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EDITORIAL COMMENT

A Vote of Confidence

Leave Well—and the B.B.C.—Alone

THE debate in the House of Commons last week on the present conduct and constitution of the B.B.C., which was heralded in some quarters as likely to develop into an earthquake which would shake the foundations of the Corporation, fizzled out instead like the proverbial damp squib, and has effectively postponed any possibility of tampering with B.B.C. affairs for some time to come.

Whilst we have ourselves often been ready to criticise little points connected with the activities of the B.B.C., yet we cannot raise any enthusiasm to support the views of those who disapprove of the way in which the B.B.C. strives to hold the balance and deal fairly with all parties and all sections of opinion at the microphone. We have nothing but admiration for the way in which this particular task has been handled by the Corporation.

If there is a criticism to make it should surely be that the B.B.C. is over sympathetic and considerate towards the multitude of spokesmen of minority opinions. It might perhaps be considered advisable that there should be more control exercised by the B.B.C. to make it less easy for the microphone to become available to minorities often so small that their members qualify to be described as "cranks." This consideration is, no doubt, constantly present in the minds of those who control the B.B.C., and possibly one result of last week's debate will be to encourage more autocratic weeding out of programme matter of doubtful value. The vote which followed the debate was nothing short of a tribute to the ability of those who at present guide the selection of broadcast matter in this country.

Every discussion arising out of the question of the autocratic powers which the B.B.C. enjoys, serves to emphasise the enormous responsibility resting upon the shoulders of those upon whom devolves the task of finding successors, as occasion arises, to replace those exercising authority at Broadcasting House. So long as we can have confidence that, as time goes on, control will pass in succession to persons of equal discretion and competence we have little cause for anxiety, but we hesitate to think what might be the effect of allowing these autocratic powers to pass into the hands of persons less fitted to entrust with so great a responsibility.

The Ferrocart III

Outstanding Selectivity

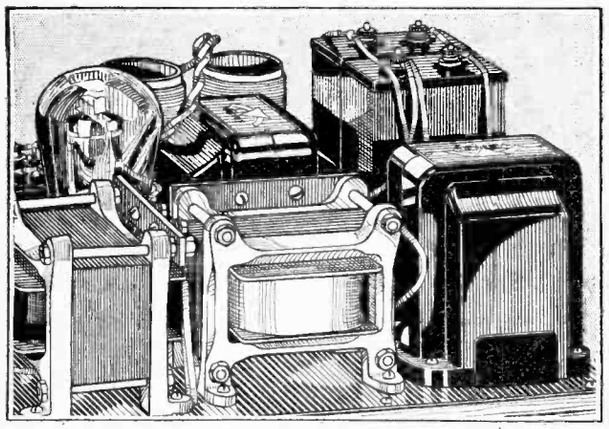
AS we announced last week, we are including in this issue a design for the construction of a three-valve receiver embodying the new Ferrocart coils which have created so much interest, first on account of the complete departure in design from coils of orthodox type, and secondly because of their very high efficiency.

In the receiver described in this issue the selectivity obtainable with a single H.F. stage is phenomenal. We chose for our first practical receiver a single stage H.F. design because this demonstrates more effectively than a multiple H.F. set the outstanding advantages to be derived from coils of this type. Whilst a feature which first strikes the eye is the minute size of the coils, this is probably the least important of the properties, for it is the switching and wiring considerations which control the eventual size of the coil unit.

Economy Smoothing

Hum-free Reception with Minimum Equipment

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



Showing the smoothing equipment required in an ambitious mains receiver

IT is comparatively easy to obtain ripple-free current from the mains supply if chokes and condensers are used regardless of cost. But to effect the same result with the very minimum of equipment requires a knowledge of those factors which contribute towards background noise and hum amplification. The author points out where economy of smoothing components can be safely made and concludes by explaining the virtues of push-pull.

IN designing the smoothing equipment for a mains-driven receiver, some people use brute-force and other people use brains. In the first method one obtains the most capacious condensers and the most massive chokes, regardless of expense, and connects them between the raw output from the rectifier and the receiver proper, and thus attempts to smooth out the ripple to such an extent that it is incapable of causing hum. The object is to make the whole supply of current to the valves practically as unvarying as that obtained from batteries.

The second method aims at putting in the smoothing components just where they are required and omitting them elsewhere.

Apart from the waste of money, the mere adding of choke to choke and condenser to condenser is by no means certain to guarantee freedom from hum. This is particularly true of D.C. working. Not only is the cost of amateur receivers sometimes unnecessarily high, but those produced by manufacturers are not always as economically arranged as they might be. For example, it is sheer wastefulness to pass the current to all the valves through the same smoothing circuit, except, perhaps, in the very simplest type of set.

A Reservoir Analogy

The commonest class of receiver at the present time is the three-valve combination—screen-grid high-frequency stage, detector, and pentode. To illustrate the various ways in which smoothing can be carried out, such a receiver will be assumed, and Fig. 1 shows a skeleton circuit of one.

The irrelevant details are omitted in order to emphasise the parts that are being considered. Thus the intervalve couplings are merely suggested by a non-committal oblong which may contain a tuning coil, transformer, resistor, loud speaker, etc., according to fancy. Grid bias is left out of account, and may be supposed to be looked after by the usual automatic bias resistors, one for each valve requiring it. A valve rectifier is indicated, but the arguments apply equally to metal rectifiers, or to no rectifier at all in the case of D.C. supplies; but while the principles applicable to A.C. operation include D.C. to some extent, the latter is rather special in some ways and will be considered later.

What we have to do, then, is to take a raw output from a rectifier, consisting of separate pulses of current, and smooth it so that when fed to the three anodes, one screen grid, and one pentode grid, the residual ripple is not enough to give rise to hum from the loud speaker. The simplest system is that shown (Fig. 1) in which C1 is a condenser which acts as a reservoir for the irregular gushes from the rectifier, just as a municipal reservoir enables a uniform supply of water to be delivered to the inhabitants, regardless of vagaries of rainfall.

A condenser alone would not be enough unless it had an impracticably enormous capacity, so there is inevitably a certain amount of ripple voltage across C1. To prevent this from causing a corresponding ripple in the current supply to the valves, the iron-core choke L is interposed, because it acts as a high impedance to such ripple current. And what does get through L finds an easy by-pass *via* the second condenser C2, so the proportion reaching the valves is very minute.

Actually C2 is the more effective condenser in minimising hum; C1 is valuable mainly in improving the efficiency of the rectifier and permitting it to deliver its full output.

Amplified Hum

However effective these smoothing components may be, there is always *some* remaining ripple. According to the arrangement of Fig. 1 the current supplied to all the valves carries an equal proportion of ripple, let us say 1 per cent. of the steady feed current. Such a small amount in the supply to the output valve is incapable of creating a bad hum in the speaker, because the musical or vocal ripple corresponding to the broadcast received is very much greater: perhaps 50 per cent. But the supply to the detector valve also has 1 per cent. hum ripple, which reaches the grid of the power valve *via* the intervalve coupling, and is thus amplified along with the more desirable sound currents, so that it may be 20 per cent. by the time it reaches the power valve; a much less satisfactory result. There is, further, the feed to the H.F. valve, and if the coupling to the detector is by way of a condenser, a fair proportion reaches the detector grid and is amplified by that valve also. The hum may thus be actually louder than the proper programme. If the coupling is by H.F. transformer very little is passed on to the detector directly, as such a device is very

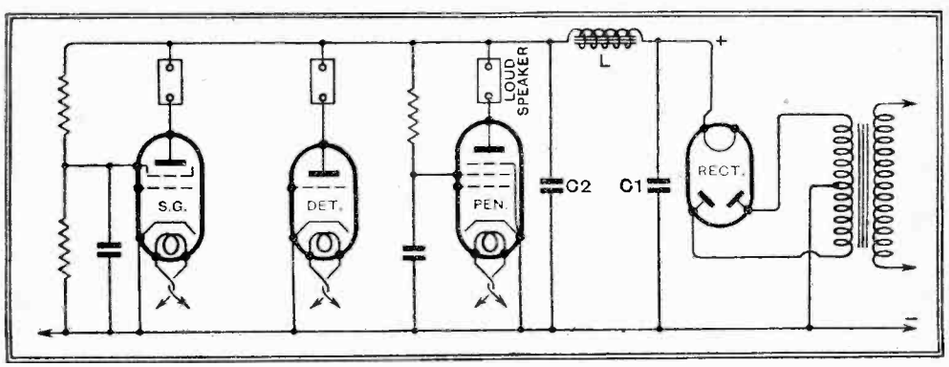


Fig. 1.—Skeleton circuit of a typical three-valve receiver fed by a valve rectifier from A.C. mains.

Economy Smoothing—

ineffective at the low frequency of the hum; but when the carrier wave of a station is tuned in, the hum ripple varies the H.F. amplification and thus modulates the carrier wave. In this way we get the effect of a hum which is only present when a transmission is being received. This variety is usually called modulation hum.

It is clear, then, that the filter C1, L, and C2 must be effective in reducing the ripple to such an extent that it is inoffensive even when amplified.

In former days the cost of such a simple filter for a large set would have been out of all reason, so it was customary to use two chokes and three condensers (Fig. 2) in order to obtain smoothing in easy stages. Two moderately large chokes are cheaper than a single fantastically large one. But now the loud speaker field winding, which is equivalent to a very effective choke, is usually available free of charge; while electrolytic condensers

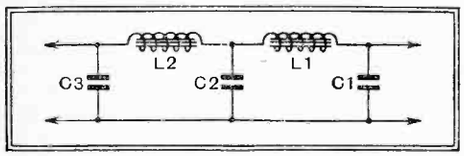


Fig. 2.—To avoid using a very large single choke, two chokes are often used to obtain smoothing in easy stages.

provide a large capacity cheaply. Even so, it is difficult to get enough smoothing from the Fig. 1 filter.

But a receiver of the sort indicated usually—one may say invariably—has decoupling devices in the earlier stages, and these act to some extent as hum filters. In fact, the valves which most need decoupling are just those that most need hum filtering. The reason is the same in both cases—the large subsequent amplification.

Proportional Smoothing

This suggests that we are making a huge mistake in trying to smooth all the current to suit the earlier stages, because the bulk of it goes to the output stage, for which much coarser fodder is good enough. So let us use a filter which is just enough for the last valve, and then pass the relatively small amount of current required for the other valves through a second filter specially designed for it. This may appear strange economy, to add some extras; but let us see. With 4 mfd. condensers, the Fig. 1 filter may easily require a 200 henry choke to kill hum sufficiently. A typical 3-valve receiver takes a total of 40 milliamps. Enquiry as to the price of a choke which is 200 H. at 40 mA. is likely to make one very thoughtful. But a 20 H. choke is probably enough for the last valve only, and the remaining current, say 5 mA., is taken through a 200 H. choke for the benefit of the other valves (Fig. 3). A 200 H. choke to carry 5 mA. is about the same size as the 20 H. for 40 mA.

If L1 is a loud speaker field winding, which is likely to have an inductance of more than 20 H, a still smaller choke will do for L2. But the relatively large ripple voltage developed across the field winding may induce some hum directly into the loud speaker moving coil, so manufacturers usually provide a hum-bucking coil.

Pentode *versus* Triode

The smoothing components now boil down to condensers of reasonable size (C3 at least is low voltage also) and one very diminutive choke. Even if the speaker field is not available, very complete smoothing is possible with two small chokes.

So far, no specific mention has been made of the auxiliary grid of the pentode. The foregoing argument may be applied equally well to a triode. But an interesting point emerges in considering the case of the pentode. If the characteristic curves are consulted it will be seen that quite large variations of anode voltage have scarcely any effect on the amount of anode current. Therefore a ripple voltage superimposed on the supply to the anode has to be quite large to produce an audible effect. Therefore, also, the sketchiest sort of smoothing suffices for this avenue of current, which is by far the largest. The auxiliary grid is not so; its current must be very pure and good, and if the choke L1 is pared to the bone the voltage-dropping resistance R and condenser C (Fig. 3) may not be enough to augment the smoothing, and it will be preferable to draw its supply from the same source as the other valves.

The ordinary triode power valve is much more sensitive to ripple than the pentode, and must be provided for accordingly, but the smoothing situation is considerably altered if push-pull amplification is adopted. Push-pull is commonly supposed to be a method of obtaining a larger output, or less distortion. No doubt it does this to some extent, but there is surprisingly little difference if one valve is removed altogether. The real virtue of push-pull, though it seems to be hidden under a bushel, is that the ripple current

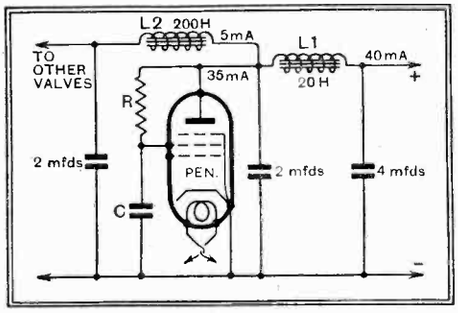


Fig. 3.—Proportional smoothing in which two chokes are used, suitably chosen for the current passing in the output and earlier stages respectively.

in the feed to the two anodes passes through the two halves of the output transformer primary in opposite directions, and cancels out. It is not possible to use totally raw current, for the amplifying properties of the valves would be somewhat upset and, moreover, the valves are not likely to be perfectly balanced. But it is possible to use feed current that is several times rougher than that which would be needed for an equally powerful single valve or parallel valve output. Sometimes it is even practicable to abolish the choke and trust to the standard 8 mfd. electrolytic condenser.

The output transformer also may be enormously cheapened because there is no

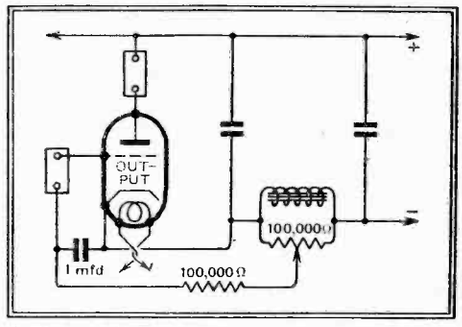


Fig. 4.—Using the volts developed across the speaker field for automatic bias.

resultant polarising effect to saturate its core. But that is outside our subject. The advantage of using a push-pull output for a really powerful amplifier taking a heavy current is immense, for the cost of adequate chokes and transformers otherwise becomes positively alarming. Of course, push-pull does not help the earlier stages; but we have seen that their relatively small consumption renders effective smoothing an easy matter.

D.C. Mains Smoothing

It seems to have become an established custom to connect a choke in the positive side. There appears to be no inherent advantage in this. In fact it may be a definite advantage to place it in the negative lead. For it inevitably drops some volts, particularly if it is a loud speaker field winding. The bias resistor for the power valve also drops volts. By the time all these volts have been lopped off, the power valve is not likely to be doing as well as it ought, so if the choke is in the negative side it may be used simultaneously as a bias resistor. It would be rather a stroke of luck if it were just right for the purpose. Generally it has to be augmented by some resistance added in series, or reduced by tapping. In either case a very imperfectly smoothed bias voltage results, which requires a little subsidiary filter to put it in order (Fig. 4).

Even though smoothing is everywhere adequate it does not necessarily mean freedom from hum. There are other causes of hum which must be eliminated.

In the case of D.C. the actual smoothing required is quite small. For instead of 100 per cent. ripple as in the case of a rectifier output, it is already fairly smooth when supplied by the authorities. But the ripple that is present is most obstinate. It is high pitched in tone and the ear can detect a far smaller amount in the loud speaker output. For the same reason it finds its way into forbidden territory by capacity paths.

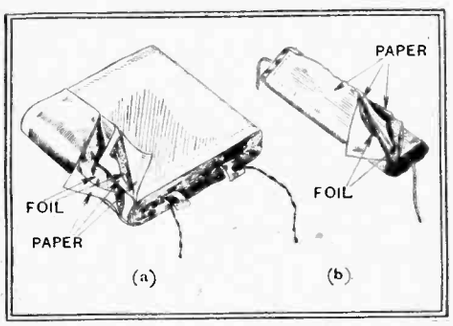
The larger the smoothing choke, the larger the stray capacity is likely to be, so that an endeavour to increase the filtering may be rewarded by more hum.

Practical HINTS AND TIPS

AIDS TO BETTER RECEPTION

A SMALL point with regard to paper condensers of high capacity may be responsible for uncertainty when a stock of existing components is to be used in building a new receiver. The non-inductive condenser has only been manufactured in large quantities during the last few years; condensers of earlier vintage will probably be inductive, and, unless they can be guaranteed as free from this property, there may be a natural hesitation to use them, even though they may be rated to withstand the voltages existing in the receiver.

Condensers: Inductive and Non-inductive



Inductive and non-inductive condensers compared. In the latter (sketch (b)) contact is established along the whole length of each metal foil, and not merely at one end.

These doubts may be set at rest by saying that there is very little risk of trouble through using inductive condensers in any position except where H.F. currents are to be dealt with. Accordingly, old condensers may be employed in L.F. circuits for by-pass and decoupling purposes, and also for smoothing, but they should not be inserted in the anode, grid, or screening grid circuits of the H.F. amplifier.

With regard to the detector anode circuit, where both H.F. and L.F. currents are handled, the position is not quite so clearly defined, but as a general rule the use of inductive condensers is not likely to do serious harm. Any paper condenser of high capacity will almost invariably be on the "dead" side of any H.F. filter that may be included in the circuit.

The accompanying sketch will help to make clear the essential difference between inductive and non-inductive condensers. The first are usually wound with two continuous strips of paper-interleaved foil, electrical connections being made only to one end of each strip. Charging currents flow through the convolutions of the winding, and it is not hard to see why the condenser has some of the properties of a tuning coil. A non-inductive condenser might be built up with a series of flat plates interleaved by paper insulation, but the more common course is to wind the two foils in such a way that their edges project so that contact may be made with them at a number of points, either by soldered or clamped joints. There are other, and rather more subtle, methods of ensuring an absence of inductive properties, but the simple and obvious method described is widely used.

IT is risky to hazard an opinion on the capabilities of a short-wave set after, say, a mere half an hour's experience with it. Short waves are notoriously uncertain, and conditions for their reception may vary from day to day or from hour to hour. Directional transmission has partly, but not entirely, overcome this element of uncertainty—as witness the Empire Service.

Improves with Acquaintance

When conditions are good a most unpromising receiver may afford wonderful results over enormous ranges, while the best of sets in unfavourable circumstances may fail entirely to receive intelligible signals from any distant station.

Accordingly, a short-wave receiver should, strictly speaking, be neither condemned nor praised except as the result of a direct comparison with other sets. The second-best alternative to this is a prolonged series of tests spread over a period of time.

The human element also comes into the picture. Those whose experience has been confined to normal broadcast reception are apt to feel very much at sea when first handling a short-wave set; until this feeling wears off it is unlikely that the user will get the best possible results from his set.

THE clearances allowed in moving-coil loud speaker construction are usually very small, and so it is not surprising that the worst sometimes happens, and the moving coil makes intermittent contact with the sides of the gap in which it works. This highly undesirable rubbing contact may take place at all positions, or it may only occur towards one end of the travel of the coil. In all cases the result is serious distortion, and, as a rule, a reduction in volume.

Centring the Moving Coil

A rubbing contact between the moving coil and the magnet is not so easy to diagnose as one might expect, and probably the simplest and most certain way of making sure that this trouble is present is to listen to the loud speaker when it is reproducing a sustained pure note of constant intensity, and preferably low periodicity. If the trouble in question is present a secondary frequency, superimposed on the applied tone, will be audible.

A supply of about 20 or 30 volts of A.C., periodicity 50 to 100 cycles, is suitable for the purpose of testing; it may not be obvious to users of A.C. sets that voltages of this order are usually available in their own receivers.

