of screws and nuts being supplied with each chassis.

With the aid of these, coils can be mounted either vertically or horizontally, and extension terminals are available to bring the various contact points below the chassis for convenience of wiring. A longer type of terminal extension is available for use when the base plate is mounted on a metal receiver chassis and so carry the contact points to a convenient depth for under-deck wiring.

A two-coil chassis costs 1s. 6d., one for three coils 2s., and a four-coil model 2s. 6d.



Goltone coil chassis showing one coil in position and extension terminals.

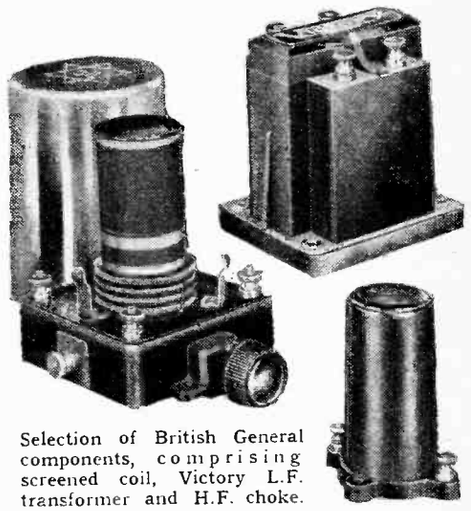
The short, or type A, extension terminals cost 4d. a packet of six (sufficient for one coil), whilst the type B, or longer size, cost 5d. per packet of six.

BRITISH GENERAL COMPONENTS

FROM the selection of components sent in by the British General Manufacturing Co., Ltd., Brockley Works, Tyrwhitt Road, London, S.E.4, a few were chosen at random for test, since space does not permit a detailed review of the full range.

The latest screened coils are particularly attractive, for they are mounted on cleanly moulded bakelite bases and enclosed in polished aluminium containers. They are the customary dual-range types with the medium-wave section wound on a 1¼in. paxolin tube whilst the long-wave portion is slot-wound. The specimen tested was the H.F. anode coupling coil which can be employed either in a tuned anode circuit or in a tuned grid circuit. Both medium- and long-wave sections are tapped down for the anode connection, the change-over from one tapping to the other being made by the wave-range switch.

The efficiency of the coil is particularly good, being well above the average for its class, and the specimens tested were found to be closely matched. The inductance of the medium-wave section is 145 microhenrys, whilst that of the long-wave portion is 1,870 microhenrys, and although these values are slightly lower than in the average coil of this type it is yet possible to cover the broadcast bands of 200 to 550 and 700 to just under 2,000 metres when using a 0.0005 mfd. condenser. The price is 9s. 6d. for either aerial or anode coil.



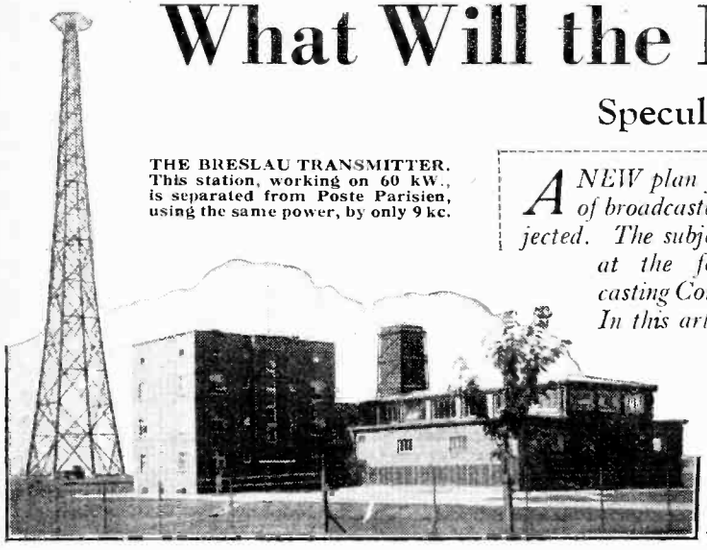
Selection of British General components, comprising screened coil, Victory L.F. transformer and H.F. choke.

Of the two H.F. chokes made we chose the larger model for test, costing 5s. 6d. This has an inductance of 128,000 microhenrys which, coupled with the low self-capacity of 4.5 m-mfds. not only ensures that it will meet all requirements on the medium- and long-wave bands, but extends its usefulness to short-wave use, for it will prove quite satisfactory on wavelengths as low as 50 metres.

The Victory L.F. transformer is an inexpensive component, costing but 7s. 6d. It affords a step-up ratio of 1 to 3½, and is housed in a moulded bakelite case. It has a primary inductance of 12.8 henrys with no D.C. flowing, 11.1 henrys with 2 mA. and 9.5 henrys with 4 mA. of D.C. The resistance of the primary winding is 500 ohms. When connected in the anode circuit of a medium impedance detector it gave quite pleasing reproduction.

What Will the New Wave-Plan Be?

Speculation on the Lucerne Conference



THE BRESLAU TRANSMITTER. This station, working on 60 kW., is separated from Poste Parisien, using the same power, by only 9 kc.

A NEW plan for the organisation of broadcasting in Europe is projected. The subject will be discussed at the forthcoming Broadcasting Conference at Lucerne. In this article our contributor speculates as to the proposals likely to be adopted in an endeavour to straighten out the wavelength tangle.

By J. GODCHAUX ABRAHAMS

EUROPE, to-day, if chaos in the ether is to be avoided, is confronted with a serious problem—that of devising a new wave-plan to replace the one previously compiled at Prague; not only must the authorities allot channels to the transmitters now in operation, but they are also called upon to find suitable wavelengths for stations which are still in course of construction.

Since the original *Plan de Prague* was brought into operation conditions have entirely altered. As the power of the transmitters working at the time was the main factor which decided the geographical separation of stations broadcasting on neighbouring wavelengths, a separation of 9 kilocycles between channels, in conjunction with the relatively low energy of the transmitters, was a practical proposition; but when the power of the stations, as in some cases, was increased tenfold, this new factor completely upset all calculations. From the moment the majority of the main European transmitters increased their energy, interference was reported from almost every quarter of the European continent, and since that time conditions generally have been going from bad to worse.

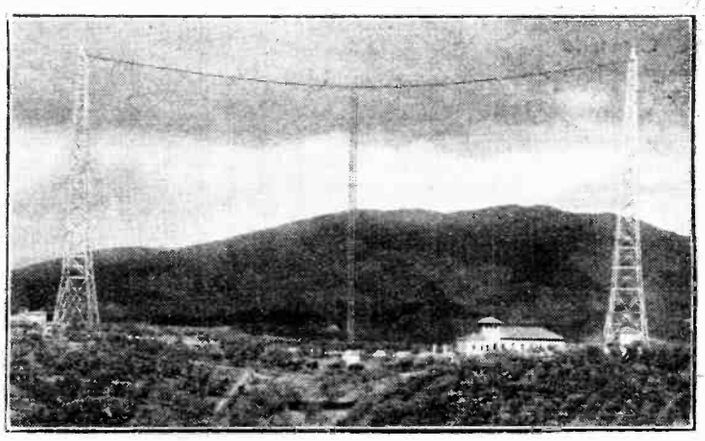
More High-power Stations

A comparison of to-day's list of broadcasting stations with one published, say, even three years ago will show to what extent the number of high-power transmitters has grown, and to it must still be added the stations which are nearing completion, in early stages of construction, or still proposed by European countries anxious to develop *their* radio system in the near future.

Roughly speaking, over and above those already launched, we may expect to see during 1933-4 new high-power transmitters in action at Berlin, Hamburg, Moscow, Kalundborg, Motala, Trondheim, Bergen, Brussels, Paris, Lille, Lyons, Marseilles, Rennes, Toulouse, Bordeaux-Lafayette, Nice, Belgrade, Wychbold, Bucharest, Luxembourg, Vienna, Lisbon, Madrid, Barcelona, Hilversum, Poznan, Budapest, Algiers, Rabat, etc., etc. This list is by no means complete *if all the plans of the European nations mature*. Taking these altered factors into consideration, it is obvious that to gain a workable frequency separation between channels used by these giant stations a completely new plan must be devised at Lucerne in June. Although but little information has transpired regarding the workings of the preliminary conference at Brussels, it is possible to state definitely that alterations will probably be made in the wavelengths of *almost all European transmitters*. Neighbouring wavelengths will be allotted to stations *at considerable distance from one another* in order that no mutual interference may arise. At present we have such anomalies as Breslau-Poste Parisien, Mühlacker-London, Brussels-Florence, and so on, transmitting on channels with a minimum frequency separation. Slight adjustments under present conditions are worse than useless, and more drastic methods must be adopted.

The establishment of a completely new wave-plan to some extent has been facilitated by the fact that the broadcast band has been slightly extended, namely, from 200 to 600 metres; from 1,132 to 1,875 metres; and that within reason, and providing the geographical positions of stations so permit, a certain number of channels incorporated in the 600-1,000-metre band may be used. As this region is reserved to maritime services the allotment of wavelengths in this band will be dependent on authority obtained by individual States, but there is no doubt that in many instances a number of channels will be gained in this manner. The advantage derived by the increased number of wavelengths allotted to the broadcasting services will permit the allocation of a further channel to some countries, such as Austria, Finland, Switzerland, Hungary, and so on; in fact, it will allow the inclusion of a number of new transmitters for which, under present conditions, no wavelength is available. There is little doubt, also, that to gain channels a greater number of shared wavelengths will be created; this will be feasible so long as they are given to stations at great distances from each other. In the "long" waveband more room will be found than has hitherto been the case, and in this region in the future we may find Spain, Portugal, Roumania, Finland. According to a Continental report, such stations as Sundsvall, Rabat, and Astrakhan may be required to operate on a common wavelength (note their geographical position in relation to each other). Moreover, it will not be necessary to stand rigidly by a 9-kilocycle separation when compiling the new plan; more elasticity will be permissible in the creation of channels, and where it is deemed necessary a difference of 11 kilocycles between certain powerful transmitters may be carried out.

It is very likely that the number of *ondes communes* will not be reduced, but stations to which they are allotted will be classed under two separate headings. In the first we shall see transmitters of which the power does not surpass 2 kilowatts but which are not allowed to deviate much from their allocated positions in the waveband. In the second class will be placed all local relays of low energy (not exceeding, say, 600 watts); on these small transmitters channels between 200 and 206 metres will be bestowed. Apparently, in the compilation of this new wave-plan—will it be called the *Plan de Lucerne?*—the technical members of the Brussels Conference have realised that Europe will shortly possess a number of giants capable of radiating programmes with an energy of from 100 to 150 kilowatts—perhaps even more.



The transmissions from Florence (20 kW.) are not easily kept clear of Brussels No. 1 (15 kW.) operating 10 kc. away.

Simplified Aids to Better Reception

MANY constructors of D.C. mains sets would feel easier in their minds if it were possible to check the current flowing through the series-connected heaters of the valves. Unfortunately, a suitable type of ammeter or milliammeter is not often available, but it may be borne in mind that if the anode currents of all the valves correspond roughly with the rated values we have *prima facie* evidence that the heater circuit is also correct. This test is still more likely to be reliable if, in the output stage at any rate, automatic bias be temporarily replaced by a bias battery.

D.C. Heater Circuits

THERE is no mystery about the requirements for successful single-control or ganged tuning of a number of circuits. Nevertheless, the success or failure of a one-knob receiver is dependent upon the taking of a few simple precautions, and it should be emphasised that the three basic constants in each circuit must be identical.

Matched Circuits

Complete success can only be attained when each coil has the same inductance value, each section of the ganged condenser has the same capacity at any corresponding angular settings, and when the initial capacity of each circuit is brought up to the same value. In other words,

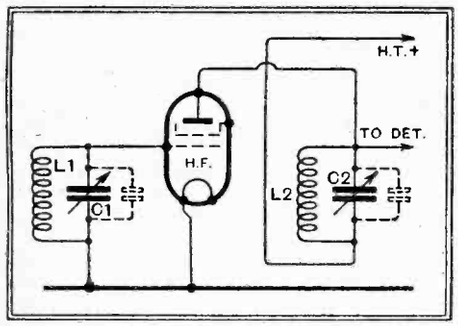


Fig. 1.—A simplified diagram showing the requirements for ganged tuning control of two circuits. The condensers shown in dotted lines represent the combined capacity of trimmers and "strays."

the arrangement shown in Fig. 1 cannot be ganged properly unless L1 and L2 are identical, C1 and C2 properly aligned, and the stray capacity indicated by dotted lines adjusted to the same value.

Inequalities in the value of inductance or variable condenser capacity can usually be compensated for at any one wavelength by adjustment of the trimming capacity, but such an adjustment cannot hold good at other wavelengths.

HIGH-CAPACITY, low-voltage condensers of the dry electrolytic type have now been available for some time; they have a number of applications, but are nowhere more usefully employed than in grid bias circuits. This is especially true in the case of mains-driven resistance-coupled amplifiers where ordinary methods of grid decoupling are not effective.

Retaining Low Notes

In such amplifiers it is usual to obtain bias by inserting suitable resistances in the individual cathode leads of each valve. Across these resistances a by-pass condenser is usually shunted, but the trouble is that ordinary paper condensers of reasonable size and cost have insufficient capacity to prevent a reversed reaction effect at low frequencies, which introduces a loss of bass.

The substitution of 50-mfd. electrolytic condensers as by-pass capacities is quite a practical expedient, and will generally bring about a noticeable improvement in the proportional reproduction of the lower register. Condensers of this capacity, and rated to work at 12 volts—quite enough for all stages except, perhaps, the output—cost only a few shillings.

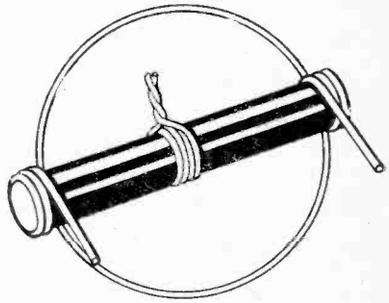
A MOULDED resistance of the carbon or composition type may in many circumstances be used quite successfully as a potentiometer, especially if critical adjustment is not needed.

In a resistance of this type, the conductive material is equally distributed, and, if care be taken, it is possible to pick up a voltage from any point along the length of the resistance rod. Before attempting to do so, it is, of course, necessary to remove the protective coating of enamel and to scrape the rod quite clean.

A Cheap Potentiometer

The only difficulty likely to be encountered is in making a sufficiently intimate contact with the resistance element; a light single-point contact is certain to have a high resistance.

A fairly satisfactory method is illustrated in the accompanying sketch; here the rod is wrapped with two or three turns of tinned copper wire. A more satisfactory and more easily adjustable connection can be made with a light circular metal clip fitted with a tightening screw; the inside surface of the clip may with advantage be "tinned" with a thin layer of solder, or a strip of tinfoil may be used.



A tapped connection on a fixed resistor of the carbon type, which may in this way be converted into a potentiometer or variable resistance.

A practical use for a potentiometer of this type is in regulating the screening grid voltage of an H.F. valve.

IN devising an automatic volume control system, the aim of the designer is, in the simplest terms, to arrange matters so that one or more of the H.F. or I.F. amplifying valves in the receiver may be fed automatically with the correct grid-bias voltage. By "correct" it is to be understood that value of bias which corresponds to just sufficient sensitivity to give reproduction of a pre-determined loudness. In practice, the controlling grid-bias voltage is always developed across a resistance, so connected that voltage differences existing across it will be applied to the grids of the controlled valves.

Points About A.V.C.

It will be realised that the amount of bias thus developed is of prime importance; if it never reaches a sufficiently high value, control will be insufficient when dealing with strong signals. There is also the possibility, with some systems, that the initial bias applied under "no signal" conditions may be too high, with the result that the amplifier can never work at full efficiency.

Obviously, therefore, it is a matter of some importance to have an idea of the bias voltage developed under varying conditions. With ordinary instruments it

Practical Hints and Tips—

is impossible to make a direct measurement of voltage, and so as a rule the information must be acquired by indirect means. Knowing the value of the bias resistor, the current flowing through it is measured, and then the applied voltage is ascertained by multiplying *resistance* (in ohms) by *current* (expressed as a fraction of an ampere). As resistances are often high, and currents are low, a very sensitive meter is sometimes needed.

An indication that everything is working "according to plan" is afforded by connecting a milliammeter in the anode circuit of the controlled valve (or valves). Normally, the current flowing will assume a steady value, depending on the amount of sensitivity required. Any change in the H.F. input from the aerial should be followed by a corresponding change in current. For instance, if fading sets in, current should begin to creep upwards; obedient to the action of the automatic control system, negative bias is being reduced in order that sensitivity may be automatically increased to cope with the new conditions. For test purposes, input to the receiver may be artificially reduced by connecting a variable resistance—of about 25,000 ohms—between aerial and earth terminals.

Those who are unfamiliar with the operation of an automatic volume control system should perhaps be warned that the tracing of a fault, even of the simplest nature, is often difficult when the control is operative. It is accordingly a good plan to make provision for cutting it out of circuit when required.

ON THE SPOT

Visits to Foreign Broadcasting Stations

VII—Kaunas, 155 kc., 1,935 m., 7 kW.

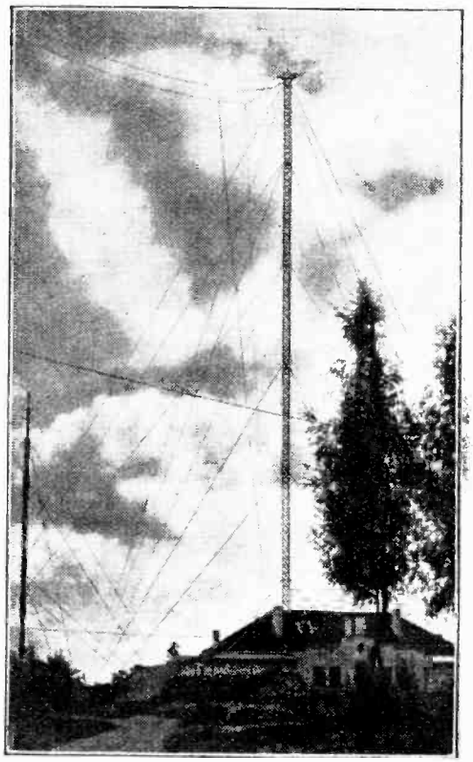
KAUNAS is the "provisional" capital of Lithuania, the historical capital of the country, Wilna being under Polish occupation. The station, which, incidentally, employs Europe's longest broadcasting wavelength, stands on a hill immediately above the town. During the war a Russian transmitter stood there, and on my recent visit I still saw the Russian masts in the beautiful grounds in which the present transmitter stands.

Lithuanian broadcasting is controlled by the Ministry of Posts on the technical side and by the Ministry of Education in the matter of programmes.

The officials at Kaunas are very friendly, but as no one at the station understands English the visitor must make what use he can of his knowledge of Russian, German and French. However, I met a local journalist who spoke excellent English with a slight Oxford accent which, he said, he had acquired from listening to B.B.C. announcers! He had never been farther west than Germany.

Kaunas transmits every day, but I fear that few people take the trouble to search for the longest wavelength. But I can promise you a good evening's entertainment if you should hit upon old Pupu Dede, a contemporary author who every Saturday night poses as the oldest inhabitant. Perhaps he is not so simple as he sounds, for gramophone companies once took him over to America to make records of his wonderful renderings of Lithuanian folk songs.

WANDERING WAVE.



The station buildings, which stand on a hill overlooking the town, originally formed part of a Russian fortress.

Mlle. Irene Garmiute, the announcer, giving the Kaunas time signal. Note the candle for use in the event of a lighting failure!

DISTANT RECEPTION NOTES

SO far I have not heard (nor have I received reports from others who have done so) any of the new high-powered Continental stations which are expected to be starting test transmissions this spring. There is an extraordinary crop of them, and we shall, no doubt, be hearing a good deal of them within the next few weeks. The giants that are to come into full operation before the summer is out include Budapest, Vienna, the two Brussels stations, Belgrade, Bucharest, Hamburg, and probably Madrid Union Radio within the limits of the medium waveband. The most important high-powered newcomer expected on the long waves is Kalundborg.

Progress with the French broadcasting scheme, known as the General Ferrié Plan, seems to be rather slow. The only official high-powered stations under this scheme now in operation are Radio-Paris, the Poste Parisien and Bordeaux Lafayette. All of the P.T.T. stations are State property, but the great majority of these have quite small plants rated at from a fraction of a kilowatt to 2.5 kilowatts. Most of them will eventually be replaced by 20-kilowatt or 60-kilowatt transmitters. The Eiffel Tower, which, one understood, was to fade out shortly after the taking over of Radio-Paris, still continues to transmit programmes. Work has started on the new 60-kilowatt transmitting station at Nice, which is eventually to replace the 0.8-kilowatt Juan-les-Pins.

Atmospherics Below Normal

There has been very little trouble from atmospherics so far this year, which is as it should be since we are approaching a sunspot minimum. At the time of writing the surface of the sun is entirely clear of spots, and it is to be hoped that it will remain so during the coming months. Summertime reception depends very largely upon the presence or absence of atmospherics. When these are frequent, even if they are of the mild kind, it is virtually impossible to obtain reproduction of genuine entertainment value from any but the nearer or more powerful stations. To receive those that are weaker and farther away the set must be made sensitive, with the result that if atmospherics are about they are often brought out so strongly as to interfere badly with the transmission, if not indeed to drown it altogether.

Should the summer prove to be, as the indications are that it should, much freer from atmospherics than those of the past two or three years have been, there is no reason why foreign station reception should not be good during the warm months.

The long waves are generally the worst affected by atmospheric interference. Since there is none worth mentioning just now, reception of the long waves is wonderfully good at all times.

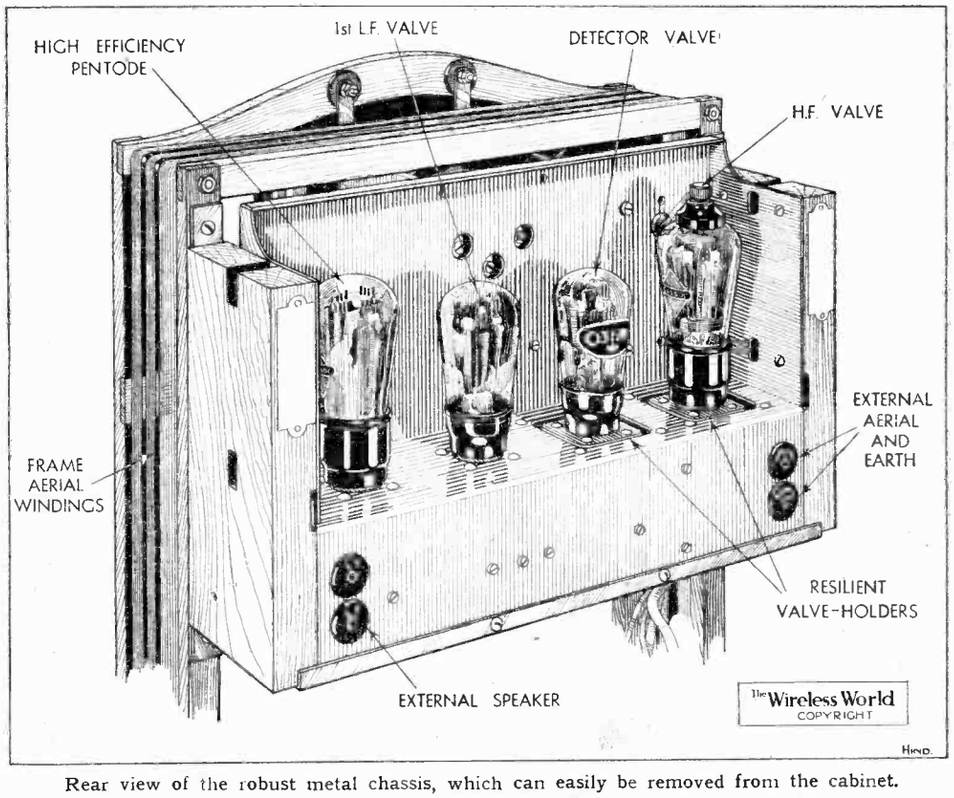
I have been trying for a long time to discover just which station was responsible for the persistent heterodyne upon Beromunster. There is no question that it is of Russian origin, as are a good many other unwelcome whistles that we experience. The Russian Government is considering a ridiculous programme embracing the erection of a further score or more of high-powered stations, of which there can be no genuine need. It is to be hoped that they may be brought to see the error of their ways before it is too late.

D. EXER.

McMICHAEL Duplex Four TYPE CMC

A Four-valve Battery Receiver with Frame Aerial

Features: *A self-contained 4-valve battery set with frame aerial. Permanent-magnet moving-coil loud speaker. H.T. consumption 8 mA. Single H.F. and two L.F. stages. Pentode output. Automatic grid bias. The controls include (1) ganged tuning, (2) trimmer, (3) wave-range, (4) reaction, (5) volume control and combined on-off switch.* ***Price,*** *17 guineas.* ***Makers:*** *McMichael Radio Ltd., Slough, Bucks.*



Rear view of the robust metal chassis, which can easily be removed from the cabinet.

THE name "McMichael" runs through the history of portable receivers from their earliest days, and to those listeners familiar with earlier McMichael portables it will seem only natural that the new Duplex Four should provide its owner with a highly satisfactory performance. Actually, the set gives results comparable with those of a mains receiver. Selectivity is of a high order, especially if use is made of the directional properties of the frame aerial.

The power output of about 350 to 400 milliwatts is sufficient for all normal requirements and is derived from a high-efficiency pentode working into a permanent-magnet moving-coil speaker, the applied H.T. voltage being 115 to 120. That the speaker and matching transformer combination have been well chosen is apparent from the quality of reproduction which has been carried down farther into the bass than is usual in battery sets.

At the other end of the frequency scale the rendering is pleasing and all shrillness has been removed by the use of a limiting condenser across the primary of the output transformer.

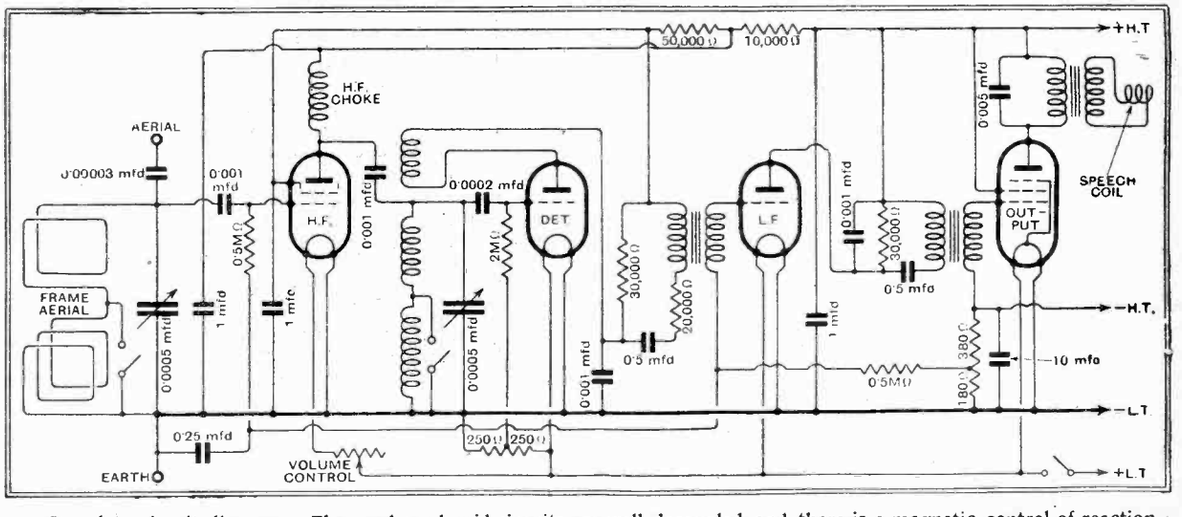
There is little need to press reaction since the range is good—a fair choice of foreign programmes being possible on the medium waveband in broad daylight. The inclusion of two sensitivity controls is of great advantage in obtaining the very best performance even in difficult conditions, for by operating the input volume control and making good the consequent loss of signal strength by reaction many additional foreign transmissions can be enjoyed.

The action of the volume control, which consists of a filament rheostat on the H.F. valve, is a little disconcerting at first, as one has to wait for quite an appreciable period until the full effect is evident. This, of course, is due to the slow heating of the filament. After very little experience, however, the pre-judging of the best position of this control becomes quite simple. The tuning control is exceptionally well designed with an open white scale, calibrated in wavelengths and commendably easy to read. Exact resonance of the two-gang circuit is ensured by the small movement of a trimmer, the control of which is brought out to the panel.

There is an ingenious wave-range switch which causes the tuning indicator to point to the appropriate wavelength scale. On the left of the cabinet the reaction adjustment is to be found. This does not consist of the usual capacitive control but of a variable magnetic coupling, use being made of a small ball rotor.

The circuit contains a number of interesting points. Automatic bias for the H.F. and two L.F. valves is derived from a tapped resistance in the H.T. – lead, and a critical positive potential for the grid detector is obtained from a potential divider across the L.T. supply. Both L.F. stages rely on the parallel-fed transformer system of coupling.

The cabinet, which is mounted on a turntable, has pleasing lines and is beautifully finished.



Complete circuit diagram. The anode and grid circuits are well decoupled, and there is a magnetic control of reaction.

BROADCAST BREVITIES

By Our Special Correspondent

Director of Gramophone Programmes

UNBEKNOWN to the general public, a new department has been formed at Broadcasting House within the last few weeks. Although it bears no official title it could well be described as the "Gramophone Programmes Section." It constitutes a distributing centre for all gramophone records broadcast, and when, last week, I talked with the Director of the new department, it soon became evident that he and the seventeen members of his staff have work on their hands which will keep them busy all the year round.

Centralisation

Whereas in former days each station director had his own pet collection of records for broadcasting in odd moments at his own sweet will, the new gramophone department now provides the records and, what is more, chooses and arranges the programme.

Records in Bins

At the moment there are some 10,000 records reposing in the new steel bins in the gramophone department. They are stored twenty to a bin in such a way that any record can be extracted at a moment's notice. They consist for the most part of the standard musical works—major symphonies, light classics, and what the Director of the section aptly termed a "movable feast" of dance records. These last are not kept for more than a few weeks.

A Record Library

The records chosen for permanent storage should make a fitting nucleus for one of the biggest record libraries in the world.

However, the B.B.C. cannot hope to rival the British Museum Record Library, which obtains *and retains* a copy of every record placed on the market.

Feverish Activity

Meanwhile seventeen people are busily cataloguing the records as they come in, compiling programmes for this and that provincial station, despatching the gleaming discs north, east, south, west, and—perhaps the worst job of all—examining them on their return for wear and tear.