Most mains transformers have a primary winding tapped for various intermediate voltages between 200 and 250 volts, and in these tappings we have just what is needed. To make a test, the loud speaker output transformer may be disconnected from its usual position in the circuit and joined across the power-transformer tappings in the manner shown in Fig. 1. The position of the output-transformer connections depends on the power required to vibrate the loud speaker diaphragm at reasonable amplitudes for testing. Care must be taken not to apply too much voltage, and, most important of all, not to impose a short-circuit on the mains supply.

While tests are being carried out the leads originally connected to the output-transformer primary may be joined together in order to maintain a sensibly constant load on the H.T. power supply system of the receiver, and thus to prevent damage to condensers, etc.

It is hardly to be generally recommended that the amateur should himself undertake the somewhat ticklish operation

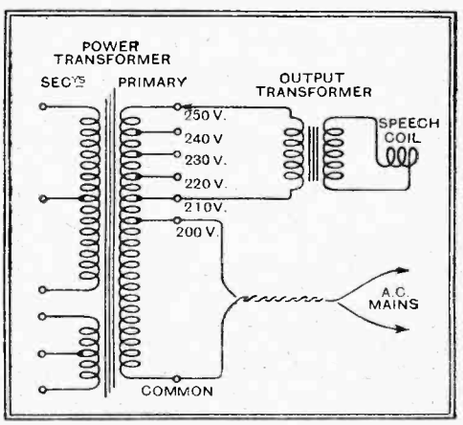


Fig. 1.—A.C. voltages of from 10 to 40 or 50 volts may be obtained, for test purposes, from the tapped primary of a mains transformer.

of re-centring the moving coil if the service department of the makers is available for doing it for him. Patience and a light touch is generally needed, and the work can best be done while the loud speaker diaphragm is being actuated by the stepped-down mains voltage. The fact that the rubbing contact has been removed is shown by the disappearance of the secondary audible frequency.

Broadcast Brevities

By Our Special Correspondent

B.B.C. and the "Ultra Shorts"

FROM being the topic of the hour, the ultra short wave tests at Broadcasting House have become a prosaic affair of daily routine. Certain of the engineers have rigged up ultra short wave adaptors at their houses, listening in daily to ultra short relays of the National or Regional programmes. One man uses his "ultra short" set as far away as Purley, fifteen miles distant.

Day Unto Day

From time to time the quality of reception is compared with that from the medium-wave transmitters, and an entry is made in a log book. So the tests go on. In a few years' time, if all goes well, a senior engineer may inspect the logs, discover that ultra short-wave broadcasting is a practical proposition, and write a paper for the I.E.E.

No harm will be done because, by that time, the Regional scheme will be decently obsolete.

A Subject for "Free Grid"

"FREE GRID," whose absence abroad, by the way, has aroused a surprising amount of interest in unexpected quarters, would be pained to hear that the Blattnerphone is being used this week by the B.B.C. for the Leicestershire County celebrations without the fact being indicated to listeners. And I have private information to the effect that this form of recording, unheralded and unsung, has been used on similar occasions in the past.

The explosions in a Leicestershire quarry which will be broadcast to-morrow (Saturday) were recorded several days ago.

Not What it Seems

And those factory noises. The more intelligent of listeners must have guessed, of course, that no factory staff would set to work at full pelt at 9 p.m. simply to provide "noises" for a B.B.C. programme. These sounds of work, always so soothing to people who are not working, are Blattnerphoned during the day and broadcast at night.

Mugwumpery

THE Commons debate on broadcasting had the result which everyone in Broadcasting House predicted, viz., a vindication of the *status quo*, no additional Parliamentary control being considered necessary in the public interest. The only highlight in the debate was the display of verbal pyrotechnics by Mr. Winston Churchill, whose allusion to "pontifical anonymous mugwumpery" seemed, to at least one listener, to be more disrespectful than untruthful.

Ambiguous

A mugwump, according to the Pocket Oxford Dictionary, is a "person affecting superiority to party politics." The term is of North-American-Indian origin and stands for "great chief."

On second thoughts I feel that Mr. Churchill intended a compliment.

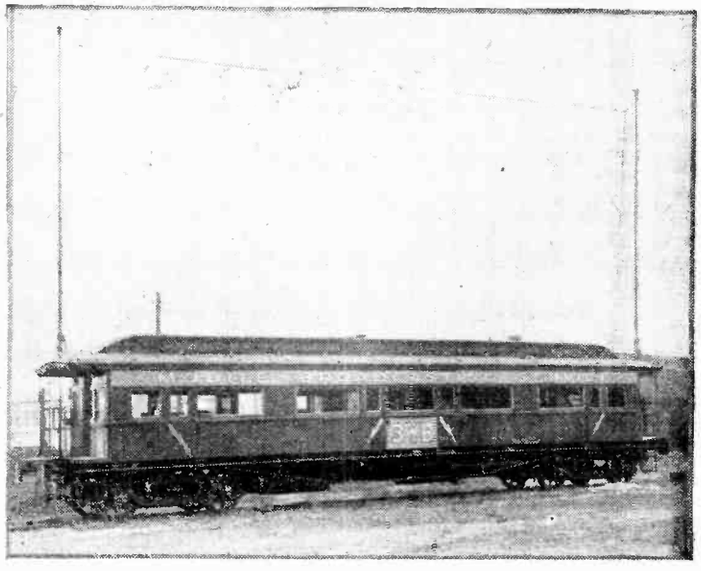
Remarkable Coincidence

HARMAN GRISEWOOD is to make his last appearance in radio drama next month in the revival of "Chopin," by Wilfred Rooke-Ley, which is to be broadcast Nationally on March 31st, and from the Regionals on April 1st. He will then join the Broadcasting House announcing staff which, by a remarkable coincidence, already includes Frederick Grisewood—no relation!

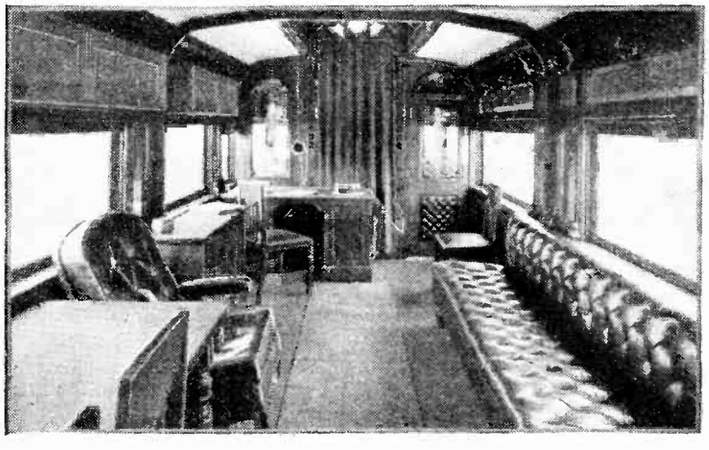
I am told that the chances of another Grisewood (unrelated to either) joining the announcing staff within a twelvemonth are 1,743,101 to 1. Try working it out with a pack of cards and the joker.

Announcing to the Empire

De Groot, the young London announcer, is now devoting his time to Empire announcements only, and, in the words of the Cockney, "the job ain't no synagogue," for the Empire station transmits for twelve-and-a-half hours daily.



HERE TO-DAY AND GONE TO-MORROW. This travelling broadcasting station roams Victoria, Australia, distributing sponsored programmes over a fairly wide service area.



A STUDIO ON RAILS. A portion of the Victorian Railways coach is utilised as a studio, seen above, the remainder housing the transmitter and power generators.

Time-Table Changes

The Empire transmission times are being changed slightly as from April 2nd next in such a way that the Third and Fourth Zones will be virtually merged.

At present the African Zone (III) receives its own programmes from 6 to 8 p.m. G.M.T., and the West African Zone (IV) from 8.30 to 10.30 p.m. G.M.T. Under the new arrangement the programme for both Zones will be a continuous affair from 6 to 10.30 p.m.

The Indian Zone (II) period will also be extended, transmission being continuous from 1.30 to 5.30 p.m.

Sticking to G.M.T.

Although British Summer Time begins on April 9th, the B.B.C. intends to use Greenwich time as the basis for all Empire broadcasting time-tables.

Film Talks by Cecil Lewis

CECIL LEWIS—"Uncle Caractacus" of former days and Director of Programmes—will shortly return to the microphone to give a series of talks on "How a Film is Made."

Since he left the B.B.C. five years ago, Cecil Lewis has done much scenario writing and production for British International Pictures at Elstree, and I imagine that he could "talk shop" at the microphone in a highly interesting manner.

The Boat Race Relay

J. D. M. SNAGGE, who made such a success of the Boat Race Relay last year, will perform the same task on the afternoon of April 1st, when he will follow the crews in the launch "Magician." As in past years, the short-wave transmission from the launch will be picked up on the roof of Harrod's Depository, near Hammersmith Bridge. The race is expected to start at 3.50 p.m., in which case the commentary will begin a quarter of an hour earlier.

The Grand National

THE Grand National Relay is always a favourite. This year the race takes place on March 24th. The commentators will be Mr. R. C. Lyle, who will give his description from Topham's private stand, and Mr. W. Hobbis, who will be occupying a strategical position at the Canal Turn. Mr. Snagge, of Boat Race fame, will describe the scene at the start.

What more could one want, except to back a winner?

NEWS of the WEEK

Wireless in Church

A WIRELESS set in every church within the next three years is the forecast of the vicar of St. James's, Carlisle, the Rev. F. W. Hopkins, whose church is used for the reception of broadcast services.

Finlandia

FINLAND stations are to be increased in power. We understand that the Viipuri station is to be raised from 10 to 40 kilowatts, while Oulu is to increase its power to 10 kilowatts.

Listening Boom in Irish Free State ?

A BIG jump in the number of wireless licences in the Irish Free State is expected following the opening of the Athlone high-power station.

The increase will not come too soon. At the end of last year only 31,094 licences had been issued, which is equivalent to a licence for one person in a hundred.

Toulouse Gets Impatient

DESPITE appeals to the Post Office authorities, Radio Toulouse, the new 60-kilowatt station at Saint Agnan, is not yet licensed for transmission. The touring organisations of the Pyrenees and the Basque Coast have now demanded that the station should be allowed to function in the same manner as other private transmitters such as Radio Paris and Poste Parisien, "which have already been authorised to increase their power."

Did You Hear the Nouba ?

WHILE we wait impatiently for news of the postponed electrical music concert from the German stations, it is consoling to know that Radio Algiers broadcast an entire "Nouba" on February 23rd. A correspondent states that the broadcast included "the overture, its Messeders, its betaihis, its derdjs, its nessrafs, its final or meklass and its partial preludes or kersis." He adds that a Nouba, "though it suggests some sort of a sweet thing, is a common or garden symphonic suite in A minor."

Prize for Radio Cabinet Design

A TEN-GUINEA Wireless Set is offered by the Six-Sixty Radio Company for a design for a radio cabinet in connection with the Royal Society of Arts Competition of Industrial Designs, 1933.

Messrs. Ferranti, Ltd., offer a first prize of £20 and a second prize of £10 for designs for window showcards advertising synchronous Electric Clocks.

The descriptive booklet concerning the competitions can be obtained from the Royal Society of Arts, John Street, Adelphi, W.C.2, price 4d., post free.

A Radio Church

AUCKLAND, New Zealand, has a "Radio Parson," the Rev. C. G. Scrimgeour, who has relinquished control of a city mission in favour of a "radio church" operated by station 1ZR.

Current Events in Brief Review

Fewer Sponsored Programmes from Paris ?

FROM a reliable source we learn that *Radio Paris* will be definitely taken over by the French postal authorities on April 1st, a step which it is expected will mean a diminution in the number of sponsored programmes from the station. Originally the P.T.T. intended building an official station to replace the Eiffel Tower for broadcasting purposes, but the purchase of *Radio Paris* has been decided upon for economic reasons.

Presidential Broadcasts To-morrow

PRACTICALLY every broadcast wavelength in America will be occupied to-morrow (Saturday) with verbal and musical details of President Roosevelt's inauguration at Washington. The broadcast is to be the most elaborate in history.

The Presidential programme will run from 2.30 p.m. to 9.30 p.m. G.M.T., and the parade of welcome in Washington will be described from speakers' booths, from "roving stations" strapped on the backs of peripatetic reporters or carried in cars, from aeroplanes and airships, and from (for the inaugural address) the stand at the east entrance to the Capitol. Radio cars will follow the new President in the procession to the White House, and listeners will hear the noise of the gathered multitudes.

Among the American short-wave stations which are expected to broadcast the event are W3XAL (49.18 metres), W8SK (48.86 metres), W2XAF (31.48 metres), and W8XK (25.27 metres).

Opera from Greece

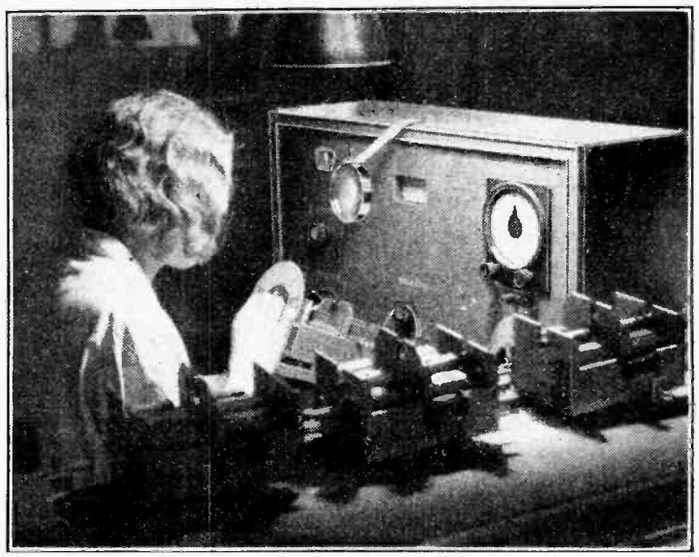
IF "burning Sappho lived and sung" in our times she would be eligible for the job of lady announcer in Greece, for the first Hellenic transmissions are now being carried out in a businesslike manner by Radio Salonika on a wavelength of 265 metres and a power of 2 kilowatts. The station is run by the Salonika Association of Wireless Listeners, who recently arranged a vocal recital by Vitsou and Epitropaki, soprano and tenor, respectively, of the Hellenic Opera.

New R.M.A. Chairman

MR. W. WITT BURNHAM has been elected chairman of the Radio Manufacturers' Association in succession to Mr. Leslie McMichael. Mr. Burnham, who is now head of the radio activities of the Edison Swan Electric Co., was connected with the industry long before the advent of broadcasting. He was chairman of the National Association of Radio Manufacturers and Traders for three years before the present organisation came into existence.

German Political Broadcasting

THE German Government is taking rigorous measures to ensure that propaganda broadcasts in connection with the coming elections shall not be interfered with. Recently when Herr Hitler was giving a speech a line linking the hall with the Stuttgart broadcasting station was cut fifteen minutes before the end of the speech. Next morning, writes a correspondent, the Ministry of Posts in Berlin ordered that the officials responsible for the technical side of Stuttgart broadcasting should be immediately suspended from their duties until the matter had been investigated.



TESTING VARIABLE CONDENSERS. Before being passed for mounting in a receiver, condensers in the Lorenz factory, at Berlin, are tested in a small transmitter. The tester is here seen watching the dial readings through a magnifying glass.

Special Revolution Service

"A REGULAR service of alarming and disturbing news" was broadcast from a mystery station in Barcelona during the recent Communist troubles, writes a correspondent. Orders have been given to the Postal Administration to track the transmitter and bring its owners to justice.

Comfort for Cooks

THE French "Bulletin National du Commerce et de l'Industrie" contains a special notice assuring chefs and all engaged in the restaurant trade that their livelihood is not likely to suffer in the near future by the introduction of cooking by wireless.

The writer, under the signature "Le Maitre d'Hôtel," refutes all rumours to the contrary.

H.F. in Food Preservation

ALTHOUGH experiments in the preservation of food by means of short electro-magnetic waves are not a novelty, it is interesting to learn that the Soviet Government has voted 60 millions of roubles to a competent organisation undertaking food sterilisation of cooking by wireless.

Professors Kasterine and Lacharov are stated to be in charge of the experiments at station MGSPS.

Canadian Listeners to Pay More ?

CANADIAN Government estimates for radio services during the 1933-34 fiscal year further set at rest apprehensions among Canadian broadcasters that the recently established Canadian Radio Commission will take over the ownership and operation of broadcasting stations under the nationalisation scheme voted by Parliament last year.

Though the estimates represent an increase of $562,975 over the appropriations for the current fiscal year, they include only $1,000,000 for broadcasting services, which is only a fraction of the amount that would be needed to take over Canadian stations from their present owners.

Proposals have been made to increase the listener licence fee of $2 to $3, $4 or $5.

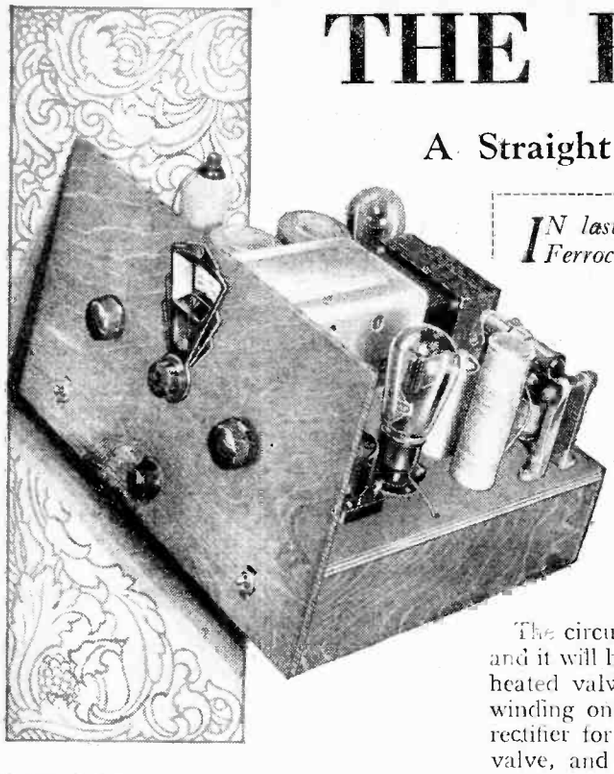
Eavesdropping on the Police

POLICE "broadcasts," which provided a craze among American listeners on the short waves some months ago, may have a similar effect in this country judging from the experience of Brighton listeners during recent tests by the local police with their pocket wireless system. The transmissions are made from a station on the roof of the Town Hall, and, although a wavelength of 147 metres is used, listeners in the neighbourhood appear to have heard the tests at various points on their receiver dials.

"I heard the messages on 200 to 400 metres and 1,000 to 1,750 metres," declared one listener. Apparently no secrets are being given away by the Brighton police, for the messages picked up by listeners merely ask patrolling officers to ring up headquarters on the next telephone!

THE FERROCART III

A Straight A.C. Set of Outstanding Selectivity



IN last week's issue appeared the first description of the British version of Ferrocart coils. Practical tests showed that so high was the efficiency of these coils that it was possible to obtain from a simple straight set a degree of selectivity which bids fair to rival that of the superheterodyne. The Ferrocart III receiver, constructional details of which are presented in this article, gives an outstanding performance and is undoubtedly a great advance over other receivers with a similar number of valves and tuned circuits.

By W. T. COCKING

THE benefits to be derived from the use of the new high-efficiency iron-cored tuning coils were fully discussed in last week's issue of *The Wireless World*, and it is, therefore, unnecessary to enter into the theoretical side of the matter here. It will suffice to point out that the employment of Ferrocart coils leads to a normal performance so far as sensitivity and quality of reproduction are concerned, but permits the attainment of vastly improved selectivity. The small and inexpensive three-valve set, therefore, is once again rendered capable of meeting the exacting conditions imposed by the present congestion of the broadcast ether.

The circuit diagram is shown in Fig. 1, and it will be seen that the three indirectly heated valves are all run from the same winding on the mains transformer. The rectifier for the H.T. supply is a 442BU valve, and it is supplied with 350 volts A.C.; the 4 mfd. reservoir condenser C17 is of the electrolytic type. The D.C. potential across this condenser is reduced to the value required by the receiver valves, some 250 volts, by the passage of the total anode current through the smoothing choke Ch4. This component has a resistance of 2,500 ohms and a working inductance of 70 H., so that in conjunction with the 8 mfd. condenser C18 a very high degree of smoothing is obtained. Actually, of course, the requisite smoothing could have been provided by a lower resistance choke, and a smaller A.C. input to the rectifier would then have been permissible. The extra voltage, however, increases the cost to a very small extent, and it makes it readily possible to energise the field winding of a moving-coil speaker, should this be used. With such a speaker it is merely necessary to omit the choke Ch4, and to connect the 2,500 ohms field winding in its place. If hum is to be avoided with this arrangement, of course, the speaker must be fitted with humbucking.

Circuit Values

The screen of the output pentode, an MP-Pen, is fed directly from the 250 volts line, and the anode is also fed from the same point through a tapped pentode output choke Ch3, across which is connected the usual pentode compensator, comprising the 10,000 ohms resistance R14 and the 0.01 mfd. condenser C15. The speaker itself is fed through the 2 mfd. condenser C16, and in view of the step-down ratio normally employed, this allows of full bass reproduction to be obtained by virtue of resonance with the speaker.

The grid bias for the pentode is obtained by the voltage drop along the 300 ohms

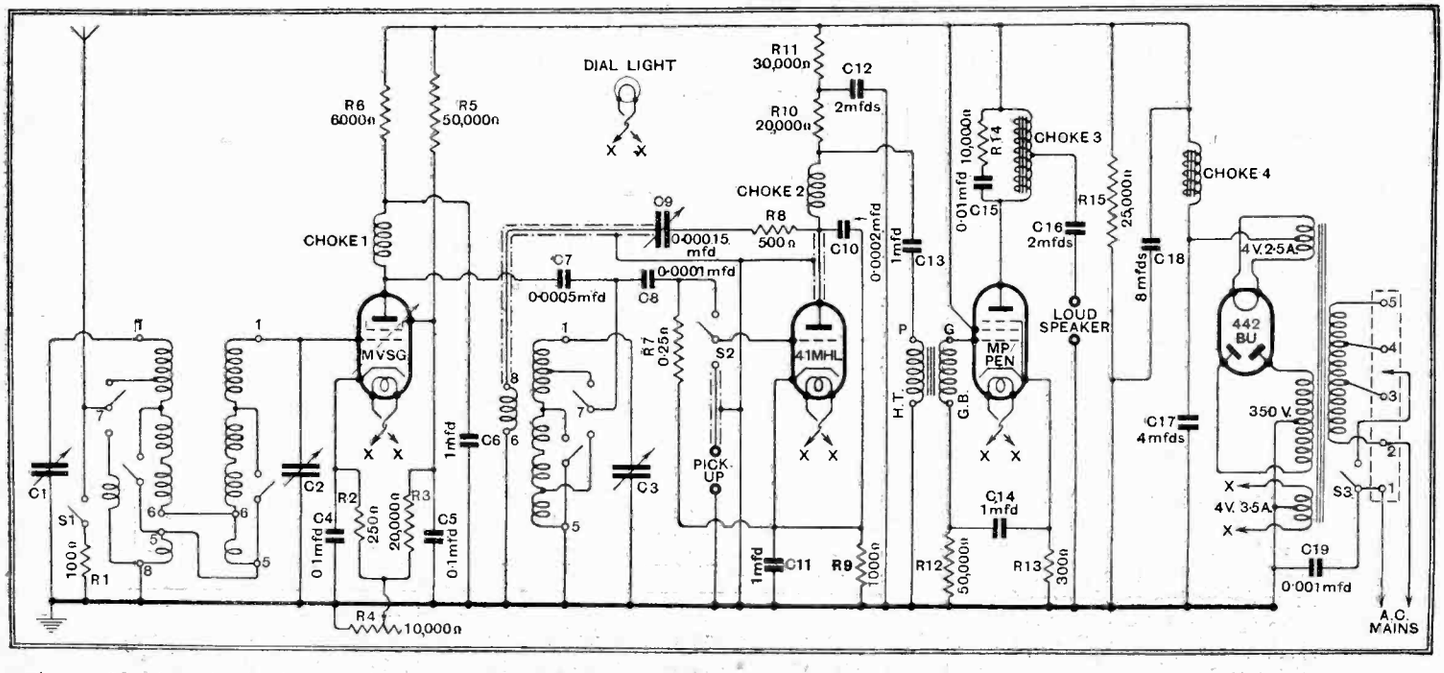
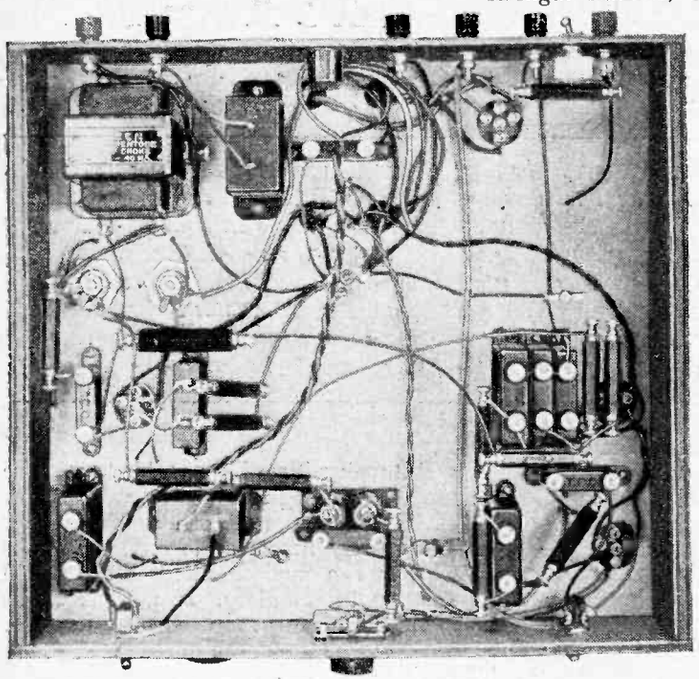


Fig. 1.—Complete circuit diagram of the Ferrocart III receiver. The overall response of the three tuned circuits is such as to give good quality of reproduction over the wavebands.

Ferrocart III—



View of the under baseboard where most of the decoupling components are mounted.

resistance R13 in the cathode circuit, and the grid circuit is decoupled by the 50,000 ohms resistance R12 and the 1 mfd. condenser C14. The L.F. intervalve coupling is by means of a resistance-capacity fed transformer, the resistance R10 in the detector anode circuit being given a value of 20,000 ohms and the coupling condenser C13 a capacity of 1 mfd. The detector anode circuit is decoupled by a 30,000 ohms resistance R11 and a 2 mfd. condenser C12. The H.F. choke Ch2 and the by-pass condenser C10, of 0.0002 mfd. capacity, serve to prevent the passage of H.F. currents into the purely L.F. circuits and also ensure the correct operation of reaction. A bias resistance R9 of 1,000 ohms, shunted by a 1 mfd. condenser C11, is provided in the detector cathode circuit to provide the necessary negative bias for gramophone reproduction, and the switch S2 in the grid circuit permits a change from radio to gramophone to be readily made.

Two Volume Control Ranges

The variable-mu H.F. valve is fed from a network of resistances designed to keep the anode and screen potentials substantially constant, irrespective of the actual bias voltage. The anode is fed through the 6,000 ohms resistance R6, with a 1 mfd. non-inductive by-pass condenser C6, while the screen is fed from the combination comprising R5, R3, and R4, with values of 50,000 ohms, 20,000 ohms, and 10,000 ohms respectively, the last being the volume control. The screen and cathode are both by-passed to earth by the 0.1 mfd. non-inductive condensers C5 and C4, and the fixed minimum value of bias for the H.F. valve is provided by the 250 ohms resistance R2.

The range of control afforded by the variable resistance is ample for all normal strength stations, but it fails when it is desired to reduce a nearby local station to a reasonable volume. To cover this important case, therefore, a local-distance switch S1 is fitted, whereby a fixed resistance R1 of 100 ohms can be thrown at will across the aerial and earth terminals, thus giving a fresh range of control.

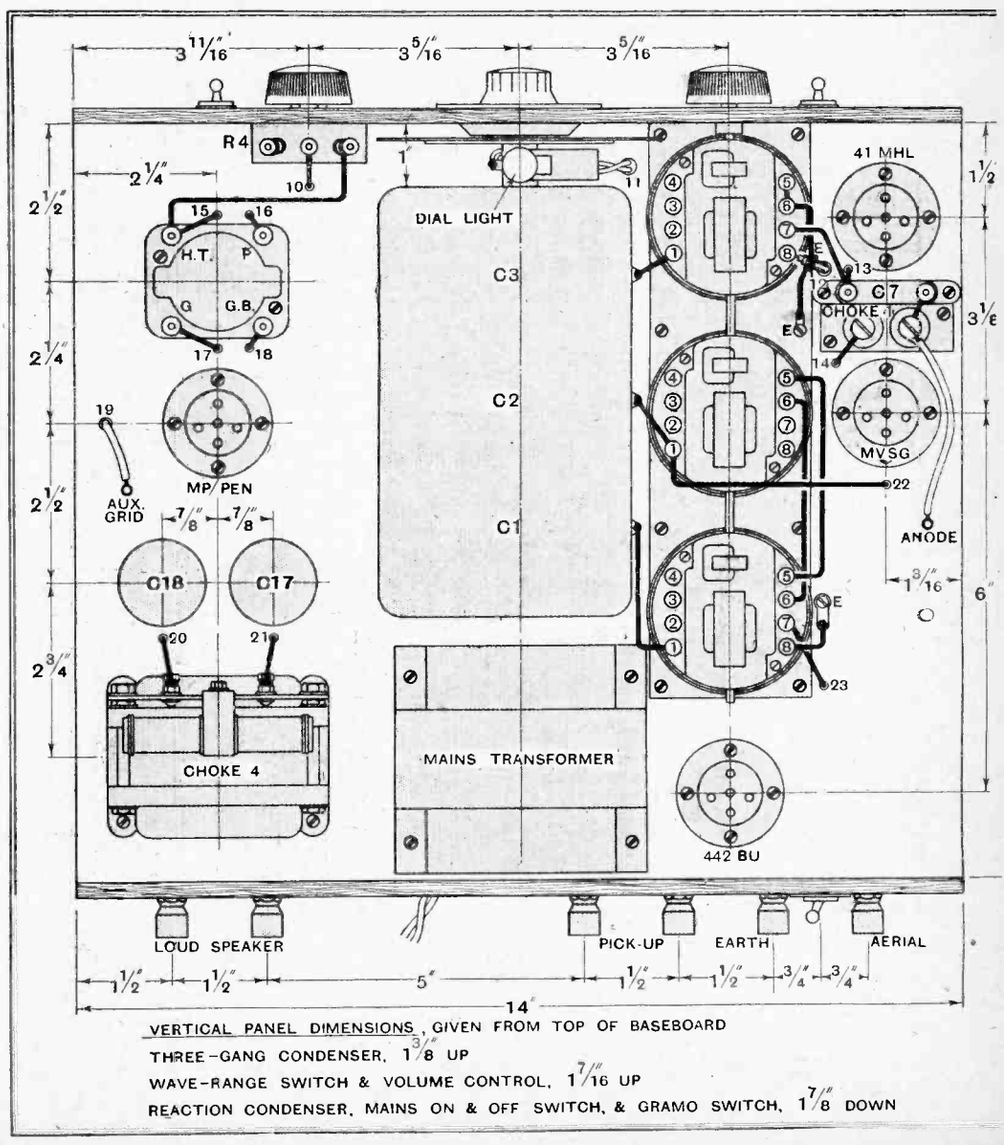
It is unnecessary here to enter into the design of the H.F. circuits, for this was dealt with in last week's article. It will be obvious that the input filter and the intervalve coupling are tuned by the three sections C1, C2, and C3, of the three-gang condenser, and this, of course, is of the straight type, with identical sections. Accurate matching is of the first importance, and the necessity for using a high-quality component cannot be too highly stressed. The H.F. chokes Ch1 and Ch2 have also an effect upon the ganging, and it is recommended that no deviation be made from the specification in respect of these by no means unimportant items.

Initial Adjustments

The layout adopted for the receiver is very straightforward, and no constructional difficulties should be met with. The aluminium covered baseboard is obtainable in chassis form with the large holes already drilled, and the metal covering is easily pierced with a pricker for the remaining wood screws. For those who prefer it, a stamped metal chassis is available as an alternative.

Although the actual component is of the differential type, the reaction condenser C9 is wired up as a straight condenser. One set of fixed plates, therefore, is left blank. The mains transformer is of the

THE LAYOUT OF PARTS ABOVE AND BEL



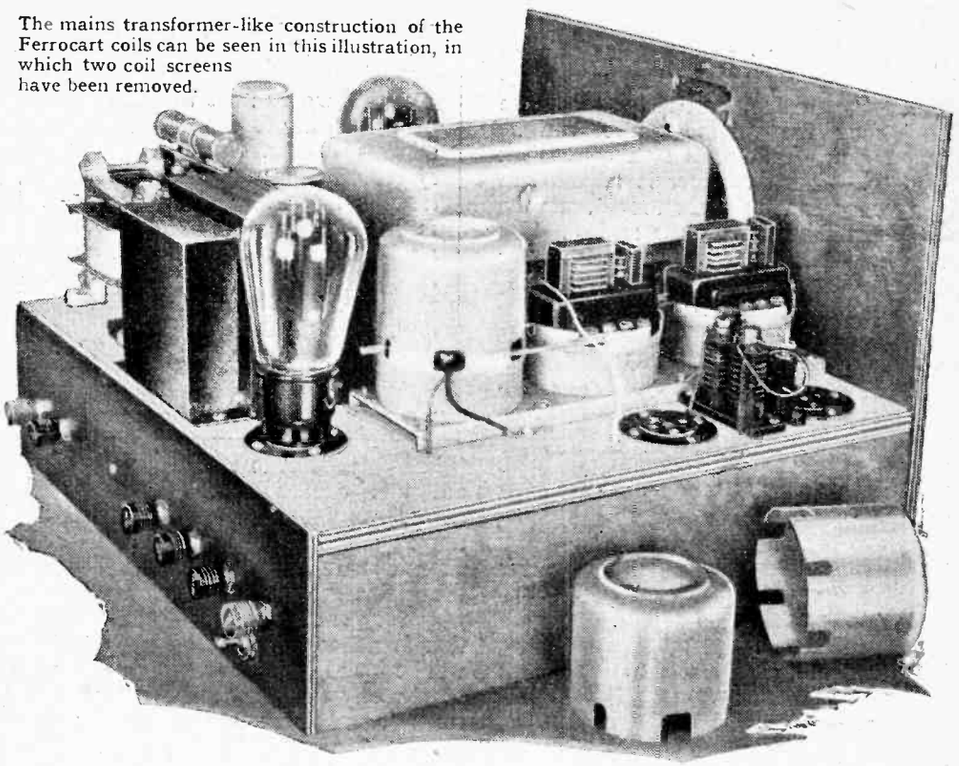
VERTICAL PANEL DIMENSIONS, GIVEN FROM TOP OF BASEBOARD
THREE-GANG CONDENSER, 1 3/8" UP
WAVE-RANGE SWITCH & VOLUME CONTROL, 1 7/16" UP
REACTION CONDENSER, MAINS ON & OFF SWITCH, & GRAMO SWITCH, 1 7/8" DOWN

Ferrocart III—chassis mounting type, without terminals, and the leading-out wires are brought through the baseboard beneath the component. For the sake of safety, and to facilitate the connection to the mains, a 5-way terminal block is fitted as an anchorage to the primary tappings.

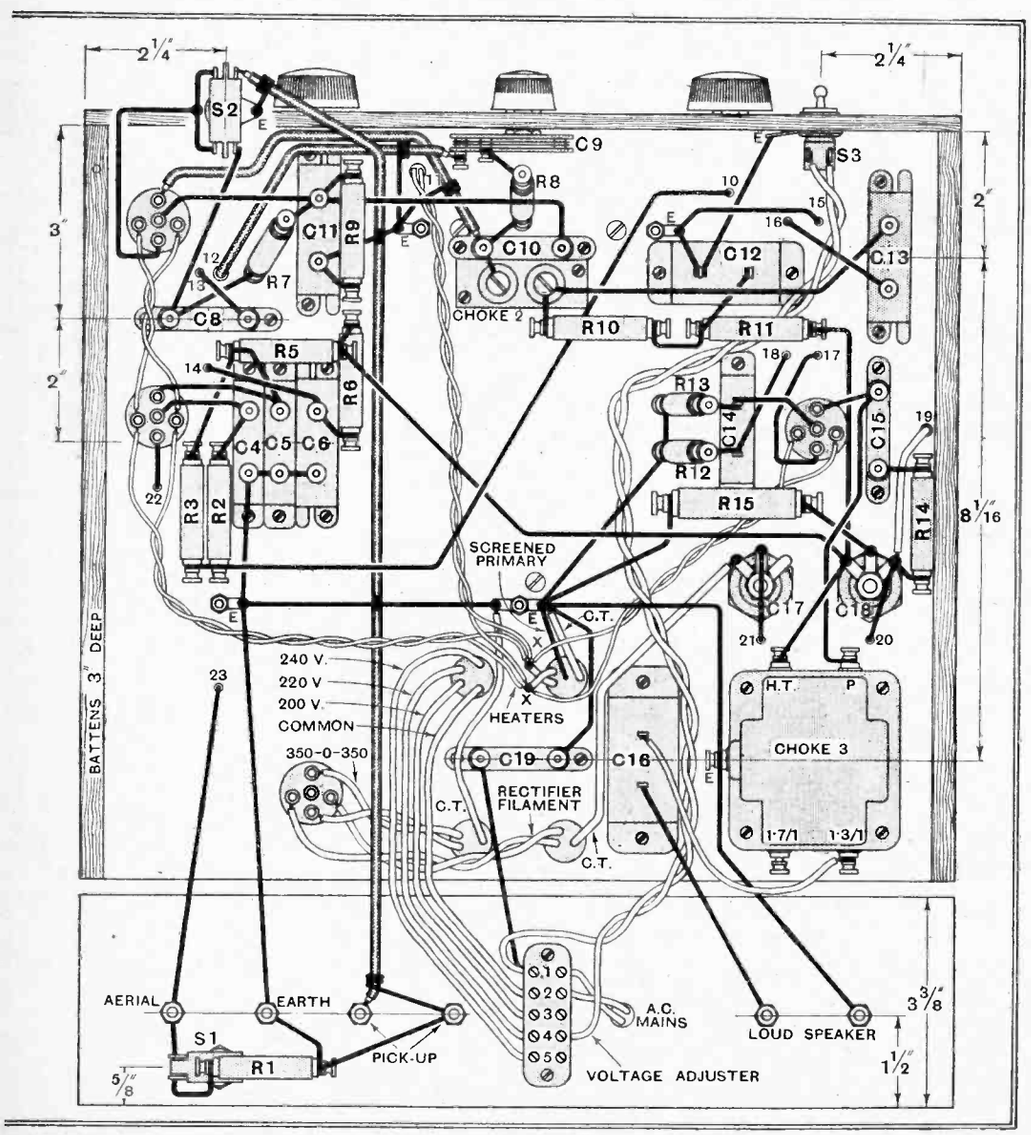
The frame of the gang condenser is earthed by its contact with the metal-covered chassis, and so it is of the first importance to see that a really sound connection is made. The fixing bolts must all be well tightened up, and as they may slacken after a time, due to the compression of the wood, it is a wise plan to go over the set a week or so after it has been built, and re-tighten all bolts. The coils are supplied mounted on a metal strip, and here, again, care must be taken to see that the strip makes good contact with the base. The switch rod for the coils should be earthed by a metal contact bolted to the coil strip and pressing against the rod between the filter and intervalve coils. Without such an earthing contact, instability will be found on the long waveband, and ganging will be affected.