Ten Years Hence

It will be in a few years' time, perhaps a decade, that this library will become really valuable, especially if, as some prophets declare, the disc has then been displaced by the film record.

A Resumed Tour

BON VOYAGE to Mr. Malcolm Frost who, to-morrow (Saturday), resumes his world travels on behalf of the B.B.C. It will be remembered that Mr. Frost was stricken with malaria last December when he had proceeded no farther than Cape Town. This time he is taking his Empire records to Australasia, *via* New York and Canada. I hear that he plans to reach Auckland, New Zealand, on May 15th, whence he will travel to Australia, and after crossing the Commonwealth, on through the Malay Straits to Ceylon and India.

A Director to Tour?

He will not attempt to distribute the records in Canada because, according to present arrangements, the Dominion is to be visited in the near future by one of the B.B.C. officials controlling Empire broadcasting. Indeed, it is quite probable that Mr. Cecil Graves, Director of the Empire service, will himself cover the Dominion, perhaps in a tour with Mr. Gladstone Murray, the B.B.C. publicity chief.

The Room of the Seven Clocks

FOR sensitive listeners it is rather disturbing to step into a room containing seven identical clocks standing side by side on the shelf, all working in synchrony, but all showing different times. This is the surprising sight which greets anyone who visits the office of the Empire Press Section of Broadcasting House, for each of these electrically controlled clocks serves to indicate the time in one of the Empire zones.

One Under the Eight

Four zones have one clock each, while Canada, although contained in Zone 5, has two clocks, as the time difference between East and West is not less than five hours. One of the clocks shows G.M.T.

THE PRESIDENT'S OWN. This is the special microphone presented by the Columbia Broadcasting System to President Roosevelt and used by him at his inauguration ceremonies. The microphones are for public address, broadcasting, gramophone recording and news films.

Easter Sunday

ON Easter Day (April 16th) the morning service will be relayed from York Minster to National listeners. The address by the Archbishop of York will be broadcast.

Talk on Motor Racing

MR. S. C. H. DAVIS, of *The Autocar*, is broadcasting a talk to-morrow (Saturday) on the highly topical subject of "Motor Racing."

Davis at one time did quite a lot of racing himself. It may be recalled that in 1927 he was the winner of Le Mans Grand Prix d'Endurance with J. D. Benjafield. In 1930 he was the winner of the B.R.D.C. five hundred miles race at Brooklands, when he drove an Austin with Lord March.

A Famous Bell

DURING the relay from Dover on April 23rd of the annual memorial service to the men of the Dover Patrol who fell at Zeebrugge fifteen years ago, the famous Zeebrugge Bell will be heard at the ceremony outside St. Mary's Church. This bell was used by the Germans at the Mole, Zeebrugge, to warn the people against British air attacks and later was presented to Dover by the King of the Belgians. Normally the bell hangs in the belfry of Dover Town Hall, but it is being transferred to the West Door of St. Mary's Church for the broadcast.

"The Ringer" on Wednesday

THE services of Miss Dorothy Dickson have been secured for the first broadcast of "The Ringer," by Edgar Wallace, on April 19th and 21st. Miss Dickson will take the part of Cora Ann Milton, a character which she created at Wyndham's Theatre in 1926.

Wembury will be played by Evelyn Roberts, Bliss by Ben Welden, Samuel Hackitt by Ivor Barnard, Maurice Meister by Phillip Leaver and Ronald Simpson will appear as Doctor Lomond. The play will be produced by Val Gielgud.

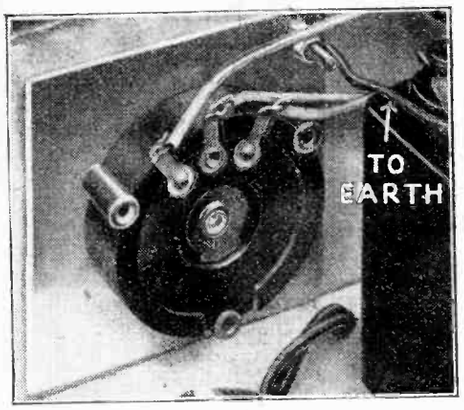
If the broadcast "Ringer" is anything like as good as the stage and film versions, listeners have a real treat in store.

The Mixture as Before

THOSE of us who hoped that the B.B.C. would strike out with something new in the way of architectural designs for the new station at Droitwich are to be disappointed.

I learn that in appearance the station will resemble those of the Regional scheme in all except size. The familiar square, sugar-box outlines will become part of the landscape at Wychbold, where Messrs. Higgs and Hill will begin constructional work in a few weeks' time. Indeed, to a distant observer, the only apparent difference between Droitwich and the Regionals will be found in the disposition and shape of the masts.

READERS' PROBLEMS



An anti-hum device; a metal shield is fitted between the potentiometer and front panel of the A.V.C. Monodial.

The A.V.C. Monodial

THERE is some uncertainty as to the small metal screen which was specified for the Monodial receiver in its latest form (with A.V.C.).

This screen, which is merely a small sheet of aluminium measuring about 2½in. square, is fitted behind the volume-control potentiometer, by the fixing nut of which it is secured in position. A terminal is fitted to the screen, in order that it may be earthed to the nearest convenient point.

The purpose of the screen is to avoid the possibility of hum, which might otherwise occur when the user's hand is brought into proximity with the control knob.

Detector Circuit Decoupling

IN a typical modern set, it is safe to conclude that the most practicable way of curing motor-boating is to increase the amount of decoupling provided in the detector anode circuit.

Unfortunately, the modern detector valve generally takes quite a lot of current, and so it is hardly possible to make any worthwhile increase in the value of the associated decoupling resistance. This leaves us with the alternative—and it is quite a practical one—of increasing the size of the by-pass condenser, which should, and usually does, have the desired effect.

A reader asks whether a high-capacity electrolytic condenser would be suitable at this point. Although these condensers are more generally employed for smoothing purposes, there is not the slightest reason why they should not be employed for decoupling in L.F. circuits.

Economical Volume Control

NOT the least of the advantages of a variable-mu battery valve is that its anode current consumption may be reduced by the application of negative bias. When receiving strong signals, for which full magnification is not needed, it is obviously much more economical to use a grid bias control than any other method which does not have any effect on the current consumption of the set.

We are reminded of this by a request for criticism from a reader who is planning a simple H.F.-det.-L.F. set, in which he proposes to use no other form of volume control than reaction and a series aerial condenser. The H.F. valve is to be of the variable-mu type, and we think it would be a thousand pities to forgo the advantages it offers in the way of combining an efficient volume control with economy. A grid bias potentiometer for the H.F. stage should certainly be fitted, as the slight extra expense will be more than repaid by reduced cost of H.T. battery upkeep.

For Short Aerials

WHEN working under adverse conditions, it is particularly necessary to make every effort to obtain maximum efficiency in all the receiver circuits. For instance, the standard method of coupling a long outside aerial to the first tuned circuit of the set is unlikely to be the best possible arrangement to adopt when an exceptionally short and almost vertical aerial is employed.

A reader, who is forced by circumstances to use a relatively inefficient aerial of this type, has asked for information as to how this handicap may best be offset by taking suitable precautions in the input circuit, and asks whether it would be worth while to rewind the primary coils of the aerial-grid input transformer.

We think it would hardly be worth while to do this. With a very short aerial of low capacity, it is generally best to couple it to the high-potential end of the input tuned

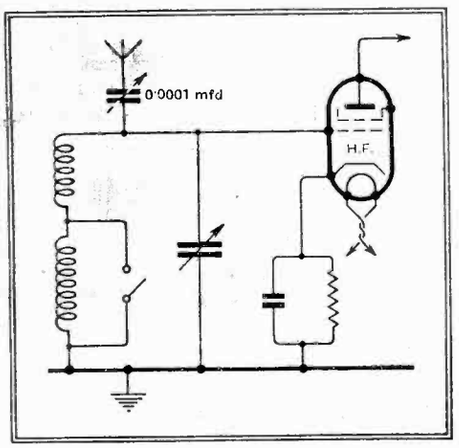


Fig. 1.—When an exceptionally short aerial is fitted, the simplest method of coupling is generally the most efficient.

circuit through a small semi-variable condenser in the manner shown in Fig. 1. We are assuming that the various circuits of the receiver are to be tuned by a ganged condenser, and if this is so, it would be as well to remove the trimmer of the section which controls the input circuit, and to make trimming adjustments by means of the series-connected aerial condenser.

Pentode *versus* Triode

ONE of the great advantages of a pentode output valve is that the input voltage required for full loading of its grid circuit is relatively small. In practice, this means that most of the pentodes in common use may easily be fed directly from the detector valve without the need for an intermediate L.F. stage.

This point should be borne in mind by those who wish to substitute a three-electrode output valve in a receiver for which provision has been made for a pentode in the original design. The rule to remember in such cases is that whatever type of valve is to be used should not normally be rated to work with an appreciably greater grid bias voltage than that of the original valve specified. The detector output is, of course, the limiting factor here, and usually there is not very much margin of safety. The particular case we have in mind at present is that of a reader who wishes to substitute in the Ferrocart III a valve requiring about three times the bias—and consequently about three times the input—of the specified pentode. It is extremely doubtful if the undistorted output of the detector as described would be sufficient to load up the proposed valve.

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 brief particulars, with the fee charged, are to be found at the foot of this page.

Erratic Contact

WHEN a potentiometer-operated volume control of the modern type fails to produce smooth and gradual changes in intensity as the control knob is rotated, it is generally to be suspected that the contact brush is making in certain positions an imperfect contact with the resistance element.

In spite of the fact that a reader, who complains of erratic functioning of this control, has examined his potentiometer carefully, we are inclined to think that the trouble described is most probably present. His potentiometer controls the grid voltage of a variable-mu H.F. valve, and we suggest that a conclusive test should be made by wiring a milliammeter in series with the anode circuit of this valve. With the potentiometer set at minimum volume, the meter should read practically zero, and the current indicated should rise progressively and steadily as the control knob is rotated towards the "maximum" position.

THE A.V.C. UNIT: AN OMISSION

A double-pole switch (S and S1) of "W.B." manufacture was inadvertently omitted from the list of parts published in the issue of March 31st.

The Wireless World INFORMATION BUREAU

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, Stamford Street, London, S.E.1, 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.

The Wireless World

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CONTENTS

EDITORIAL COMMENT

Prices

A Word of Warning

ONE or two comments which have reached us since the appearance of our Leader of the issue of April 7th discussing the price of components, suggest that our views have not been correctly interpreted, for it has been suggested that our urge for the reduction in the price of components would lead to the production of shoddy and inefficient apparatus.

Let us make our views quite clear on this subject. We believe that there is room for a reduction in the cost of components and that such a reduction is necessary if the public is to be given satisfaction in the future, but (to quote from our Leader in question), "We do not want to see the electrical efficiency of components suffer in an attempt to bring down the retail price, but we believe that prices can be brought down by attention to economies other than the reduction of the electrical efficiency." As further confirmation of our views that prices ought not to come down at the expense of efficiency, we have only to refer to a Leader in the issue of March 10th, in which, commenting on the future development of the complete receiver, we stated: "Only one aspect of progress need cause us anxiety for the future. There has been a recent tendency to cheapen the product to a point where performance begins to show signs of suffering." And again, "We recognise that price must always remain a very important factor, but we sincerely trust that progress will not be stayed as a result of over-emphasis of the significance of price reduction."

Somewhere it should be possible to arrive at the happy medium between low prices and unnecessarily extravagant production and retail marketing without any loss in performance.

An investigation of the cause of high prices of components would probably reveal that this was largely accounted for because of the somewhat elaborate cartoning as well as the attempts made to enhance the external appearance of components for the retail market. The arguments for attractive appearance of components are not so strong to-day as they were some years back when the constructor usually built up a receiver on a baseboard and seldom considered using the set in a cabinet, but to-day few constructors would prefer to leave an assembled set exposed to dust and the risk of accidental damage when cabinets are so readily obtainable.

Wireless in Public

A Fair Policy

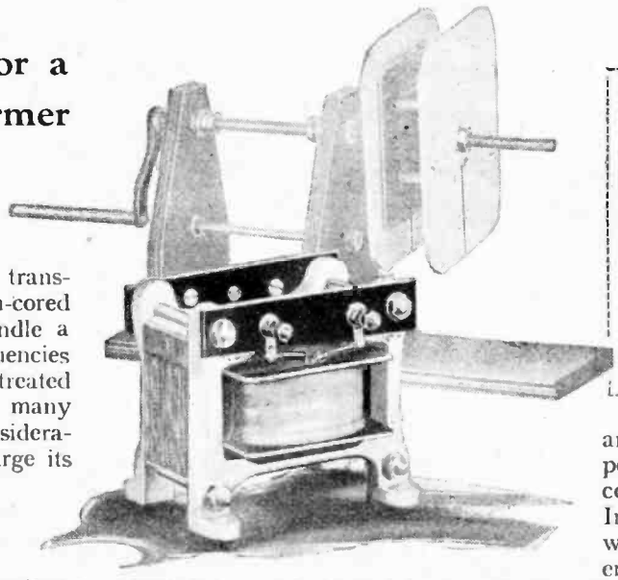
THE recent test action brought by the Performing Right Society appears to have established that owners are entitled to royalties on performances of copyright works given in public through the medium of a broadcast receiver. It is always unsatisfactory in a matter of this kind when the legal position is uncertain because no test case has been conducted, but now, fortunately, all parties have the satisfaction of knowing where they stand.

We welcome the attitude adopted by the Performing Right Society in stating, since the result of the action was known, that it is not proposed to depart from its former policy of making no claim in respect of performance of music by wireless or music dealers in the course of their business on their premises. The action was brought to protect rights which the Society has acquired.

Output Transformer Design

Constructional Data for a 3-watt Output Transformer to Carry 60mA.

By H. B. DENT



WITH the help of an improvised winding machine the construction of an efficient output transformer is well within the scope of the average set builder. Details are here given for a number of models to meet special requirements so that the matching of almost any valve to any loud speaker becomes possible. Particular attention is paid to leakage inductance.

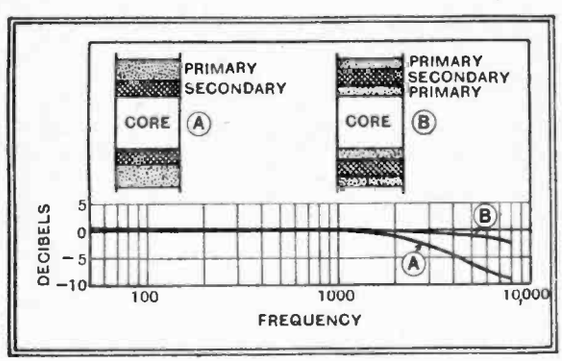
THE design of output transformers and other iron-cored structures required to handle a wide range of audible frequencies becomes somewhat involved when treated mathematically, for there are so many factors that must be taken into consideration if the component is to discharge its functions satisfactorily. Whilst it is not proposed to burden the reader with a host of formulæ, since this article is essentially practical and is concerned with the constructional side, we might profitably devote a little space to a brief review of a few fundamental facts, for, knowing what to avoid and where liberties can be taken without marring its performance, it is possible to steer clear of the main pitfalls.

Correct Matching

An output transformer is essentially a power device, for its principal function is to transfer energy from the anode circuit of the output valve to the loud speaker without undue loss and with the minimum distortion. The last-mentioned condition can be met by maintaining the flux in the core at a reasonably low level, whereas, in a mains transformer, for example, it is customary to work the iron at a very much greater flux density, since distortion within reasonable limits is of little consequence.

To comply with the conditions of maximum undistorted power output the impedance of the loud speaker should be equal to the optimum load resistance of the valve; but as modern loud speakers have but a few turns only on the speech coil and, consequently, a very low impedance, a transformer is employed having a ratio adjusted to throw back into its primary circuit an impedance of the correct order required. If the reactance of the primary winding on the transformer is high compared with that of the valve's optimum load we can ignore it and adjust the ratio by taking the valve's load resistance and the loud speaker impedance and calculate the ratio required for any particular case.

A very simple formula suffices for this, and the transformer ratio for any combination of valve and loud speaker can be found by dividing the optimum load resistance for the valve by the impedance of the loud speaker and taking the square root of this. The load resistance for all power valves in general use to-day are given in *The Wireless World* Valve Data Supplement, whilst if the impedance of the loud speaker is not known it can be found approximately by measuring the D.C. resistance of the speech coil and multiplying by two.

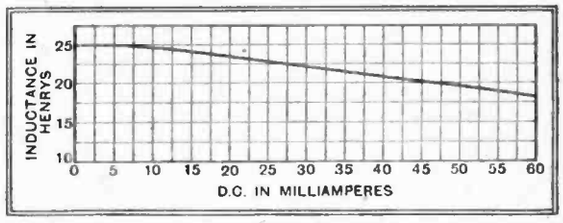


With sectionalised winding the leakage inductance is reduced and the upper register improved.

In an output transformer the self-capacity of the windings can be ignored, for with the usual types this never attains a value sufficient to affect its performance. The only serious losses we are likely to encounter are those introduced by the leakage inductance. This results in a progressive attenuation of the frequencies from about 1,000 cycles upwards and may, unless taken in hand, lead to a very serious loss in the upper register, with the result that the reproduction lacks brilliance and becomes a very poor replica of the original broadcast or the gramophone recording.

The leakage inductance is brought into being when all the magnetic lines of force generated by the primary do not link with the secondary winding. It would not appear if the secondary occupied the same space as the primary, as, for instance, in an output choke, which for practical purpose is a one-to-one transformer with a common primary and secondary winding. In any other case, especially where two windings of dissimilar number of turns are employed, a certain leakage is inevitable, but by careful design we can so arrange matters that the leakage inductance is brought down to a sufficiently low level that over the frequency range covered its effect is of small account.

That this is quite possible of attainment in practice and without unduly complicating the construction can best be shown by some curves taken with a few experimental models, of which one and that of the design adopted finally are reproduced here. The size of the core, also the primary and the secondary windings, are identical in both examples; in the one, however, the secondary was wound on first and the primary followed. The assembly is shown in the sketch A and its curve is similarly marked. Above 1,500 cycles the attenuation is quite appreciable and the output is 9 decibels down at 8,000 cycles.



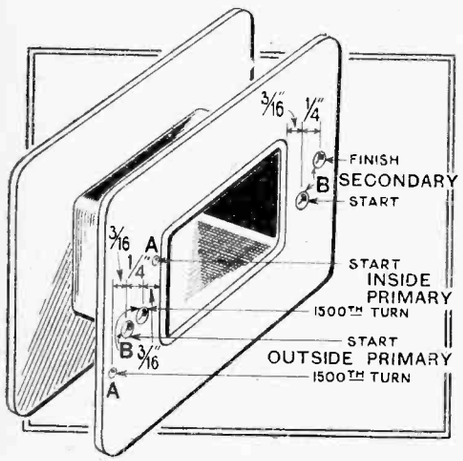
The primary inductance is well maintained even with quite large D.C. currents.

Leakage Inductance

By rearranging the windings as shown in the sketch B, the core and the number of turns being otherwise the same, a marked improvement was obtained, as can be seen from the curve B, the higher frequencies are maintained at a much better level throughout and the output at 8,000 cycles is now only 2.5 decibels lower than that at 1,000 cycles. An improvement might be possible by further sectionalising the windings, but the curve is sufficiently good as it stands to satisfy most requirements.

Output Transformer Design—

These results are obtained with a component having a primary inductance of the order of 20 henrys under working conditions, and although it will carry a D.C. current of 60 mA. and still maintain an adequate primary inductance, it is not likely to be called upon to deal with anode currents much in excess of 50 mA. Yet it is reasonably compact, measuring but 3⅝in. × 3½in. × 3¼in. and is intended to handle an A.C. output of 3 watts.



Drilling details of the bobbin, giving the positions of the various holes.

The model illustrated here is designed to give a step-down of 1 to 39, but any ratio can be adopted to suit individual requirements. Various ratios, such as 1 to 27.4 and 1 to 13.7, have been used with the same method of winding, and in every case the curve was in very close agreement with that shown.

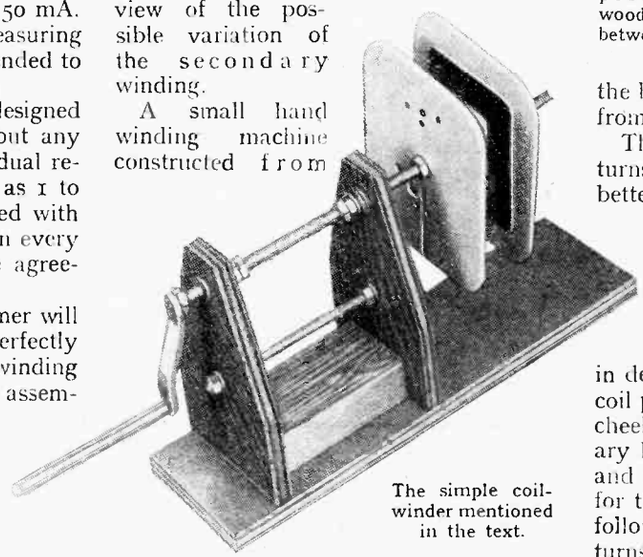
The construction of the transformer will present no difficulty, as it is perfectly straightforward and consists of winding three separate coils on a bobbin, assembling the core, and fitting terminal strips.

The material required consists of 100 pairs of Stalloy No. 30 stampings, obtainable from Joseph Sankey and Sons, Ltd., Grove Works, Junction Road, Highgate, London, N.19, who also supply stampings. The wire for the secondary depends on the current flowing in the loud speaker circuit, and this is governed by its impedance and the power output. A few typical examples have been prepared and are given in the table; in every case the maximum output of 3 watts is assumed. For a 2-ohm impedance loud speaker No. 20 S.W.G. enamel wire is required, for a 7.5-ohm model we find that No. 22 S.W.G. enamel serves, and for one of 15 ohms No. 24 S.W.G. enamel may be used. The quantity varies throughout, but 6oz. will suffice in most cases.

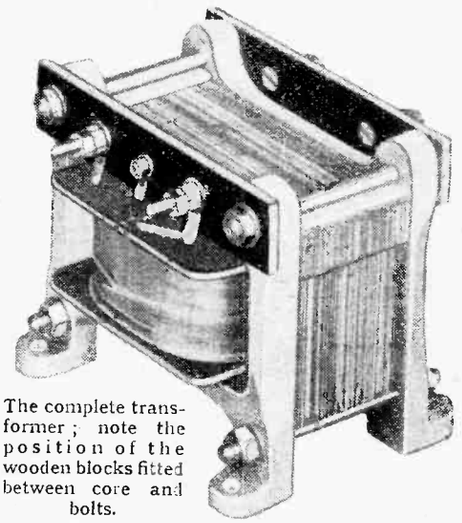
The Winding Machine

Before commencing to wind the bobbin six holes should be drilled in the positions shown on the sketch to bring out the start and finishing ends of each coil. They are drilled in opposite end-cheeks along the shorter of the two sides, and those marked A can be 1/16in. in diameter, whilst the holes marked B had best be ⅛in. in diameter, since it is not possible to position them accurately in view of the possible variation of the secondary winding.

A small hand winding machine constructed from odds and ends to be found in most scrap-boxes would be very useful, and it will not be beyond the ingenuity of the reader to build something on the lines of that shown in the illustration. A revolution counter would be a useful addition, as it relieves the constructor of the tedium of counting the primary turns. The primary is wound in two sections, the first consisting of 1,500 turns of No. 34 S.W.G. enamel wire, which must be put on evenly though not necessarily in layer form. This section when finished should be not more than 1/16in. deep. The finishing end is brought out through a hole in the side cheek and then two layers of empire cloth, cut just a shade wider than the inside of the bobbin, are put on to insulate primary from secondary.



The simple coil-winder mentioned in the text.



The complete transformer; note the position of the wooden blocks fitted between core and bolts.

The appropriate number of secondary turns can now be wound on, and this had better be done by hand so as to ensure a perfectly even winding with each turn touching adjacent ones. The wire is put on layer by layer and wound as tightly as possible, and when finished should take up not more than one-quarter of an inch in depth. The start and the finish of this coil pass out through the holes in the same cheek, but at the opposite end to the primary leads. Incidentally, a larger gauge, and for preference D.C.C. should be used for these. Two layers of empire cloth now follow, and finally the remaining 1,500 turns of the primary. One or two layers of empire cloth, or black bookbinding material, put on over the winding, will protect the coil and give it a finished appearance.

Assembly of the Core

We now come to the assembly of the core. The centre hole in the bobbin is packed with as many T pieces as it will accommodate, a note being made of the actual number used for an equivalent quantity of U pieces must be employed for the other half of the core. These are stacked together, placed in position so that the ends of the U's butt against the stroke of the T's, and then the aluminium end-clamps are gently eased over the bobbin, care being taken to see that the various leads are not broken or nipped between the core and the clamps. They are held in position by the bolts and nuts supplied with the clamps, but at this stage the nuts should be run up finger tight only,

TABLE OF SECONDARY WINDINGS.

Optimum Load for Output Valve.	Impedance of Loud Speaker.	Transformer Ratio.	Secondary Turns.	Wire Gauge S.W.G.
2,000 ohms	2.0 ohms	1 : 31.6	95	No. 20 (En)
2,000 „	7.5 „	1 : 16.3	184	No. 22 (En)
2,000 „	15.0 „	1 : 11.5	261	No. 24 (En)
3,000 „	2.0 „	1 : 38.7	72	No. 20 (En)
3,000 „	7.5 „	1 : 20.0	150	No. 22 (En)
3,000 „	15.0 „	1 : 14.1	212	No. 24 (En)
4,000 „	2.0 „	1 : 44.8	67	No. 20 (En)
4,000 „	7.5 „	1 : 23.1	130	No. 22 (En)
4,000 „	15.0 „	1 : 16.3	184	No. 24 (En)
5,000 „	2.0 „	1 : 50.0	60	No. 20 (En)
5,000 „	7.5 „	1 : 25.8	116	No. 22 (En)
5,000 „	15.0 „	1 : 18.2	165	No. 24 (En)

NOTE.—No. 20 S.W.G. (En) winds 22 turns per layer on bobbin.
No. 22 S.W.G. (En) „ 30 „ „ „
No. 24 S.W.G. (En) „ 38 „ „ „

Output Transformer Design—

as we have yet to adjust the air gaps in the core and fit the terminal strips.

The bolts are just long enough to allow two strips of either ebonite or paxolin $\frac{1}{8}$in. thick to be accommodated on each side between the nuts and the clamps. The terminal strips are $3\frac{3}{4}$in. long and $\frac{5}{8}$in. wide, and each carries two terminals consisting of $\frac{3}{4}$in. 4 BA screws and nuts, their positions being such that the heads are clear of the metal clamps. Although two terminals suffice for each winding, a small 6 BA screw with soldering tag and nut is provided on the primary terminal strip to act as an anchorage for the end of the first section and the beginning of the second part of this winding.

When these are fitted the air gaps can be adjusted by inserting strips of paper, empire cloth, or similar material cut $\frac{1}{2}$in. wide and $1\frac{1}{2}$in. long and 0.005in. thick, between the ends of the U stampings and the strokes of the T pieces. This is equivalent to No. 39 S.W.G., or twice the thickness of the paper on which *The Wireless World* is printed.

The writer is in favour of inserting thin strips of wood between the clamping bolts and the core to prevent the air gaps opening, for it is trusting too much to providence to expect them to remain correctly adjusted indefinitely, since a jolt might quite well open the gaps slightly, with the result that the primary inductance would be lowered by an appreciable amount and quite possibly reduced to half its normal value. Incidentally, the resistance of the primary is 205 ohms, so that when passing 50 mA. of D.C. 10 volts only will be lost.

Next Week's Issue *will be devoted mainly to short-wave problems and will include articles on the development of ultra-short-wave communication, a review of the short-wave receivers, adaptors and special components on the market together with*

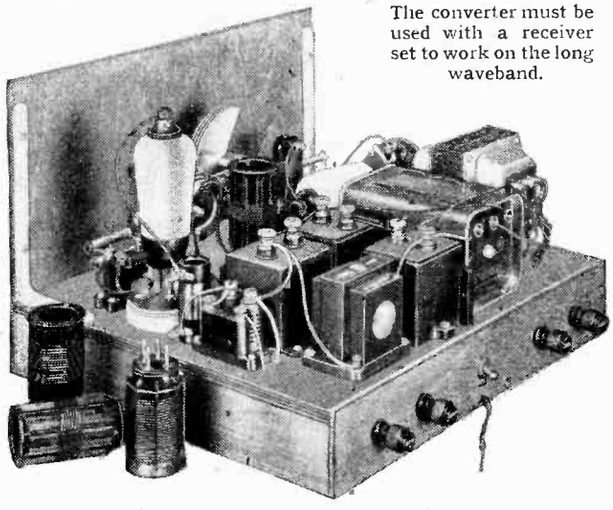
Full Constructional Details of a

Universal A.C. Short-wave Converter

An Easily Constructed Unit for Use with any Broadcast Receiver

THE converter operates on the superheterodyne principle, and enables the range of $12\frac{1}{2}$ to 100 metres to be covered with any reasonably sensitive broadcast receiver. It contains its own mains equipment, and no alteration whatever is needed to the receiver, which may be either of the straight or superheterodyne type.

Two variable-mu valves are employed, one as an ordinary H.F. stage and the other as an autodyne-frequency changer. Tuning is effected by a single control, and there are four plug-in coils to enable the full range to be covered.



The converter must be used with a receiver set to work on the long waveband.

LIST OF PARTS

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

1 Variable condenser, 0.00015 mfd. (Eddystone)	Cyldon type SW15
1 Slow-motion dial with micrometer adjustment	Igranic type 2296/56
2 S.W. H.F. chokes	Igranic
1 S.W. H.F. choke	Eddystone
2 5-pin valveholders	Eddystone type 500
1 4-pin valveholder	Eddystone type 501
1 Set S.W. coils, types 2BB, LB, Y and R	Eddystone 932
2 Fixed condensers, 0.001 mfd., 1,000 v. D.C. test	T.C.C.
3 Fixed condensers, 0.001 mfd.	T.C.C. type 34
2 Fixed condensers, 0.00005 mfd.	T.C.C. type 34
4 Fixed condensers, 0.01	T.C.C. type 34
2 Fixed condensers, 4 mfd., 200 v. D.C. working	T.C.C. type 61
1 Fixed condenser, 4 mfd., 400 v. D.C. working	T.C.C. type 80
1 Smoothing choke, 25 h. 850 ohms (Trix. type C30A, model 18M)	R.I.
1 Mains transformer, shrouded with screened primary Secondaries, 110 v. 75 m.a., 4 v. 2 amps. C.T.	Sound Sales type SS/Shielded
1 Metal rectifier	Westinghouse H.T.6
1 Q.M.B. On-off switch	Bulgin type S80
1 Valveholder bracket	Peto-Scott
1 Resistance, 150 ohms	Claude Lyons
1 Resistance, 600 ohms	Claude Lyons
2 Resistances, 20,000 ohms	Claude Lyons
2 Resistances, 30,000 ohms (Dubilier, Erie)	Claude Lyons
1 H.F. choke	McMichael Binocular Junior
4 Terminals, A.E.+Output—Output	Belling-Lee, type "B"
1 Plymax baseboard, 12×14×3/8	Peto-Scott
Valves: 1 Mazda AC/SGVM and 1 Mazda AC/S1VM	

DISTANT RECEPTION NOTES.