In order to prevent hum on operating

The mains transformer-like construction of the Ferrocart coils can be seen in this illustration, in which two coil screens have been removed.



HE BASEBOARD, ALSO COMPLETE WIRING PLAN



the radio-gram switch, the metal body of this component is earthed by a large tag inserted under its fixing nut, and the same course is adopted for the mains on-off switch. Since the wires to the latter are in the mains circuit, they must be kept away from other components, and in order to avoid modulation hum due to H.F. currents being transferred from them to the receiver circuits, a 0.001 mfd. 1,000 volts test condenser C19 is connected between the mains and earth.

No. 22 gauge tinned copper wire is used throughout for wiring, and the use of screened sleeving is confined to the gramophone circuits and the anode side of the detector valve. No use is made of this sleeving in the H.F. circuits, since it has been found unnecessary in this case, and it tends to introduce losses.

The Trimmers

Apart from the choice of the correct tapping on the output choke to suit the particular speaker employed, the initial adjustments are confined to the ganging. These are few in number, and readily carried out, but it is important that they be made accurately. The grid circuit of the H.F. valve will be found to have the highest stray capacity, so that the trimmer on this circuit must be nearly fully screwed out, whereas the trimmers on C1 and C3 should be nearly fully screwed home.

It is essential for the trimming to be adjusted on a very low wavelength, but if it be found impossible at first to tune in a suitable station a preliminary adjustment should be made on a higher wavelength. After this there should be no difficulty in receiving a station on a wavelength below that of the London National, and the ganging can then be accurately adjusted. When ganging the local-distance switch *must* be at distance.

Ferrocart III—

While ganging it is important to use as much reaction as possible without the set actually oscillating, and if the signal be too strong the volume control can be turned down until it is at a convenient strength. Each trimmer is adjusted in turn for maximum signal strength, and the settings will be found quite critical. The aim should be to arrive at a setting for each trimmer such that any further alteration causes decreased signal strength.

LIST OF PARTS

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

1 **3-gang condenser**, 0.0005 mfd., with right-hand trimmers — **British Radiophone**
1 **Dial and dial light assembly** — **British Radiophone**
1 **Reaction condenser**, differential or straight, 0.00015 mfd., C9 — **Formo 28c** (Polar, Ormond)
1 **Set of Ferrocart coils** — **Colvern**
2 **H.F. chokes, Ch1, Ch2** — **McMichael "Binocular Junior"**
4 **5-pin Valveholders** — **Clix chassis-mounting type** (Eddystone)
1 **Volume control**, 10,000 ohms. R4 — **Colvern ST5C** (British Radiophone, Igranic, Watmel)
1 **Electrolytic condenser**, 4 mfd., C17 — **T.C.C. type 802**
1 **Electrolytic condenser**, 8 mfd., C18 — **T.C.C. type 802**
2 **Fixed condensers**, 2 mfd., 250 v. D.C. working. C12, C16 — **T.C.C. type 65**
1 **Fixed condenser**, 1 mfd., 250 v. D.C. working. C14 — **T.C.C. type 65**
2 **Fixed condensers**, 0.1 mfd., non-inductive, 400 v. D.C. test. C4, C5 — **T.C.C. type 50**
3 **Fixed condensers**, 1 mfd., non-inductive, 400 v. D.C. test. C6, C11, C13 — **T.C.C. type 50**
1 **Fixed condenser**, 0.0005 mfd., C7 — **T.C.C. type 34**
1 **Fixed condenser**, 0.0001 mfd., C8 — **T.C.C. type 34**
1 **Fixed condenser**, 0.0002 mfd., C10 — **T.C.C. type 34**
1 **Fixed condenser**, 0.01 mfd., C15 — **T.C.C. type 34**
1 **Fixed condenser**, 0.001 mfd., mica, 1,000 v. D.C. test. C19 — **T.C.C.** (Dubilier).
2 **Q.M.B. make-and-break switches, S1, S3** — **Bulgin S80**
1 **Q.M.B. change-over switch, S2** — **Bulgin S81** (British Radiophone, Claude Lyons)
1 **Pentode output choke, Ch3** — **Telsen power type W172** (R.I.)
1 **2,500 ohms speaker field replacement choke, Ch4** — **Sound Sales** (R.I., Scott Sessions)
1 **Mains transformer**, screened primary, 350-0-350 v. 60 mA. 4 v. 2.5 amp. C.T., 4 v. 3.5 amp. C.T. — **Bryce** (Challis, Parmeko, R.I.)
1 **L.F. transformer** — **Lewcos type L.F.T.4** (Varley)
1 **Resistance**, 100 ohms, R1 — **Graham Farish "Ohmite"**
1 **Resistance**, 250 ohms, R2 — **Graham Farish "Ohmite"**
1 **Resistance**, 300 ohms, R13 — **Graham Farish "Ohmite"**
1 **Resistance**, 500 ohms, R8 — **Graham Farish "Ohmite"**
1 **Resistance**, 1,000 ohms, R9 — **Graham Farish "Ohmite"**
1 **Resistance**, 6,000 ohms, R6 — **Graham Farish "Ohmite"**
1 **Resistance**, 10,000 ohms, R14 — **Graham Farish "Ohmite"**
2 **Resistances**, 20,000 ohms, R3, R10 — **Graham Farish "Ohmite"**
1 **Resistance**, 30,000 ohms, R11 — **Graham Farish "Ohmite"**
2 **Resistances**, 50,000 ohms, R5, R12 — **Graham Farish "Ohmite"**
1 **Resistance**, 250,000 ohms, R7 — **Graham Farish "Ohmite"**
1 **Resistance**, 25,000 ohms, 3 watts, R15 — **Graham Farish "Ohmite" Power type "HD"** (Dubilier, Erie, Claude Lyons)
1 **5-way Connector** — **Wilburn**
6 **Terminals**, aerial, earth, L.S.+, L.S.−, 2 pick-up (Belling-Lee, Eelex, Igranic) — **Clix type "B"**
1 **Plymax baseboard**, 14in. x 12in. x ⅜in. — **Peto-Scott** (Prepared Metal Base Plate, bent and drilled Colvern)
Panel, oak-faced ply, 9in. x 14in. — **Peto-Scott**
2 **Lengths screened sleeving** — **Harbros** (Goltone, Lewcos)
2 ozs. 20 tinned copper wire, wood. 6 lengths sistoflex, etc.
Screws: 14 ⅛in. No. 4 R/hd.; 4 ¼in. No. 6 R/hd.; 20 ⅜in. No. 4 R/hd.; 4 ½in. No. 4 R/hd.; 12 ¾in. No. 4 R/hd.
Valves: 1 MVSG, 1 41MHL, 1MP/PEN, 1 442BU — **Cossor**

Readers selecting alternative components from the suggestions given above, should remember that slight modifications may be necessary in the drilling positions for fixing these components on the panel and baseboard. The prepared metal base plate listed as an alternative will, we understand, be drilled to accommodate the components used in our design and listed in black type.

PROGRESS NUMBER

NEXT week's issue will be devoted principally to a survey of recent wireless progress. Successive advances of outstanding interest have been crowded into the last few years and it is felt that the time is ripe to take stock of the situation and see where we stand to-day.

There will be articles devoted to the advances made in H.F. amplification, detection, L.F. amplification and loud speaker technique, as well as the evolution of the superheterodyne.

The only point to watch while carrying out this operation is that too much capacity is not used, for then the tuning range would be restricted. If stray capacities are kept down to the figures of the original receiver, and there is no reason why they should not be if the specification is adhered to, the correct condition will be found with the trimmer on C2 very nearly fully unscrewed. When the adjustment is completed at a low wavelength the ganging will hold over the whole of both wave ranges.

The next step is to select the optimum tapping on the output choke, so that the speaker is correctly matched to the pentode. If a moving-coil speaker with a pentode transformer be used the 1-1 ratio will be needed, and in this particular case it would be possible to dispense entirely with the output choke and C16, and to connect the primary directly in the pentode anode circuit. In general, however, other types of speaker will be used, and the ratio should be selected experimentally for the best quality. The values of the compensating circuit R14 and C15 have been chosen to suit the majority of moving-coil speakers, but with moving-iron types it may pay to experiment with other values.

With a good aerial, and after dark, the sensitivity is sufficient to permit good reception of most of the stronger Continental stations with reaction at zero. It will usually pay, however, to use a little reaction, even although it may be unnecessary from the point of view of signal strength, and to keep the volume at the desired level by reducing the setting of the volume control. In this way it is possible greatly to increase the selectivity above its normal level, although this latter is unusually high.

Reaction is particularly valuable when receiving a station situated in wavelength close to the local, and, in fact, when searching it is often advisable to work with reaction close to the oscillation point and the volume control turned well down. When the desired station is found it can then be tuned in accurately, and the reaction reduced while simultaneously increasing the volume-control setting, until the best compromise between selectivity and quality is found for that particular station.

It is unnecessary to say much here about the performance obtainable, for details of this have already appeared in *The Wireless World*, and the completed receiver will speak for itself. It may be said, however, that the sensitivity is entirely adequate for most normal purposes, hum is absent, and the quality of reproduction reaches a very satisfying standard, for both high and low notes are present in the output and the volume obtainable is quite considerable. It is in the matter of selectivity that the receiver is so outstanding, and it is not too much to say that, among ordinary receivers, it is surpassed only by the superheterodyne.

The completed receiver was tested within nine miles of Brookmans Park, and, while both locals were working, it proved possible to receive some seventy stations on the medium waveband alone. The spread of the London Regional was confined to about three channels on either side, and that of the London National to about six channels. In its power of separating adjacent distance stations the receiver proved entirely adequate, and only in rare cases was intelligible modulation interference experienced.

BLUE PRINTS

For the convenience of readers constructing this receiver, full-sized blue prints of the complete layout and wiring diagram are available from the publishers at 1s. 6d. post free.

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

CLUB NEWS

For Short-wave Enthusiasts

THE London Chapter of the International Short Wave Club holds meetings which are open to members and non-members alike. The meetings are held at the R.A.C.S Hall, Wandsworth Road, London, S.W.8.

Full particulars are obtainable from the European representative, Mr. A. E. Bear, 10, St. Mary's Place, Rotherhithe, London, S.E.16.

The Twelfth Year

THE Ilford and District Radio Society is enjoying its twelfth year of active work. On a recent evening Mr. H. L. Ranson lectured on "Measuring the Performance of a Receiver," giving a demonstration on laboratory lines and testing a commercial A.C. receiver with a standard signal generator.

Hon. Secretary: Mr. C. E. Largen, 16, Clements Road, Ilford.

A Local Loud Speaker

PARTICULAR interest attached to the last meeting of the Bristol and District Radio and Television Society, as a local enterprise—The Ray Engineering Co., Ltd., of Bristol—gave a demonstration of their Ray Senior P.M. Speaker. When demonstrated on a 5-watt amplifier and pick-up reproduction was very good, and the output at high and low frequencies was considered by members to be above the average.

Hon. Secretary: Mr. G. E. Benskin, 12, Maurice Road, St. Andrew's Park, Bristol, 6.

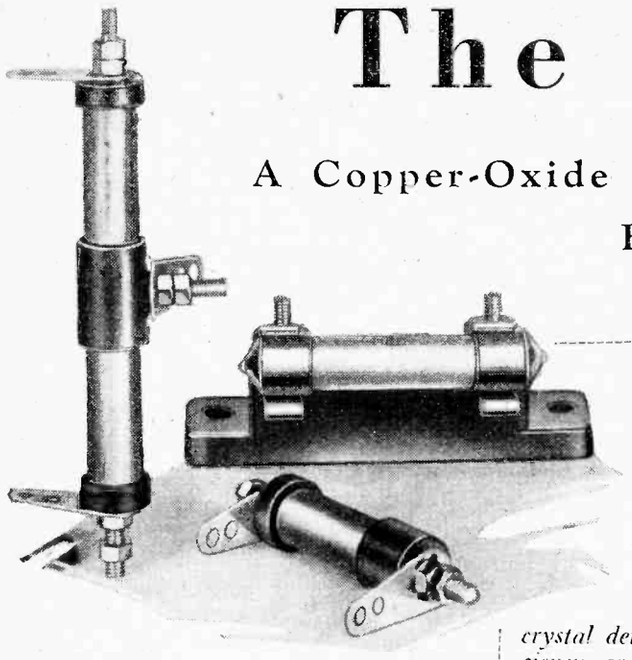
Loud Speaker Night

THE types of loud speaker used during the last ten years were interestingly described by Mr. F. Neale at the last meeting of the Tottenham Wireless Society. Almost forgotten types, such as the Sterling Fan, Western Electric Kone, and the Yankee three feet cones were recalled to memory. Mr. Burns followed with a talk on "Loud Speaker Construction," and the evening concluded with a practical demonstration of modern types.

Hon. Secretary: Mr. W. B. Bodemeaid, 10, Bruce Grove, Tottenham, London, N.17.

The Westector

A Copper-Oxide Rectifier for H.F. Currents



The new Westinghouse Westectors shown alongside a grid leak. The larger of the two is type W.M.26 and the smaller W.4.

THE valve has for so long been supreme as a detector in receivers that it comes as something of a shock to find any serious rival. Non-thermionic rectifiers have, of course, long been known, as witness the crystal detector, but either their efficiency or their reliability has been so low that they have been completely displaced by the valve. The properties of the new Westinghouse detector are such that it can replace a diode detector in the superhet and still permit A.V.C. to be obtained.

THE use of metal rectifiers in H.T. supply units is quite familiar; it is a development of these which now threatens the supremacy of the valve. Metal rectifiers are now available for the rectification of radio-frequency currents; in their physical dimensions they are strictly comparable with a grid-leak type resistance, as can be seen from the illustration; they require no current or voltage supply, they need no adjustment, and, so far as short tests can determine, they are reliable.

The rectifier, of course, does not amplify, and if its efficiency be compared with either an anode bend or a grid detector, it will be found greatly inferior. This is not a fair comparison, however, for these methods of valve detection are really dual stages, in which a single valve gives both rectification and amplification. To be fair, a Westector must be compared with a diode detector; in theory, it should give a practically identical performance, and practical tests show that the difference with correctly designed circuits is negligible.

Comparable with a Diode

There are two main types of Westectors, the W. 4 and the W. 6; these are both half-wave rectifiers, strictly comparable with an ordinary diode detector. Each is rated to pass a maximum current of 0.25 mA. and the W. 4 is designed for a maximum input of 24 volts peak, whereas the W. 6 can handle up to 36 volts. Full-wave types are also available, and these are comparable with the duo-diode; they consist of a pair of W. 4 or W. 6 rectifiers and are designated as types W.M. 24 and W.M. 26. Their characteristics are the same, but as the signal input is normally applied in push-pull, the permissible values are doubled, and a total of 72 volts peak can be applied to the W.M. 26. As far as the output circuit is concerned, of course, the rectifiers are in parallel, so that the maximum current output becomes 0.5 mA.

In the design of these rectifiers, every precaution has been taken to reduce the inevitable capacity to a minimum. In spite of this, however, the capacity is rather higher than that of a valve, and the rectifiers are, generally speaking, not so suitable for use directly on the medium-wave broadcast band as in I.F. circuits. At 1,000 kc. (300 metres), the makers quote the equivalent load of the detector as 10,000 ohms. This is rather a low figure, and would damp any tuned circuit to which it might be connected. Furthermore, it might necessitate the use of a power H.F. stage immediately preceding the detector.

These difficulties will probably be overcome, but at present the chief practical use for the Westector undoubtedly lies in the superheterodyne. At the low intermediate frequency (110 kc. or so) generally employed the damping is much less, for the capacity of the unit is comparatively unimportant. As a result, the preceding tuned circuit can be of more normal effective efficiency, and the necessity for a power H.F. stage is avoided. Indeed, an ordinary variable-mu valve can be used satisfactorily to drive the detector.

In all respects, the Westector behaves as a diode detector in a superheterodyne, and in the same way it may be used to provide automatic volume control. As a test on the operation, the type W. 26 was substituted for a duo-diode valve in an A.V.C. superheterodyne with an intermediate frequency of 110 kc., and, judged audibly, there was no difference whatever in the performance. A type W. 6 was then substituted for an ordinary diode detector in an A.V.C. superheterodyne of similar type, and here again no audible change was detectable. The response is understood to be substantially linear, and this is borne out by the fact that during the tests distortion remained at as low a level as with a valve detector.

Owing to the fact that neither electrode need be at earth potential, modified circuits become permissible, and the makers advise the use of the arrangements shown in Fig. 1 (a) and (b) for half- and full-wave rectification respectively. If A.V.C. be used, the polarity of the rectifier is important. It should be understood that the use of these circuits is not essential, for the ordinary diode valve circuits can also be used, treating the positive and negative terminals of the Westector as the cathode and anode. The makers claim,

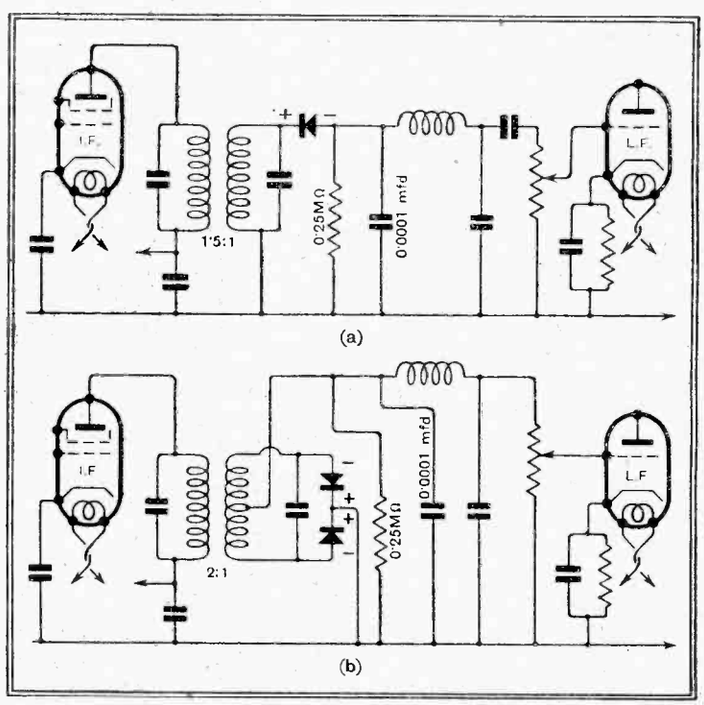


Fig. 1.—The recommended connections of the Westector as the second detector of a superheterodyne are shown at (a) for half-wave rectification and at (b) for full-wave.

The Westector—however, that, with the recommended arrangement, the I.F. currents in the output are about one-tenth of those with more normal circuits, so that less I.F. filtering is needed. In order to reduce damping of the tuned circuits to as low a figure as possible, step-down ratios in the transformers are advised, and the ratios are marked on the circuits.

It would appear, therefore, that these rectifiers open up a useful alternative to the valve diode detector in superheterodynes, and it seems probable that one of their chief applications will lie in the development of simple automatic volume-control systems. The makers are the Westinghouse Brake & Saxby Signal Co., Ltd.

DISTANT RECEPTION NOTES.

W.W. Station Finder

THOUGH I had no doubt after reading the published description of it that *The Wireless World* Station Finder was a good thing, I must confess that I had hardly expected to find such extraordinary accuracy as it has proved to possess during the week that I have had it in use.