MANY who did not happen to see in the daily papers a report of the fate that it had met wondered why it had suddenly become impossible to hear Radio Toulouse. The station was completely gutted by an outbreak of fire, caused, it is reported, by some smoker's carelessly thrown-down cigarette, and as the new plant has been ready for a long while it is exceedingly unlikely that anything will be done as regards repairing it. Possibly the destruction of the old transmitter will induce the French Government to grant their long-delayed permission to the new station to come into regular operation. We shall miss the 8-kilowatt Toulouse, one of our oldest and most faithful European sources of entertainment; we might regret its demise still more were it not for the very poor quality which has characterised its transmissions for a long time now. The tests that took place some time ago have shown that the new plant will provide not only good field strength, but also excellent quality in this country.

Station of 200 kW.

Luxembourg is becoming more and more of a nuisance on the long waves, and it is to be hoped that steps will be taken to prevent this unauthorised and unjustifiable grabbing of a wavelength. It cannot be claimed that 200 kilowatts and a wavelength of 1,250 metres are necessary to cover properly the minute Duchy of Luxembourg. The country has already an authorised wavelength in the lower part of the medium waveband which should enable an adequate programme service to be provided for such a comparatively small area.

On April 24th two noteworthy events occur. The B.B.C.'s Western station near Minehead is to begin tests, and the Athlone station is to start sponsored programmes. One only hopes that the Irish broadcasting authorities will not allow advertising to be overdone, as it has been in some other countries. In Canada a very wise step has been taken in this connection; it has been laid down that no station may devote more than five per cent. of its programme time to advertising matter.

Good Reception Conditions

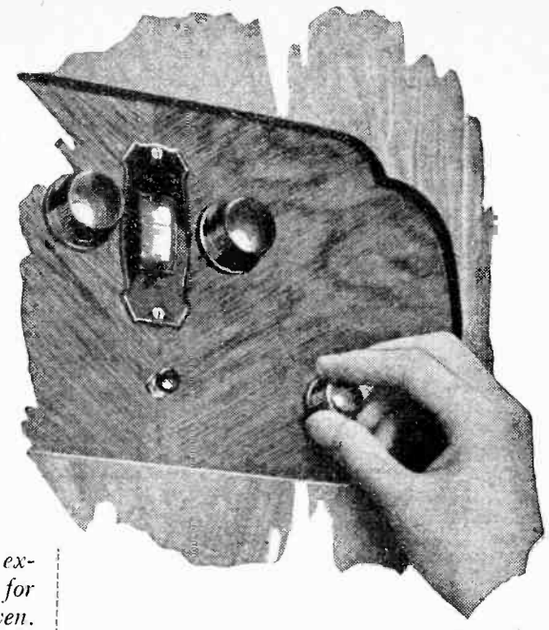
The early part of April has brought the most remarkable conditions for long-distance reception that I can remember in any spring. One would have thought that the long-continued spell of warm dry weather would have led to a marked falling off, but just the opposite result has occurred. On many recent evenings between forty and fifty Continental stations have been receivable at good strength.

A great improvement is noticeable in the lower part of the medium waveband, where Hörby, Rennes, Fécamp, Nürnberg and Trieste are all worthy of note. Very fine reception, too, has been obtained from stations near the top of this waveband which a short time ago were not quite up to the mark. Brussels No. 1, Budapest, Munich, Vienna, Florence, Prague and Langenberg are all quite excellent. Other stations well worth attention are Katowice, Rome, Hamburg, Strasbourg, Göteborg, Bordeaux and Hilversum. D. EXOR.

Manual Volume Controls

The Importance of Tone Correction

By L. E. T. BRANCH, B.Sc.



IT is generally recognised that when the volume control is turned down, low notes are weakened out of proportion to high notes. In this article the reasons why this happens are explained and practical circuits for overcoming this defect are given.

LATELY the subject of volume control has been receiving a considerable amount of attention. It is a subject which, in wireless, is as old almost as crystal sets, and whatever may be achieved with various forms of anti-fading devices which keep the input to the detector valve constant, or nearly so, these can never remove the necessity for some form of manual volume control to provide for differing individual tastes.

Usually listeners of more advanced years prefer their music "soft," while the "younger bloods" crave for it "full strength," especially jazz music—but even those who like a high intensity for serious listening prefer it "turned down" when the music is to form only a background to other things. In short—the volume from the loud speaker itself can *never* be automatically controlled, and manual adjustment must stay. The automatic volume control which is so much to the front at the moment usually implies "keeping the input to the detector valves the same for all stations and conditions." The manual volume control which must therefore always be provided on a receiver, as with a pick-up, should preferably control the audio frequency reproduction, that is to say, it should be a means of varying the magnification of the audio frequencies after the detector, so that this, too, is really "volume control." The distinction is that the automatic arrangements should precede the detector, especially if it is a diode, so as to keep its input constant, and therefore its efficiency and its freedom from distortion constant, while the manual control should follow the detector. Since it controls audio frequencies it is closely allied to the volume control for a gramophone pick-up. The purpose of the present article is to put forward practical arrangements for post-detector manual volume control and also manual volume control of the gramophone pick-up output, and not to touch upon A.V.C., which has been dealt with in numerous articles in *The Wireless World*.

It is well known that the sensitivity curve of the human ear is not a straight line, but falls off very considerably at the lower frequencies, and also to some extent at the higher frequencies, so that at different sound intensity levels the "character" of the reproduction appears different even if the overall response curve of the reproducer remains unchanged. This is probably the fundamental reason why the "high intensity" individual moans when the intensity is considerably reduced—he has become so accustomed to hear all the frequencies, especially the lower ones, well reproduced that at the lower intensity he painfully notices their absence—because to the ear they have fallen below the sensitivity limit, and are therefore absent.

Compensated Control

It is the general experience that this reason accounts more for the complaint in question than does the mere reduction of the intensity. The same applies to the highest frequencies, but to a very much lesser degree in practice—so that, while it is desirable to design the manual volume control so that it lowers the intensity of the lowest and highest frequencies to a less extent than it does the middle frequencies, it is often sufficient to design the control so as to lower the lowest frequencies to a less extent than the rest, which type of control can be extremely simple. Those who have once tried a volume control of this nature immediately appreciate the point that at low intensities it is the *apparent* lack of bass rather than the mere low intensity which is so unsatisfactory, and even those who always prefer their music "soft" also consider the arrangement an improvement, hence usually everyone is pleased.

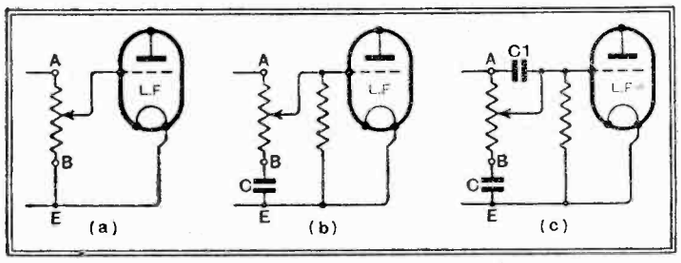


Fig. 1.—Simple circuits which provide for a compensating volume control.

Some Practical Examples

Some of the simplest ways of arranging a type of manual volume control which gives the desired result are shown in Fig. 1, and these have the important advantage that they can be applied in a few moments to almost all existing manual volume controls, but only, of course, if they are of the post-detector kind. In Fig. 1 (a), the grid of the L.F. valve is connected to the arm of a potentiometer so that the input to the valve increases as the arm slides along towards A, and decreases as the arm slides towards B. In Fig. 1 (b), we have a similar arrangement, except that there is now inserted the condenser C between the end B of the potentiometer and the "earth line" E. Incidentally, a one megohm grid leak is connected across the grid and E to enable the grid to receive its proper bias. In this arrangement the working potentiometer is really now the original potentiometer, plus the condenser, i.e., A to E, although, of course, the arm can only move over the amount A to B. The effect of this is that, as the arm of the potentiometer is moved towards B in order to decrease volume, the condenser C remains always wholly in circuit, and since the impedance of a condenser varies widely with frequency the amount of signal picked off by the arm of the potentiometer is greatest at the lowest frequencies, and the proportion of these frequencies will be greatest at lowest volume; in other words, as the volume is lowered the lowest frequencies are not decreased in strength as much as are the middle and upper frequencies. To take a working example, suppose that the resistance of the potentiometer AB is 250,000 ohms and the condenser C has a capacity of 0.1 mfd.

Manual Volume Control—

The impedance of this condenser at 50 cycles is $\frac{106}{2\pi \times 50 \times 0.1} = 33{,}000$ ohms, and at 5,000 cycles is 330 ohms. Therefore, while at full volume, it is clear that all frequencies are fully and equally transferred, on the other hand, at low volume, say, when the arm X is at 10,000 ohms from B, a 50 cycle frequency is transferred sufficiently approximately in the proportion

$$\frac{\sqrt{10{,}000^2 + 33{,}000^2}}{250{,}000} = 13\%,$$

while a 5,000 cycle frequency is transferred in the proportion

$$\frac{\sqrt{10{,}000^2 + 330^2}}{250{,}000} = 4.1\%.$$

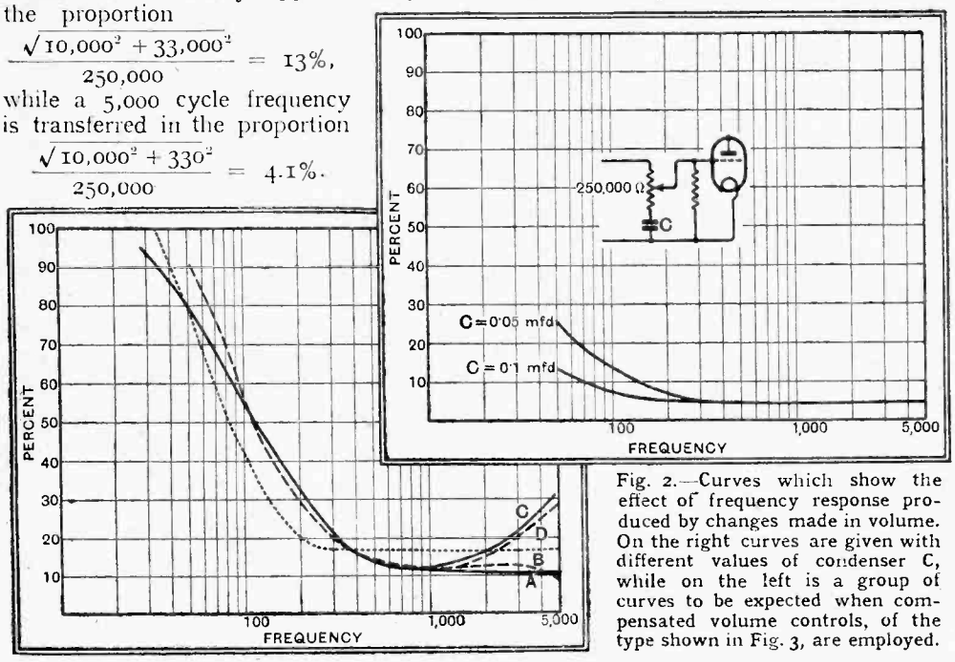


Fig. 2.—Curves which show the effect of frequency response produced by changes made in volume. On the right curves are given with different values of condenser C, while on the left is a group of curves to be expected when compensated volume controls, of the type shown in Fig. 3, are employed.

This is shown more fully by the curves of Fig. 2 (right), which also show the effects of decreasing the size of the condenser to 0.05 mfd., thereby increasing still further the retention of the low frequencies at low volume settings. Of course, the best value of condenser will have to be chosen to suit individual requirements, but for those who require a good starting point for experiment the values recommended are those set out in the second column of the table. When experimenting with other values of the condenser C remember that the low frequencies are *increased* by *decreasing* the capacity of the condenser. It is usually advisable to decrease the capacity when this method is used to control the volume from a gramophone pick-up on account of the great deficiency of the low frequencies as recorded on the records themselves.

If it is desired to retain also the highest frequencies another fixed condenser C1, shown in Fig. 1 (c), is included. This condenser has a relatively low capacity, as its function is to pass the highest frequencies direct to the grid of the valve. Suggested values which have been tried in practice are given in the third column of the table. The high frequencies are, of course, increased if the capacity of C1 is increased, and vice versa to suit individual requirements.

Other convenient methods of achieving a similar result are shown in Fig. 3. These methods are particularly useful when applied to a gramophone pick-up, because variation of the volume control also varies the load on the pick-up, the load increasing with increase of volume, so that the function of the control is of a very complex nature, not to be considered in detail here.

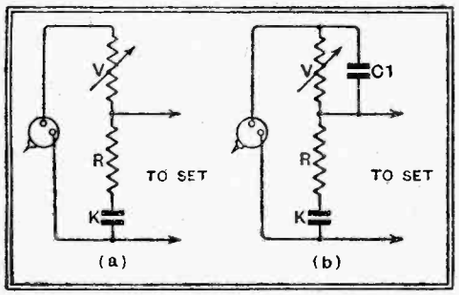


Fig. 3.—Methods of compensated volume control particularly suitable for use with pick-ups in gramophoue reproduction.

Resistance.	C.	C1.
Ohms.	Mfd.	Mfd.
1,000,000	0.025	0.0002
500,000	0.05	0.0005
250,000	0.1	0.001
100,000	0.25	0.002
50,000	0.5	0.005
10,000	2	0.02

Since in most cases gramophone pick-ups give more output than is normally required, this type of volume control has the very distinct advantage that when not "full on" it compensates for the falling-off of the recording curve at low frequencies, to an extent which is a maximum possible with such simple apparatus. It is true that the volume cannot be turned down to nil, but no one wishes to play a record in such circumstances. An example will help to illustrate the operation of the method and give an idea of the compensation which can be effected.

The schematic arrangement is shown in Fig. 3 (a), and consists of a variable resistance V in series with a fixed resistance R and a condenser K. The pick-up is connected, as shown, to the extreme ends, while the leads to the set embrace only the resistance R and condenser K. To vary the volume only the resistance V is varied, and this may obviously be a potentiometer in which only two terminals are used, so that it functions merely as a variable resistance. R should have a value of not more than one-tenth of the total resistance of V, while the impedance of K should usually be approximately equal to the value of R at 1,000 cycles. It is clear that, as the resistance V is increased, the volume falls, although at low frequencies it falls less than at the middle and upper frequencies on account of the variation of impedance of the condenser K with frequency. The principle is thus somewhat similar to the previous case, and, as would be expected, the high frequencies can also be retained to an increased extent by shunting the resistance V with a small fixed condenser, preferably of about one-twentieth the capacity of K, Fig. 3 (b). This arrangement, when used with a pick-up, has a rather complex action owing to the variation of load across the pick-up, both for volume variation and frequency difference.

A fairly close calculation can be made and the full line curve (A) in Fig. 2 (left) shows the calculated result expected, in which K is 0.0025 mfd., R is 80,000 ohms, and V is a one megohm variable resistance all in use, i.e., minimum volume, as will often be the case in practice with modern sensitive pick-ups. If a greater range of control of volume is required it is usually best to retain V as one megohm (variable), and alter the values of R and K both in the same proportion; thus, if R is 20,000 ohms and K is 0.01 mfd., a wider range is obtained.

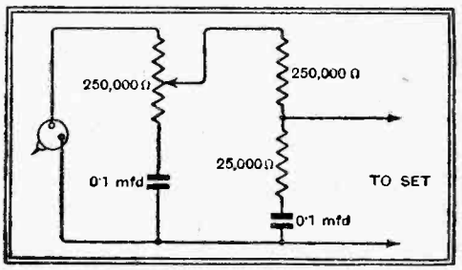


Fig. 4.—A further circuit for gramophone reproduction recommended for use with sensitive pick-ups.

The inverse of the recording curve is shown as a dotted line on the same graph, and, as this is the curve which should be aimed at in designing the volume control, it is gratifying to note the close similarity. The broken line curve (B) shows the results obtained in practice, using the values used for calculating the full line curve, while curves (C) and (D) show the calculated and measured effect of the use of a 0.0001 mfd. condenser across V. In record reproduction it is sometimes desirable to include such a small condenser (which can be variable) across V if the highest frequencies have been worn from the record or are attenuated by the amplifier or speaker.

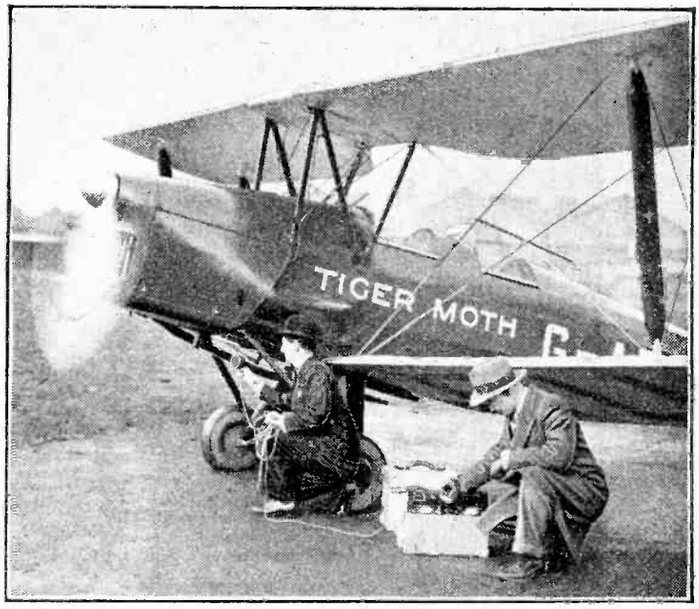
In conclusion, Fig. 4 shows a further development which can be recommended when the pick-up is much more sensitive than is normally required to operate the amplifier. This also has the advantage of giving a very great range of control of volume, and retains completely the full correction for the recording curve.

ESTIMATING LOUDNESS

Is the Ear an A.V.C. Device?

By R. T. BEATTY, M.A., B.E., D.Sc.

RECENT experiments, in which nearly two hundred observers took part, go to show that the ear does not respond proportionately to increases in sound intensity. It appears, for example, that in cases where the loudness of a sound is actually increased eight times according to the decibel scale, mental estimates will assess the final result as being only twice the original volume.



Noise measurement of an aeroplane engine by a Western Electric sound meter.

LET me begin by registering a protest against a certain aspect of the scientific mind. Physicists and engineers express phenomena in terms of units such as inches, watts, candle-power, and so on, which is a perfectly legitimate thing to do, but they also show a tendency to assume that when phenomena are perceived by means of the human senses the sensations aroused in the brain are to be measured by scales similar to those used by the scientist.

A few examples will show how grotesque are the results to which such an assumption leads. A refuse heap is objectionable in a residential district; hence if the heap is doubled in size it becomes twice as objectionable. Ten flowers in a pot are twice as pretty as five flowers. Two crying babies are annoying, but if one baby is removed the annoyance is halved.

The last example introduces the subject of scales of loudness. Here again physicists have produced a *measure* of loudness which does not agree with our *sensations* of loudness. The method in common use is to compare any sound with a pure note of frequency 1,000 cycles per second which sounds equally loud. Then, if equality of loudness occurs when the 1,000-cycle note is 30 decibels above the threshold of hearing, the loudness of the sound is said to be 30 units; if equality occurs at 60 decibels the loudness is said to be 60 units. But such a scale of loudness is based on scientific measurements of power expressed in watts and does not help us to find the power ratio between two sounds when one seems to our natural judgment to be twice as loud as the other. In fact, as will be shown presently (Fig. 2), when the loudnesses on the physicist's scale are 60 and 30, the loudness ratio on our intuitive scale is 10 to 1. The contrast is between the roar of Piccadilly Circus and the murmur of a quiet suburban street.

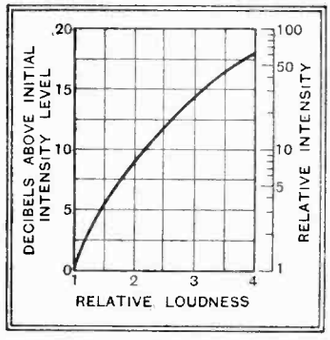


Fig. 1.—Curve showing the apparent increase in loudness noted in the course of 4,500 observations made by 175 listeners. When the intensity level rose by 9 decibels, the loudness was judged to be twice its original strength.

But, you may ask, is the intuitive scale to be relied on? Is it a scale which remains invariable from day to day, and is *my* mental scale of loudness the same as *your* scale? Recent experiments[1] disclose that consistent estimates are made by any one observer, and that the differences between one observer and another are small enough to allow a useful scale of natural loudness to be constructed. In these experiments an observer listened to two similar sounds, A and B, which were equally intense at the beginning of the experiment, and hence equally loud. He then increased the intensity of B till, in his judgment, it was two, three, or four times as loud as A; 175 observers took part in the tests, and 4,500 observations were made, with the results shown in Fig. 1, which gives the smoothed curve.

It appears from Fig. 1 that when the intensity level of B rises by 9 decibels the loudness is judged to be twice that of A, while a further rise of 9 decibels once more doubles the loudness. When A was brought up to this new level so as to start again with equal loudnesses at the higher level it was found that a further rise of 9 decibels in the level of B made its loudness double that of A, and so on. Expressing these results over the whole range of intensities from the threshold of hearing upwards, we get the table given on the next page.

[1] "Loudness and Intensity Relations," by Ham and Parkinson, *Journal of the Acoustical Society of America*, April 3rd, 1932, page 511.

Fig. 2 shows the curve obtained from this table. It a sound is raised 30 decibels above the threshold—that is, if its intensity is made 1,000 times as great—the loudness is only tenfold the threshold loudness. Similarly, if the intensity is a million times threshold the loudness is only 100 times threshold. Hence each of us judges loudness by an intuitive or mental scale which is quite different from the scale of actual intensity of the sound.

Intuitive Estimates

Now this is a most remarkable thing. For all of us have had during our lives plentiful opportunities of comparing sounds by means of their intensities. We can recall the noise produced by eight cars and compare it with that produced by one car; we can compare the volume of sound due to a single speaker with that due to eight people talking at once. And yet, in

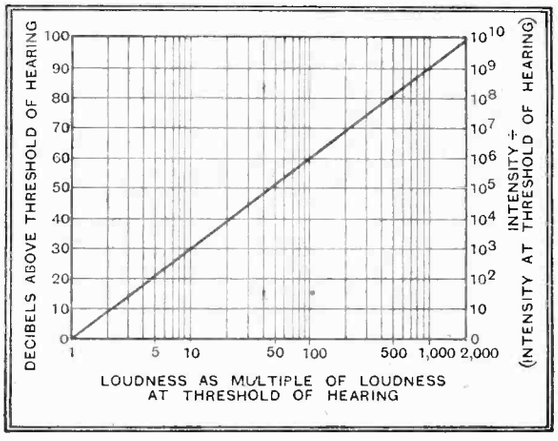


Fig. 2.—The curve obtained from the table at the end of the article, covering the whole range of intensities from the threshold of hearing upwards.

Estimating Loudness—

spite of this combined evidence offered to eye and ear, we persist in saying that one of these sounds is twice (not eight times) as loud as the other.

Let us see whether other senses give such anomalous results. For example, what about vision? Does a room look twice as bright with two lamps as with one? We must be careful in interpreting our sensations in this case, for the eye has self-regulating mechanisms which are denied to the ear. When we pass from sunlight into a curtained room the eye gradually adapts itself to the new conditions both by enlargement of the pupil and by the building up in the retina of materials which are sensitive to light. Hence, in order to avoid these complications, we must make our comparisons quickly. A simple method is to take a number of photographic plates which have been slightly fogged and to look for a moment through each of them in turn at some bright object, choosing the plate which seems to diminish the brightness to one-half. When such a plate is tested in a photometer it is found to transmit only about one-eighth of the light, so that our mental estimate of brightness ratios agrees fairly well with the scale of loudness ratios shown in Fig. 2. In both cases the *objective* intensity ratio is roughly 8 when the *subjective* intensity ratio is 2.

Intensity Relative to Threshold Intensity.	Decibels Above Threshold.	Relative Loudness Judged Intuitively.
1	0	1
8	9	2
$8^2=64$	$9\times2=18$	$2^2=4$
$8^3=512$	$9\times3=27$	$2^3=8$
$8^4=4,096$	$9\times4=36$	$2^4=16$
$8^5=32,768$	$9\times5=45$	$2^5=32$
$8^{10}=1,067,000,000$	$9\times10=90$	$2^{10}=1,024$

It would seem, then, that there is some mechanism common to eye and ear which is responsible for this peculiar scale of sensation, and we turn for information to the physiologists, who, working on the borderland of the brain itself, have intercepted and deciphered the messages which stream along the sensory nerves—messages which carry in code form all the information which reaches us from the outside world. In all types of nerves which have been examined the messages pass as a series of discontinuous impulses; they are probably chemical in nature, but are accompanied by electrical effects which allow the impulses to be picked up by electrodes placed on the nerve, and after amplification to be recorded on a string electrometer. It appears that the effect of an increased stimulus is an increased number of nerve impulses per second. Quantitative results on the auditory nerve are difficult to obtain, but experiments on all other types of nerve show that the frequency of nerve impulses increases more slowly than does the intensity of the applied stimulus. Take, for example, the experiments made by Adrian, at Cambridge, on the optic nerve of the conger eel (Fig. 3). The frequency of the nerve impulse is doubled when the intensity of the light falling on the retina increases from 2.5 to 19 (about 8-fold).

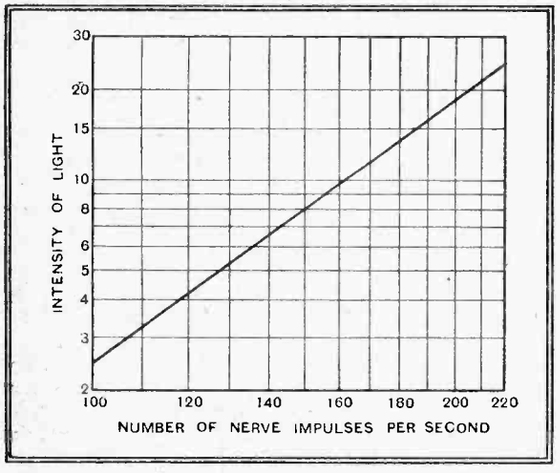


Fig. 3.—Does the nervous system function on the lines of automatic volume control? Auditory nerve measurements are difficult to obtain, but the above curve, showing the response of the optic nerve of a conger eel to light sensations, indicates that nerve impulses are doubled in frequency when the intensity of light increases eight times.

Now put all these facts together. An 8-fold increase in sound intensity doubles the loudness, while in light intensity it doubles the brightness, and in the one case which has been examined it doubles the rate at which messages are sent to the brain along the optic nerve. Even if we heavily discount the agreement between these figures on the score of insufficient experimental accuracy we still have good grounds for concluding that *our estimates of loudness or brightness express correctly in the domain of consciousness the messages which travel along the corresponding sensory nerves.*

It is noteworthy that in these estimates we are unable to sum two loudnesses to make a third: our attitude is rather to regard one sensation as a multiple or a fraction of another. It is as if this part of the brain had only learnt the tables of multiplication and division, without ever reaching addition and subtraction.

CLUB NEWS

International S.W. Club

RECTIFICATION was the subject chosen by Mr. D. Ashby, A.C.G.I., B.Sc., for his recent lecture before the International Short Wave Club (London Chapter) at the R.A.S.C. Hall, Wandsworth Road, S.W. The Club will meet again on April 28th and May 19th.

European Representative: Mr. A. E. Bear, 10, St. Mary's Place, Rotherhithe, London, S.E.16.

A New Society in Sidcup

A SUCCESSFUL inaugural meeting of the Sidcup and District Radio Club was recently held at the Regal Cinema, Sidcup, the subject of discussion being "Man-made Static." Several technical members offered their services in a campaign against local electrical interference.

Radio manufacturers who are willing to give lectures and demonstrations are invited to write to the Hon. Secretary. The meetings are held every Wednesday, at 8 p.m., in the Regal Cinema, and prospective members are more than welcomed.

Hon. Secretary: Mr. T. E. W. Towers, 22, Crombie Road, Sidcup, Kent.

A New Way with Slugs

THE electrocution of slugs was vividly described by Mr. F. G. Sawyer, recently, lecturing before the Croydon Radio Society on "Mains Transformers and Their Manufacture at the Works of Partridge, Wilson and Co." Mr. Sawyer described how one very useful application benefited the farmer, for a transformer was made to make and break so that a cheerful 80,000 volts wandered on to a certain section of the land, slaying all slugs in its path.

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

The Late Herr Schäffer

THE unexpected passing, on March 24th last, of Walter Schäffer, Chief Engineer of the Reichs-Rundfunk-Gesellschaft, and of his wife came as a great shock to his many friends.

Schäffer's great achievements were, undoubtedly, accomplished in the domain of broadcasting technique, writes a correspondent.

The son of a Jewish merchant, of Breslau, he was born in that city on September 20th, 1881.

At the end of the War, in which he was attached to the Airship Service, he was engaged by the Telefunken Company as an engineer for their Transmitter Laboratory. Very soon he was made chief of the Transmitter Laboratory.

When, subsequently, the first experiments in broadcasting were made in U.S.A., Schäffer at once recognised its great significance, and turned his whole attention to the development of broadcast transmitters. The first German transmitter, that of the postal authorities at the Berlin Voxhaus, was built under his direction.

Schäffer was eventually appointed head of the Technical Section at the Reichs-Rundfunk-Gesellschaft, the technical side of all the other German broadcasting companies (with the exception of Munich) being put under the direct control of the R.R.G., and thus under Schäffer.

Schäffer took part in all the deliberations of the Technical Committee of the Union Internationale de Radiodiffusion as the representative of the R.R.G., and on the question of distribution of wavelength he put up many a strong fight in the interests of Germany.