I tried it first of all with a particularly selective seven-valve super-heterodyne which is calibrated to the proverbial hair's breadth. In this way I was able to check to a nicety the readings of the Station Finder. After the small adjustment to the trimmer which took about five minutes to make, the Station Finder showed itself to be dead accurate over the whole of the waveband that it covers, that is, between Fécamp on 223 metres and Ljubljana on 574.7 metres. Every station came in at exactly the setting indicated by the Finder.

The next test was to apply it to an uncalibrated set which was completely strange to me. A preliminary survey of the key stations indicated that no further adjustment of the trimmer was required and within an hour I was able to prepare with the help of the Station Finder a large-sized calibration chart for the set based upon the readings required for no less than thirty-eight stations.

The Station Finder is unquestionably a real boon to the long-distance enthusiast, for it makes the business of identifying stations not mere guesswork but a certainty. I have only one criticism to make: it takes in only the medium waveband. Could the designer evolve a model which covers both the medium and the long waves?* Possibly, too, something might be done with a short-wave Station Finder, which would be invaluable. Short-wave reception lends itself admirably to the absorption method of measuring frequencies or wavelengths.

I have received an interesting letter from a Marlow correspondent, who asks whether I was listening to American stations during the early hours of February 14. He reports wonderful reception of many U.S.A. transmissions, whose strength he describes as "honestly comparable to that of European transmissions." As luck would have it, I did not sit up late on that night, though I have heard from several quarters that transatlantic reception was then particularly good. There have been also some very favourable nights since then.

It was stated some time ago that Germany was making certain changes in her relay network in view of the large service areas obtained by the high-powered transmitting stations. Though I have no official information on the subject, it would appear that on several nights during the week at any rate the Berlin relay, which works on the wavelength of 283 metres, is using considerably more than the half-kilowatt with which it is credited in the lists. Further, it seems as if this station were then working without wavelength partners. It can be picked up at full loud-speaker strength and without a trace of the distortion one associates with common-wave transmissions.

Readers should note that this relay now often furnishes the best means of receiving the Berlin programmes, for the volume obtainable from the 283-metre transmission is considerably greater than that from the parent station, Berlin Witzleben, on 419.5 metres.

D. EXER.

* A long-wave model was considered, but it was thought that the cost could not be justified in view of the limited number of long-wave stations and the fact that they are really easy to identify compared with those of the medium band.—ED.

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

Empire Broadcasting

PLEASE accept my very best wishes for 1933. My very best thanks and esteemed appreciation in "The Great Push" you have given to Empire broadcasting.

Using the battery version of the "Single Dial Super" in conjunction with the S/W adaptor published in your issue of December 23rd, 1931, I have nightly received the tests from the Empire Station at full loud speaker strength. The 31-metre transmission is the only satisfactory wave received here, the 49-metre being swamped by Moscow and Morse. It is rather strange to relate that the transmissions to the Canadian and Indian zones are received at practically the same strength as those transmissions intended for South Africa, and, of course, the times are much more convenient for Mauritius. As regards times, I think that these could very well be modified. You will appreciate that remaining out of bed from 10 p.m. till midnight is not very appealing to one in this climate. Of course, it is quite OK for the South African folk; they get the transmission at 8 p.m., a most convenient time, but we are two hours ahead of them, so it means 10 to 12 p.m. for us. I do think the authorities at home might alter the time of the transmission to South Africa from 17.00 to 19.00 G.M.T. I don't think the South African folk would mind; this would coincide with 9 to 11 p.m. here, and, of course, 7 to 9 p.m. South African time. Well, it is no use grumbling, and I must thank you for what we have got. In any case, it is 100 per cent. superior to G5SW, which was never more than a whisper, and not that on most evenings. Without doubt, the most consistently received station is Pontoise France; he just roars through any old time, but his modulation is just appalling.

RICHARD C. WADE,
O/C Radio,
H.M. Radio Station,
Rose Belle, Mauritius.

Daventry 5XX

IN the issues of *The Wireless World* dated February 10, under the heading of Broadcast Brevities, your special correspondent makes some remarks concerning the Daventry 5XX National programme transmitter, which we consider misleading and likely to give a grossly inaccurate impression of the reliability of that equipment.

We think you will be interested in the actual breakdown figures of Daventry 5XX taken over two periods of six months in 1932 and up to the end of the first week in February of this year. For the six months ended June 30, 1932, the percentage breakdown was 0.034 per cent., for the subsequent six months 0.056 per cent., and for the period January 1 to February 4, 1933, the figure was 0.032 per cent. You will observe that the percentage breakdown of the station is actually less this year than it was either in the first or the last half of 1932. Further, more than half the breakdown periods were due to valve failures which, of course, have no relation to the age of the transmitting equipment.

F. W. BISHOP,
for Chief Engineer,
The British Broadcasting Corporation.

What Does the Public Want?

A LISTENER may be content with local station reception for six days a week, but occasionally requires to receive a distant transmission (e.g., Radio Paris on Sundays). To do this, the receiver must have a fair performance, according to the listener's ideas of selectivity and quality. Because of this performance on the one desired distant transmission, the remainder of distant transmissions must perforce come into step with it.

So we get the listener with good performance by his receiver on two local and one distant stations, with all others thrown in whether he particularly wants them or not.

Warwickshire. R. F. COOKE.

UNTIL a few months ago I resided in London, and I think that it is due to "Diagnostic" living within a service area of a British station that he writes as his view that few people listen to foreign transmissions. Almost any set, under these conditions, will give interference-free reception of the local stations, but the reception of foreign programmes on nearby wavelengths is impossible. So that except, perhaps, on Sunday, when the English programmes from Radio Paris are on the air, the set is usually used for local reception. Take this set outside a service area, and it will be found that only the National is worth listening to, of all the English stations. In this district French and German stations have a greater signal strength than the home medium-wave

ones, and what is more, they are a much steadier signal. The result is that if there is a vaudeville programme on the Regional, sets are tuned in to it, and the whole is blotted out every few minutes by a more powerful foreign station. When the vaudeville is over, the set is tuned to whichever powerful station happens to be sending over music. It is to help solve such problems that better sets are needed. But the number of valves required seem excessive when a purchaser says, "But I only want to receive the English stations."

J. S. THOMAS.

Chippenham, Wiltshire.

IN the vehement correspondence engendered by "Diagnostic," one is left with the impression that either receivers for local stations are all that one needs, or else that the possessor of a long-range and sensitive super-het. is wasting the money he has invested in the expensive set.

But what is a local station?

The Londoner, with his usual parochial mind, imagines that his own experience covers the whole of this island kingdom. With a two- or three-valve set he can receive the two London transmitters without interference, and thinks that the rest of his countrymen can do likewise. In Sussex, the *local* station is Fecamp, as reference to any map will prove, the nearest B.B.C. transmitter being somewhere in the region of eighty miles distant. In order to receive the English transmissions one must possess a set that will equally receive a large number of foreign programmes. I installed the Monodial A.C. Super, not for its power to pick up some 140 stations (which it does), but because it enables me to receive *any* programme I choose without any interference by other stations, and yet, by its tone corrector, give a quality denied to me by any other super-het.

Because I possess an acknowledged supersensitive and selective receiver, I do not consider that ether-searching is its main function. For fully 90 per cent. of my listening time I am satisfied with one or other of the B.B.C. programmes. For the balance, some attractive foreign programmes selected from *The Wireless World* fill the bill. I am quite sure that, like myself, a preponderating number of listeners have installed the Monodial and other selective sets in order to receive B.B.C. programmes *perfectly*, no matter where they may be.

E. HOWARD BURNETT.

Hove.

I AGREE with your correspondent "Diagnostic" in his contention that there is a public demand for a simple type of receiver that is capable of receiving the local station with good quality and nothing much else. The majority of listeners do not make a practice of tuning in foreigners, except perhaps on Sundays.

The snag lies in the expression "local station." Here, in the South of England, to receive satisfactorily London Regional and Midland Regional clear of interference a very selective set is necessary. Although one may be quite content to listen to these stations, a simple type of receiver will not deliver the goods. All I want is a set that will give me three stations with good quality after dark, but such a set must necessarily throw in foreign stations whether I want them or not.

"Diagnostic's" criticisms of receiver design seem to be based on the supposition that one lives near a Regional station.

Fareham. "SOUTHERNER."

I WAS very interested in your leader and the letter signed "Diagnostic" regarding the range required by present-day listeners in their receivers.

From my geographic situation, the only stations giving "satisfactory" service are Belfast and Daventry 5XX. Possibly I will be able to add Athlone to the list later. When I say satisfactory I refer not so much to quality as freedom from fading. If I am prepared to sit with my hand on the volume control (my set has one H.F. stage) and follow the fading, I can obtain results which satisfy my not too critical ear from most of the important European stations. Of course, on really bad nights this "following of the fading" will prove impossible or not worth while owing to distortion.

I have been following the details of A.V.C. as set out in your various articles over the past twelve months with the greatest interest, and am most definitely convinced that a smaller set than a super-het. so fitted would find a very large market.

I am well satisfied with the B.B.C. programme in 80 per cent. of my listening, but when the alternatives available are too highbrow or too religious I switch over to the Continent.

J. W. BROWN.

Northern Ireland.

"DIAGNOSTIC" is apparently like a large number of British manufacturers in thinking that the public should be supplied with what is good for them and not what they ask for.

But, seriously, what would be the use of a super-quality local station receiver to a large number of listeners, as, for instance, the residents of the City of Portsmouth? A measurement of field strength would indicate that many foreign stations are received as, or more, powerfully than the B.B.C. stations. In these conditions it is quite obvious that a set must first have selectivity of a high order and a degree of sensitivity sufficient for reasonable quality. Even bearable quality cannot be obtained if the set has to be worked full out.

Without wishing to be dogmatic, I can say that definitely all the listeners I know in this locality use the foreign transmission to a greater or less degree, and find considerable entertainment value therein. Furthermore, I am of the opinion that sets can be made to give quality satisfying to most music-lovers, and yet give a degree of selectivity sufficient to separate stations which are not actually heterodyning each other.

No! "Diagnostic," I think *some* of the public are demanding the type of receivers they require.

L. S. COLLINS.

Portsmouth.

THE public want, as they always have from time immemorial, something different, something new, something for a change from that which they have hitherto been accustomed; hence the desire for sets to reach out farther and farther.

Just take a note of those chronic radio grumblers we know, and we can bet a modern super-het against their "local" set that they are very limited in their programme selections.

That our programmes are greatly appreciated abroad will not be denied; and for the same reason that theirs are equally appreciated over here—they constitute a welcome change from the type of entertainment which, sooner or later, will become tiring owing to its familiarity.

That the reception quality of foreign stations is not so good as the local will also not be denied, but this is the age of progress and we must urge our manufacturers to keep abreast of the times.

There is ample scope for improvement yet, and it is futile to deny that the general public will ever consider that anything is so good that it cannot be better.

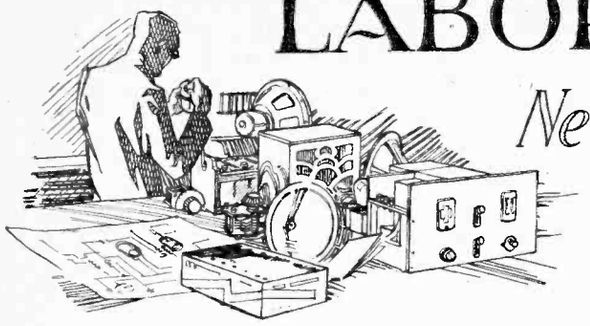
Our manufacturers *must* go on and on and on, *or else they will go out.*

Highbury, N.5. W. GARTLAND.

SM6UA. Owned by Mr. J. F. Karlson, of Redbergsplatzen, Göteborg, Sweden, one of the oldest and certainly the best known Swedish amateur, whose original call-sign was SMUA. During the summer months the station is often transferred to Mr. Karlson's country residence at Orust. He is always glad to work or assist in tests with anyone, and the "mural decorations" indicate that he has been in communication with all parts of the world.

LABORATORY TESTS

New Radio Products Reviewed



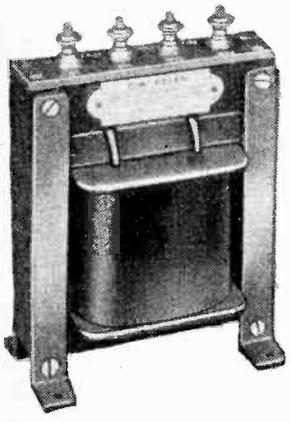
EELES L.F. TRANSFORMER

ALTHOUGH the size of this transformer is appreciably greater than the majority in general use to-day, it possesses the distinct advantage that comparatively large amounts of D.C. can be passed through the primary winding without serious effect on its inductance. The resistance of the primary is 800 ohms. With no D.C. flowing the primary shows an inductance of 34 henrys; with 4 mA. this falls to 27.5 henrys, and with 10 mA. the inductance is 20.5 henrys. Since valves taking anode currents of this magnitude will be of fairly low impedance, an inductance of 20 henrys or so under working conditions is quite adequate to ensure a good bass response.

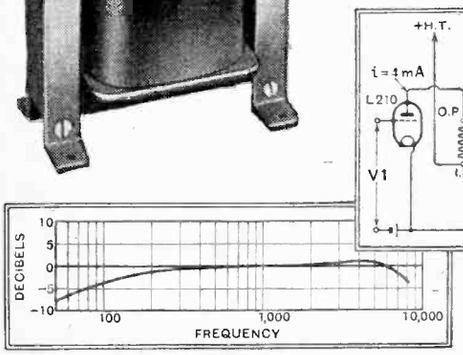
The transformer was tested in an amplifying stage fitted with a valve of 10,000 ohms A.C. resistance and with 4 mA. of D.C. flowing in the anode circuit. The quality of reproduction was exceptionally good, comparing very well indeed with that usually associated with parallel-fed coupling systems, in which the primary inductance is maintained at a high level by deflecting the steady D.C. through a high anode resistance.

At 50 cycles the amplification is less than 8 decibels lower than that at 1,000 cycles, but from this point up to 7,000 cycles it is sensibly constant. At 8,000 cycles the drop is a shade less than 4 decibels only.

As a whole the performance is decidedly good. The transformer affords a voltage step-up of 1 to 4, and the price is 25s.



Eeles L.F. transformer giving step-up ratio of 1 to 4.



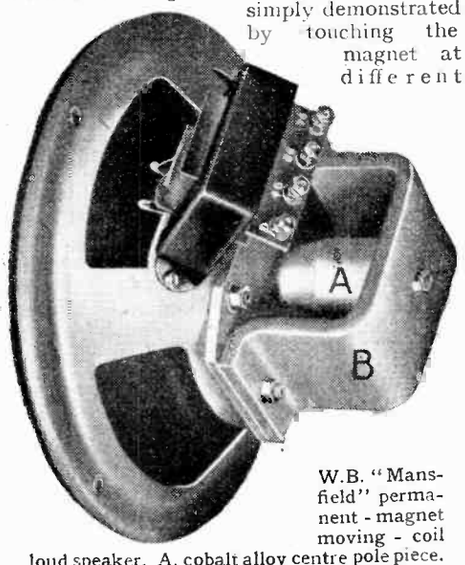
Overall characteristic curve of Eeles L.F. intervalve transformer.

The makers are C. W. Eeles, 17, Bramerton Street, Chelsea, London, S.W.3.

W.B. "MANSFIELD" LOUD SPEAKER

THIS inexpensive permanent-magnet moving-coil loud speaker is notable for the design of its field magnet. The magneto-motive force is supplied by the short centre pole piece which is a steel alloy of very high cobalt content. A special steel alloy having low reluctance (magnetic resistance) is used for the U-shaped return piece, and as a result a gratifying high flux density is concentrated in the gap for a minimum volume of the comparatively expensive cobalt alloy.

Another feature of this system is the reduction of magnetic leakage, as may be simply demonstrated by touching the magnet at different points with a screwdriver. Advantage has been taken of this to fit a steel diaphragm chassis, bolted directly to the top plate of the magnet. This has resulted not only in a slight reduction of production costs but also in greater mechanical strength and permanence of alignment.



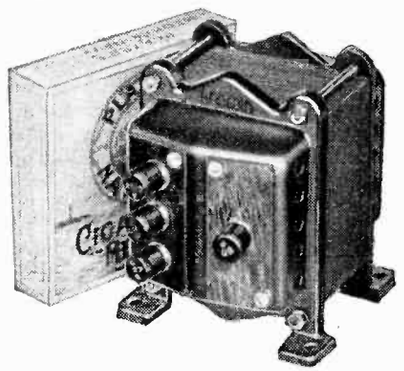
W.B. "Mansfield" permanent-magnet moving-coil loud speaker. A, cobalt alloy centre pole piece. B, low-reluctance alloy steel return piece.

On test the sensitivity was satisfactory having regard to the small dimensions of the magnet. The useful frequency range is from 100 to 4,500 cycles with a group of not too obtrusive resonances in the vicinity of 150 cycles. The 2,500-3,500 resonance which is a frequent fault in small moving-coil loud speakers was entirely absent in this model.

A tapped transformer with ratios of 45 : 1, 55 : 1, and 25 : 1 working into the 2½-ohm speech coil is included, and the price is 27s. 6d. The makers are Whiteley Electrical Radio Co., Ltd., Victoria Street, Mansfield, Notts.

HEAYBERD FILAMENT TRANSFORMERS

PARTICULARLY well-made filament transformers, giving an output of four volts, and especially well suited for use when converting a receiver to A.C. mains operation, are obtainable from F. C. Heayberd and Co., 10, Finsbury Street, London, E.C.2. Three models are available, described as the types 723, 727, and 731, their respective current outputs being 3 amps., 5 amps., and 10 amps.



Heayberd 4-volt 3-amp. filament transformer, model 723.

Tests were made with the smallest model, which will supply one to three A.C. valves. With one amp. flowing the secondary A.C. volts were 4.2, with two amps. 4.05, and with 3 amps. 3.92 volts. The regulation is quite satisfactory, and is as good as can be expected from a transformer of this type and size, irrespective of price.

The transformer is provided with a core of adequate size, and the winding is fully protected by the special cast aluminium end-plates adopted. It has a tapped primary winding to suit supply mains of from 200 to 250 volts at 50 cycles, while the secondary winding has a centre tapping. The price of the model 723 is 12s. 6d. The 5-amp. model costs 17s. 6d., and the 10-amp. type 22s. 6d.

UTEX TIME SWITCHES

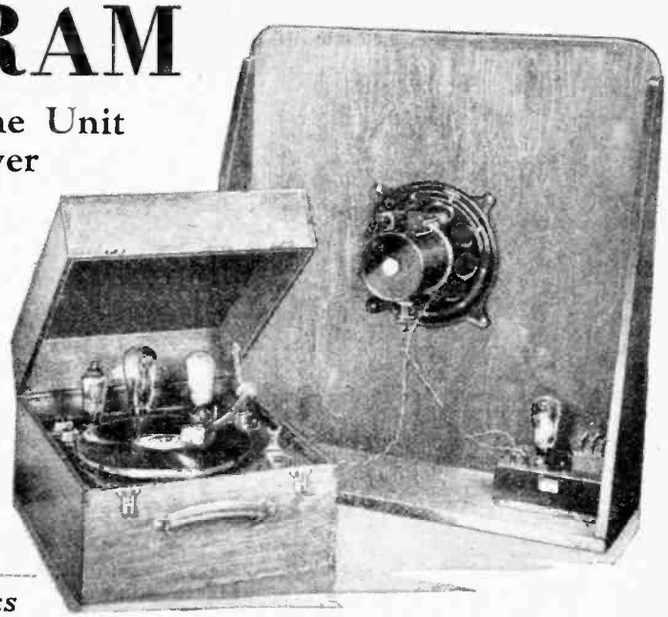
SPECIAL switches designed to fit on the back of an alarm clock for the purpose of switching on and off the wireless receiver at any prearranged time can be obtained from the Utex Manufacturing Co., Ltd., 39, Holborn Viaduct, London, E.C.1. Two models are available, the one for use with battery sets, which costs 2s. 6d., and the other designed for including in the electric supply leads to an all-mains receiver. The price of this model is 5s. 6d. Either of these mounted in a full lever movement clock costs 5s. extra.