His numerous journeys abroad gave him a good insight into foreign broadcasting organisations, and by reason of his charming manner and his great technical talents he made many friends abroad.

NEWS *of the* WEEK

Current Events in Brief Review

Television in the West

PLANS are in hand for the formation of the Western England Television and Scientific Society for the benefit of all interested in television, talking films, and kindred subjects. Correspondence should be addressed to Mr. H. Montague Smith, Eden House, Eden Grove, Filton, Bristol, 7.

Awful Prospect?

DISTINGUISHED guests at the recent opening of the new Marignan-Pathé-Nathan Cinema in the Avenue des Champs Elysees, Paris, were filmed on arrival and, before leaving the theatre, enjoyed seeing and hearing themselves on the screen.

In a few years' time it may be possible to televise the arrival and departure of cinema patrons for the benefit of their respective families.

Short Waves to the Rescue

MARCHESE MARCONI has offered to install a short-wave wireless station at the new hospice which four St. Bernard monks are founding nearly 15,000ft. above sea level in the heart of the Himalayas. The monks intend to carry out rescue work on the borders of India, Tibet, and China, the hospice being at a place called Si La. It is believed that short-wave wireless will be of exceptional value for this purpose.

High, Medium, or Low?

NO longer will it be necessary to argue as to the precise extent of the low, medium, and high frequencies if the International Radio Consulting Committee obtains acceptance of its proposals for a new classification as follows:—Low frequencies, up to 100 kilocycles (3,000 metres); medium frequencies, 100 to 1,500 kc. (200 metres); medium high frequencies, 1,500 to 6,000 kc. (50 metres); high frequencies, 6,000 to 30,000 kc. (10 metres); very high frequencies, above 30,000 ks.

100kW. from Portugal?

WILL Portugal be contributing another 100 kilowatts to the broadcasting power now daily launched on the European ether? We learn that the 20 kW. station now being erected at Lisbon by Standard Telephones and Cables, Ltd., for the Portuguese Government, is so designed that its power can be increased to 100 kW. Tests will probably begin in September on a wavelength of 283.6 metres. Wavelengths of this order are used by many amateur Portuguese stations, which will either have to "go off the air" or revert to short-wave transmission. No tax is paid by the 30,000 listeners in Portugal, but the Government is considering the introduction of a licence fee when the new station opens.

Doing Without G.M.T.

GREENWICH time signals mean nothing to New Zealand, where listeners prefer to check their time daily by the signals radiated from Washington, U.S.A., and Nauen, Germany. The Greenwich signals are received only at 6 a.m. and 10 p.m., and both times are inconvenient for broadcasting purposes

Radio Commission Goes Marching On

FEARS that Democratic administration might abolish the American Federal Radio Commission have been partially set at rest by the announcement of several new appointments to the Commission. Judge E. O. Sykes, who is Southern Zone Commissioner, has been elected chairman, writes our Washington correspondent.

The Radio Commission is said to be costing something like 750,000 dollars annually—an important consideration in these days.

Looking to Lucerne

NORTH African listeners, according to a correspondent, would be happier folk if Germany had never opened that big station at Stuttgart. They find that the reception of Algiers, although the station has a power of 13 kilowatts, is ruined by the German.

The Rabat station, too, is being badly jostled by the new Athlone transmitter, and this is yet another reason why Moroccan listeners are waiting impatiently for the Lucerne Conference.

Short Waves from Germany

THE German broadcast system owns two short-wave transmitters. These are at Zeesen and, depending upon the wavelength and aerial used, they employ the following call-signs: DJA, DJB, DJC, DJD. DJA and DJB operate on the directional aerials; DJD is used for special transmissions to North America on 25.51 metres; while DJC is used for the same purpose on a wavelength of 49.83 metres.

Why U.S. Amateurs are More Venturesome

THE "here-to-day-and-gone-to-morrow" atmosphere has departed from American amateur radio with the welcome decision of the Federal Radio Commission to extend all existing licences for a period of two years and to issue new licences for three-year periods. Besides saving State time and money, the new measure is encouraging many amateur transmitters to experiment more ambitiously. The American Radio Relay League seems hopeful of an increase in new inventions.

New Blood in German Broadcasting

DR. KURT MAGNUS, the founder of the original Berlin Funkstande and managing director of the existing Reichs Rundfunk Gesellschaft, has resigned his position in company with many other important officials. His successor is Dr. Kruckenburg, who retains his post as Radio Commissioner and is at the same time chief of the broadcasting department of the "Ministry for the Enlightenment of the People and of Propaganda." According to our Berlin correspondent, Dr. Kruckenburg's tenure of three important posts gives him immense power while simplifying the German broadcasting organisation.

Dr. Hubmann succeeds the late Mr. Schäffer as Chief Engineer. German broadcasting is now completely in new hands.

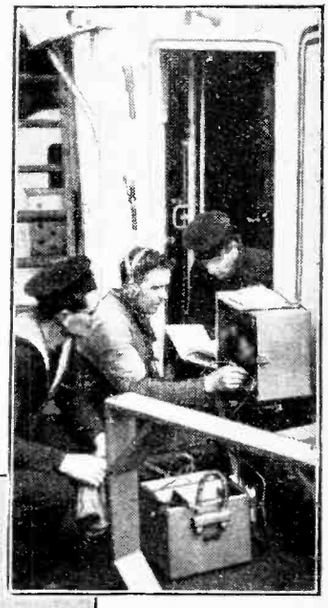
R.S.A. Exhibition

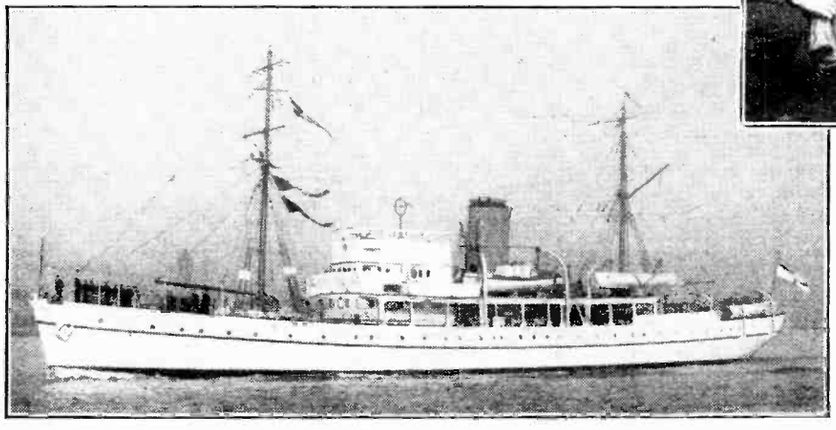
IT is to be hoped that the Royal Society of Arts will be successful in its appeal for financial help to continue the annual competitions of industrial designs. Wireless enthusiasts will recollect that from year to year the competitions have offered scope for the design of radio cabinets, the preparation of radio advertisements and other activities for enhancing the attractiveness of wireless. The designs sent in for this year's open competition are to be shown in the Exhibition Pavilion of the Imperial Institute, South Kensington, London, S.W., from August 5th to August 31st (Sundays included).

Piccard Enlists Amateur Aid

WHEN Professor Piccard makes his next ascent by balloon into the stratosphere he will have the co-operation of Europe's most efficient amateur transmitters in enabling him to keep in touch with the outside world. The "Ragchewers' Club" which, with headquarters in Holland, numbers among its members the cream of European amateurs—is placing its services at the disposal of the Professor.

The next ascent into the stratosphere will be made some time between June and September. Every effort will be made to maintain communication with the balloon, which will be carrying a short-wave transmitter.





WIRELESS FOR NAVAL SURVEY. On the left is H.M.S. Challenger, which has just left Portsmouth to carry out survey work, with the aid of wireless, off the coasts of Labrador. Note the D.F. aerial on the bridge. Above: Sailors examining transportable sets.

Mr. Gladstone Murray in Canada

ARRANGEMENTS for a new Canadian radio network under the auspices of the Canadian Radio Commission are progressing favourably. Major Gladstone Murray, who has been "lent" by the B.B.C. to act as consultant to the Commission, is now in Ottawa. Plans are under way for linking all Canadian stations by land-line for programmes to be provided daily by the Commission between 6 and 11 p.m. These programmes will be regularly broadcast by the three stations recently purchased from the Canadian National Railways.

Atwater Kent Superheterodyne

An A.C. Set for the Short and Medium Wavebands

Features: Ten-valve A.C. multi-range superheterodyne with single-dial tuning, moving-coil speaker, automatic volume control, and push-pull output stage. Wavelength range 14–550 metres with built-in coils. Variable-mu H.F. pentodes for the H.F., first detector, and both I.F. stages. Triodes for the oscillator, A.V.C., and second detector, and pentodes in the output stage; valve rectifier. Three pre-selector circuits are operative on the medium waveband, and two on the short wavelengths. The six I.F. circuits are tuned to 472.5 kc. The controls include: (1) Tuning control with calibrated and illuminated dial and neon tuning indicator. (2) Combined wave range and local-distance switch. (3) Combined mains on-off switch and manual volume control. (4) Tone control switch. **Price:** *45 guineas.* **Suppliers:** *G. A. Brittain, Ltd., 5, Hanover Square, London, W.1.*

ALTHOUGH the normal broadcasting bands offer sufficient variety of entertainment for general requirements, there is a growing interest in the possibilities of short-wave reception. It is interesting to see, therefore, a receiver which covers the range of 14-550 metres, but not the long waveband, in four bands of 21.2-8.2 Mc., 9.2-3.6 Mc., 4-1.5 Mc., and 1,500-550 kc., with built-in coils. Ten valves are employed, and four of these are of the variable-mu screened H.F. pentode type; single control ganged tuning is operative on all wavebands, and the frequency changer is of the two-valve type.

The simplified circuit diagram of the set, omitting wave range switching, is illustrated, and the coils shown are those for the medium waveband. It will be seen that the H.F. stage is preceded by an inductively coupled band-pass filter, but it is not so obvious from the circuit that the aerial coupling to the first filter section is of a type specially designed to maintain high efficiency at the low-frequency end of the tuning range.

The first detector and the H.F. valve are coupled by means of the tuned grid circuit, so that there is a total of three tuned pre-selector circuits. A triode valve is employed for the oscillator, and it is biased by a grid leak and condenser, the oscillator padding condenser acting not only to maintain correct ganging, but also as the grid condenser. The method of coupling the oscillator to the first detector is, at first sight, a little peculiar. It should be understood that American H.F. pentodes have the suppressor grid brought out to one of the pins in the base, unlike the British types, in which this grid is internally connected. When the valve is used as an amplifier this grid is usually connected directly to the cathode, but in the first detector stage the connection is made through an H.F. choke, and the oscillator reaction coil is included in the first detector cathode circuit. Cathode injection is thus used, but the suppressor grid is maintained at constant H.F. potential.

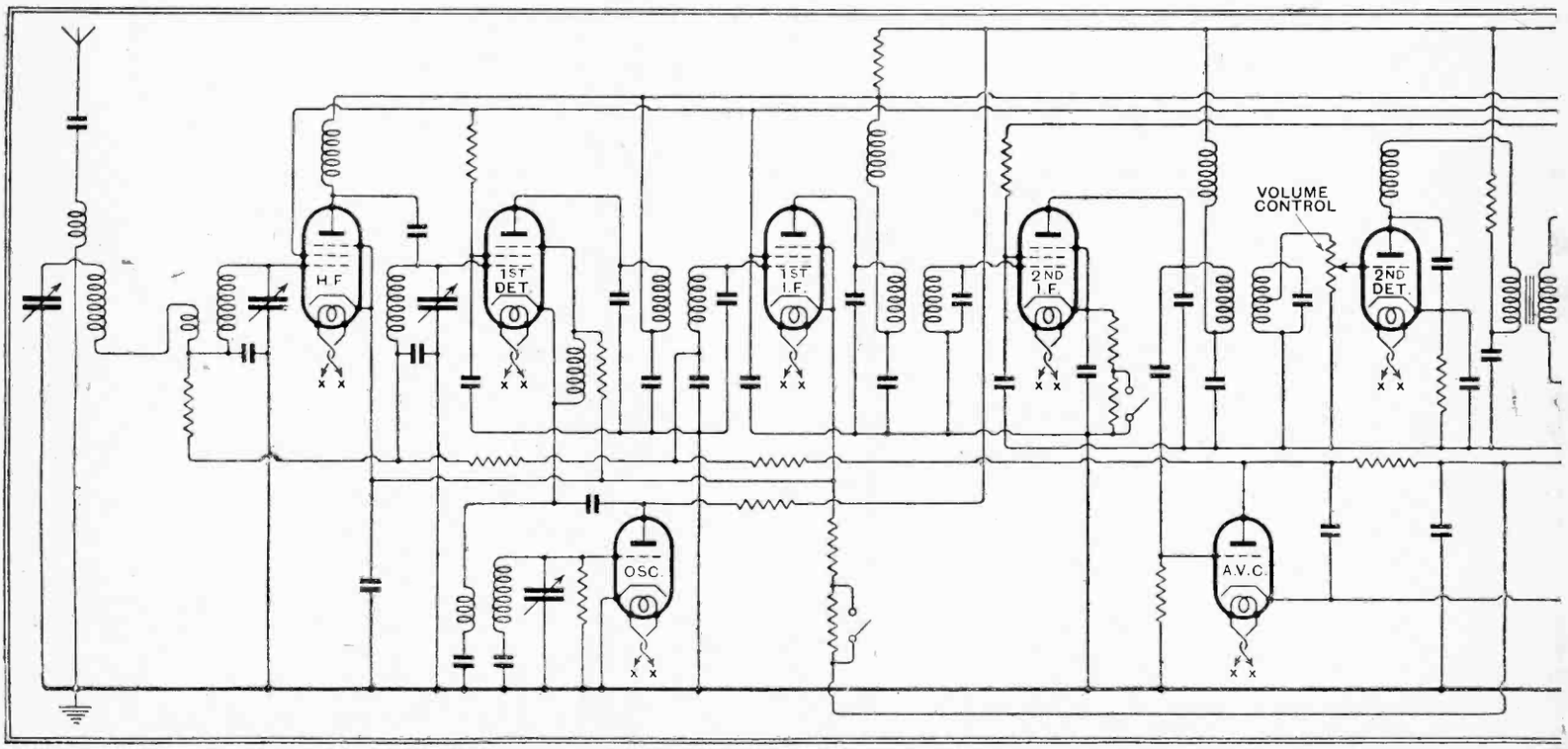
Two I.F. stages are employed with three pairs of coupled coils for the intervalve couplings; there are thus six tuned I.F. circuits forming three band-pass filters. The second I.F. valve has its bias determined only by the drop across a resistance in its cathode lead, but the first I.F. stage, in common with the H.F. and first detector valves, is biased from the automatic volume control valve. The fixed initial bias for these stages is obtained through a resistance in the cathode circuit, and the local-distance switch operates by increasing the value of this resistance and also that of the second I.F. biasing resistance.

Automatic Volume Control Circuit

The automatic volume control functions in the usual manner. A triode acts as an anode bend rectifier, taking its input energy from the primary of the last I.F. transformer, and the increase in current which naturally results is made to develop a voltage across a resistance included in its anode circuit. This voltage is fed back as bias to the controlled valves. The change of anode current of these valves is made to control the neon tuning indicator.

The second detector is also of the anode bend type, but is self-biased so that it can handle a large input. It is fed from the secondary of the last I.F. transformer through the manual volume control potentiometer—a most unusual arrangement. As a result, although A.V.C. is employed, the volume control is still operative in the pre-detector circuits, and the use of a purely L.F. control is avoided.

Transformer coupling to the push-pull output stage, in which

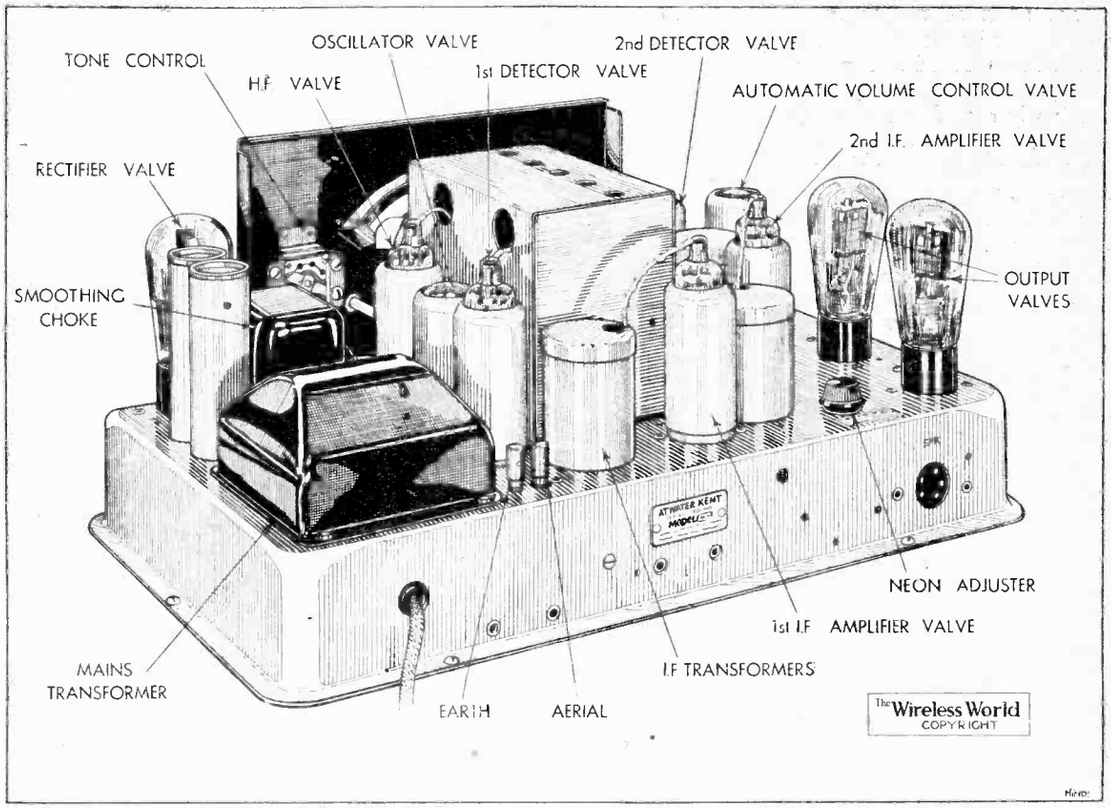


Simplified circuit diagram with waveband switching omitted. Tuning is facilitated by the use of a neon indicator and special interest attaches

dyne MODEL 480

pentodes are fitted, is used, and the tone control consists of a four-position switch which permits different capacity condensers to be connected at will across the secondary of this component. The output to the loud speaker is, naturally, through a transformer, and the usual pentode compensating circuits are fitted to the primary. The speaker field is energised from the smoothing circuit, but is not relied upon entirely to ensure hum-free operation, for a choke is also included.

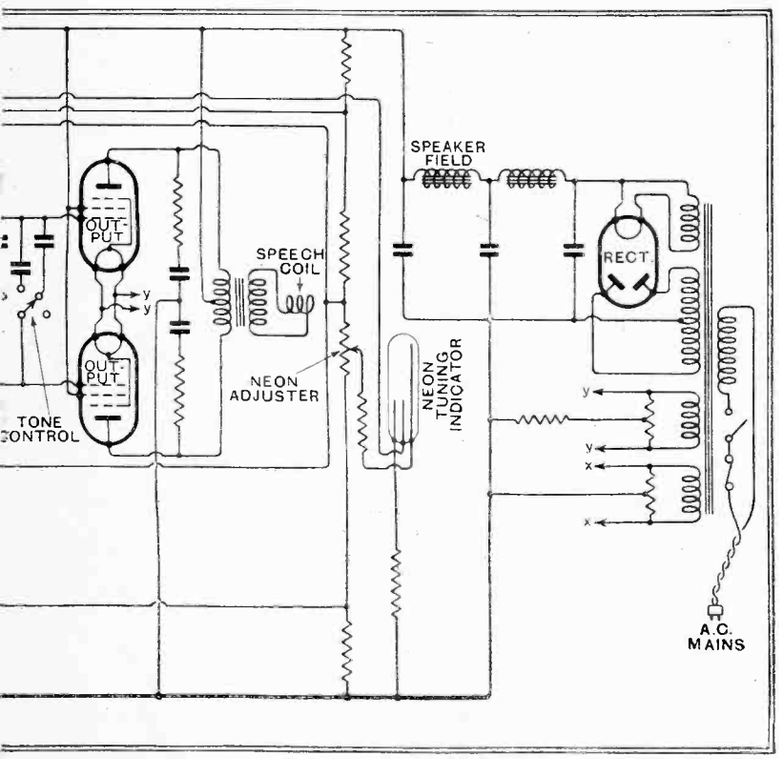
On the three short wave ranges some circuit modifications are introduced, and the chief of these is the alteration of the aerial tuning system to a single tuned circuit instead of a band-pass filter. The H.F. inter-valve coupling remains essentially the same as on the medium waveband, only the values of components being changed, and the oscillator also suffers little alteration. In spite of this, however, the switching is fairly complicated, since not only must the coil connections be changed for each range, but also the padding condensers for the maintenance of accurate ganging.



Rear view of chassis showing clean layout and accessibility of valves.

The receiver has been tested on a full-sized outdoor aerial at about nine miles from Brookmans Park, and, even at this short distance from the locals, not a single whistle was evident on the medium waveband. Such complete absence of second channel and kindred forms of interference is most unusual, and it is not to be accounted for only by the inclusion of three tuned pre-selector circuits, but partly by the fact that the high intermediate frequency of 472.5 kc. is used. This high frequency is adopted primarily with a view to reducing second channel interference on the short wavelengths, where a large degree of pre-selection becomes difficult, but it naturally has the same advantageous result on the medium waveband.

The price to be paid for this complete absence of second channel interference, of course, is slightly reduced adjacent channel selectivity. It should not be thought that this is low, however; on the contrary, it is higher than that of many superheterodynes using a much lower intermediate frequency. Throughout the medium waveband, stations separated by the regulation 9 kc. can easily be separated, except perhaps in the case of those immediately adjacent in wavelength to the locals. The sensitivity is of a very high order, and it will be a rare event, even with a poor aerial, for the set to be working all out. The automatic volume control functions admirably. Although it is a very useful feature on the medium waveband, it is on the short wavelengths that its desirability is most felt, for it greatly counteracts the variations of volume due to the prevalent fading.



the manual volume control in the second detector circuit.

Reception of American Stations

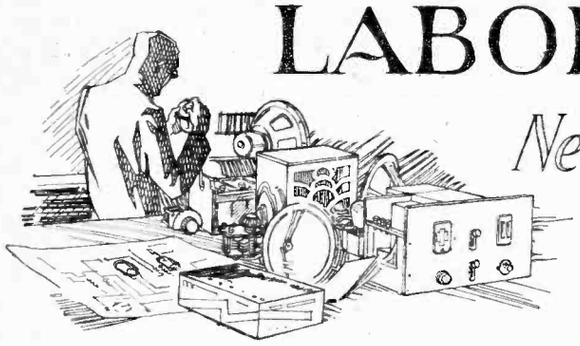
On these latter ranges the performance reaches a high standard, and during the tests no difficulty was experienced in tuning in America during the early hours of the evening. The dial is calibrated in megacycles for these ranges, thus greatly simplifying searching and station identification. No trace of cross-modulation or whistle due to the locals was evident on any range.

Background hiss is commendably low, and on any station strong enough for its programme to be of entertainment value under average atmospheric conditions, hiss is inaudible. Mains hum also is absent. The quality of reproduction reaches a high standard, and it is unusually brilliant with the tone control set to give full treble. The maximum volume obtainable from the push-pull pentodes is sufficient for any normal purposes, and during the tests the volume was uncomfortably loud long before the maximum setting of the control was reached. The range of control afforded by the potentiometer, however, is ample, and it is readily possible to reduce the strongest station to silence.

High electrical efficiency is of little use if the mechanical details are poorly conceived, however, for breakdowns then become a probability. It is good to see, therefore, that the same care has been bestowed upon the mechanical design as upon the electrical. The chassis is very rigid, and the valves are mounted in accessible positions; the switchgear is exceptionally robust and appears likely to function indefinitely without trouble. To sum up, the performance of this superheterodyne is deserving of the highest of praise.

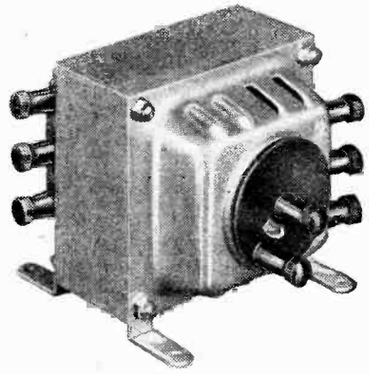
LABORATORY TESTS

New Radio Products Reviewed



WEARITE MAINS TRANSFORMERS

THE mains transformers made by Wright and Weaire, Ltd., 740, High Road, Tottenham, London, N.17, are available in three sizes and classified as types A, B and C. Type A models are for use with Class A rectifying valves, but this series includes also a number of models for Westinghouse rectifiers. Types B and C have been designed for the rectifying valves designated as Class B and Class C. Tests were made with a B type transformer wound to give 350-0-350 volts at 120 mA. for the H.T. supply; there are two L.T. windings,



Wearite type B mains transformer embodying special input voltage selector

the one rated at 4 volts 2.5 amps. for the rectifier filament, and the other 4 volts at 4 amps. for the heaters of A.C. valves.

The rectified, or D.C. output, measured across the 4-mfd. reservoir condenser at various current loads and using a Mazda UU120/350 valve, was as follows:—

Current in mA.	Volts D.C.	Current in mA.	Volts D.C.
10	460	70	370
20	437	80	360
30	418	90	350
40	404	100	342
50	390	110	330
60	378	120	320

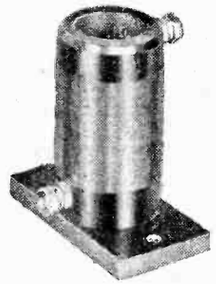
Regulation of the H.T. secondary winding is very good, so, also, is that of the two L.T. windings, for when fully loaded the A.C. voltage of both L.T. windings remained well within the tolerances for A.C. valves. For example, with 30 mA. flowing in the H.T. circuit the rectifier filament and the four A.C. valves were operated at 4.17 volts, whilst increasing the H.T. load to 120 mA. brought both L.T. supplies down to 3.96 volts. During these tests the transformer remained quite cool and showed not the slightest trace of overheating. Types A and B are fitted with a special input voltage selector which dispenses with the need for a row of terminals, and, furthermore, provision is made for close adjustment of the input to suit various supply voltages. The primary is tapped at 10-volt intervals from 200 to 250 volts at 50 cycles.

The price of the type A transformer varies from 17s. 6d. to 25s. according to the style of rectifier it is designed to work with, whilst the type B, such as the one tested, costs 27s. 6d. The C model is priced at 37s. 6d.

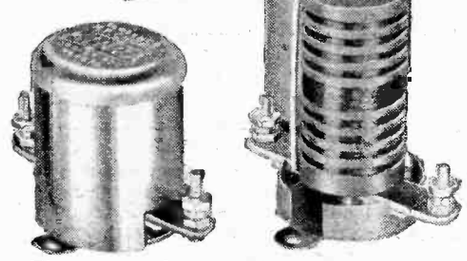
KINVA H.F. CHOKES

POSTLETHWAITE BROS., Church Hill, Kinver, Stourbridge, Worcs, who were among the first, if not the first, firms in this country to market a screened H.F. choke, have added two new models to their range. One is an unscreened short-wave choke wound on a one-inch ebonite former and having an effective wave-range of from 10 to 80 metres. The winding is protected to avoid possible damage to the wire, and the price is 2s. 3d.

The other new model is described as the Kinva Major Screened H.F. Choke, and has been designed especially for use in superheterodyne circuits. It has an inductance of 280,000 microhenrys and the low self-capacity of 8 m-mfds., and the price is 5s. 6d. This model was found to be perfectly satisfactory, not only for use in superhets., but also in straight circuits over the normal broadcast wavebands.



Kinva range of H.F. chokes.

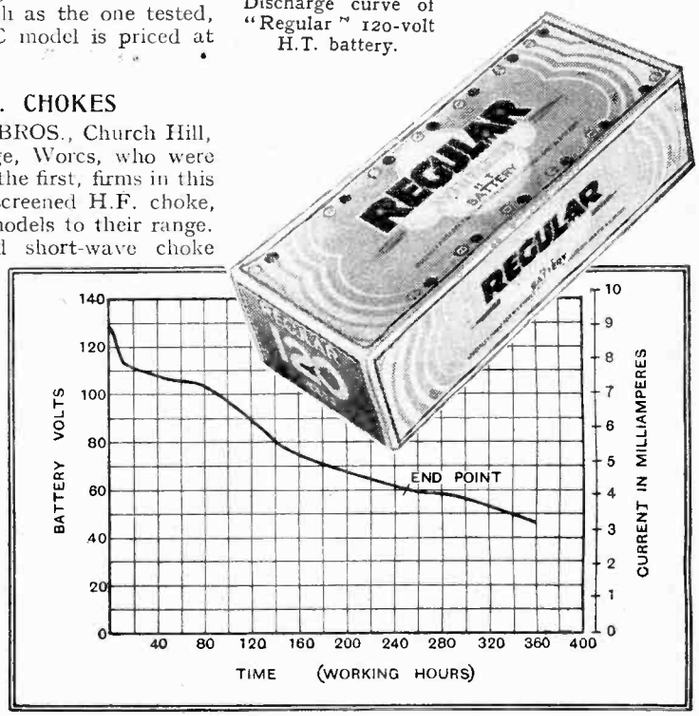


The standard model is retained without change as it is suitable for use over a range of wavelengths extending from 50 to 2,000 metres. Its inductance is 102,000 microhenrys, and the price is 2s. 9d.

"REGULAR" 120-VOLT H.T. BATTERY

THE "Regular" dry cell H.T. battery of 120 volts nominal value is made for and marketed by Polchars, Ltd., 20, Bridge Street, Bristol, 1. It is tapped at convenient intervals, the first being at 25 volts,

Discharge curve of "Regular" 120-volt H.T. battery.



and thereafter at 9-volt intervals up to 120 volts. On a life test the battery gave a working time of 250 hours, the end point being taken when the voltage had fallen to half the nominal value. During the early stages it maintained its voltage at a satisfactorily high level, remaining over the 100-volt mark for the first 90 hours.

The battery was not discharged continuously, but in periods of four hours, with similar time intervals for recuperation, on the curve these rest periods are omitted and only the actual working hours shown. On the whole the "Regular" H.T. battery acquitted itself very well indeed, for the test is a severe one and in normal use, when the battery is active for about four hours only per day, it will give considerably longer service. The most economical discharge rate is between 7 and 8 milliamps. The price is 7s. 6d. for a 120-volt unit.

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Catalogues Received

A. C. Cossor, Ltd., Highbury Grove, London, N.5.—Illustrated folder describing the new short-wave superheterodyne receivers. The wave range is 13.5 to 70 metres and 200 to 550 metres; one model is battery operated, the other for A.C. mains. They are for overseas use only.

Ward and Goldstone, Ltd., Pendleton, Manchester—48-page illustrated catalogue dealing with the full and comprehensive range of "Goltone" products and specialities.

Broadcast Brevities

By Our Special Correspondent

A Stuntless Summer?

WHERE are the stunts of yesteryear? The "outside broadcasts" department of the B.B.C. still has time to show its daring before all the summer programmes are planned, but at the moment the prospects are, to put it mildly, rather grey.

Five years ago the B.B.C. was straining every nerve to introduce novelties into the programmes, and although we grumbled then, as now, we could at least give the Corporation credit for trying to keep us glued to our loud speakers.

Nothing New

Nowadays there are no novelties. Is it because all the good ideas have been used up, or can it be that the B.B.C. has lost that first fine frenzy and is suffering from a dried up imagination? Such troubles afflict individuals, so why not a Corporation, especially a Corporation which has been steadily drilled to act as a disciplined unit?

Money for Ideas

The Corporation has enough money to offer financial reward to anyone who can provide good programme ideas. Why not open an "Ideas Bureau" to which any member of the public could contribute?

No one would contribute from sheer love of the B.B.C., but monetary inducements will work wonders. *Vide* newspaper competitions.

Talking About Lucerne

TAXIS are disgorging B.B.C. officials at St. Martins-le-Grand these days. Mr. Ashbridge and his party are holding earnest conversations with the Post Office engineers, with whom they will shortly make a trip to Lucerne to engage in the *Conference that is to end Conferences.*

Speculation

Lucerne should certainly go down in broadcasting history as the birthplace of the most ambitious wave plan yet formulated, but we have yet to see whether the Conference will, in actual fact, produce such triumphal results as were achieved at Prague in 1929.

The curtain rises on Monday, May 15th. No one knows when it will descend.

Cardiff v. Bristol

THE West Regional station will share the distinction with the Scottish of possessing two studios of almost the same importance. While our Welsh friends are staunchly upholding the seniority of the Cardiff headquarters, I see no reason why Bristol should not claim equal honours, for it will serve a larger area, *i.e.*, the West of England, than that to which Cardiff is ostensibly dedicated.

Rivalry

Anyway, some more or less good-natured rivalry is bound to develop, nor is it likely to be assuaged by Welsh claims that one of the Western transmitters should be devoted exclusively to programmes for the Principality. The same spirit prevails up north, for it will be recalled that Edinburgh and Glasgow have always been at loggerheads in broadcasting affairs; there is still some heart-burning to-day as to which studio shall monopolise the greater amount of time on the Scottish ether.

Command Performance

AND now we are to have the B.B.C.'s own "Command Variety Performance"! One cannot but admire the determination of the B.B.C. to be independent at all costs, but unless His Majesty gives explicit instructions for the holding of such an event, I fail to see how the B.B.C. can ordain a "command" show on its own account.

In the Autumn

Strictly speaking, the Command Variety Performances of the last few years have not deserved that title, for I believe that His Majesty has actually "commanded" only one performance of the kind, and that was back in the war years.

The B.B.C.'s special variety performance will, without doubt, be broadcast from the Concert Hall in the early autumn, but how the artistes will be selected and who will select them, it is not for mere mortal to say.

Why not let the Director General make a choice?

FORCEPS HOUR. The day of the stunt is not dead in America. Here is Dr. O'Connell giving a dental talk and demonstration at the WCFL, Chicago, microphone.

A Departing Chief

MR. CLEGHORN THOMSON, who has resigned his position as the B.B.C.'s Scottish Regional Director, paid a tribute the other day to the generous treatment accorded him by the Corporation.

This generosity of the B.B.C. towards those who leave its ranks is becoming a by-word; indeed, I hear that certain people would be prepared to join the staff for a few months only in order to secure the lifelong competence which would accompany their resignation.

"Trelawny of the Wells"

REAL Victorian melodrama will be offered us during the first week in June, when Sir Arthur Pinero's "Trelawny of the Wells" will be broadcast.

It is interesting to note that the part of Rose Trelawny was originally taken by Miss Irene Vanbrugh, who is one of the subjects of Mr. Agate's series on "Stars in Their Courses."

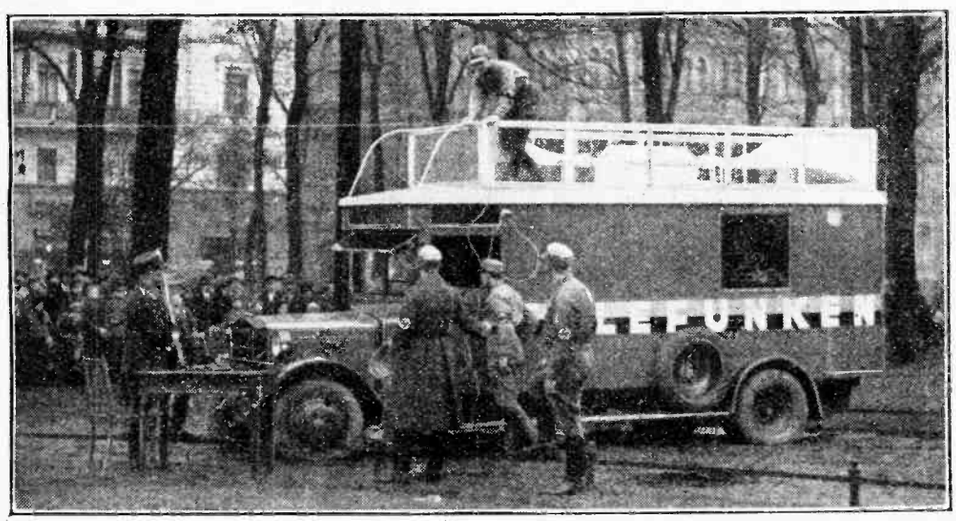
Celebrations at Stratford

THE Shakespeare birthday celebrations at Stratford-on-Avon on April 24th will furnish a relay to National listeners. Speeches by Sir Philip Ben Greet, Miss Lilian Baylis and the Mayor will be heard.

Rapid Drop

SIR CHARLES CARPENDALE, Controller of the B.B.C., is no mean ski-er himself, and I can imagine what feelings of friendly rivalry must have been his at the news of Major Gladstone Murray's triumph in Canada. Major Murray has improved the shining leisure hour over there by descending the Mount Baldy run at St. Marguerite, Quebec, in the record time of 2 min. 55 sec.

He must have been training for this rapid drop in those Broadcasting House lifts, which are probably the swiftest in London.



THE UBIQUITOUS LOUD SPEAKER. This photograph shows a typical scene in the streets of Berlin, where the Nazi "storm troops" rely largely on public address systems for securing big audiences. The van is one of the new Telefunken mobile receiver and amplifier models.

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 brief particulars, with the fee charged, are to be found at the foot of this page.

Explaining Background Noise

THE carrier wave of a broadcasting station acts as a vehicle for the transmission of speech and music; unfortunately, it also "gives a lift" to interfering noise-producing voltages through the circuits of a receiver. This, we think, will serve as an explanation to a correspondent who wonders why the background noises produced by his set are increased by tuning the circuits to an incoming carrier wave.

This effect is by no means abnormal; it indicates that most of the interfering voltages happen to be of a low-frequency nature, which, in the absence of a carrier wave, are not passed on to any extent by the tuned H.F. or I.F. couplings of the receiver. A carrier wave, on the other hand, may be modulated locally by such interference, which is then passed through the intervalve coupling, and so to the detector and output valves.

Long-wave Reaction

WHEN reaction works "according to plan" on the medium wavebands, but fails to produce a steady increase in signal strength on long waves, it is always to be suspected that spurious oscillations are taking place. The symptoms described by a correspondent would indicate that his receiver is suffering from this trouble; reaction is practically useless on the long-wave side for increasing signal strength, but it is possible to produce self-oscillation. However, when the set is in an oscillatory condition, heterodyne whistles are not heard.

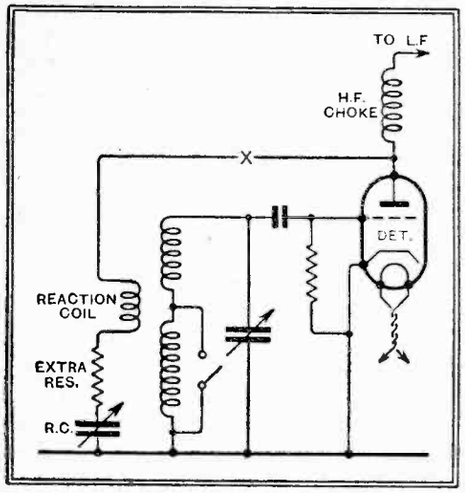


Fig. 1.—An "anti-parasitic" device; the extra resistance, in series with the reaction coil, prevents a form of spurious oscillation which sometimes occurs at a frequency other than that to which the receiver circuits are tuned.

We advise in this case the insertion of a non-inductive resistance of between 500 and 1,000 ohms in series with the reaction circuit, in the manner indicated in Fig. 1. The position of this resistance is seldom of much importance, and if it is more convenient to do so, it might be placed at the point X instead of that shown.

Warming Up

A READER, who is otherwise quite satisfied with the performance of his A.C. mains set, is apparently perturbed by the fact that a loud hum is heard shortly after switching on the receiver. After half a minute or so, this hum disappears, and while the receiver is in normal operation, the background is exceptionally quiet. We are asked to say whether this hum indicates any fault.

This effect is by no means unusual, and we do not think that our querist need be perturbed. Until its heater has reached a normal working temperature, the internal A.C. resistance of the detector valve is extremely high, and, as a result, the primary circuit of the L.F. transformer is practically undamped; in this condition it is particularly likely to pick up stray hum voltages.

The A.V.C. Unit

SEVERAL questions with regard to the A.V.C. Unit (March 31st) refer to the H.T. and grid bias batteries required for this device. It is asked whether the sources of voltage which normally feed the receiver could be used for the control unit.

Generally speaking, this is impossible, as it is necessary that the batteries should not be directly connected to the receiver circuits, except in the manner shown. Fortunately, the current drawn from the batteries of the unit is almost negligible, and so they will have a long life; further, the smallest and least expensive types may be employed.

There is no theoretical objection to altering the unit for "all-mains" operation, but it is hardly economical to do so. Entirely separate sources of G.B. and H.T. would be needed; critical voltage adjustment of the former must be provided, but the precise value of H.T. is unimportant.

It should also be made clear that the system described does not work with diode or anode bend detectors.

Insufficient Resistance

ANOTHER query with regard to the A.V.C. Unit relates to the conversion of a receiver which, as it stands, is not suitable for operation with this device. As stated in the original article, voltage changes for actuating the control valve are only obtainable when a relatively high value of resistance is included in the detector anode circuit. This condition is not satisfied when the detector is linked to the succeeding valve by means of an ordinary transformer, unless decoupling is fitted.

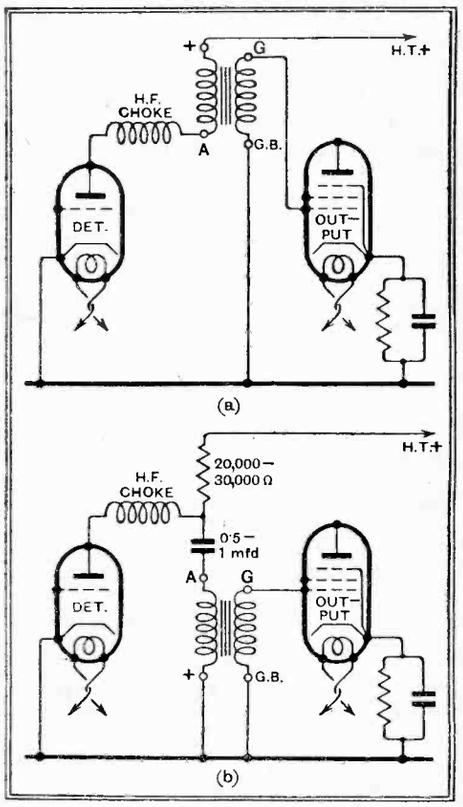


Fig. 2.—A receiver with simple transformer L.F. coupling, as in diagram (a), may almost invariably be converted to the parallel-feed system without impairing results.

A reader proposes to overcome this difficulty by inserting, in series with the transformer primary, a resistance of 20,000 ohms. To do this is bad practice, as a fair proportion of the available signal voltage would be wasted in this resistance, and sensitivity would be reduced. Even if a by-pass condenser were added, the scheme would still be open to objection, as very probably detector anode voltage would then be insufficient.

It is recommended, in cases like this, that the parallel-feed system of coupling should be adopted. Almost every transformer, even though not designed for this method of coupling, will work well when operated in this manner; no falling off in performance is to be anticipated, and very often there will be an actual improvement.

For the benefit of the reader who raises this point, and also of others, a simplified diagram is given in Fig. 2 to show the alterations that will be necessary. Extra components needed are a feed resistance and a coupling condenser of roughly the values indicated in Fig. 2 (b). The connections of the transformer should be noted.

The Wireless World
INFORMATION BUREAU

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, Stamford Street, London, S.E.1, 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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CONTENTS

EDITORIAL COMMENT

Quality *v.* Cost

No Room for Compromise

IN recent issues we have drawn attention to the dangers which might accompany efforts to cheapen wireless apparatus, and, in particular, the complete receiver, where such cheapening impaired electrical or mechnical efficiency. The industry cannot afford to face the increased cost of servicing which would be a direct result of such unwise economies, but what we view as the most serious aspect of any general policy on the part of the industry to cheapen the product is the inevitable departure from the standard of quality of reproduction, which we consider it is imperative that the wireless manufacturer should maintain.

In years gone by a good deal of criticism has been levelled by musicians and others at the relatively poor quality of broadcast reproduction, but as time went on, and the design of receivers improved, this prejudice against wireless on the part of the musically trained and the discerning sections of the public has largely disappeared.

Still, finality in quality of reproduction has not yet been attained, and the highest praise is still only applicable to a small proportion of the receivers sold, so that we are still a long way off the time when all wireless sets can be regarded as a satisfactory permanent advertisement for broadcasting.

Now it would seem that we have reached another stage of "progress," when the tendency is to try to compromise between quality of reproduction and cost: we contend that this is a compromise which ought never to be entertained. There should be no compromise with quality. There are already far too many sets in existence which, every time they are switched on, damage the prestige of broadcasting and discourage the public from enthusiasm over the benefits of the service.

It is because we hold strong views on the necessity for maintaining a high standard of quality of reproduction that we feel considerable uneasiness at the opinions expressed recently by leading figures in the wireless industry to the effect that sets must be cheapened, and also that the midget set must claim the attention of British manufacturers as likely to be the biggest seller in the near future.

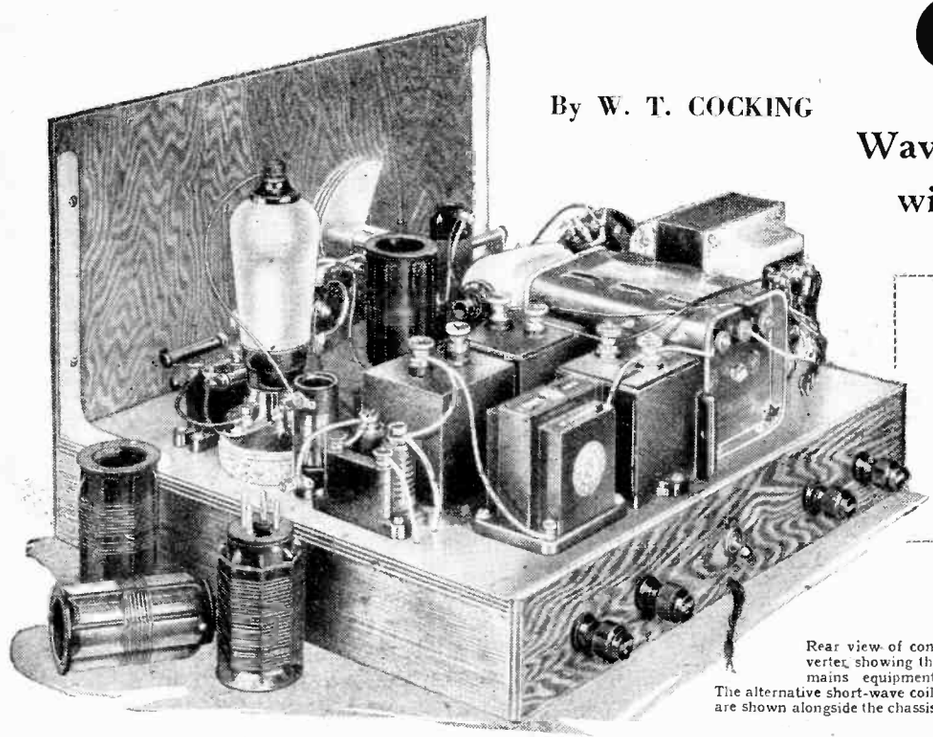
Maintain a High Standard

The midget set is a good example of clever design, because of its compactness and portability, but not of quality in reproduction. In our view this fact alone should make the British manufacturer hesitate to adopt sets of this type as a standard for his production of the future. At present it would seem that midget size and good quality of reproduction are incompatible requirements, and until means are found for bringing the quality of the midget set up to a standard of which the industry can be proud we should hesitate to support it. Even in America, where the midget set has found favour, manufacturers are already realising its shortcomings. A prominent representative of the American radio industry has recently stated: "The majority of manufacturers believe that the large console receiver will return and the midget set be used to serve its original purpose as the *second set*." As a second set there is a very good excuse for the midget, but this country has, as yet, by no means reached the stage where such saturation has been achieved that second sets are in demand.

Universal A.C. Short-wave Converter

By W. T. COCKING

Wave-range of 12·5 to 100 Metres with any Broadcast Receiver



Rear view of converter, showing the mains equipment. The alternative short-wave coils are shown alongside the chassis.

Features.—*A superheterodyne type short-wave unit giving reception over the 12½ to 100 metres waveband with four plug-in coils. Good reception is readily obtainable with any sensitive receiver set to work on the long waveband. The unit is fitted with its own mains equipment and no alteration whatever to the receiver is needed.*

SUCCESSFUL short-wave reception depends very largely upon the receiver employed, and high sensitivity and ease of control are the two most important factors. The deservedly popular detector-L.F. type of set is capable of giving very satisfactory results if it be correctly designed and operated. It leaves much to be desired, however, for its tuning adjustments are very critical, it does not lend itself well to mains operation, and at best its sensitivity is lower than is desirable.

There can be little doubt that the superheterodyne forms the best short-wave receiver; there is no limit to the possible sensitivity, tuning is less critical, mains operation is quite easy, and it is probably the only type of short-wave set in which automatic volume control can be included. A purely S.W. superheterodyne, however, is likely to be of limited application, appealing only to overseas listeners and S.W. enthusiasts. To the majority the short-wave bands alone give an insufficient range of programmes.

An all-wave superheterodyne is the obvious solution, and one highly satisfactory design was recently described in *The Wireless World*.[1] The necessary waveband switching, however, often proves complicated, and constructional difficulties begin to make themselves apparent. Where short-wave reception is required in addition to the normal broadcast wavebands, therefore, the best method often consists in using an ordinary receiver in conjunction with a short-wave adaptor.

Such an adaptor operates on the superheterodyne principle, and, in effect, converts the normal waveband receiver into a S.W. superheterodyne. It has long been known that this is an entirely satisfactory method of reception when the receiver is of the straight type, but it has been believed that it would lead to difficulties when applied to an ordinary superheterodyne.

When a S.W. converter is used with a superheterodyne, of course, the apparatus becomes a double superheterodyne with double frequency-changing. There is no objection to this in itself, but it has been felt that the presence of two oscillators in the receiver would lead to the production of whistles, since there is a possibility of the S.W. oscillator beating with harmonics of the ordinary oscillator.

In spite of the knowledge that for this very reason the scheme had been abandoned in America, it was felt to be worth a trial. Conditions in this country and in America are by no means identical, and, if successful, the arrangement would provide the solution of the problem of

[1] The All-wave Monodial. *The Wireless World*, January 27th and February 10th, 1933.

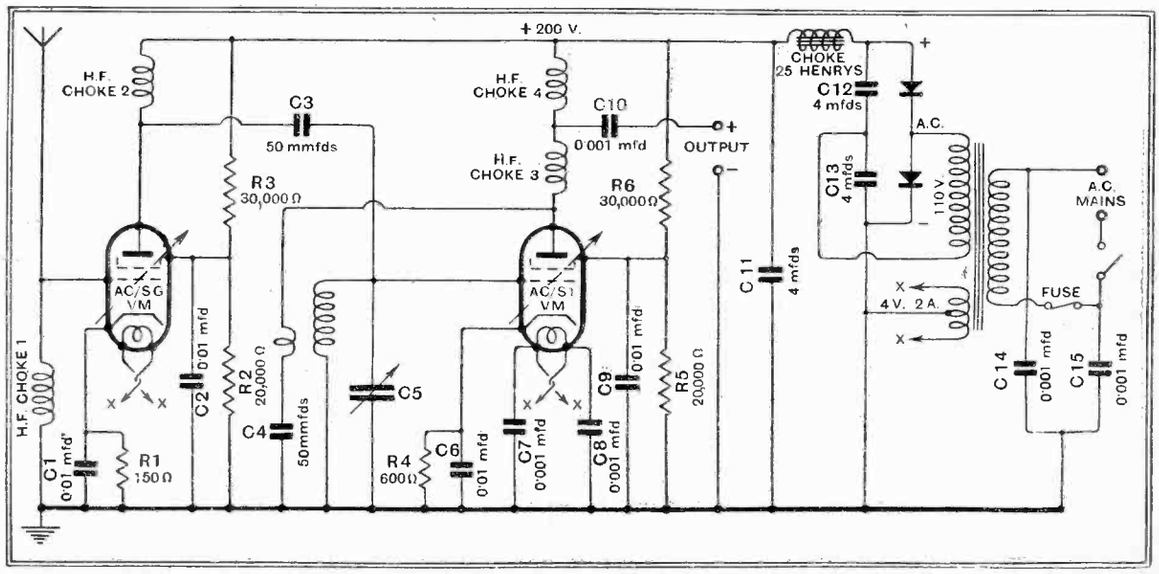


Fig. 1.—Complete circuit diagram. It will be noted that the aerial circuit is aperiodic and that the tuning condenser of the autodyne frequency changer is the sole control.

Universal A.C. Short-wave Converter—obtaining easy short-wave reception without still further complicating the design of the receiver. It is pleasant to record, therefore, that it proved entirely satisfactory, *provided that the receiver were set to work on the long waveband.*

This proved to be the secret of obtaining satisfactory results with a S.W. converter and a superheterodyne type receiver. The American failure to obtain a good performance can be attributed to the fact that their receivers do not contain a long wave-range. The necessity for keeping the receiver tuned to the long waveband can readily be seen. Suppose that we set it on the medium waveband, so that the oscillator is functioning at 1,000 kc. The S.W. tuning range is from 3,000 kc. to 24,000 kc., and all the oscillator harmonics from the 3rd to the 24th fall within it. Harmonics up to about the 20th are quite strong enough to produce a whistle, so that there are endless possibilities of interference.

If, however, we set the receiver on the long waveband so that the oscillator is working at 200 kc., the lowest harmonic to fall within the S.W. range is now the 15th, and the highest is the 120th. Harmonics higher than the 20th can be ignored, so that we shall be quite free from whistles on wavelengths below 75 metres, and obtain not more than six between 75 metres and 100 metres.

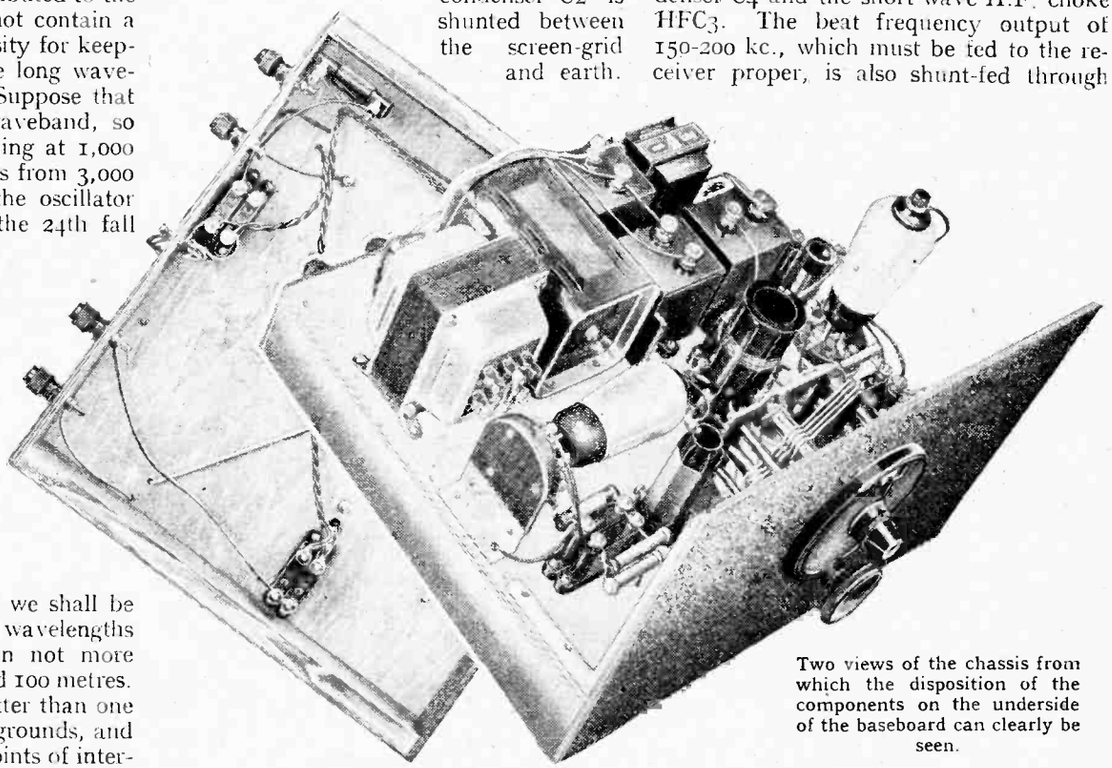
In practice, matters are better than one might suppose on theoretical grounds, and in the actual tests only two points of interference were found, both above 80 metres. Interference of this type, therefore, can be considered as negligible, and it becomes readily possible to construct a S.W. converter which can be used with any ordinary straight set or superheterodyne, and which need have but a single control. It can be connected to any receiver without the smallest modification.

The circuit diagram of the complete converter is shown in Fig. 1, and it will be seen that it contains its own A.C. mains equipment. This renders it truly universal in its applications, for were the power to be derived from the receiver proper there are few sets which would not need extensive modification.

Aerial Loading Removed.

The two variable-mu valves are used as an H.F. stage and as an autodyne-type frequency changer. The H.F. valve provides a moderate degree of amplification, but its chief purpose is to remove the aerial loading from the tuned circuit and to prevent aerial radiation. The aerial coupling is aperiodic, and the choke HFC1 is highly important if the converter is to be used anywhere near a high-power medium-wave broadcasting station. If this choke has too high an inductance, an appreciable signal from the local station will be placed on the grid of the first valve, and cross-modulation of S.W. signals will occur. If the choke inductance be too low, however, S.W. signals will be weak. The component selected has been found to have the optimum inductance, and it is advised that no change be made at this point.

The H.F. valve is biased by the resistance R1 of 150 ohms, shunted by the 0.01 mfd. condenser C1, and the screen-grid is fed from the potentiometer comprising the 30,000 ohms resistance R3 and the 20,000 ohms resistance R2; another 0.01 mfd. condenser C2 is shunted between the screen-grid and earth.



Two views of the chassis from which the disposition of the components on the underside of the baseboard can clearly be seen.

The frequency changer has the tuned circuit connected in its grid circuit, and the coil is tuned by a 0.00015 mfd. variable condenser fitted with a two-ratio slow-motion dial. This dial is provided with a normal ratio of about 10-1 for rapid searching, and with a micrometer adjustment giving a ratio of 500-1 for accurate tuning; a ratio of this order is very necessary on the short wavelengths. The coupling to the H.F. valve is arranged through a 50 mmfd. condenser C3 with the H.T. supply to the anode of the H.F. valve through the S.W. H.F. choke H.F.C.2. The frequency changer valve is self-biased by the voltage drop along the 600 ohms resistance R4, which is by-passed by a 0.01 mfd. condenser C6, and the screen is fed from a potentiometer built up from the resistances R6 and R5 of 30,000 ohms and 20,000 ohms respectively. Another 0.01 mfd. by-pass condenser C9 serves to keep the screen-grid effectively at earth potential.

The reaction coil is shunt-fed from the anode circuit through the 50 mmfd. condenser C4 and the short-wave H.F. choke HFC3. The beat frequency output of 150-200 kc., which must be fed to the receiver proper, is also shunt-fed through the 0.001 mfd. condenser C10 and the long wave type choke HFC4.