The switch is mounted close to the alarm winding handle and is actuated when the alarm mechanism is released by the rotation of the winding handle. They are quite easy to fit, as a special template is supplied with every model giving the correct position for the fixing holes.

A specimen mains model was mounted on an ordinary alarm clock, as described in the instructional leaflet, and has proved to be perfectly satisfactory. Having set the alarm to the hour at which a desired item in the programme is required, the clock then switches on the receiver without fail at the appropriate time.

B.S.R. AMPLIGRAM

An Electric Amplifier and Gramophone Unit Giving 5.9 Watts Undistorted Power Output



THE Ampligram is an A.C.-operated self-contained power gramophone designed primarily for public entertainment, and consists of a two-stage amplifier, an electric gramophone motor complete with automatic stop, a Marconiphone pick-up, tone and volume controls, and a high grade moving-coil milliammeter. The electrical equipment throughout is of the highest standard with all components conservatively rated to ensure that the unit will give a trouble-free service. Yet despite this wealth of equipment careful design has enabled the complete unit to be condensed to fit into a portable-type case of solid oak measuring 17in. × 21½in. × 11¾in. high. The lid when raised gives access to the turntable, valves, and all controls, albeit there are two only, their respective functions being volume and tone adjustment.

Matching Output Valve and Speaker

The mains input and voltage adjustment, also the loud speaker sockets, are located at the rear of the case, access to these being obtained by removing a panel held in position by two screws. The mains transformer is tapped to suit supply voltages of from 190 to 250 at 50 cycles. Provision is made to match the output valve to loud speakers of different impedance, the output transformer fitted giving the choice of three ratios, viz., 1:37.5, 1:19.4, and 1:13.7, these giving correct matching where speakers of 2 ohms, 7.5 ohms, and 15 ohms, respectively, are employed.

An AC/SG. valve occupies the first position in the amplifier with its circuit arranged as described by McDonald in *The Wireless World* dated November 12th, 1930. This is linked by a resistance-capacity coupling to a PP5/400 valve giving an undistorted output of 5.9 watts as the maximum. The volume obtained from this amount of power, using one of the many suitable heavy duty loud speakers, is ample to fill a hall seating up to 300 people.

High tension is derived from a full-wave valve rectifier—a UU120/500—and the smoothing is carried out by a choke of generous size and large capacity high voltage condensers.

Two models of the Ampligram, both identical so far as general construction and design are concerned, are available. These are known as the types AG1 and AG2. The only difference is that the model AG2 has provision for the attachment of a microphone and includes a special input transformer and a change-over switch.

Since these units are intended primarily for entertainment purposes, special attention has been given to the matter of reproduction. The tonal quality is exceptionally good, the bass response in particular being most satisfactory, for drums and other orchestral instruments rich in low notes are well in evidence but do not obtrude or overshadow the middle and upper registers. As a whole the reproduction is definitely pleasing, needle scratch is not very noticeable which is due largely to the fact that a response curve of the unit shows that from 50 cycles up to 5,000 cycles the amplification is sensibly constant, but above this upper limit there is a marked attenuation. It can truly be said that the Ampligram has attained a very high standard in reproduction and is undoubtedly in a class apart so far as electric gramophone reproducers are concerned.

FEATURES

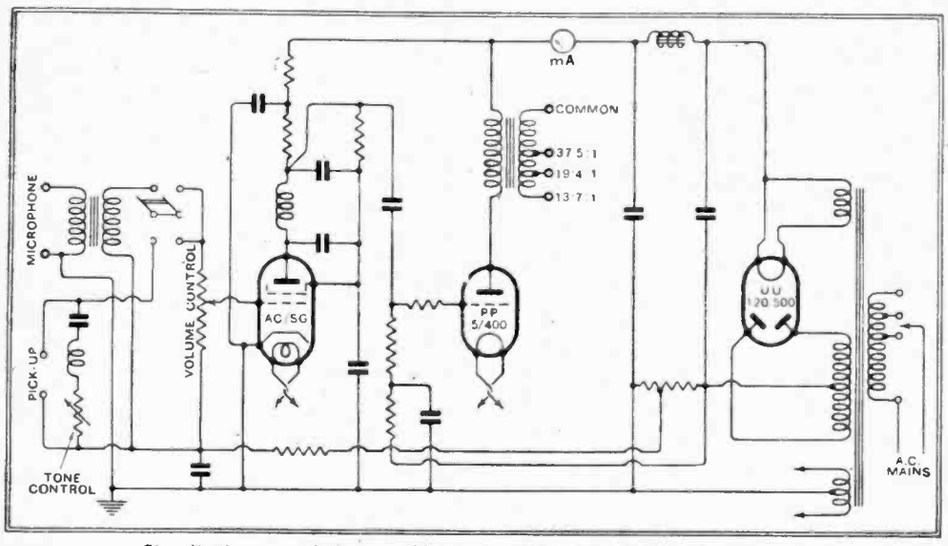
General. *— Portable electric gramophone entirely A.C. operated. Voltage range 190-250 at 50 cycles. Undistorted output 5.9 watts. One model has provision for microphone.*

Circuit.—*Screen-grid valve employed in first amplifying stage, resistance-capacity coupled to PP5/400 power valve. Output matching transformer with three ratios to suit loud speakers of 2 ohms, 7.5 ohms and 15 ohms. H.T. by full-wave valve rectifier.*

Controls.—*Tone and volume controls.*

Price.—*Model AG1., £26 10s.*
Model AG2., £27 15s.

Makers.—*Birmingham Sound Reproducers, Ltd., Claremont Works, Claremont Street, Old Hill, Staffs.*



Circuit diagram of the amplifier embodied in the B.S.R. Ampligram.

BOOKS RECEIVED

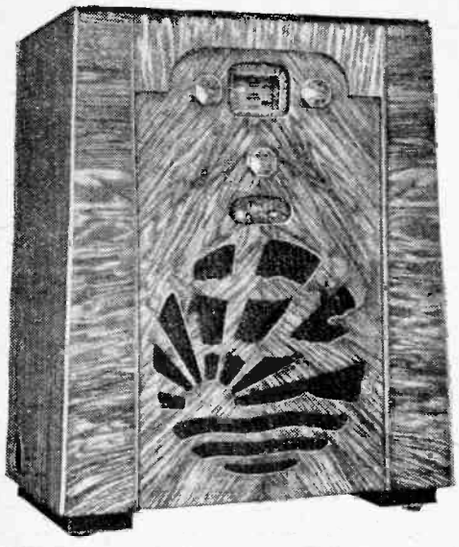
Radioactivity and Radioaction Substances (3rd Edition), by J. Chadwick, M.Sc., Ph.D. —Including the Nature of Radioactivity, Ionization of Gases, Methods of Measurements, The alpha, beta and gamma rays, Radioactive changes and substances, Production of Helium, etc. Pp. 116 xii, with 33 diagrams. Published by Sir Isaac Pitman & Sons, Ltd., London. Price 2s. 6d.

Alternating Current Electrical Engineering (4th Edition), by Philip Kemp, M.Sc. Tech., M.I.E.E., A.I.Mech.E., Mem.A.I.E.E.—Including General Considerations of Alternating E.M.F. and Current, Inductance, Reactance and Impedance, Capacitance and Condensers, Wave Form, Polyphase Currents, Alternaters, Transformers, Motors, Converters, Rectifiers, and Valves, etc. Pp. 595+xi, with 418 Diagrams and Illustrations. Published by Macmillan & Co., Ltd., London. Price 15s.

Un nuevo sistema para la impresión foto-eléctrica del sonido. By Alberto Laffon y Soto and Ezequiel de Selgas.—A description of a new method of recording sound on a cinematograph film. Pp. 21, and numerous diagrams. Published by Revista de Obras Publicas, Madrid.

Pye G/B Battery Receiver

A Three-stage Set with Q.P.P. Output



IN view of the extraordinary appeal exerted by the Q.P.P. principle recently, considerable interest naturally attaches to the first review of a commercial receiver which includes this system. That the new push-pull development has been well applied in the Pye G/B set is evident from the large volume of sound obtainable from the receiver, despite the use of a small high-tension battery only. Nor is it on volume alone that the set thoroughly satisfies; a moving-coil loud speaker is incorporated providing quality which justifies its use in a battery receiver.

The circuit contains those refinements which characterise Pye sets and which raise them well above the level of mediocrity. The aerial is tapped down the primary of the band-pass filter for both medium and long waves, and is joined to earth *via* a 25,000-ohm variable resistance. This component is ganged to the bias potentiometer, and the two together form a single volume control of adequate range. Too often it is left to the bias potentiometer alone to adjust the volume level, with the unfortunate result that signals from local stations can be reduced appreciably only by the unsound expedient of decreasing screening-grid volts.

Circuit Refinements

The anode circuit of the H.F. valve is decoupled by a 10,000-ohm resistance and a 0.25-mfd. by-pass condenser, and although battery filters are not used in the other stages, no signs of instability were evident. With Q.P.P. the fluctuating anode and auxiliary grid currents preclude the use of common impedances in the H.T. circuits of the output stage and decoupling must perforce be omitted. Parallel-feed is used for the L.F. transformer coupling so as to maintain a high primary inductance; furthermore, in this circuit the necessity for a special anti-surge resistance to protect the pentodes is avoided.

A point of interest is the values of the condenser components of the H.F. filter in the anode circuit of the detector, for, together with the choke, complete immunity from unwanted H.F. responses in the L.F. amplifier is ensured. With all push-pull circuits parasitic oscillations are liable to occur, but the usual separate grid stoppers are not effective with Q.P.P., and recourse must be had to a single resistance in the grid return circuit. This can be seen in the circuit diagram.

An impedance-limiting device across the primary of the output transformer is included, which has the effect of preventing undue shrillness of reproduction. That the resistance value is high, and the capacity value low, speaks well for the characteristics of the speech coil. Since the advent of Q.P.P. the electrical reproduction of gramophone records in battery receivers has come into its own, and represents, perhaps, one of the most important advantages of the new system of amplification. A pick-up can be used with the set under review, but an external volume control is necessary. There is an intermediate position on the wave-range switch marked "Gram.," which links the pick-up to the detector grid circuit, and at the same time short-circuits the input to the H.F. valve.

A simple but ingenious connection for an external loud speaker is arranged on the left side of the cabinet, but the details cannot easily be shown on the circuit diagram. A plug to which leads from the extra speaker should be connected is supplied with the receiver. When the plug is pushed half-way into the sockets both speakers will be in circuit, and when pushed right home the internal speaker is cut out of circuit and contact is made to the extra speaker only. It is important that the instrument chosen for use with extension leads should have a speech coil impedance from 1.5 to 2.5 ohms, which means that with many speakers on the market the built-in matching transformer must be cut out of circuit.

On testing the receiver one is at once struck by the tremendous volume from the two small pentodes, which together deliver no less than 1,000 milliwatts for a quiescent anode current of approximately 1.8 mA. per valve. On the score of quality, practically no adverse comment can be made. Individual instruments in an orchestra can be followed with ease, and harmonic distortion is not audible. The high-note output has been purposely curtailed, and the result is a pleasing immunity from heterodyne interference. Slight criticism might be levelled at a bass resonance, but this is hardly enough to be annoying. The selectivity reaches an entirely satisfactory standard, and close to Brookmans Park it was possible to receive a number of stations between the two local transmissions. The band-pass circuit fulfils its function admirably, giving a sharp cut-off on either side of resonance. The performance on long waves was exceptionally good, and reaction was not found to impair quality unless pressed to the limit.

Thanks to the attention paid by the designers to the tuning control, the identification of stations is made extremely simple. A large illuminated drum dial driving the three ganged condensers by means of a chain, provides an ample surface area on which are printed both wavelengths and principal broadcasting stations. So that there should be no confusion between the two wavebands, all data appertaining to the medium range are printed in black, and to the long waves in red.

To enable a thoroughly satisfactory servicing scheme to be carried out, the manufacturers have constructed the chassis so that it can be removed from the cabinet for examination or repair in a few moments, and every precaution has been taken against damage in transit by the inclusion of rubber buffers between the chassis and its container.

Altogether, the Pye G/B receiver must be considered a great advance in battery receivers, giving as it does an output which has hitherto been considered the prerogative of the mains user. The total average H.T. battery consumption is but 8.2 milliamps, and as matched Pen. 220 valves are supplied the consumer is not under the necessity of balancing the output stage.

FEATURES.

General.—*A self-contained 3-stage receiver (4 valves) for battery operation with Q.P.P. output. For use with external aerial and earth. Built-in permanent-magnet moving-coil speaker and provision for gramophone pick-up. Sockets for external speaker, which can be put in circuit with or without the internal speaker.*

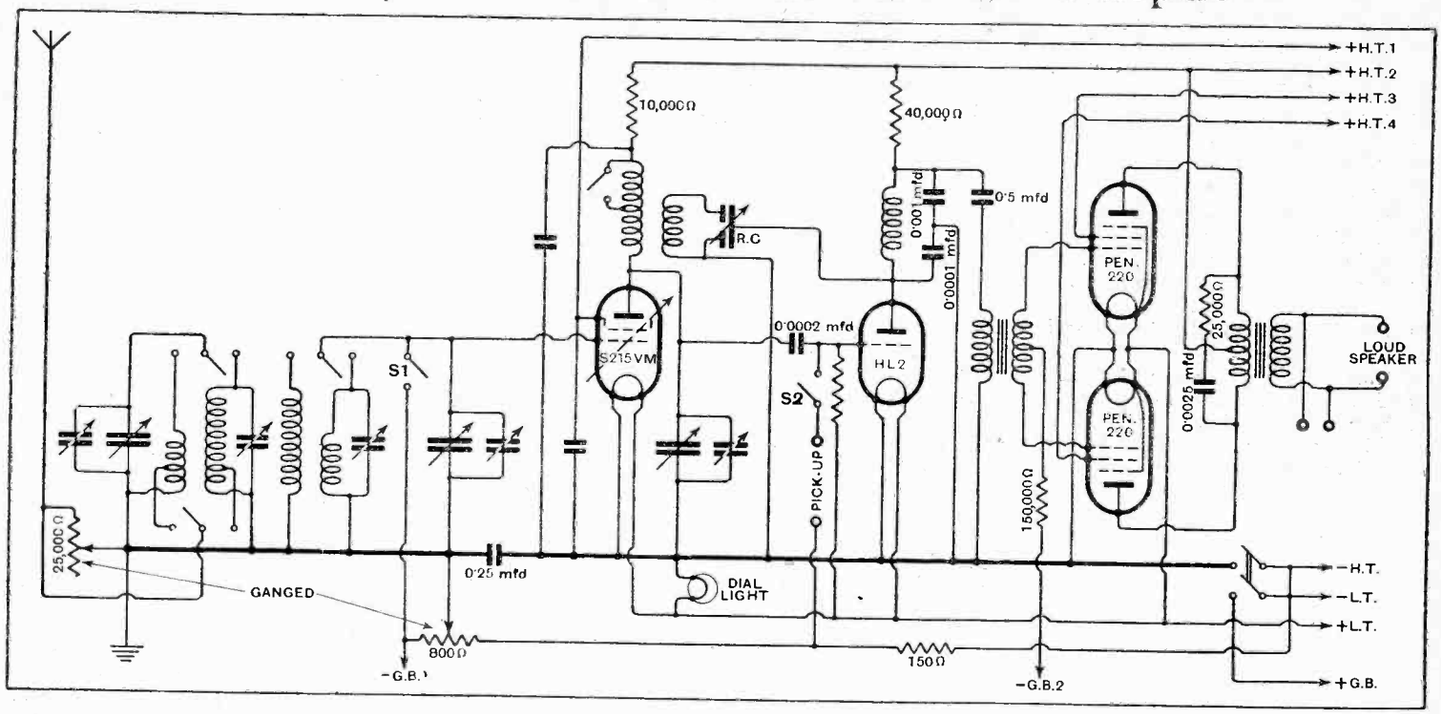
Circuit.—*Band-pass input circuit, variable-mu H.F. valve with dual volume control actuating aerial resistor and bias potentiometer. Tuned anode coupling with reaction. Parallel-fed push-pull L.F. transformer linked to two Pen. 220 valves in Q.P.P. giving 1,000 milliwatts undistorted output.*

Controls.—*(1) Ganged tuning with illuminated dial calibrated in stations and wavelengths. (2) Combined wave-range and radio-gramophone switch. (3) Reaction. (4) Volume (dual). (5) On-off battery switch.*

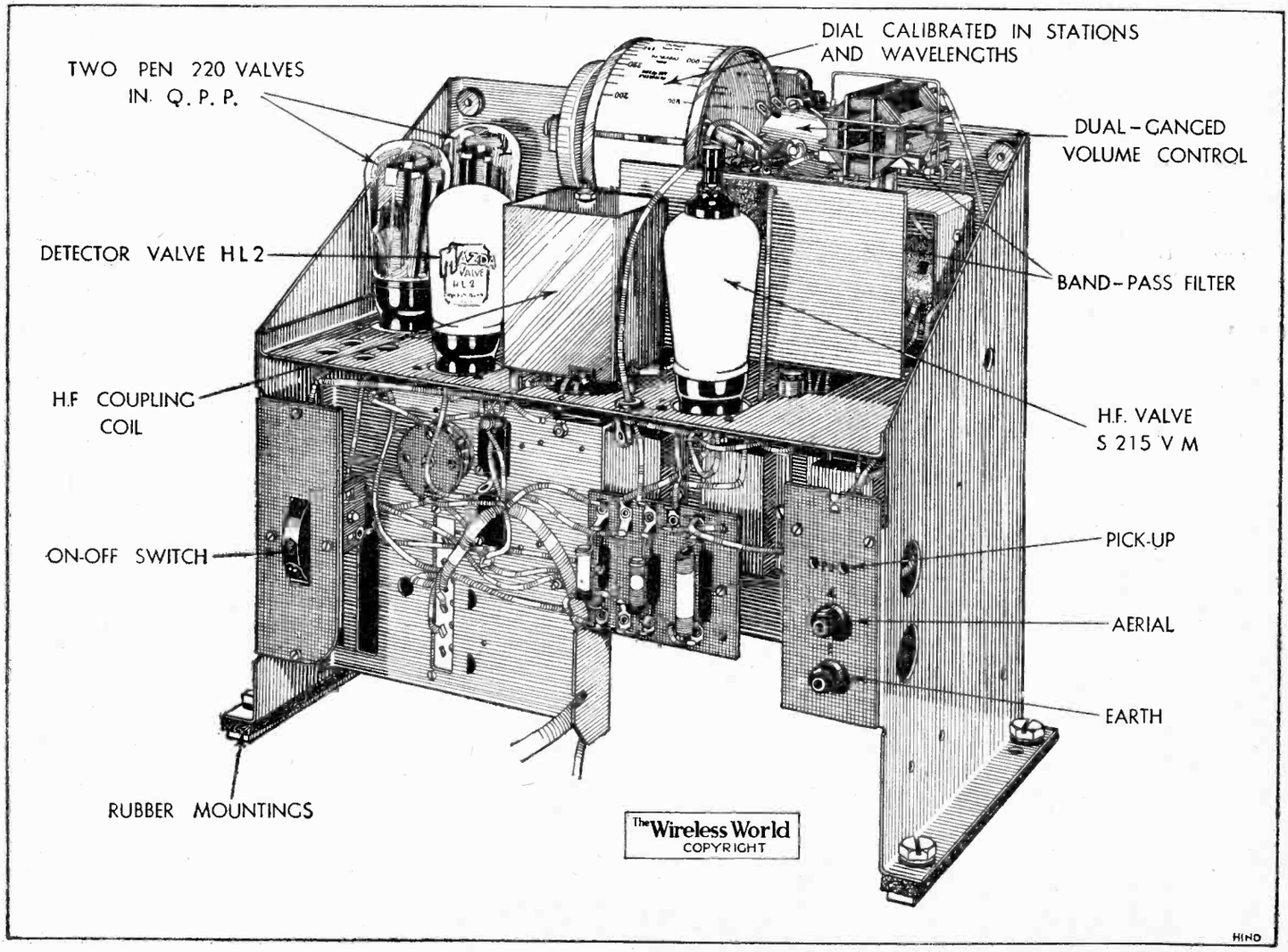
Price.—*11 Guineas complete.*

Makers.—*Pye Radio, Ltd., Africa House, Kingsway, London, W.C.2.*

Battery Receiver with Mains Output



Complete circuit diagram. Voltages and currents are as follows: Max H.T. volts 159; auxiliary-grid volts about 144; H.F. screening-grid volts 60; total H.T. consumption under working conditions 8.2 mA.