The mains transformer is of the shrouded type, and is fitted with a screened primary; in addition, two 0.001 mfd. 1,000 volts test condensers C14 and C15 are connected between the mains and earth to prevent modulation hum. For the same purpose, another pair of 0.001 mfd. condensers C7 and C8 are connected to earth from each side of the frequency-changer heater. The H.T. supply is taken from an H.T.6 metal rectifier used in the voltage doubling circuit with 4 mfd. condensers C12 and C13, while smoothing is

LIST OF PARTS

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

1 Variable condenser, 0.00015 mfd. C5 (Eddystone)	Cyldon type SW15
1 Slow-motion dial with micrometer adjustment	Igranic type 2296/56
2 S.W. H.F. chokes HFC1, HFC3	Igranic
1 S.W. H.F. choke HFC2	Eddystone
2 5-pin valveholders	Eddystone type 500
1 4-pin valveholder	Eddystone type 501
1 Set S.W. coils, types 2BB, LB, Y and R	Eddystone 932
2 Fixed condensers, 0.001 mfd., 1,000 v. D.C. test C14, C15	T.C.C.
3 Fixed condensers, 0.001 mfd. C7, C8, C10	T.C.C. type 34
2 Fixed condensers, 0.00005 mfd. C3, C4	T.C.C. type 34
4 Fixed condensers, 0.01 C1, C2, C6, C9	T.C.C. type 34
2 Fixed condensers, 4 mfd., 200 v. D.C. working C12, C13	T.C.C. type 61
1 Fixed condenser, 4 mfd., 400 v. D.C. working C11	T.C.C. type 80
1 Smoothing choke, 25 h. 650 ohms (Trix. type C30A, model 1SM)	R.I.
1 Mains transformer, shrouded with screened primary Secondaries, 110 v., 75 m.a., 4 v. 2 amps. C.T.	Sound Sales type SS/Shielded
1 Metal rectifier	Westinghouse H.T.6
1 Q.M.B. On-off switch	Bulgin type S80
1 Valveholder bracket	Peto-Scott
1 Resistance, 150 ohms R1	Claude Lyons
1 Resistance, 600 ohms R4	Claude Lyons
2 Resistances, 20,000 ohms R2, R5	Claude Lyons
2 Resistances, 30,000 ohms R3 R6 (Dubilier, Erie)	Claude Lyons
1 H.F. choke HFC4	McMichael Binocular Junior
4 Terminals, A.E.+Output—Output	Belling-Lee, type "B"
1 Plymax baseboard, 12×14×3/8. Panel, 14×9×3/16, plywood	Peto-Scott

Valves: 1 Mazda AC/SGVM and 1 Mazda AC/SIVM

Universal A.C. Short-wave Converter—

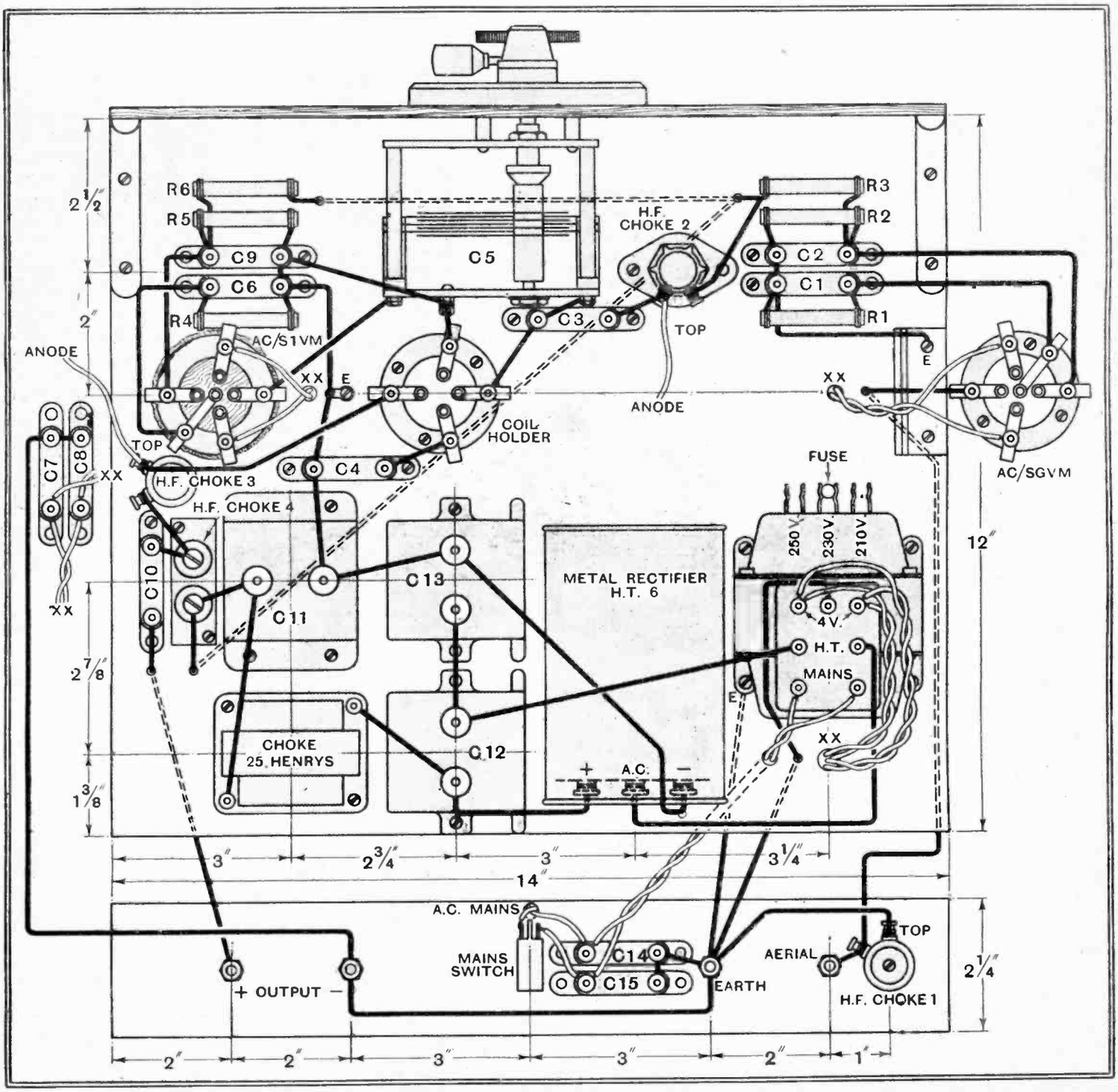
provided by a single 25H. 850 ohms choke in conjunction with a 4 mfd. condenser C11. At the small current taken by the unit, a supply of 200 volts is available for the anodes of the valves.

Constructionally, the converter is very simple, and the details will be apparent from the drawings. The H.F. valveholder, it should be noted, is mounted vertically on a bracket, so that the valve lies horizontally; thus considerably shortening the wiring. The valveholder for the frequency-changer is mounted on a block of sponge rubber, in order to avoid howling due to acoustic reaction. The valveholder should be fastened to a thin disc of wood which is glued to a disc cut from half-inch sponge rubber. This, in turn, is glued to the aluminium covered base, and it will stick securely if the aluminium surface be roughened slightly. All connections to this valveholder, of course, should be made with flexible wire.

In use, the aerial and earth are connected to the terminals on the converter, and the two output terminals are joined to the aerial and earth terminals of the receiver. Care should be taken to see that the lead from C10 is connected to the aerial, and not the earth, terminal of the set. A good earth should be used if hand-capacity effects are to be avoided, and for the best results the aerial is equally important. The best aerial for the broadcast bands, however, is not necessarily the best for the short wavelengths, so that it will often pay to do a little experimenting. It is the writer's experience that a small aerial is often better below 100 metres than the usual horizontal span of 40ft. or so. A simple vertical wire of some 20ft. or 30ft. will often be the most satisfactory if it can be erected; much depends on local conditions, however.

Normally, the receiver should be tuned to a wavelength a little above Huizen, for there is then little chance of experiencing interference from any longwave station. Should the receiver be insensitive at this point, however, a lower wavelength should be selected. All tuning can then be carried out on the converter dial, and it will be found quite critical. The dial

PRACTICAL WIRING PLAN



Layout of the components above the baseboard. The under-baseboard wiring is shown dotted.

Universal A.C. Short-wave Converter—

settings will depend upon the wavelength to which the receiver is tuned, so that if a record be kept one should not omit to note also the receiver dial setting.

The fact that the tuning is dependent on the receiver as well as on the converter can be turned to useful account. Below 20 metres the converter dial settings are critical even with the 500-1 ratio. When a station has been approximately tuned in, therefore, the exact adjustment may often be most easily obtained on the receiver dial. The tuning of this will be very flat in comparison with the converter dial, for the full 100 deg. will give a frequency change corresponding to only 1 deg. at some parts of the S.W. dial. The adjustment of volume is also carried out by the control fitted to the receiver.

For the convenience of readers constructing this converter, a full-size blue print is available from the publishers at 1s. 6d., post free.

The converter has been tested with a sensitive type of superheterodyne fitted with automatic volume control, and it gave a highly satisfactory account of itself. Literally dozens of tonic-train morse stations could be obtained, and at suitable times, excellent S.W. broadcasting was available. 2XAD, 3XAL, and 8XK were all well received, as well as numerous European stations.

If results seem poor when first testing the converter, a defect should not be suspected unless another S.W. receiver is available for a comparison. There are by no means infrequent spells when conditions are extremely poor, and if it should happen that the converter is first tried out during one of these, little may be receivable, even although the apparatus is functioning with full efficiency. A suitable time of the day should also be chosen, for some wavelengths are useless at certain hours, and alive with signals at others.

In general, wavelengths below about 25 metres are of little use after dark, and it is usually a waste of time to search over this range. Just about sunset, however, the 16-25 metres band is often at its best, and good reception of the midday American programmes is often possible. Below 16 metres full daylight seems necessary. Conditions around 30 metres usually seem to be little affected by the time of day, but the higher wavelengths are often at their optimum after dark.

In conclusion, it should be pointed out that although the best results will be secured with a highly sensitive A.V.C. superheterodyne, such as the Monodial A.C. Super, simpler apparatus is entirely adequate for good reception. An efficient three-valve set is not too small, if it be fitted with reaction, and a set such as the Ferrocart III should prove entirely satisfactory.

A short-wave converter built to this design is available, as usual, for inspection at 116/117, Fleet Street, London, E.C.4.

DISTANT RECEPTION NOTES

Lively Conditions on Both Wavebands

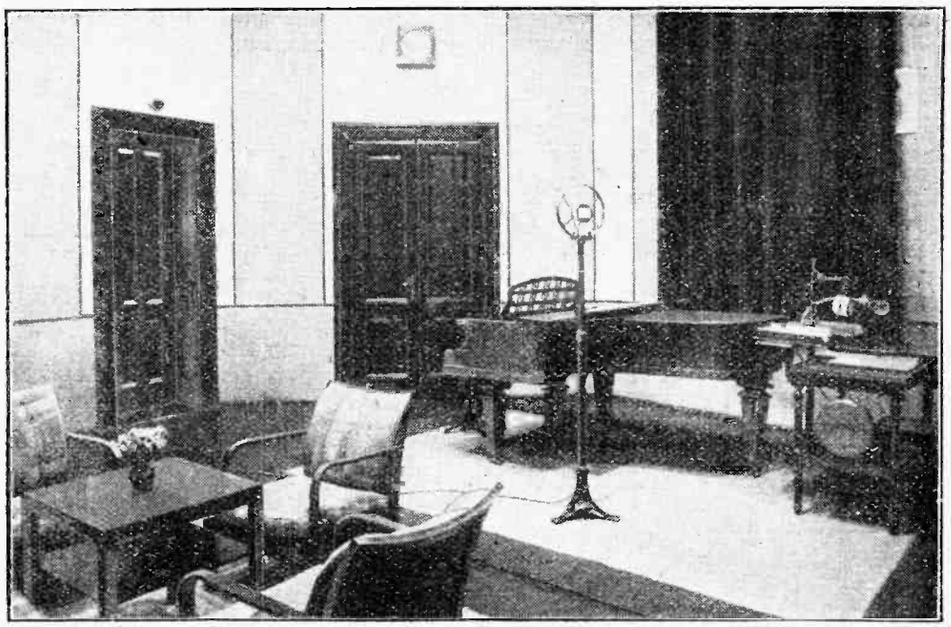
IT is reported, though I have not been able to obtain definite confirmation, that the new Sofia transmitter with a rating of 14 kilowatts is now ready for action. If this is so, it will mean a certain amount of reshuffling, for though the wavelength of 318.8 metres unquestionably belongs to Bulgaria, it has been used for some little time by both Dresden and Naples. One rather wonders whether the transmission heard on occasional nights of late on a variety of wavelengths between 318.8 and 321.9 metres was the Sofia station testing. It was not possible to obtain any call-sign, but there certainly was a transmission there, and when it was working it interfered badly with Göteborg.

A new Zagreb transmitter will shortly replace the present 750-watt plant on the wavelength of 307.1 metres. The station now under construction will have a power output of 15 kilowatts. It is situated, in accordance with modern ideas, some distance outside the city. The studios are in Zagreb itself, and working will be on the same lines as that which takes place between Broadcasting House and Brookmans Park. Here, again, some rearrangement will probably be necessary, for at present the wavelength of 307.1 metres is used jointly by Zagreb, Radio-Vitus, and Falun. When I say that Radio-Vitus uses the wavelength, I mean that he does so in theory. Actually there were no two consecutive nights during the whole of March upon which this little Parisian pest used the same wavelength. It wobbled between 306 and 309 metres, being successful in the process in interfering with both Cardiff and Bordeaux Lafayette. It seems ridiculous that one small and unimportant station should be allowed to make such a nuisance of itself.

I hear that an entirely new wavelength scheme for Europe is to be submitted by the U.I.R. for consideration at the Lucerne Conference, which opens in the middle of May.

It is to be hoped that the Lucerne Conference will devote special attention to the problem of sideband splutter. This is unquestionably due in most cases to overmodulation or, at any rate, to modulation of far greater depth than is necessary on speech transmission.* If some agreement can be reached limiting the modulation when speech is being transmitted to a reasonable amount one of the most serious causes of interference between stations will automatically disappear. On the other hand, if nothing is done in this direction we are likely to be faced with the sorry spectacle of station after station ruining the transmissions of its wavelength neighbours.

Long-distance conditions continue to be little short of amazing. The receiving set has that pleasant lively feeling which is associated with D.X. at its best. There is practically no atmospheric interference, and almost every division of the tuning dials brings in something.



A POPULAR ITALIAN STATION. A typical studio at Trieste. Since the erection of the modern transmitting plant, Trieste has steadily increased its appeal to listeners all over Europe.

Motala is now one of the star stations of the long-wave band, both the quality and the volume obtainable from it being magnificent. Kalundborg suffers occasional Morse interference, but is otherwise first rate. Zeesen is almost the only long-wave station of importance which is not quite up to the mark. One wonders whether experiments are being made with some part of the transmitting plant.

The choice amongst medium-wave stations is extraordinarily wide. The pick are perhaps Rome, Langenberg, Prague, Strasbourg, Brussels No. 1, Heilsberg, Hilversum, Leipzig, Stockholm, Breslau, Trieste, Katowice, and Florence. There are, though, many others which deserve attention, and not the least important of these are Lyons Doua, Beromünster (at the moment free from heterodyne interference), Nürnberg, Bratislava, and Brno.

D. EXER.

*The principal cause is more probably frequency modulation.—ED.

100 Metres and Below

The Evolution of the Ultra-short Wave

By C. C. WHITEHEAD

THE congestion of the ether is becoming so great that efforts are continually being made to extend the channels of communication to higher frequencies. Wavelengths as low as 12 metres are now commonplace, but attempts to work below this are fraught with many difficulties. At about one metre the period of oscillation is comparable with the time that the electrons take to pass from electrode to electrode in the valve, and the ordinary valve-oscillator theory breaks down. The accompanying article outlines the history of short-wave communication and summarises the position to-day.

SINCE the War, on account of the increasing congestion in the field of radio communication, attempts have been made to extend in every possible direction the range of frequencies available for this purpose.

At the close of the War the generally used wavelengths ranged between 100 and 20,000 metres (3,000 to 15 kc.). Since the 10-15 kc. range verges upon the audio-frequency spectrum, there was obviously no room there for extension, so wavelengths had perforce to be found in the zone below 100 metres (above 3,000 kc.). How the use of wavelengths below 100 metres and down to 15 metres was developed is now a matter of fairly common knowledge.

Of course, there was one great advantage in the possibility of using ultra-short waves, apart from the relatively efficient

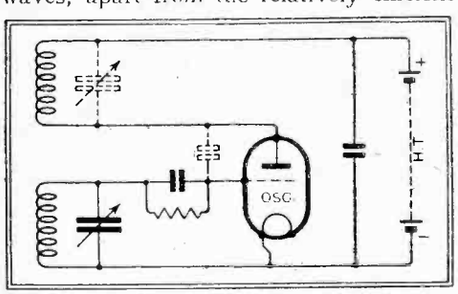


Fig. 1.—The fundamental oscillator circuit. If grid and anode circuits are in resonance the electrostatic coupling produced by the valve's electrode capacity is sufficient to cause oscillation.

aerial systems which could be used in connection with them, i.e., the fact that stations could be "packed closer" (since the spacing was a matter of frequency difference) as the wavelength was reduced. Even so, the waveband between 15 and 100 metres soon became congested, and so the possibility of using even shorter waves was soon investigated.

Though it is not really within the province of this article, it may be profitable to discuss briefly the properties of these very short waves. As predicted by theory, it was very soon discovered that they were too short to be reflected or refracted by the ionosphere, and therefore there was no phenomenon of "skip distance," due to the presence of the direct and indirect rays. Also the "ground wave" suffered very rapid attenuation, so that sending or receiving apparatus situated close to the ground had a very short range. In fact, the range bore a direct relationship to the height of the antenna from the ground. If, however, the two stations were situated so as to be within sight of each other, very long ranges were obtained with very small powers. The waves behaved in this way in a very similar manner to the much shorter light waves, thus earning for themselves the name "quasi-optical."

Very early during the pioneer work on these waves in the field of communication it was suggested that it would be possible to control the "service area" of a transmitter by altering the effective height of the antenna. The use of directive aerial systems was also easy and economical.

But some workers in this particular branch of radio communication have long felt that, in spite of theory and early results, it might be possible to attain long ranges with these waves. Some recent experiments have tended to confirm this view, ranges well beyond the "optical range" having been attained, first between France and Corsica on wavelengths of the order of 3 metres, and lately between ship and shore over a distance of 168 miles on a wavelength of 57 centimetres.[1] The mechanism of propagation in these cases is not yet understood.

[1] Ref. recent talk before the Royal Institution by Marchese Marconi.

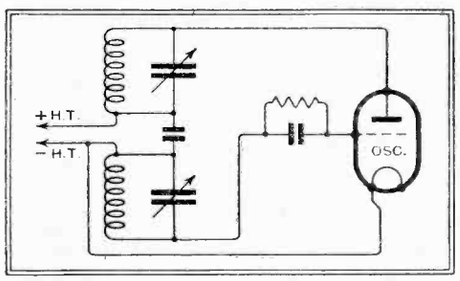


Fig. 2.—The circuit of Fig. 1 redrawn without the H.T. battery.

Prior to this time, methods of generating very short waves had been sporadically used, mostly for physical research purposes. The basis of nearly all successful methods is, of course, the triode, in one form or another.

There are two forms of circuit suitable for the generation of very short waves by means of the triode valve: First, the reaction circuit, and, secondly, the "electron-oscillation" circuit. With care, the reaction type of circuit may be used to generate wavelengths down to 1 metre in length, but the power available and the efficiency falls off rapidly below 2 metres. This is because the period of oscillation ($1/f$) is comparable with the time of transit of the electrons within the valve,

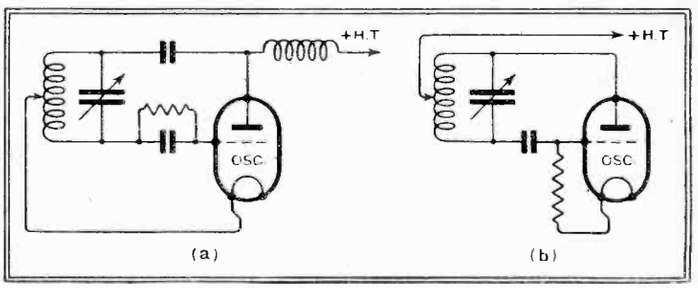


Fig. 3.—A simplification of Fig. 2 producing the well-known Hartley circuit with (a) series and (b) shunt feed.

so that it becomes impossible to ensure that there shall be the correct phase relationship between the electrode voltages and currents according to standard valve-oscillator theory to give normal efficiency.

To generate wavelengths shorter than a metre in length, use must be made of the natural period of flight of the electrons between the valve electrodes. This is the basis of the "electron-oscillation" methods of generating very short waves, due in the first place to Barkhausen, Kurz, Gill, and Morrell. By these means waves as short as 5 centimetres have been successfully generated and controlled.

Oscillation systems

The application of reaction methods of producing ultra-short waves is very interesting in its development, and throws light upon the question of valve oscillator circuits in general.

Consider the fundamental oscillator circuit shown in Fig. 1. The coupling between the grid and anode circuits may be either by means of the interlinking magnetic fields of the two coils, the inter-electrode capacity (grid-anode) of the valve, or a combination of both. Whether this coupling is sufficient to produce oscillation will depend, among other things, upon how close to mutual resonance the two circuits are. If they are in resonance, the slightest magnetic coupling, or the small amount of electrostatic coupling represented by the inter-electrode capacity

Sep. from 30 m. to 40 m. = 2,500 Kc.
" " 300 m. to 310 m. = 33 "

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of the valve is amply sufficient to produce oscillation. Hence the "tuned plate-tuned grid" type of oscillator favoured by amateur short-wave transmitters.

The circuit of Fig. 1 may be redrawn as in Fig. 2. Since the source of H.T.

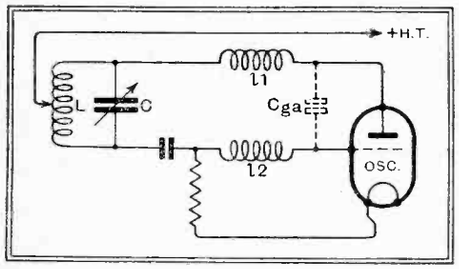


Fig. 4.—An oscillator for a wavelength of about four metres.

contributes nothing to the sum of the H.F. potentials, we have omitted drawing it in. The two coils and tuning condensers are seen to be virtually in series, so an obvious simplification is as shown in Fig. 3, producing the well-known Hartley circuit, either "series" (Fig. 3 (a)) or "shunt" fed (Fig. 3 (b)).

Any of the types of oscillator just described may be used with success on ordinary short wavelengths (down to 5 metres), but when we wish to generate shorter waves still they are not so satisfactory. Using an ordinary large receiving valve or small transmitting valve, the lengths of the leads within the valve may be quite as great as the length of wire forming the coil, so that, instead of having a true Hartley circuit as in Fig. 3, we have the queer arrangement shown in Fig. 4. This leads to several troubles. First, the relative amount of inductance included between the condenser terminals

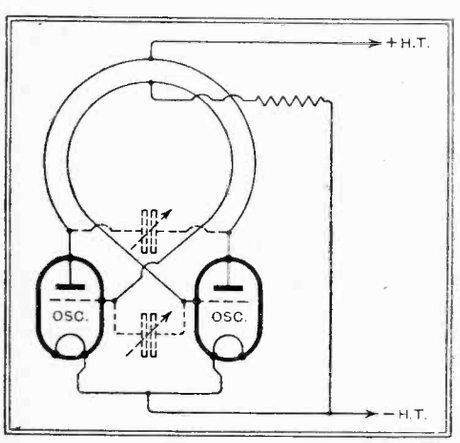
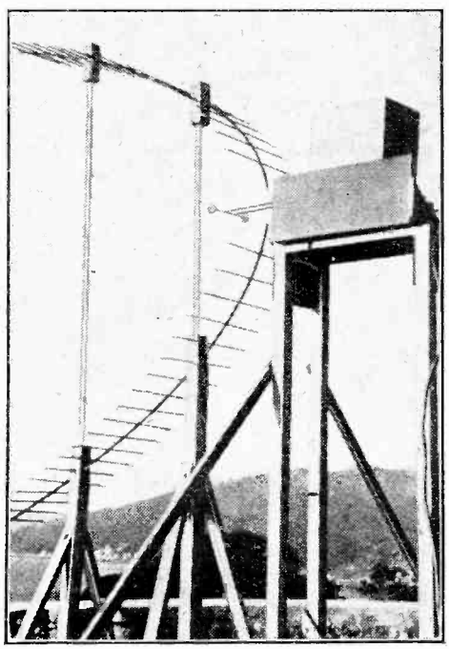


Fig. 5.—The Mesny push-pull oscillator successfully employed for wavelengths down to about three metres.

is small compared with the total amount of inductance in the circuit, the parts of the inductance lying without the L-C circuit acting as chokes and reducing the potentials applied to the valve electrodes. Secondly, we can trace *two coupled circuits* in Fig. 4, one being the L-C circuit, and the other the circuit *via* L—*l*1—*Cga*—*l*2. Under these conditions, when C is reduced below a certain point, it "loses control," and the second of the two circuits, that *via* the inter-electrode capacity (*Cga*) of the valve takes charge, and the generated wavelength suddenly jumps to some value quite unrelated to the setting of the "tuning" condenser C. The combination of these effects sets a limit (round about 4 metres, usually) to the shortness of the wavelength generated by this type of circuit. It had also two further disadvantages. First, if it was shunt fed (Fig. 3 (b)), part of the self-capacity of the H.F. choke used to introduce the anode feed was added to the other effective stray capacities in the circuit, since it was connected at a point of high H.F. potential; if series fed (Fig. 3 (a)), there was the damping effect of the grid leak (generally quite low in ohmic resistance, not more than 20,000 ohms) and the capacity of the grid condenser to earth, the grid condenser, in these very short-wave circuits, being a relatively



A receiver for the quasi-optical wavelength of 50 centimetres recently used by Marchese Marconi.

"bulky" component. Secondly, in either case both sets of vanes of the tuning condenser are at a high H.F. potential relative to earth.

A push-pull circuit

To overcome most of these disadvantages, the "push-pull" circuit shown in Fig. 5 and generally ascribed to R. Mesny was used. Here the valve inter-electrode capacities are effectively in series as regards the tuned circuit, and a high degree of electrical symmetry, which is very desirable, is attained. But the latter objection urged against the Hartley circuit still exists. Also, on account of the fact that only *half* of the tuned circuit is effective as a load in the anode of each valve, the effective anode load decreases much more rapidly with a decrease of wavelength than in the case of the single-valve circuit, though this is partly offset by the smaller effective inter-electrode capacities. The Mesny type of circuit is usually successful down to about 3 metres with ordinary valves. Note that the effective reaction coupling in this case is partly electromagnetic. If the coils are constructed the wrong way round (uncrossed), the two reaction effects (electromagnetic, *via* the coils, and electrostatic, *via* the valve inter-electrode capacities) may cancel out and no oscillations be obtained.

A suitable single-valve circuit, apart from avoiding the necessity of pairs of matched valves, can, if properly designed, be made to operate at shorter wavelengths than the Mesny type of circuit. The forerunner of the most successful type of

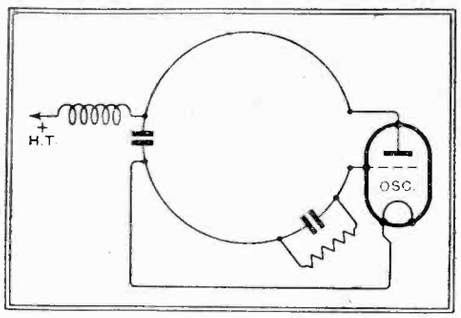


Fig. 6.—An early single-valve short-wave circuit of symmetrical form.

single-valve circuit for this purpose seems to have been devised by Messrs. Gutton and Touly round about the year 1919, and is shown in Fig. 6. One comment upon it is necessary: the mistake was made of having the grid condenser in the position shown, where it is (to use an illuminating expression that the writer once heard) "knocked about at a high-frequency potential above earth." A later version of the circuit is shown in Fig. 7. When we examine it closely we find that it is hard to describe it in terms of conventional valve circuits. The beauty of this arrangement lies in the fact that the external inductances L1, L2 are continuous with the internal leads *l*1, *l*2 (Fig. 7 (a)), the whole tuned circuit being formed by the two inductances L1-*l*1, L2-*l*2 and the two capacities C and *Cga*, forming a "link." If carefully arranged, this circuit is much less likely to show the undesirable coupled circuits effect of the Hartley circuit previously described. Furthermore, there is no limit to the shortness of the external leads (L1, L2) beyond that of the length

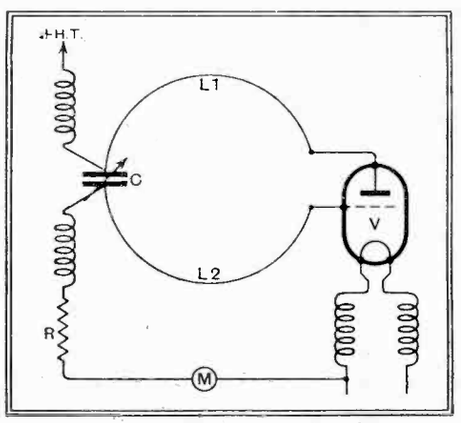


Fig. 7.—A later version of the circuit of Fig. 6.

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necessary for mechanical reasons, to connect C. Moreover, the grid and anode current leads can be led in (as shown *via* chokes) at points of low or zero H.F. potential with regard to earth.

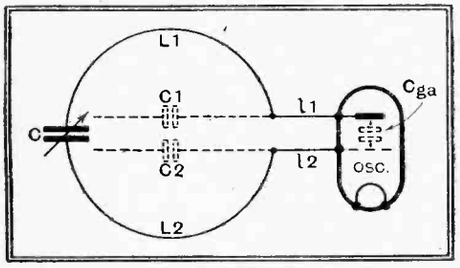

Fig. 7 (a).—The equivalent circuit of Fig. 7 with the self-capacities shown.

Practically, the circuit values for Fig. 7 may be: V=any receiving power or super-power valve, Ra about 2,000-4,000 ohms; L1 and L2, pieces of stout copper wire, bent into semicircles, each piece about 4in. long; C, any good make of air-dielectric *miniature* variable condenser, about 0.0001 mfd., max.; and R, 10,000-20,000 ohms.

The grid and anode chokes may each consist of about fifty turns of fine wire on a former $\frac{3}{8}$in. diam. Filament chokes will usually be found necessary and may consist of the same number of turns (fifty) of stouter wire (say, 30 S.W.G., for a valve taking not more than 0.25 amp. filament current) wound in "bifilar" fashion on a former about $\frac{3}{4}$in. diam.

With the arrangement described, the wavelength obtained will be somewhere in the neighbourhood of $2\frac{1}{4}$ metres. This circuit has the great advantage that it never refuses to oscillate, provided that the valve is O.K. By "decapping" the valve, cutting the external leads as short

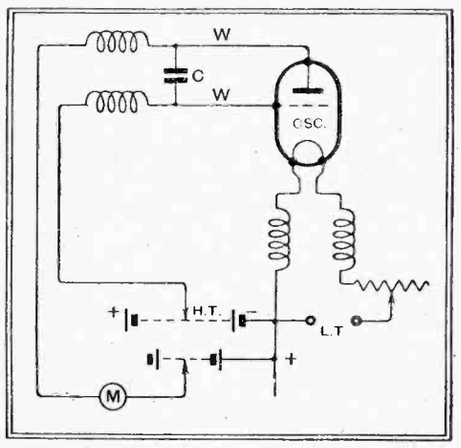

Fig. 8.—For generating waves shorter than one metre, an electron oscillation circuit must be used. Note that positive H.T. is applied to the grid.

as possible, carefully adjusting the value of R (the grid leak), using a selected valve, and applying as much anode voltage as it will stand safely, the generated wavelength (with C at its minimum value consistent with oscillation) may be brought down to the neighbourhood of $1\frac{1}{2}$ metres.

A close inspection of Fig. 7 (a) will show that if the self-capacities between the various parts are considerable (especially in the cases of the leads as shown by C1, C2) and the wavelength short, this circuit approaches the condition of a "tuned plate-tuned grid" circuit, with C as a coupling capacity. This means that in some circumstances the coupled circuit effect previously discussed may appear, but it is not usually troublesome. The only real snag is that, as the value of the tuning condenser C is decreased, there comes a point where the oscillations cease, owing to the fact that this condenser is also acting as a coupling between the grid and anode circuits, and decreasing its value in order to reduce the wavelength also reduces the coupling. The grid-current meter M (suitable value 0-2 mA.) provides a good indication of output, and is very useful for wavelength-measuring purposes in connection with absorption circuits and Lecher wire systems.

When it is desired to generate waves shorter than 1 metre, use must be made, as before mentioned, of an entirely different principle of operation. Strangely enough, and as a matter of interest, the

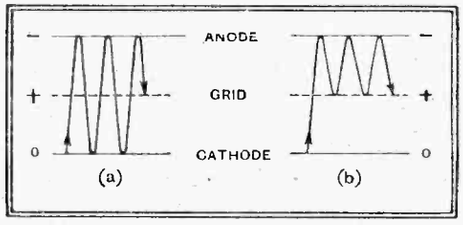

Fig. 9.—The cloud of electrons may "dance" in time with the oscillations either between cathode and anode or grid and anode.

circuit used is mechanically almost identical with the Gutton-Touly type of reaction circuit just described. In fact, the same circuit and valve may (provided conditions are suitable) be used without any (mechanical) change for the production of both types of oscillation. The general arrangement used is shown in Fig. 8. The point to notice is that the positive H.T. potential is applied to the *grid*, and a *negative* potential of lesser value is applied to the plate, which is rather an unconventional arrangement.

The dance of the electrons

The actual way in which this arrangement functions does not seem to have been definitely settled so far, but a plausible explanation which fits the experimental facts is as follows:—

On switching on the circuit, a cloud of electrons starts from the cathode and is attracted strongly towards the grid by the powerful positive potential thereon. Some of them are caught by the grid during their first flight, and take no part in the oscillatory action. Many, however, attain a high velocity and pass through the spaces between the grid wires, travelling towards the plate, where they are repelled by the negative potential thereon. If this latter potential is of the right value, the majority of the electrons just manage to reach within a short distance of its surface before their velocity is reduced to zero, when the positive charge on the grid again affects them and they are finally drawn back to it and absorbed. If the constants of the circuit connected to the electrodes are suitable, this rush of electrons (=a rush of current; in fact, a "transient") impulses the circuit, the return swing of which assists the retarding voltage upon the plate to return the electron cloud towards the grid. During this impulse the second return swing (again in the positive direction with respect to the cathode) helps the positive potential upon the grid to attract a further batch of electrons from the cathode, and may also reattract many of those which had been repelled from the plate back towards it.

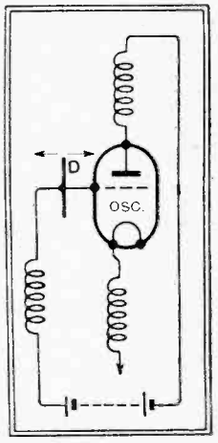

Fig. 10.—A copper disc 20 to 30 cms. diameter, as shown at D arranged as a slider, can be successfully employed in the grid circuit of the electron-oscillation valve.

The net result is that clouds of electrons may "dance" in time with the oscillations in the external circuit either between cathode and plate (Fig. 9 (a)) or between grid and plate (Fig. 9 (b)). In either case the frequency and therefore the wavelength is dependent upon the time of swing of the electrons between the two electrodes in question. This time period is in its turn dependent upon the distance between those electrodes, and inversely proportional to the voltage between them. Since (under the same operating conditions) the distance between the grid and plate is less than that between the cathode and plate, the former method of oscillation gives rise to the shorter waves.

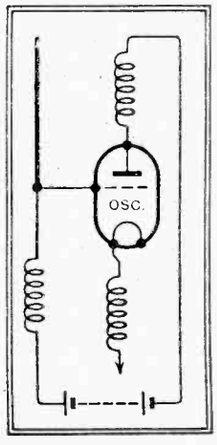

Fig. 11.—Another form of oscillator in which a vertical wire of quarter wavelength is attached to the grid terminal.

The H.F. potentials set up in the external circuit by the oscillating electron clouds may influence, *via* the changes of potential upon the electrodes, the time of swing. The result of this appears to be that in some circumstances the constants of the external circuit can affect the period of swing and therefore the wavelength, whilst in other circumstances this is determined solely by the geometry of the valve and the operating potentials, the constants of the external circuit merely affecting the output, by resonance with the electron oscillations.

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In the former case the type of oscillation is referred to as the "Gill-Morrell," and in the latter case as the "Barkhausen-Kurz," from the names of the two investigators who in each case first demonstrated that particular type of oscillation. It is not easy to predict which type of oscillation will be produced in any particular case, but it may be said that in general a perfectly symmetrically constructed valve and low operating potentials will predispose to Barkhausen-Kurz oscillations, whilst a slightly unsymmetrical valve with high operating potentials will predispose to oscillations of the Gill-Morrell type. Oscillations of both types may co-exist simultaneously.

Referring to the practical side of the question, there is one rather serious drawback to the electron-oscillation method, i.e., it is very hard on the valve, as anyone might surmise who has had any experience of valves using high positive grid potentials. Consequently, only valves of the "bright emitter" type will stand up

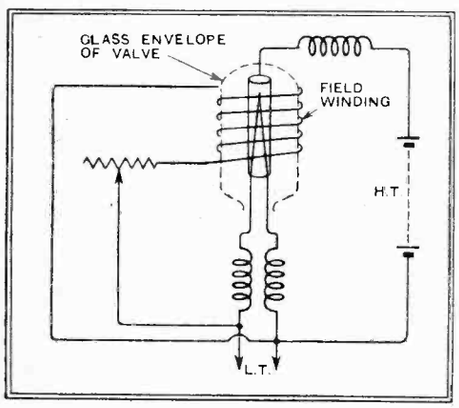
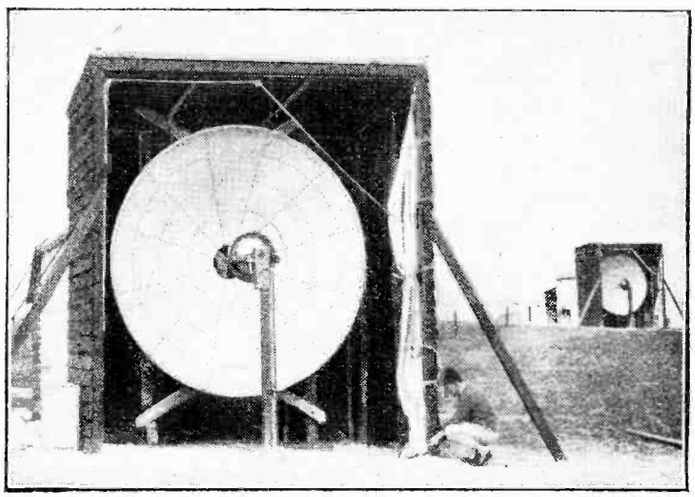


Fig. 12.—A diode with a winding outside the bulb to produce a retarding magnetic field. Five-centimetre waves have been produced by this circuit.

to the work for any length of time. For experimental purposes it is best to choose a small bright-emitter transmitting valve of robust and *symmetrical* construction. Voltages of from +200 to 300 volts may be applied to the grid, and from 0 to minus 100 to the plate. A sudden change in the reading on the plate-current meter (M, Fig. 8) will indicate that oscillation has commenced, when the bridge can be moved along the wires until maximum output is obtained, usually indicated by maximum reading on M. (In some cases of B-K oscillations there may be no indication at all on the meter M, whether the circuit is producing maximum available output or not. In these cases the indication is that the electron clouds are not actually reaching the plate, but are oscillating backwards and forwards about the grid.)

The Lecher wires (W, W, Fig. 8) may conveniently be anything from 50 to 100 cm. in length and about 5 cm. apart. The stopping condenser C may be of any value between 0.0001 and 0.001 mfd. Oscillations of the B-K type do not necessarily produce oscillatory current in the plate circuit, so the plate circuit wire may be omitted, and the bridge wire substituted by a copper disc of 20-30 cm. diameter arranged to slide along it, as shown at D in Fig. 10. This form of the circuit is generally found to be very successful,



Receiver and transmitter used in experimental 18-centimetre wavelength telephony across the Channel on March 31st, 1931.

and was originally devised by Pierret.

Still another form is shown in Fig. 11, in which the wire takes the form of a little vertical (approximately quarter-wave) "aerial" attached to the grid terminal. Oscillations having been obtained by adjustments of the valve electrode voltages, the wire is adjusted in length until maximum output is obtained.

With suitable valves obtainable in this country (A.T.40, A.T.40X, A.T.25, T.15, etc.), the wavelengths obtained will generally be somewhere between 40-80 cm. The filament current will be found somewhat critical for maximum output, and the valve will generally have to be run somewhat over its rated filament voltage. Adjustment of the filament current changes the wavelength slightly, and may be used as a "tuning" control when the circuit is used for reception purposes.

From the fact that the principle of electron-oscillators involves the employment of both an accelerating and a retarding field in what is really a diode with grid anode (since the plate only provides the retarding field), the use of a *magnetic* retarding field has been suggested and successfully tried (Fig. 12). This arrangement was first successfully developed by Okabe, and dubbed by him the "Magnetron." In its essentials it consists of a diode, with a cylindrical anode, a D.C. field winding being arranged on the outside of the bulb so that a magnetic field is produced with its axis parallel with the axis of the anode and cathode. The effect of the field is to deflect the course of the electrons leaving the cathode, so that, instead of proceeding straight to the anode, they describe a spiral with the cathode as centre (Fig. 13). At a certain critical value of the field they just fail to reach the anode, and the action is practically the same as that discussed in connection with B-K and G-M oscillations in the triode. As the value of the field is increased, the anode current decreases, so that the anode voltage can be "pushed" higher. As the strength of the field and the value of the anode voltage is increased, the generated wavelength becomes shorter. Okabe has succeeded by this means in producing 5-cm. waves. An arrangement used some time ago by the writer is shown in Fig. 14. The valve is an old bright-emitter diode rectifier with a short aerial wire, *w*, and a pair of Helmholtz coils, *f*, *f*, providing the retarding field. The usual filament and anode chokes are, of course, employed. The object of using Helmholtz coils is that the field produced at their mutual geometrical centre (the electrode system of the valve) is very uniform; also they are easy to construct and to assemble on the valve. The distance apart of the coils in the axial plane is equal to the radius of the coil (mean values).

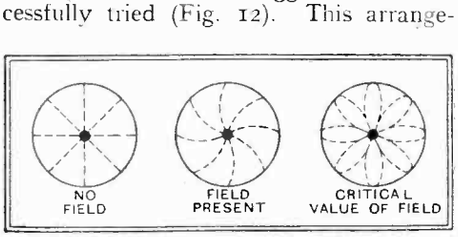


Fig. 13.—Electron formation in the "Magnetron" oscillator.

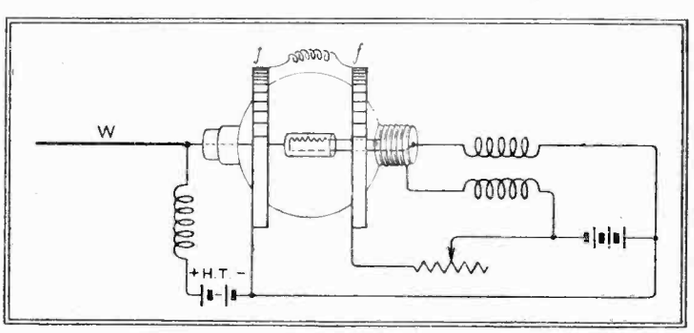


Fig. 14.—The author's "Magnetron" arrangement with which wavelengths of from 30 to 60 cms. are obtainable.

The waves produced by the magnetron arrangement are of the B-K type—that is, they are not affected except as regards intensity by the constants of the external circuit. With the arrangement just described, wavelengths of 30-60 cm. are obtainable, with anode voltages up to 300.

UNBIASED

By FREE GRID

Grace the hotel with my presence.

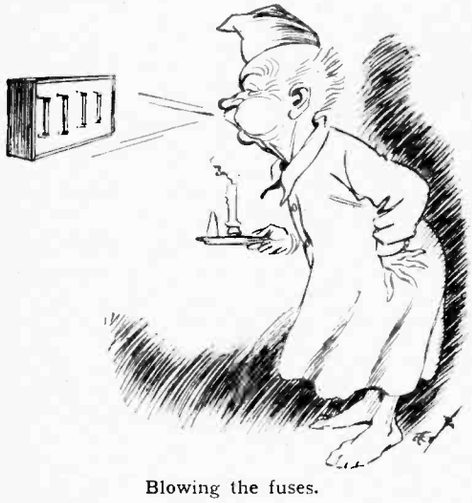
Pyjama Switches

I HAVE been singularly astonished at the pæans of praise which the lay Press have indulged in lately concerning "a remarkable new radio invention."

By means of this invention you can, to quote the words of one writer, "actually listen in bed to the last item of your favourite dance music and then switch off and go to sleep without the necessity of going downstairs in your bare feet to turn off the switch in the room in which your all-mains set is placed."

Now, even supposing that remote control switches had never been invented, it would be possible to switch off without leaving the warm comfort of your bed, simply by reaching to the end of it for your trousers, extracting a sixpence from the pockets thereof, and inserting the coin into the socket of your bedside reading lamp after removing the bulb. This would, of course, blow the household fuses, thus turning off the set.

I once passed this tip on to a friend, who, on our next meeting, complained bitterly of its ineffectiveness; but cross-examination revealed the fact that he was so unmechanically or, rather, unelectrically minded, that, lacking a sixpence, he had used a ten-shilling note.



Blowing the fuses.

But we digress: what I intended to remark was that this ignorant heralding of a remote control switch as a new invention must be particularly galling to the manufacturers who produced these devices as far back as 1925 or thereabouts. It must be still more galling to those who have gone a step farther and produced receivers with complete remote control of tuning.

As I have remarked before, it is high time that each newspaper was compelled by law to appoint a scientific censor to its staff.

Just Sit Back and Listen

I REALLY must protest against the wilful exaggerations to be found in the propaganda issued by certain short-wave addicts in their efforts to induce the ordinary listener to join their ranks.

Judging by his remarks in a very well-known weekly review, it is evident that one of these people, in his desire to induce others to join in his nocturnal pursuits has, to say the least, lost his sense of proportion.

According to this zealot, it is only necessary to listen on a humble two-valve, short-wave set to hear "the eerie call of the laughing jackass from the Australian backwoods, the roaring of lions in Kenya," and, finally, "the voices of telephone operators in New Zealand chatting with their colleagues in London." This, mark you, at any time of the day or night!

In my opinion, such wild statements do more even than the Empire programmes to deter people from short-wave listening.

Not What He Meant?

A WELL-KNOWN journalist, whose writings range from radio to rabbit breeding, has been telling the world that when staying recently in a famous hotel he was entertained by a broadcast programme *via* "wired wireless."

My first thought after reading this statement was that it was strange that such an important technical development as the establishment of "wired wireless" to relay broadcasting could have taken place without my knowing of it. Accordingly, I seized the telephone in an endeavour to get into touch with the mighty journalist. I was, however, held up by his secretary, who, judging from her cold demeanour, would have qualified with honours as a stamp-seller at an Arctic post office. No threats or cajolings on my part could induce her to put me through to the great man in question, so I gave up the quest and did what I ought to have done in the first place, namely, thought again.

It then became obvious to me that, despite what the journalist had written, he had not been listening to "wired wireless." Either he meant that every room in the hotel had been wired up to a central receiver, or that the hotel had become a subscriber to one of the numerous relay services that now exist.

"Wired wireless," of course, consists of the transmission of a number of different telephone conversations—or broadcasting programmes, for that matter—over one land line, interference being obviated by the fact that, to put it very loosely, the various conversations are electrically tuned, and thus pass over the line at different frequencies.

I am so confident of the absence of this system in this country that if any hotel over here is receiving, or distributing, any broadcast programmes by means of "wired wireless," I will undertake to grace it with my presence for one night without making any charge.

Spots Before the Eyes

IT seems that I was guilty the other week of underrating the progressiveness of the talkies. Not only has a list been sent to me of well over a hundred cinemas in all parts of the country where headphones and volume controls are provided for the use of deaf and other people, but a striking instance has been brought to my notice of even more astonishing managerial enterprise.

I owe my experience to a correspondent who is in cinema management himself.

He bade me go along to his "speak-easy" on boat race afternoon, and, having nothing better to do, I followed his advice. I arrived rather too soon, and was forced to endure the long drawn-out agony of a "burning love drama."

When it at length fizzled out I was agreeably surprised to see on the screen a pictorial map of the boat race course, and to hear the preliminary remarks of the B.B.C. commentator. It was quite evident that a radio receiver had been hooked up to the main talkie amplifier.

At the beginning of the race two moving spots of light shot off from the starting post, indicating the positions of the boats. I should very much like to know how the thing was done. The map was quite obviously a lantern slide, and I can only conclude that the moving spots of light came from two auxiliary projectors—glorified flashlights, in fact—wielded by operators behind the screen. I trust that something similar will be arranged for the Derby.

NEWS *of the* WEEK

Current Events in Brief Review

Why the Sets Howled

COPENHAGEN recently relayed five simultaneous baptisms. It is stated that the infants all provided very strong signals.

5½ Million

THE total number of British wireless licences in force at the end of March was 5,498,700, a net increase of 71,000 over the February total.

Next One, Please

OUR contemporary, the *Shields Daily News*, reports a radio coincidence. A Wigan man entered a relative's house the other day as the loud speaker roared, "Hallo, who's this coming in?" and, as he crossed the threshold, the next words on the wireless were, "How are you, Mr. ——?" (mentioning the man's name).

Luxembourg for All

TWO Diesel engines of 790 h.p. each are providing the Luxembourg 200 kW. station with the necessary power to swamp its neighbours on the long wave. The authorities claim that the station has an "agreeable" radius, or service area, of about 1,250 miles, so that it can serve 380 millions of Europe's inhabitants.

So as to please everybody, the station is transmitting talks in five languages: English on Sundays, Italian on Mondays, French on Tuesdays and Saturdays, German on Wednesdays and Thursdays, and Dutch on Fridays.

No Talk on Police Wavelengths

IN future all London's police patrol cars are to be equipped with short-wave wireless. This decision is the outcome of successful tests with transmitters erected at Tottenham and Kew.

To prevent interference with broadcast reception, which was noticed during the preliminary tests, police communications are to be restricted to the Morse code. This means that Londoners will be denied the opportunity of eavesdropping on gangster chases which is such an exhilarating and popular pastime in America.

No Quarter for Pirates

"PERSISTENT and pernicious piracy" by amateur transmitters is to be attacked by the Radio Society of Great Britain. At a "Conventionette" of No. 1 District of the Society at the Angle Hotel, Liverpool, recently, Mr. John Clarricoats, the general secretary, complained that there were actually members of their Society operating unlicensed transmitters. Cases of "persistent and pernicious piracy," particularly when another man's call was being pirated, should be reported to headquarters.

Members of the Conventionette paid a visit to the Post Office radio station at Seaforth.

Broadcasting Parliament

THE Spanish Government is reported to have authorised the installation in the Madrid Parliament of microphones for the purpose of amplification *and broadcasting*.

Blimps to Overcome Fading

WILL the day come when every radio research station has its "blimp"? The answer may be in the affirmative if the radio engineers of the Westinghouse Company at East Pittsburgh secure good results with the new miniature balloon which is moored high above the transmission plant of station KDKA. This "blimp" trails a long aerial, some 1,500ft. above the station. The actual aerial is 500ft. in length and is connected to the transmitter by a feeder line.

The object of the tests is to extend the range of broadcasting stations without increasing the power and to attempt to discover a transmitting level at which fading may be at a minimum.

N.Z. Still Waiting

NEW ZEALAND radio wholesalers are making strenuous efforts to induce British factors to take a more active interest in the receiver market, and, according to a Wellington correspondent, there are high hopes of an improvement this year.

At present Britain is sending New Zealand only one-sixth of her imports of components. The value of wireless apparatus coming into New Zealand from the United Kingdom in 1932 was £24,418. The United States contributed apparatus to the value of £79,012.

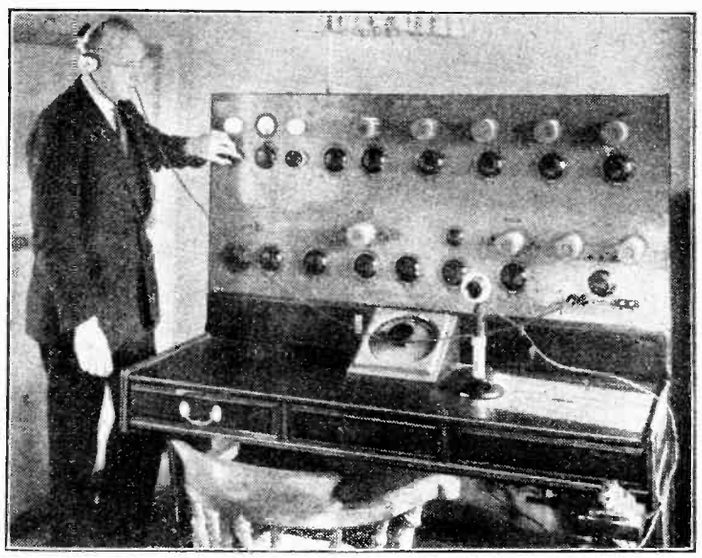
Delicious—for the Trade

A FRENCH radio journalist, possibly with an eye towards an approving wireless trade, has been recommending the simultaneous use of two receivers. He describes the effect as "surprisingly delicious," presumably owing to the stereoscopic effect so produced.

Toulouse Keeps Flag Flying

WHILE Radio Toulouse remains *hors de combat*, the programmes are being transmitted from the little station at Agen on 453.2 metres. Unfortunately, the power is only a quarter of a kilowatt, but listeners who recall the uncanny results which Toulouse has hitherto secured with only 8 kilowatts will expect Radio Agen to prove itself as good as any three other stations of the same power.

Meanwhile, we would add our plea to those of many listeners who feel that the French Post Office would perform a graceful act in granting the necessary permit for transmissions from the new 60 kilowatt transmitter of Radio Toulouse at St. Agnan.



AIRCRAFT GUIDANCE BY DAY OR NIGHT. The new Marconi-Adcock anti-night-effect direction finder at Pulham Aerodrome, Norfolk. Pulham takes bearings of aircraft in flight in conjunction with Croydon and Lympne. Note the telephone and Morse key (on right) for communicating bearings to Croydon.

A Day in Nankin

PROBABLY in the programmes of few stations are the old and new blended so remarkably as at Nankin. According to a correspondent, the morning begins with a course of physical culture, followed by European gramophone music, interlarded with general news and sporting items. At noon the programme changes abruptly. ancient prayers and music, dating from the earliest days of Confucianism, are broadcast. Highly intellectual programmes fill the rest of the day. They include courses in hygiene and medicine, English and German lessons, and talks on art.

"Yes, You're Winning!"

SHORT-WAVE wireless transmitters on racing motor cars may soon be regular practice. We understand that a racing car is now nearing completion in which wireless equipment will be installed to enable the driver to communicate with the mechanics in the fueling pit, giving instructions and receiving information regarding position in the race, speed of rivals, etc., etc.

Here is a fine new field for the fiction writer who can exploit the racing crook in his efforts to jam the cross-talk between his rival and the pit staff.

"B.B.C." for France

FRENCH listeners will shortly be able to criticise the broadcast programmes with that hearty air of proprietorship which is only possible when listeners pay for what they get. The Chamber has adopted an article of the Finance Bill establishing a scale of taxation as follows: Crystal sets, 15 francs; privately owned valve sets, 50 francs; valve sets used in public, 100 francs; used in public for gain, 200 francs. All valves are taxed at 15 per cent. of the sale price.

M. Laurant-Eynac, the Postmaster-General, said, in introducing the measure, that the State stations would, under the new regime, refuse all sponsored publicity programmes, the State regarding it as its primary duty to satisfy the public.

The Late Mr. Kellaway

THE death of the Rt. Hon. F. G. Kellaway, P.C., on Thursday, April 13th, has robbed wireless of a prominent figure. At the time of his death Mr. Kellaway was vice-chairman and managing director of Marconi's Wireless Telegraph Co., Ltd., chairman and managing director of the Marconi International Marine Communication Co., Ltd., and joint managing director of Imperial and International Communications, Ltd. To many listeners, however, Mr. Kellaway will best be remembered as the Postmaster-General who, in 1922, played a prominent part in founding agreements for the formation of the British Broadcasting Company, now the British Broadcasting Corporation. He could also claim the honour of producing for the first time a post-War surplus of income over working costs in the British Post Office administration.

Mr. Kellaway was sixty-two years of age.

The Droitwich Masts

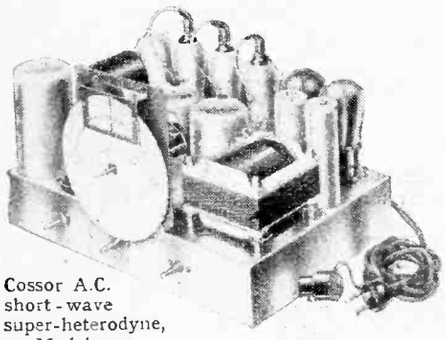
THE British Broadcasting Corporation has entrusted to Radio Communication Company, Ltd., of 34-35, Norfolk Street, Strand, W.C.2, a contract for the supply and erection of two 700ft. lattice steel masts at the Midland Regional Station, near Droitwich, similar in design to the 500ft. masts recently built by the same company for the North Regional, Scottish Regional and West Regional Stations.

Short-wave Sets and Components

Review of Apparatus Available To-day

THE potentiality of the short waves as a medium for broadcast is just now attracting considerable attention in this country, evidence of which is to be found in the number of new receivers, adaptors, and components that have made their appearance during the past few months. Much of the apparatus has been developed especially for use overseas, and in particular for reception of the new Empire short-wave stations recently put into service by the British Broadcasting Corporation.

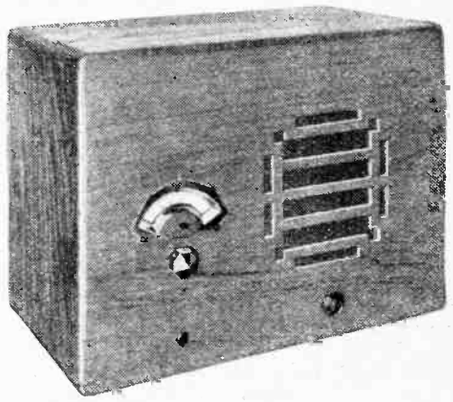
This, however, does not constitute the sole line of development, for the honours are fairly equally divided between what may be termed the "Overseas" model and "All-wave receivers." The latter are essentially broadcast sets suitable in every respect for use in this country; indeed, many represent the very latest types, possessing a very high degree of selectivity, being above the average in sensitivity and, with few exceptions, include moving-coil loud speakers. The addition of a short-wave range is not subsidiary to the main design, neither is it in the nature of a compromise to justify the description "All-wave receiver." For the performance on the short waves should be in no way inferior to that on either the medium- or the long-wave band, since the receiver as a whole has been designed to give a satisfactory performance throughout the full range of wavelengths covered.



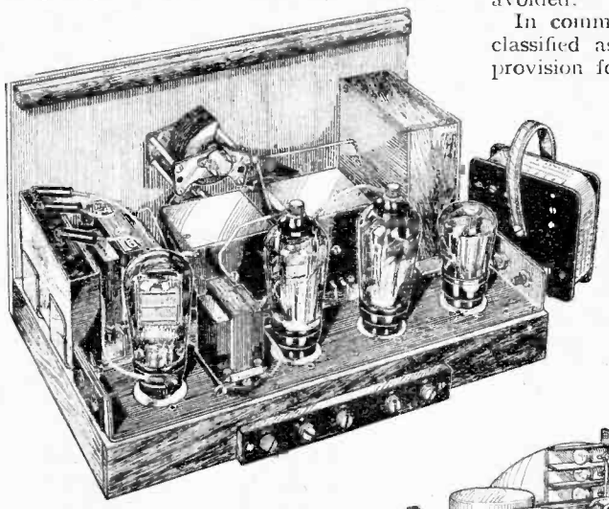
Cossor A.C. short-wave super-heterodyne, Model 359.

Having so many alternative programmes from which to choose, listeners in this country are often inclined to ignore the short waves, and, while it must be admitted that these may not provide quite so reliable a service as either the medium or the long waves, they yet possess a definite entertainment value, for it is only on the short waves that distant reception in its truest sense is possible. Furthermore, expensive or elaborate apparatus is not essential, as anyone possessing a passably good broadcast set can adapt it for short-wave use by the addition of an inexpensive unit.

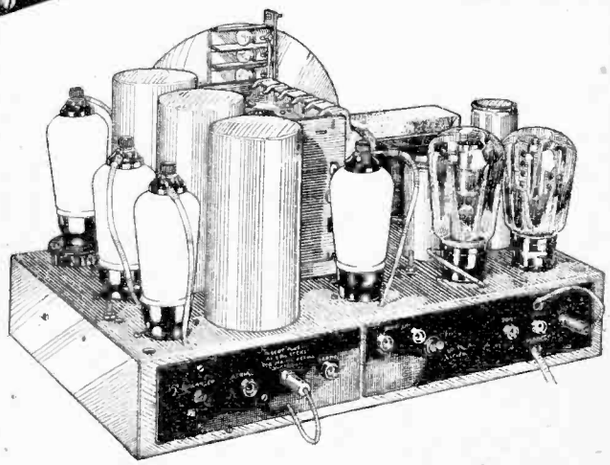
The requirements of the overseas listener differ in many respects from his *confrère* at home, for it is usually quite unnecessary to make provision for long-wave reception, and in most cases a receiver capable of covering the short- and the medium-wave bands will suffice. If the set is to be used up-country, batteries may have to be relied on to supply the operating voltages, so that economy in H.T. current is of first importance. Manufacturers of receivers intended for use overseas fully appreciate this fact, and, although the specification has not been skimped on this account, the total high-tension consumption is kept within reasonable bounds. Yet the receivers are essentially of the long-range type. Superheterodynes predominate, and there are about an equal number of battery and mains models. In this class the majority embody moving-coil loud speakers, permanent-magnet types being used in the battery sets, and energised models in the A.C. superheterodynes.