The receiver chassis which rests on rubber mountings. The large dimensions of the drum dial considerably assist the process of tuning.

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.

Q.P.P. Amplification

IT should be emphasised that no resistance of high value—even remotely comparable with the resistance of the valves—should ever be included in the anode or auxiliary-grid circuits of a quiescent push-pull amplifier. Currents in these circuits are constantly changing under the influence of varying signal-frequency voltages applied to the grids, and anything which tends to restrict these changes is bound to introduce a loss of efficiency and distortion.

This rules out the use of potentiometers and voltage-dropping resistances for regulating anode and auxiliary-grid voltages. As has already been stated, the Q.P.P. amplifier is essentially for battery feed, and the difficulties in the way of adapting it for operation with an eliminator are considerable. In any case, this system of amplification loses most of its attractions when a source of ample anode current from the mains is available.

A.C. Filament Heating

A READER who has a power transformer with a 7.5-volt centre-tapped secondary asks whether this winding could be employed to supply filament current to an output valve requiring 2 amps. at 4 volts. Information is requested as to the value of the series resistance that will be necessary for absorbing surplus voltage, and also as to whether the centre tap should be connected in the usual way.

As the 7.5 volt winding will probably be designed to deliver about 2 amperes, it should be quite possible to use it for heating the output valve described. An extra series resistance of 1.75 ohms should be included in the filament circuit in the manner shown in Fig. 1.

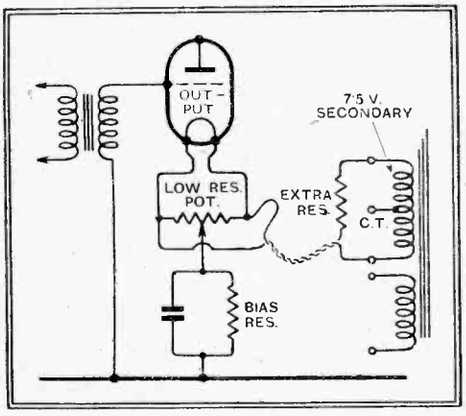


Fig. 1.—A typical output stage, with the addition of a resistance for absorbing excess filament voltage.

Under these conditions it will no longer be possible to employ the existing centre tap, but the same effect may be obtained by shunting the filament with a potentiometer of between 20 and 40 ohms; in this way an artificial centre point may be located.

Visual Indication

THE prospective constructor of a Station Finder, who does not believe in "spoiling the ship for a ha'porth of tar," asks our advice regarding the purchase of a detector anode current meter for use in conjunction with this device. It is intended that the instrument should be permanently wired as a part of the receiver, and should be used as an aid to identification by means of the Station Finder.

Meters are always worth while having, but the use of one is by no means essential to the success of the Station Finder. Indeed, with most sets having two L.F. stages, the change of anode current in the detector anode circuit which corresponds to the maximum required output is usually so small that it is difficult to detect visually. This means in practice that in order to obtain an indication it would be necessary to increase the sensitivity to a point where overloading becomes evident. This is unpleasant, and so the aural method is probably actually preferable in this case.

When, on the other hand, the detector feeds directly into the output valve, it will usually be found that the change in detector anode current under normal working conditions is quite appreciable, and so an anode current meter becomes more valuable.

Distant Control of Grid Bias

IT is rather surprising that advantage is not more often taken of the fact that the grid bias voltage—and consequently the sensitivity—of a variable-mu valve may be regulated from a point at a distance from the receiver itself. In this way remote control of volume is made possible in an extremely simple manner.

So far as A.C. valves are concerned, this matter has already been treated in the pages of *The Wireless World*. A correspondent, who realises that there is no basic reason why battery-fed valves of the same type should not be controlled from a distance, asks us to publish a circuit diagram showing how the potentiometer at the remote point should be connected to the receiver.

In actual fact the connections of this potentiometer need be no different from those applicable if it were included in the receiver, but to make the matter clear, a diagram showing the connections of extension leads is given in Fig. 2.

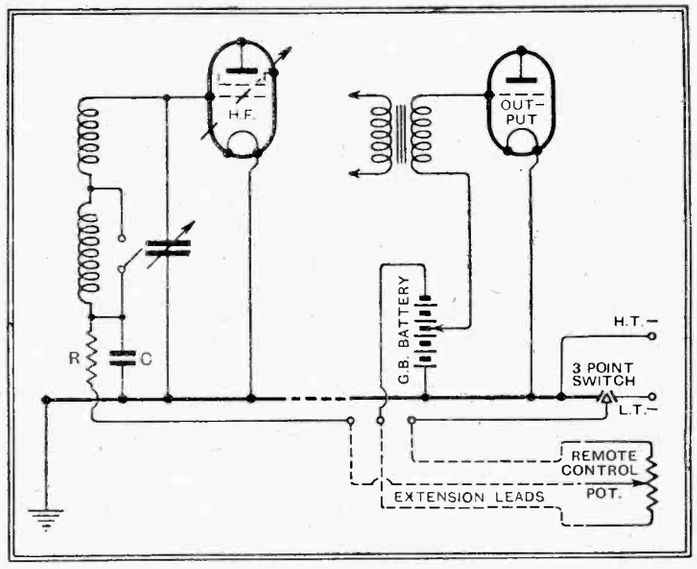


Fig. 2.—Remote volume control by variation of grid bias: connections of extension leads to the potentiometer.

As the extension leads are at low potential, so far as signal-frequency currents are concerned, the fact that they are extended to a distance should not affect stability adversely. As a rule, the amount of decoupling normally included in the H.F. valve grid circuit will be sufficient to prevent undesirable effects.

The All-Wave Monodial

IN order that the "All-Wave Monodial" (*Wireless World*, Jan. 27th and Feb. 10th) may be economical in the matter of anode current consumption, a maximum H.T. voltage of 100 volts was specified for all valves. When a source of ample H.T. current is available, there is no reason why the voltage applied to the anodes of the second detector and pentode output valve (and screen) should not be increased to the full 150 volts at which these valves are rated. The earlier valves in the receiver, however, should be worked under conditions laid down in the original descriptive articles.

Several readers who have written to us on this subject propose to feed the "All-Wave Monodial" from an eliminator; there is no objection to this course, and as a rule it will be unnecessary to include any extra decoupling beyond that provided in the original design. Of course, the eliminator must include provision for reasonably accurate adjustment of the various output voltages.

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.

The Wireless World

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CONTENTS

EDITORIAL COMMENT

Progress

Prospects Were Never Greater

IF one were to search through records from the earliest days of civilisation to the present time, we feel certain that no more typical example of progress could be found in any branch of science than wireless provides, particularly in its relation to broadcasting.

It can generally be stated that the first essential for encouraging rapid progress in science or industry is that there should be a popular demand for the results achieved, for public demand must always remain the greatest stimulant to technical progress.

To attempt to record the successive stages by which we have reached the present state of development in broadcast transmission and reception would take volumes of print and a vast amount of investigation, so that, although the present issue of *The Wireless World* is described as a "Progress" Number, it must be realised that it has not been possible to attempt more than a superficial survey of progress made, and then only in connection with the development of the broadcast receiver. We feel, however, that the time has come when our readers would like to be able to take stock of the present position and be reminded of some of the more important steps which have succeeded one another and brought us to the stage where we stand to-day.

In endeavouring to compile a Progress Number along these lines, we have dissected the modern broadcast receiver and deal with various units separately as being probably the most convenient and concise method of attaining the object in view.

Valves are likely to play a very important part in influencing the design of future receivers, and there will very shortly be released several new types having new applications and designed to be employed with new and interesting circuits.

The outstanding characteristic of many of the new valves will be that they will combine the functions of two valves in the same container. Their applications will be principally for automatic volume control and for push-pull amplification. In addition, we may expect to have the principle of the pentode applied to H.F. amplification instead of being confined to low frequency amplifiers, as in the past.

There are to-day more avenues for future progress opening up than at any previous time in the history of broadcasting, and, far from having approached a stage of stagnation, as pessimists were inclined to prophesy a year or so ago, we seem to have arrived at a position where there are so many new things waiting to be applied that the designer himself is embarrassed with the material available to him.

Reductions in Price

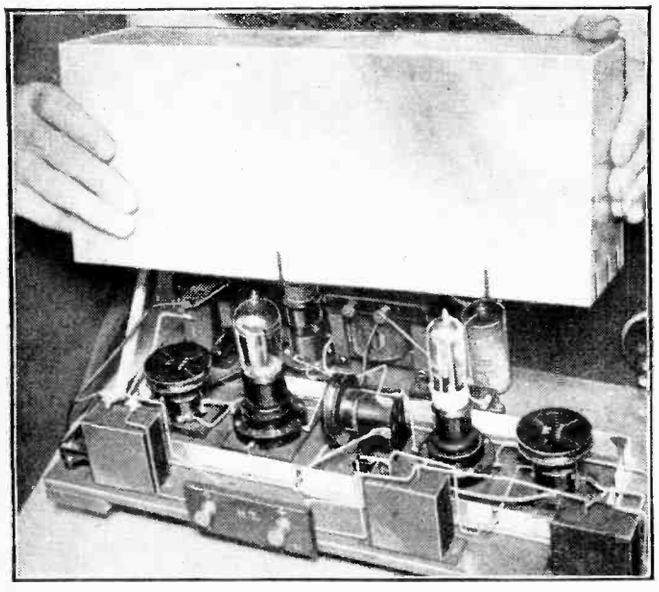
Only one aspect of progress need cause us anxiety for the future. There has been a recent tendency to cheapen the product to a point where performance begins to show signs of suffering. There is so much competition amongst manufacturers to-day that commercial success, instead of going hand-in-hand with progress, is tending to come into conflict with it. The ideal should be to give the public the advantage of every new development of importance, and to regard the selling price of the article as a subservient consideration.

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.

The Evolution of the Superhet

By W. T. COCKING

OF recent years the superheterodyne has developed so rapidly that it may seem as if finality has been reached. An examination of the question, however, shows that this is not so, and a review of past history indicates the possibility of further advances. The author traces the progress made in the last decade and suggests the lines on which future research may develop.



The I.F. stages of a superhet described in the pages of this journal during 1925

TEN years ago the superheterodyne was one of the most popular receivers, and it formed the chief standby of serious experimenters; it was, in fact, considered the ideal receiver, and it was usually spoken of as the Rolls-Royce of radio. Nevertheless, it was doomed to early extinction, and, within a few years, the superheterodyne became something of a rarity, and so it remained until its revival by *The Wireless World* in the autumn of 1930. Since that time, however, it has made rapid strides, and it has earned for itself a popularity far exceeding that which it enjoyed in its early life.

Early Examples

The superheterodyne, therefore, is unusual, for it is not common in wireless for early types of apparatus to be revived in any recognised form, and the modern superheterodyne is identical in its fundamental principles with the first working model. It is interesting, therefore, to examine in some detail the faults of the early superheterodyne which led to its former demise, the reasons which led to its revival, and the developments which are responsible for placing it in its present position of pre-eminence.

The superheterodyne was originally developed because stable and effective high-frequency amplification upon broadcast wavelengths was impossible, and it retained its popularity only as long as such amplification remained impossible. These early receivers were all very similar in design, and usually eight valves were employed. A two-valve frequency-changer was fed directly from a frame aerial, for second-channel interference was then of little importance. Three triodes were normally fitted in the I.F. amplifier, which was often tuned to 50 kc. and kept stable by the application of *positive* bias to the amplifiers; a second detector and two transformer-coupled L.F. stages completed the receiver. The current drawn from the L.T. battery was often over 6 amperes at 6 volts, and the demands on the H.T. battery were also heavy; mains operation was practically unknown, so that the receiver was obviously rather expensive in upkeep.

Changes which Contributed to a Revival of Popularity

The sensitivity and selectivity obtainable were quite high, however, and were really the sole justification for its use, for the sideband cutting of the I.F. transformers, combined with the distortion introduced by poor L.F. transformers and overloaded valves, made the receiver notorious for its poor quality of reproduction. No quality is so appalling as that given by a badly designed superheterodyne, and this type of receiver soon became identified with poor quality, and it is undoubtedly largely through this that it fell into disuse. Unfortunately, however, the blame for the poor quality was laid on the superheterodyne principle, rather than on the practical examples of it, with the result that in certain quarters the receiver is still viewed with suspicion. Actually, of course, a properly designed superheterodyne is in no way inferior to a straight set, and is capable of giving equally good quality of reproduction, as has been conclusively proved by recent *Wireless World* designs.

The development of the Neutrodyne circuit enabled stable and effective high-frequency amplification to be obtained, and sensitive straight sets were introduced. These sets employed fewer valves than the superheterodyne, and they gave better quality, so that it is hardly surprising that their use became general. Consequent upon the later development of the screen-grid valve, the straight set became practically universal, but the superheterodyne was never completely displaced, although it was employed only for special purposes.

The year 1929 saw the introduction of band-pass tuning and a consequent improvement in both selectivity and quality. In spite of this development, however, broadcasting stations were increasing so rapidly in both numbers and power that straight sets were becoming inadequate to deal with the congestion of the ether, and satisfactory distant reception was becoming increasingly difficult. It became abundantly clear that only the superheterodyne could hope to deal with the situation so far as selectivity was concerned, but there still remained the grave problem of quality of reproduction. It was soon realised by *The Wireless World*, however, that the poor quality of the superheterodyne as then known was due merely to poor design, and was in no way fundamental.

Band-pass

As soon as modern principles of L.F. amplification, power grid detection, and band-pass tuning were fully applied, and the receiver was designed throughout for both quality anl selectivity, a startling improvement was evident. All the well-known desirable characteristics of the superheterodyne were found to be still present, but the old bugbear of poor quality had disappeared. In the autumn of 1930, therefore, the first band-pass

The Evolution of the Superhet—

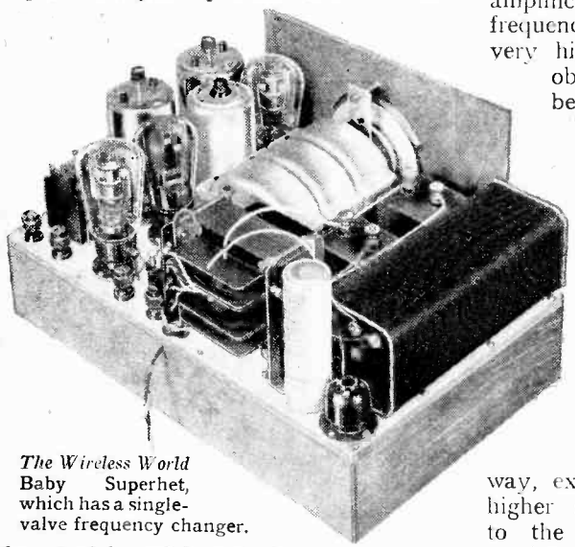
superheterodyne made its appearance,[1] and this event is a landmark in the history of wireless, for it marks the beginning of the superheterodyne revival.

Further development was still necessary, however, in order to keep pace with the increasing power of transmitters and to simplify the receiver. It was soon found desirable to employ an outdoor aerial, and this led to the design of non-radiating frequency changers,[2] so that quite modest superheterodynes became a possibility, and a five-valve set could provide sufficient sensitivity.[3] Experience showed, however, that there was a definite limit to the amount of intermediate-frequency amplification which could be usefully employed, and if this limit were exceeded background hiss became unduly prominent. In a highly sensitive set, therefore, a return to a signal-frequency H.F. stage became desirable, although this might still be unnecessary in a receiver of only moderate sensitivity.

Single-dial Control

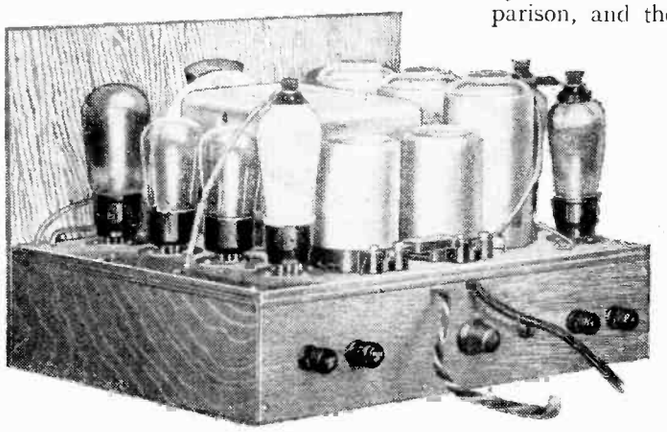
All this time the superheterodyne lagged behind the straight set in one particular—two tuning controls were employed. Ganged tuning could readily be achieved in a straight set, but in a superheterodyne the problem was much more difficult, since the various circuits had to be tuned to different frequencies but still maintain a constant frequency separation as the tuning was varied. Two solutions were eventually found, and the one which has proved the most successful from the constructor's point of view has been that in which a gang condenser with specially shaped plates is employed.

At the end of 1931, therefore, the usual superheterodyne operated from an outdoor aerial, and in order to avoid second-channel interference and radiation two pre-selector circuits preceded a non-radiating frequency changer. A single I.F. stage with band-pass tuning was used, and a power grid second detector fed a pentode output valve. Ganged tuning was just beginning to make its appearance.



The Wireless World Baby Superhet, which has a single-valve frequency changer.

The unquestioned superiority of the band-pass filter was then challenged by a rival system—the Stenode method of employing highly selective tuned circuits in conjunction with low-frequency tone correction. After much research, a combination of the two methods proved the best, and early in 1932 the Monodial A.C. Super[4] made its appearance. A judicious combination of the band-pass filter with the tone-correction principle permitted a definite improvement in both selectivity and quality of reproduction to be made, while for the first time an entirely satisfactory ganging system made its appearance. A moderate degree of I.F. amplification with additional signal-frequency H.F. amplification enabled a very high degree of sensitivity to be obtained without background hiss becoming obtrusive.



The Monodial A.C. Super with A.V.C., an announcement about which is made elsewhere in this issue.

The appearance of the Monodial does not mark so much the culmination of the superheterodyne as the start of a new class—quality superheterodynes. From that time development proceeded on distinct, and yet allied, lines; on the one hand research was conducted ever to the improvement of performance, and, on the other, to the production of a small superheterodyne comparable with the three-valve straight set in every way, except that it would possess much higher selectivity. This latter line led to the Baby Superhet[5]—a four-valve receiver of moderate sensitivity, good quality, and really good selectivity.

At the present time, therefore, we have two entirely different superheterodynes—the Monodial Super and the Baby Superhet—each representing the latest development in its class. From 1930 to 1933 the superheterodyne development has been rapid and steady, and it is now fitting to pause and enquire in what direction the future trend is to be.

In the past the straight set has progressed largely by sudden leaps forward, alternating with periods of stagnation, whereas the superheterodyne, excepting one period when it fell into disuse, has developed more slowly and steadily. The straight set falls behind the superheterodyne until it is nearly useless in comparison, and then suddenly makes a big stride forward and catches up with it. One such improvement to the straight set has just taken place—the introduction of highly efficient iron-cored tuning coils—which has resulted in a vast improvement in selectivity. It may be asked, therefore, whether the straight set may not once more become predominant.