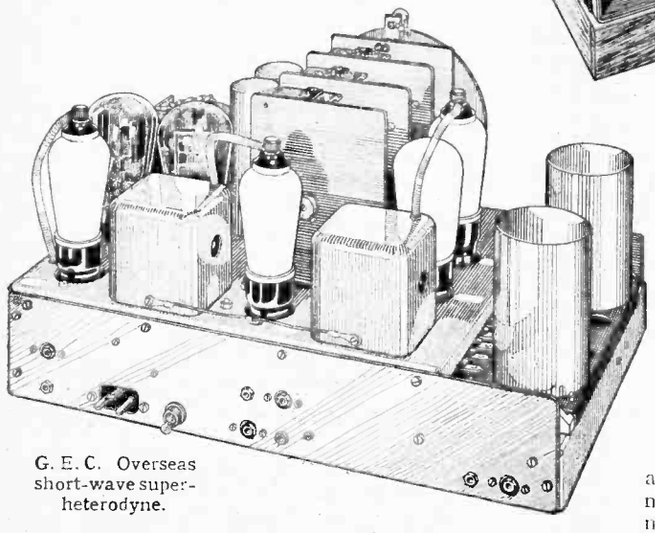
Mavox six-valve short-wave superheterodyne.



McMichael Colonial battery superheterodyne



Faraday all-wave super-heterodyne.



G. E. C. Overseas short-wave super-heterodyne.

Two typical examples of overseas receivers, both of which are superheterodynes, are found in the Cossor range. Economy in operation, in the case of the battery model, is achieved by employing the fewest valves possible, and four only are used. This is made possible by utilising the autodyne frequency changer circuit and a pentode for the output valve, the two remaining valves functioning as I.F. amplifier and second detector respectively. Particular care has been exercised in the choice of the components, and materials that would prove unsuitable in the tropics have been carefully avoided.

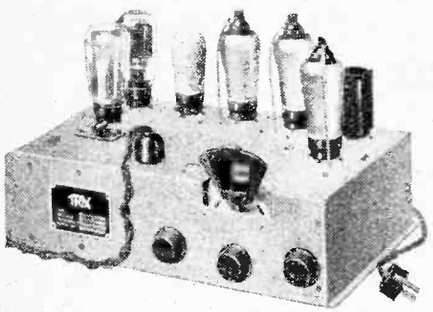
In common with all the other receivers classified as Overseas models, there is no provision for long-wave reception, and the wavebands covered are from 13.5 to 70 metres and 200 to 550 metres, approximately.

Although a moving-coil loud speaker is embodied, provision is made to use headphones if necessary, a feature that is found in quite a number of receivers in this category. For, should the voltage of the H.T. battery fall below that necessary to give loud-speaker reproduction, reception can be carried on with headphones until such time as a replacement is obtained.

Economy is achieved in some designs by embodying either the Class B output stage or using Q.P.P. amplification, since in both systems the drain on the H.T. battery bears some relation to the acoustic output from

Short-wave Sets and Components—

the loud speaker. One example of the first-mentioned practice is the Scott Sessions Equator-Super, a six-valve superheterodyne of the Overseas type covering 12 to 80 metres and 220 to 550 metres. A permanent-magnet moving-coil loud speaker is included, and in addition there is automatic volume control. Automatic volume control should



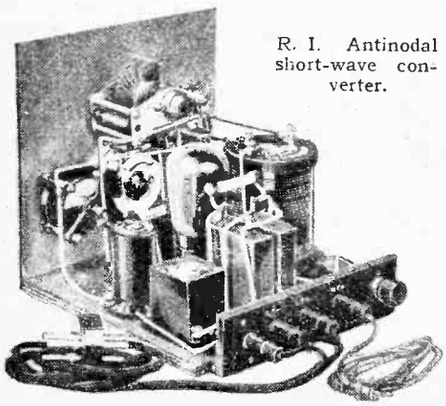
Clean lines distinguish the Trix Explora short-wave superheterodyne.

prove a very useful feature in a short-wave receiver, since fading is often more prevalent on the short waves. One other feature which distinguishes this particular receiver is the inclusion of a Westinghouse metal-oxide detector following the intermediate frequency amplifier.

Showing back view of Lissen Ultra short-wave Transportable Three.

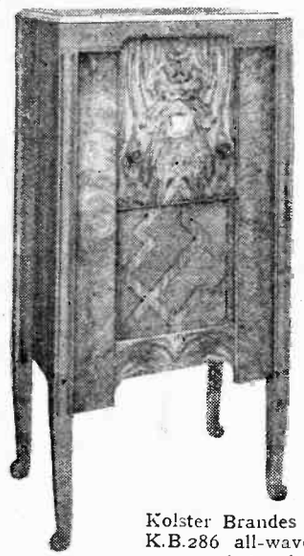
Class B amplification figures also in the latest seven-valve battery superheterodyne, model S.710, developed by Faraday All-Wave Wireless, Ltd., whilst a Q.P.P. output stage is embodied in the six-valve model (B.65) made by Mavox Radio, Ltd.

Superheterodyne receivers for overseas use



R. I. Antinodal short-wave converter.

are made by G.E.C., who have a six-valve model, battery operated, and an overseas A.C. six-valve superheterodyne. Both receivers are of the limited waveband type, in that they do not include a long-wave range. The loud speaker is not included in the design. The McMichael Colonial set takes

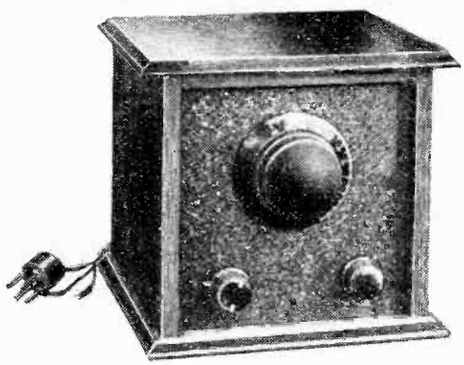


Kolster Brandes Model K.B.286 all-wave A.C. superheterodyne.

the form of a four-valve superheterodyne designed especially for short-wave use, but provision is made to cover the medium broadcast band. A neat interchangeable coil box is employed in this set. Eric J. Lever (Trix), Ltd., are responsible for a compact six-valve super for use on A.C. supplies. The metal work in the chassis is specially treated, and the components employed are of the type developed for tropical use.

Ultra-short Waves

Although superheterodynes predominate, a number of firms have made a speciality of the straight type of set. Prominent among these is Stratton and Co., Ltd., makers of the well-known Eddystone receivers. Although designed especially for short-wave reception, it is possible to extend the range of the majority of these sets to cover the medium-wave band, and in one particular



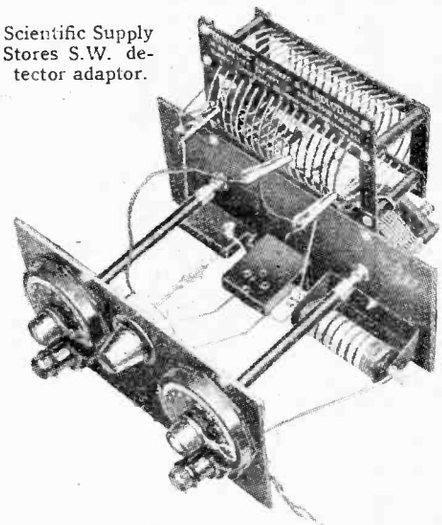
Eelex superheterodyne S.W. converter.

model, the All-Wave Four, coils for the long waves are available. The products of this firm are of particular interest to the amateur experimenter, for a special feature is made of ultra-short-wave equipment, and one receiver for use on the 5-metre waveband has been developed.

The all-wave receiver covering the short, medium, and the long waves offers the greater attraction to the average listener in this country, since the ability to receive normal broadcast is possibly of paramount importance. Thus the main feature one looks for in a set of this type is a good all-round performance on the medium- and long-wave bands, since if the set is satisfactory in this respect it may be assumed that on the short waves it will not be lacking. The largest selection is found in the mains-operated class, and such firms as Faraday All-Wave Wireless, Kolster Brandes, Mavox Radio, Pegasus and Standard Telephones include sets of this type in their range.

If the reader already possesses a satisfactory broadcast set and is reluctant to incur unnecessary expense, the acquisition of a short-wave adaptor is well worth considering. These units are made in two styles; the one converts the set into a short-wave superheterodyne, and requires that one or more H.F. stages be available, whilst the

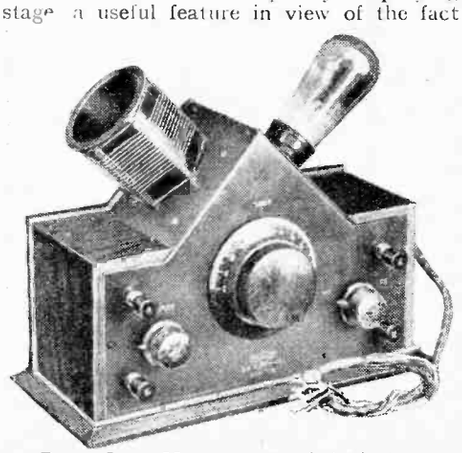
Scientific Supply Stores S.W. detector adaptor.



other is intended for use in conjunction with receivers not fitted with an H.F. stage. The detector adaptor, as the last-mentioned unit is termed, is provided with a lead and plug for inserting into the detector valve holder, and so makes use only of the low-frequency amplifying part of the broadcast set. These units are easy to install, simple to operate, and can be put out of action in a few minutes. Exceptionally good results are obtained on the short waves with either type, but in general the superheterodyne model will show the greater sensitivity, in view of the higher amplification afforded.

S.W. Adaptors

In one particular design, namely, the R.I. Antinodal short-wave converter, it is arranged to utilise the idle detector valve as an additional low-frequency amplifying stage a useful feature in view of the fact

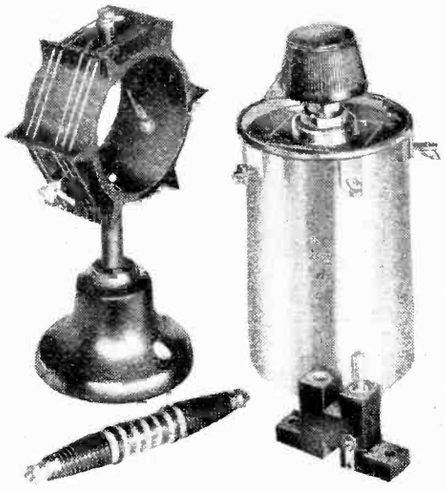


Burne-Jones Magnum super-het adaptor.

Short-wave Sets and Components—

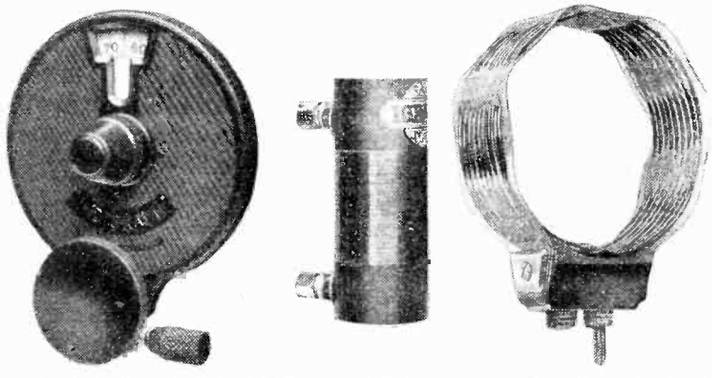
that many present-day broadcast sets are fitted with one L.F. amplifying stage only after the detector. The R.I. converter is not a superheterodyne model.

Short-wave adaptors are now obtainable



Selection of Wearite short-wave components.

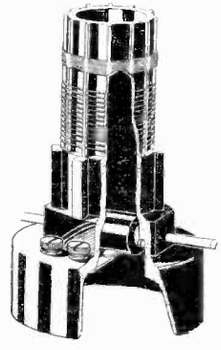
for use in conjunction with either battery or mains sets, and are made by Burne-Jones and Co., Ltd., J. J. Eastick and Sons (Eelex), Scientific Supply Stores, Haynes Radio, and Stratton and Co., Ltd.



Igranic Indigraph dial with two-speed reduction drive, H.F. choke and S.W. coil.

Components

So far as special parts are concerned, in a short-wave receiver it is only those components comprising the tuned circuits that need be of special design. Or, to be more precise, coils, variable condensers, and H.F. chokes are the principal items affected. Variable condensers for short-wave receivers must of necessity have a low minimum capacity, whilst the maximum value should not be more than about half the usual value employed for normal broadcast receivers; otherwise, tuning becomes far too critical. Particular attention is called for in the design of the condenser bearings, for these can be a very prevalent cause of crackle and noise if badly designed or made of unsuitable materials. All these points have received due attention by designers of these components, and the features enumerated above are to be found in the products of the leading manufacturers, such as Wingrove and Rogers (Polar), Jackson Bros., Stratton (Eddystone), S. Bird (Cyldon), Ormond, and F. E. Godfrey.



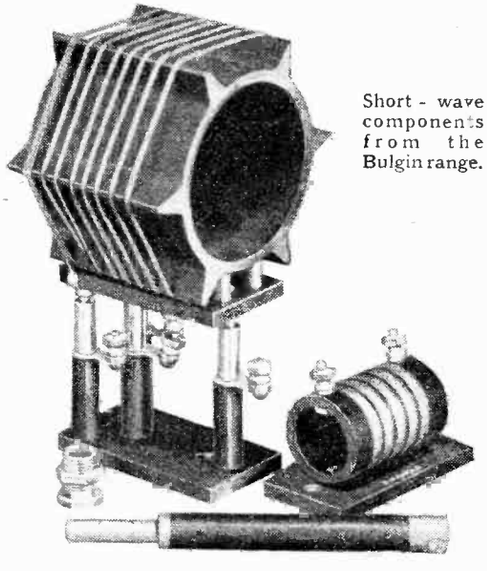
Colvern type K.S.W. dual-range short-wave coil.

The design of a short-wave coil, especially if it be of the dual-range type, presents another problem that has been satisfactorily surmounted, and some exceptionally efficient and compact coils are now made by Colvern, Lissen, R. I. Wright and Weaire, and Eelex. In addition, there is a big selection of single-range coils, mostly of the plug-in variety, the principal firms listing these being Igranic, Stratton, H. Clarke and Co. (Manchester), Ltd., Bulgin, and Lewcos.

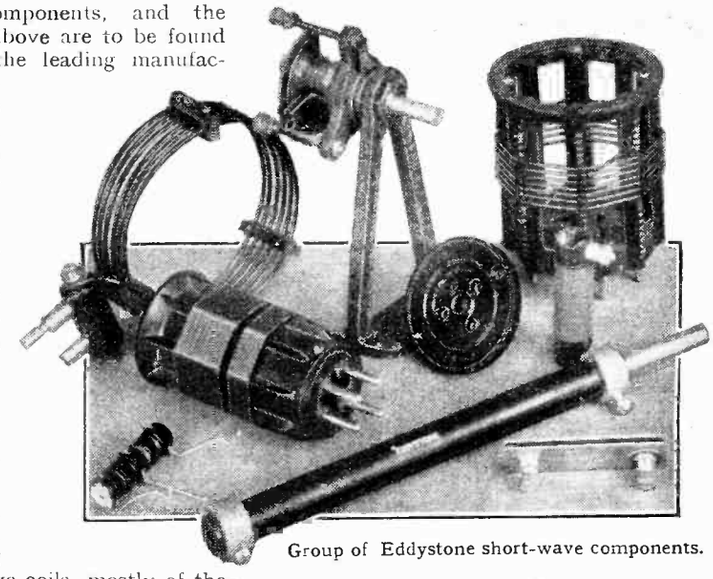
High frequency chokes for use on short-waves present a very interesting problem for unless certain precautions are observed the wave-range over which the choke is effective may be curtailed. Self-capacity of the winding is the most serious factor encountered, and various and many ingenious designs have appeared from time to time, the aim in all cases being to achieve the highest inductance possible compatible with the requirements of short-wave work, coupled with a very low self capacity.

A straightforward single layer winding, or a sectionalised winding seem now to be most popular types of construction, examples of the former being the Igranic, Postlethwaite and Eddystone, whilst sectional-wound H.F. chokes are favoured by Ward and Goldstone, Wright and Weaire, and Bulgin.

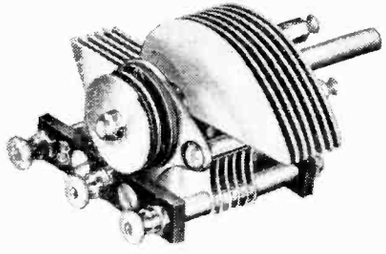
Since in the ultra-short wave field only the amateur experimenter finds an interest it is but natural that the demands for components suitable for use on these very high frequencies are few in number. Indeed, the manufacture of these is practically in the hands of one firm, namely, Stratton and Co., Ltd. They take the form of miniature variable condensers of 15 and 25 micro-micro-farads, small H.F. chokes with an effective range of from five to ten metres, coils and a few other items.



Short-wave components from the Bulgin range.



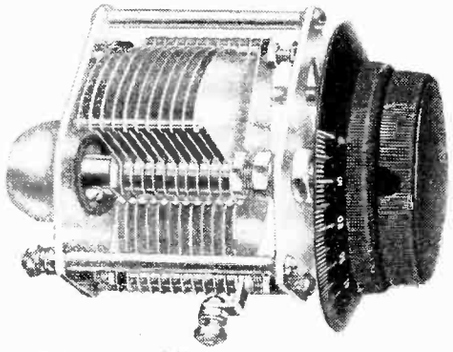
Group of Eddystone short-wave components.



J. B. short-wave special condenser.

The Peto-Scott Co. have for long specialised in kits of parts for the home constructor, and they have a very wide range of short-wave models, many of which can be supplied as finished sets.

A wavemeter which can be relied on to give an accurate indication of the frequency to which the set is tuned should prove an exceedingly useful adjunct, since it obviates much tedious searching when tuning in short-wave transmissions. Apparatus of this type is obtainable from Claude Lyons, Ltd., and also from Stratton. For general-purpose use, an exceedingly high degree of accuracy is not necessary, and the G.R. type 358 obtainable from Claude Lyons will satisfy most requirements. It has a range of 15 to 220 metres, and an accuracy of 1 per cent



Polar type "C" short-wave condenser.

BROADCAST BREVITIES

By Our Special Correspondent

Sunday Evenings: The Truth

LONG-DISTANCE listeners need not get alarmed over the rumours that their Sabbath evening quiet from six to eight o'clock is to be filched from them for the sake of less ambitious people who cannot support existence unless the local station is transmitting.

I can definitely say that while Sir John Reith wields power at Broadcasting House there will be no trespass on the holy ground set apart by arrangement with the Religious Advisory Committee.

More Week-day Broadcasting?

It is true that the question has been discussed, but the decision arrived at is bringing no comfort to those who would have things other than they are.

More may come, however, of the interesting suggestion that the daily broadcasting hours should be extended.

Wasted Talent

It is argued that studios are being used almost throughout the day for one Empire zone or another; why should all this talent, whether full-blooded or Blattnerphoned, be wasted so far as Great Britain is concerned?

So do not be surprised if one of these days we hear the triumphant announcement that morning listeners are to have alternative programmes.

Television Shows Not Wanted

A WORD of thanks to the surprisingly small number of readers who responded to my invitation for support in a plea for television demonstrations in the Concert Hall at Broadcasting House. Unless readers are bashful in the matter, I can only conclude that television, despite great technical improvements, has failed so far to stimulate the public imagination.

Dancing to a Symphonic Poem

HENRY HALL and his band will set listeners a queer problem on May 30th when they broadcast "Rhythm of the East"—a *symphonic poem for dance orchestra* by Clifford Hellier, whose brother, Cyril Hellier, is principal violin in the orchestra.

To dance or not to dance?—that is the question. Mr. Hellier's composition is based upon impressions gathered during a trip to Algeria, and as can be imagined, it abounds in tambourin, tom-tom, and other effects, including those of a melée in a café. Listeners, therefore, will begin dancing at their own risk.

Cup Final Broadcast To-morrow

A RUNNING COMMENTARY by George F. Allison on the Cup Final between Everton and Manchester City will be broadcast from the Empire Stadium, Wembley, to National listeners to-morrow (Saturday). Mr. Allison's description will be preceded by community singing, conducted by Mr. T. P. Ratcliff, accompanied by the band of the Royal Horse Guards.

Listening Groups and Bad Reception

"CHARACTERISTIC of England is the large band of devoted men and women willing to sacrifice an evening a week for many weeks in order to act as leaders of Listening Groups." I cull this remark from a highly informative and unbiased account of the Adult Education Wireless Groups contained in the Board of Education Pamphlet No. 92 (H.M. Stationery Office, price 9d.

In all, sixty-five groups were visited, and in forty-six cases the reception was reasonably good; in two cases it was so bad that the talk could not be followed. In other cases, while it was possible to follow the talk there was a background of interference. Interference was most noticeable in the North West and in Yorkshire.

Music Circles, Too?

The wireless groups have been found most useful by people who lack the opportunity to listen in quietness and comfort at home.

Many music lovers are faced with the same problem, and I imagine they would welcome the advent of B.B.C. Music Appreciation Circles organised on the same lines as the listening groups.

Grand Opera Broadcast in Full

MONDAY NEXT will be a red-letter day for all opera lovers, for it sees the opening of the Grand Opera season at Covent Garden, and the B.B.C. relay of the third act of "Der Rosenkavalier" to National listeners. On Tuesday, May 2nd, Regional listeners will hear the whole of "Rheingold," one of the very few operas to be broadcast complete.

Relays of grand opera are to take place frequently on both wavelengths during the season.

Don't Miss the Academy Banquet

FEW post-prandial speeches are so polished and witty as those delivered at the Royal Academy banquet, and even listeners who are sometimes inclined to tune out "dinner talks" ought not to miss the broadcast from Burlington House on the London Regional wavelength to-morrow (Saturday). Sir William Llewellyn, president of the Royal Academy, will be in the chair, and the following toasts will be given:—The King, the Queen, the Prince of Wales and the other members of the Royal Family, the Armed Forces of the Crown, His Majesty's Ministers, Science, the Guests, and the Royal Academy of Arts.

A GOOD STUNT. The element of novelty and surprise must never be lost sight of in planning broadcast programmes. South Africa set a good example a few weeks ago when Cape Town broadcast a description of Table Mountain. The announcer is seen at the summit with his equipment. The talk was relayed by the B.B.C.

Volume Control in the Garden

A SUPERFICIAL onlooker might consider that the B.B.C. was doing itself a disservice by asking listeners to reduce the volume of their loud speakers when used in the garden in the summer months. "Let the joyful sounds be shouted from the housetops" might seem to be the best motto, but, fortunately, the Corporation looks a little further into the matter and realises that the noisy loud speaker brings broadcasting into disrepute.

I understand that tactful suggestions for toning down the volume will be broadcast at intervals throughout the hot season.

Eighteen Hours of Drama in Sixty Minutes

THREE Japanese "No" plays, each supposed to last for six hours, are to be broadcast on May 4th (National) and 6th (Regional). But whereas Ujinobu, the playwright, who lived from 1414 to 1499 A.D., intended that "Kumasaka" should last from early lunch to late tea, Mr. Howard Rose, the B.B.C. producer, has stepped in and cut it down to something like twenty minutes. With two other similar plays—"Aya No Tsuzimi" and "Kagekiyo"—the whole entertainment will occupy rather less than one hour.

This is compression with a vengeance, and one could wish that all B.B.C. producers were as vigorous with the blue pencil. These strange old dramas should be worth listening to.

How Now, Mr. Ashbridge?

HERE is news which is more flattering to Les Allen, Henry Hall's vocalist, than to the Empire broadcasting system. I hear that Mr. Allen's parents are now travelling from Toronto to this country to hear their son sing. They decided to come after many months of fruitless endeavour to hear their son's voice "on the air."

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 brief particulars, with the fee charged, are to be found at the foot of this page.

"Class B" Conversions

MOST of the questions submitted to us regarding the conversion of existing sets for "Class B" amplification relate to H.F.-det.-L.F. receivers, in which the output valve is fed directly from the detector, usually through a step-up transformer.

When dealing with such receivers, especially if they are fitted with a small three-electrode power valve, the most convenient plan will be to convert the existing output valve into the driver. Following this plan, the main extra components required will be the special driver transformer, the "Class B" valve, and, a transformer designed for matching this valve to the loud speaker. Alternatively, the existing loud speaker, with its transformer, may be matched by interposing one of the new tapped chokes which have been specially devised for the purpose.

In order to prevent undue emphasis of high notes, a compensating device must be fitted. This might consist of the conventional resistance and condenser across the primary of the output transformer, but, for reasons that have already been explained, it is better to connect it before the driver stage. This may be done by shunting the primary of the existing L.F. transformer with a condenser and resistance (the latter preferably being variable) in the manner shown in Fig. 1. The values shown in this diagram will generally be satisfactory.

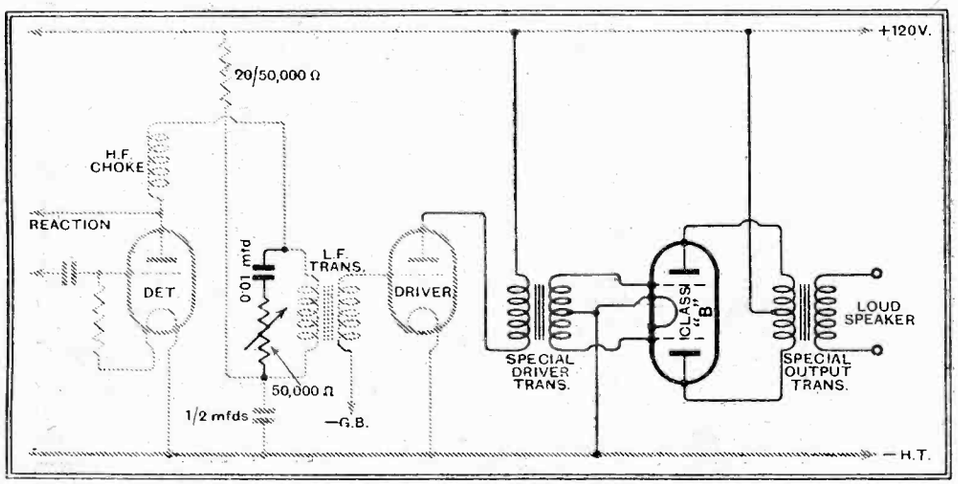


Fig. 1.—By converting the existing output valve into a "driver," a typical battery set may be easily converted to "Class B" amplification. Additions to the original receiver are shown in full lines. The driver valve will require extra bias.

With regard to the driver transformer, it is a matter of some importance that its ratio should be suitable for operating with the type of driver valve actually employed; manufacturers of transformers issue information on the suitability of their products for various conditions.

Test the Tester

IT would appear necessary to stress the point that, before carrying out a series of tests, a start should be made by assuring one's self that the testing device to be used is itself in order. It is wise to make a practice of always doing this, in order that the indications given by the device can be depended upon implicitly.

These remarks are prompted by the fact that several letters have lately been received describing results which are altogether impossible. For instance, one correspondent states that several resistances in his receiver have failed, and then goes on to give a list of measured voltages at points which could only be connected to the source of supply through the resistances that are supposed to be burnt out. We can only think, in this case, that the appliance used for testing continuity is itself at fault.

Aerial Series Trimmer

IT is quite usual practice to trim the input circuit of a receiver by adjustment of a small semi-variable condenser connected in series with the aerial circuit. When this is done, the built-in trimmer across that section of the ganged condenser which controls this circuit is ignored; sometimes, indeed, it is entirely removed.

If everything is in order, an adjustment made in this way at a low wavelength should hold over the band of frequencies covered by the set.

Occasionally, however, a somewhat misleading effect is encountered; towards the upper end of the waveband, readjustment of the series condenser may bring about an appreciable increase in signal strength, thus giving the impression that the circuits are running out of alignment. Actually, this effect is often due merely to an increase in aerial coupling, of which the resultant increase in signal voltage is greater than that due to misalignment caused by the readjustment.

This effect has been noticed by a reader, who asks us to describe how the accuracy of ganging of the aerial circuit may be checked.

We advise him to set the series condenser at a rather lower capacity than usual, and then to gang by means of the built-in parallel trimmer. Then, if a readjustment of this trimmer at a high wavelength has the effect of increasing signal strength, it must be concluded that ganging is inaccurate. If, however, no improvement can be effected by adjustment of the parallel trimmer, our querist can rest assured that ganging is correct; he should return to the original scheme, which is probably the most efficient.

Causes of Misganging

CORRECT alignment of the various tuned circuits in a superheterodyne is even more important than in a straight set; not only is sensitivity impaired, but also second-channel interference is increased by any shortcomings in this direction.

Describing certain peculiarities noticed in operating his Monodial receiver, a querist asks whether we think it possible that ganging is inaccurate; we are also asked to enumerate briefly the possible causes of such a state of affairs.

We have come to the conclusion that local interference—our old enemy man-made static—must be responsible for the minor difficulties encountered by this correspondent. However, for the benefit of other readers, it would perhaps be as well to set down the only likely causes of misganging. These are (1) incorrectly matched coils; (2) incorrect value of intermediate frequency; (3) excessive stray capacity across one of the tuned circuits; (4) a defective tuning condenser, in which the various sections are not properly matched.

It should be noted that the use of an aerial of excessively high capacity may make it difficult to obtain proper alignment. The remedy here is to insert in series with the aerial a semi-fixed condenser.

The "Power Radio-Gram"

WE are asked to say whether the addition of H.F. amplification to the "Power Radio-Gram," as described in the "Hints and Tips" section of *The Wireless World* for March 24th, is likely to increase the pick-up of extraneous noises.

It is unfortunate, but inevitable, that any addition which tends to increase the overall sensitivity of a receiver is bound to increase background noises as well. However, as the sensitivity of an H.F. stage added to the "Power Radio-Gram" in the manner recommended may be controlled within wide limits, the added background noises will be negligible when the set is being operated at about the same overall sensitivity as it possessed before the H.F. stage was added.

The Wireless World INFORMATION BUREAU

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, Stamford Street, London, S.E.1, 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.