Since superheterodynes now fall into two distinct classes, this question requires two answers; it seems probable that the straight set will now be a serious rival to, or even replace, the small superheterodyne, but it is improbable that it will ever equal, still less surpass, the quality superheterodyne. The selectivity of new straight sets will probably nearly equal that of small superheterodynes, and they will use a valve less, so that in the absence of any new development we may anticipate that the straight set will at least hold its own.

The Future

The case of the quality superheterodyne, however, is entirely different, and it seems unlikely that the same combination of selectivity and quality will ever be as simply attained with the straight set. Many new possibilities are opening out before us, and it seems probable that the superheterodyne of the future will be as great an advance upon present-day technique as modern sets are on those of a few years ago. Developments which appear probable are the general inclusion of ultra-short wavebands in the tuning range, the use of quiet automatic volume control systems, the adoption of iron-cored tuning coils, the employment of metal rectifiers instead of valve detectors, and the inclusion of controllable selectivity and quality; some of these developments will, of course, be applicable to any type of receiver, but others will be practically usable only with the superheterodyne. It should not be expected that these tendencies in design will be soon found; there are many technical difficulties to be overcome before they are realisable in a satisfactory form. Within the next few years we may hope to see most of them.

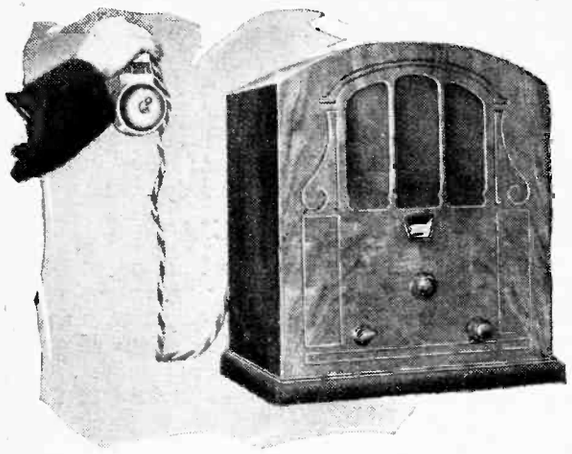
[1] The Band-Pass Superheterodyne, *The Wireless World*, November 5th and 12th, 1930.

[2] Frequency Changers, *The Wireless World*, May 6th, 1931.

[3] The Super-Selective Six, *The Wireless World*, June 3rd and 10th, 1931. The Super-Selective Five, *The Wireless World*, July 15th and 22nd, 1931. The D.C. Super-Selective Five, *The Wireless World*, August 12th and 19th, 1931.

[4] The Monodial A.C. Super, *The Wireless World*, April 13th, 20th and 27th, 1932.

[5] The Baby Superhet, *The Wireless World*, August 19th and September 2nd, 1932.



The Mains Set

Where We Stand To-day

By H. F. SMITH

ALTHOUGH the mains-operated receiver is now admitted to be superior to its battery fed counterpart in every respect, it is not so long ago that it was regarded merely as a rather unsatisfactory and unreliable substitute for it. This article deals with the vicissitudes through which the mains set has passed, and is illustrated by simplified diagrams which show that the modern power supply system is much less complex than is generally supposed.

ALMOST as soon as the first wave of public enthusiasm for broadcasting had subsided, it became evident that mains-driven receivers were bound to come sooner or later. The need for periodical battery replacements—and of finding out when they were due—was in itself a barrier to popularity among ordinary users, although a simple matter for the knowledgeable amateur.

Early attempts to press the mains into service were mainly confined to D.C. systems, for the obvious reason that no rectifier was needed. A start was made with H.T. supply, condensers and smoothing chokes being inserted at random in an attempt to eliminate ripple. When more economical valves arrived their filaments, connected in series, were heated from the same source, smoothing being effected by chokes of more or less adequate current-carrying capacity. Later on, as specialised valves for different purposes were introduced, it became necessary to employ comparatively elaborate series-parallel filament networks.

In early D.C. mains sets the detector valve often gave trouble, which was sometimes overcome by the drastic expedient of replacing it by a crystal. As often as not, grid-bias voltages were obtained from batteries, although the drop in voltage across a resistance interposed in the filament circuit was also used. Difficulties were gradually overcome, and more or less satisfactory D.C. sets, still with series-connected battery valves, were evolved. But their performance was rather uncertain, and was influenced to a great extent by the characteristics of the mains supply.

Amateur transmitters probably led the way to the use of rectified and smoothed current from A.C. mains for wireless purposes. Their rectifiers were of the electrolytic type—messy cells with aluminium electrodes in an alkaline solution. A tantalum-lead combination in an acid electrolyte proved to be rather more reliable, and was employed both for H.T. supply purposes and for charging batteries.

Early Power Rectifiers

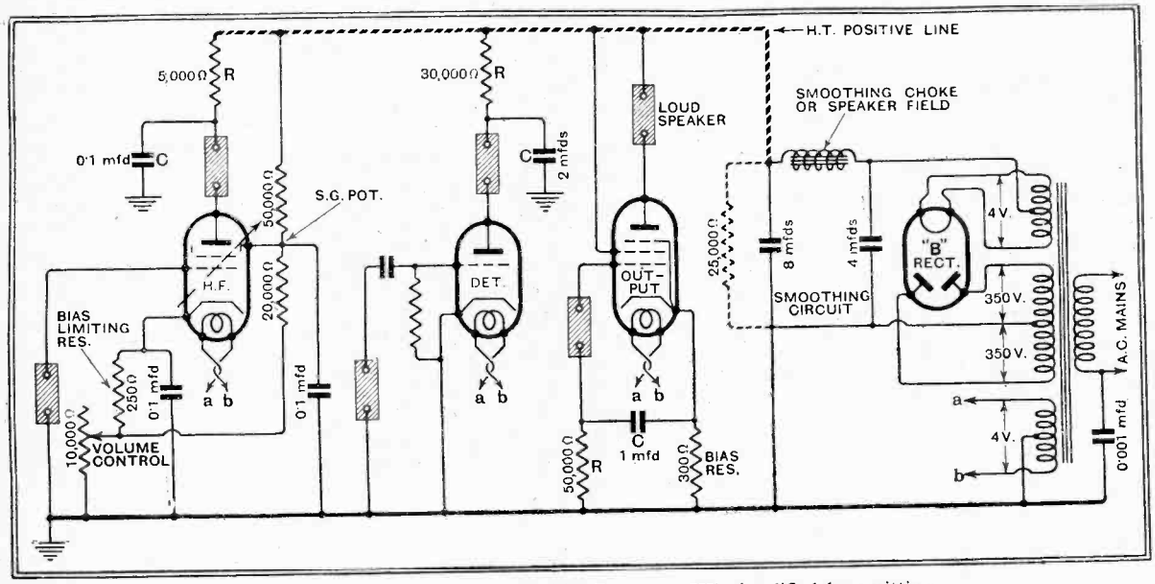
It was soon found that an ordinary bright-emitter valve, with anode and plate connected together, made quite a good half-wave rectifier, and gave enough H.T. supply for the sets of the period. Smoothing was very similar to that used to-day, but the finer points were not appreciated.

Special rectifying valves, both for H.T. and L.T., soon appeared, and by 1925 the H.T. battery eliminator and the L.T. battery charger were quite ordinary articles of commerce.

With regard to filament supply, hardly anything could be done, but, with a little luck, the early wireless enthusiast could make himself independent of the battery station by using a trickle charger for his accumulator.

Serious attempts to evolve a real all-mains set met with a measure of success in 1926. A series of Gambrell receivers, produced in that year, were fed from a valve rectifier delivering 60 milliamperes at quite a high voltage. The smoothed output of this rectifier supplied a chain of series-connected 0.06 amp. valves with filament current, H.T. supply, and grid bias potentials, the general arrangement being reminiscent of D.C. set practice.

In the same year came the far-reaching innovation of the indirectly heated A.C. valve. Up to then all valves were heated by the passage of current through their cathodes, and so heating by means of A.C. was virtually impossible where any subsequent magnification was required. As alternating differences of potential across a combined cathode-filament were inevitably impressed on the grids to a more or less serious extent, it was impossible to get reasonably hum-free reception. The new I.H. valve, on the other hand, had a separate heater and cathode, the latter element being raised to the necessary working temperature by



The power supply system of a typical modern A.C. set (the Ferrocart III) simplified by omitting grid and anode impedances, which are represented by shaded "boxes." The 25,000-ohm loading resistance reduces H.T. line voltage to the required value, at the same time ensuring ample magnetising current for the speaker field and restricting the initial rise of voltage.

The Mains Set—

heat radiated from the former. In this way the difficulties connected with A.C. filament heating were overcome, and a great impetus was given to the design of true all-mains sets.

Anode voltages at first were quite low; we regarded the power supply unit merely as a substitute for the battery, and for a time were quite satisfied to get the same output from it, plus the advantage of consistency and reduced upkeep cost. But, as better output valves were produced, the advantage of higher voltages became evident, and as any desired voltage was readily obtainable from A.C. mains there was little need to be niggardly.

In conjunction with the early I.H. valves, it was quite customary to use a directly heated battery valve of the super-power type, its filament being fed with A.C., stepped down to the rated voltage. Later on, output valves of the indirectly heated type became available, and also special types for direct A.C. heating, with thick filaments.

The early A.C. sets suffered from various defects, not the least serious of which was grid emission in the indirectly heated valves. The grid became coated with emissive material thrown off from the cathode, and itself began to emit electrons when its temperature became sufficiently high—as it often did.

All Mains—Except Bias

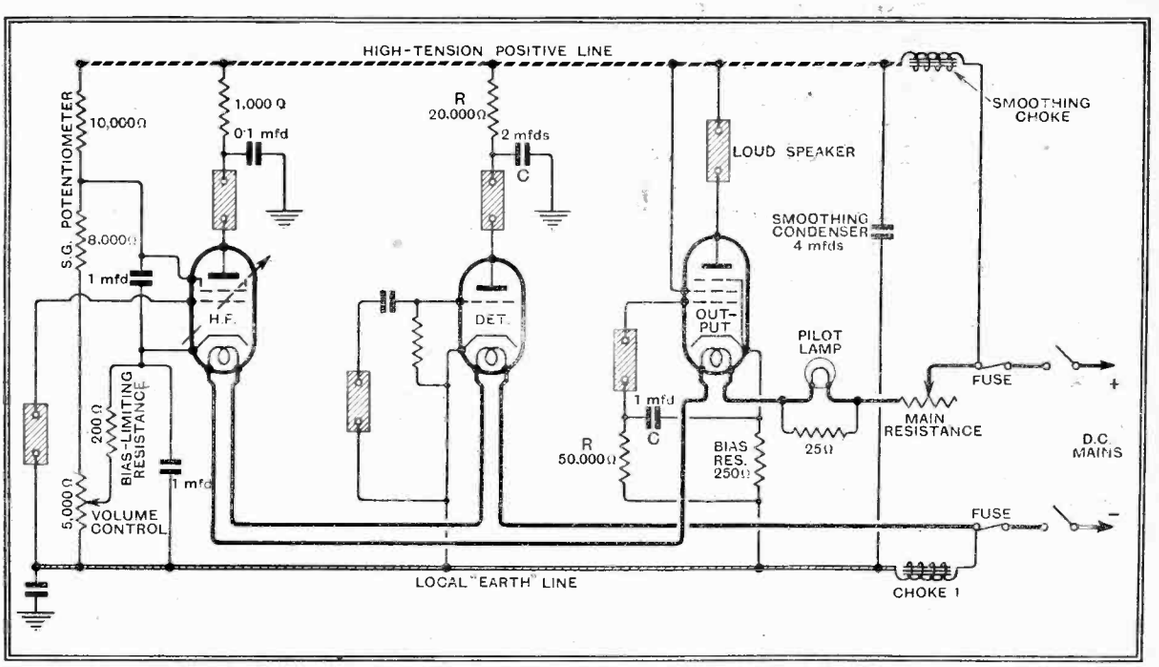
Automatic grid bias gave a lot of trouble to designers, and sometimes they chose to include bias batteries in sets which otherwise derived all their working voltages from the mains. This proved to be a bad move; the uninformed public naturally neglected the bias batteries, with disastrous results to the quality of reproduction and also to the valves. Those who avoided the use of batteries entirely often went to the length of employing a separate bias unit with its own rectifier. True self-bias, where grid voltage is derived solely from the anode current of the valve itself, was looked upon with suspicion, as cathode-heater insulation was another weak point in the early I.H. valves; it was dangerous to work them with appreciable differences of potential between these electrodes.

The Westinghouse copper-oxide rectifier, introduced in 1927, played an important part in establishing the all-mains receiver. This device, on account of its permanency, robustness, and simplicity, became almost immediately a serious competitor to the valve, and was used for the supply of H.T., grid bias, and also for accumulator charging.

The modern A.C. set dates from about 1929 or 1930, when the defect of grid emission in I.H. valves was finally overcome by improvements in construction, by which it was ensured that the grid should run cool. Since that time A.C. sets have no longer been looked upon merely as unreliable substitutes for those with battery valves; they are definitely better, on account of the inherently greater efficiency of I.H. valves with equi-potential cathodes.

Nowadays the design of an A.C. set has become an exact science, and follows almost stereotyped practice; even a short-wave receiver may be made to operate as satisfactorily from the mains as from batteries. The power supply system for a typical three-valve circuit will seldom be basically different from that shown in the accompanying diagram. Anode current is derived from a full-wave valve or a metal rectifier, smoothing being effected by the loud speaker field in conjunction with large condensers. These condensers may be of the electrolytic type, which, apart from combining high capacity and compactness with low cost, have the convenient property of restricting undue rise in H.T. voltage by developing a leak when excessive potentials are applied to them.

Valves are customarily self-biased, each by the flow of its own anode current through a bias resistor inserted in the cathode lead. Decoupling or voltage-reducing resistances are inserted in the anode feed circuits of those valves requiring less voltage than that of the H.T. positive "line." A somewhat elaborate potentiometer network is provided for maintaining a reasonably constant voltage on the H.F. valve screening grid.



The power circuits of the "Modern D.C. Three" serve to illustrate present-day practice in D.C. set design. Wiring of the series-connected valve heaters is shown in heavy lines.

Completely independent of batteries: a Gambrell A.C. set of 1926.

After many delays, the D.C. mains user has now been placed in almost as good a position as those with A.C. supplies; his remaining handicap is a limited H.T. voltage. Economical indirectly heated D.C. valves, virtually equivalent to their A.C. counterparts, have recently been produced, and they may be operated with differences of potential of well over 100 volts between cathode and heater.

The power supply system of a present-day D.C. set is generally on the lines indicated in the diagram on this page. It will be seen that the main difference, as compared with an A.C. receiver, is that the valve heaters are wired in series. The principle of self-bias is adopted—indeed, there is no satisfactory alternative — and all cathodes, grids, and anodes are returned to a local "earth." The original element of uncertainty has almost disappeared, and a set planned on these lines can be depended upon to work well in any circumstances.

Radio apparatus of almost every kind is now operated successfully from the mains, and few difficulties remain to be overcome. Excessive variations in supply voltage are still met with, but the position is improving, and it is being brought home to the supply companies that they are under a legal obligation to deliver their product "true to label."

RADIOCRACY

By

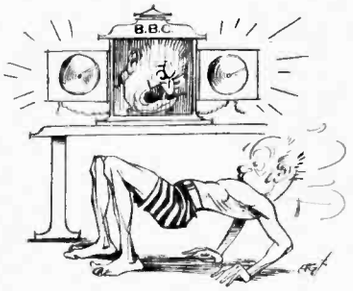
FREE GRID, Junior

Glancing Back at the Future

IT is with some trepidation that I take up my pen to record the events which have led up to the distressing state of affairs in which our country now finds itself. At great personal risk I succeeded in constructing the all-metal subterranean chamber in which I write, hoodwinking the authorities into believing that I was experimenting with a new earthing device. I am now in the one place where, owing to the screening effect of its walls, the ears and eyes of the all-powerful bureaucracy still known as the B.B.C. cannot penetrate.

It is not yet eighty years since the natal cry of the present tyranny was heard on an upper floor in what used to be known as Marconi House. In its early years it showed but little sign of the cloven hoof; indeed, it was welcomed in the homes of the people as a new invention and was regarded with friendly eye even by theatrical producers and similar parasites who at that time battened on the easy tolerance of the public.

When, however, the monster passed its teething stage the theatrical mandarins began to sense a growing menace to the fatness of their wallets. But their resistance was brief and transitory, and at the age of ten years the monster had already shown signs of riding roughshod over everything that opposed it. Its Director-General, after whom the first month of the



A brutalising routine.

year is now named, had already stated that he intended to give the people such entertainment (save the mark) as he thought they needed rather than that for which they craved. Although the monster gradually gained a stranglehold on our educational system during the next few years it cannot be said that the menace became acute until the perfection of television in what would be about the year 1940 in the old-style calendar, or 18 anno Bebeciensis in the new-style calendar established by our present oppressors as soon as they secured the reins of government.

In the decade following, the monster threw off the last vestige of its sheep's clothing and succeeded in getting Parliament to pass a Bill putting all forms of entertainment in B.B.C. hands.

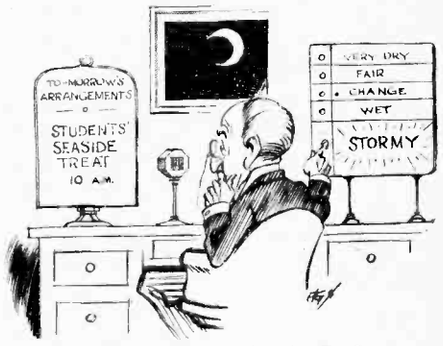
The end of all our liberties came in the year 1970 when the B.B.C. succeeded in getting Parliament to pass a Bill abolishing itself and placing the destinies of this once fair land into their own sacrilegious hands, so establishing the present reign of terror. With all power in their hands the B.B.C.'s first step was to revise the calendar and commence a new era from the date of the foundation of the B.B.C. Thus the year 1922 A.D. became 1 anno Bebeciensis; hence we are now in the year 78 A.B. At the same time all measurements of time were changed over to the decimal system, the months were reduced to ten and their names changed to commemorate the vandals who took part in our present enslavement. As these notes are intended for (I hope) a newer and a better civilisation, I shall stick to the old-style calendar.

Goodbye to All That

Following the establishment of the radiocratic form of Government in the year 1970 our ancient and hard-won freedom was speedily abolished, Magna Carta being torn up in the latter part of the same year. One of the earliest acts of the radiocracy was to abolish unemployment by the simple expedient of making it illegal. In the following year all unofficial books and newspapers were suppressed. During the next five years our children were educated on lines laid down by the B.B.C. History was definitely abolished to the great delight of the younger generation and geography was greatly modified, with the result that a child of to-day has no knowledge of any history preceding the present era nor has he anything but a hazy inkling of those lands beyond the sea where freedom still reigns. Some of the more daring of grandparents had ventured to tell their sons of the last European war.

I myself well remember how in my early years my late-lamented father told me of it and stressed the terrible privations and suffering which it brought about. Before his lamentable death at the hands of the B.B.C., however, he had discreetly changed his opinions and used to sigh for the good old days when he spent many happy hours knee deep in icy water with but little to eat and the shells bursting all around him.

In those days one was not compelled to take protein and carbohydrates in the special quantities and times prescribed from Broadcasting House; it was permissible to eat anything you could get hold of, while drinking was allowed for at least six hours during the day. It will probably be remembered that quite early after the founding of the new regime my lamented parent was arrested on an old charge of breaking into Broadcasting House some thirty-five years previously and summarily put to death, his embalmed body being suspended in the foyer of Broadcasting House as a public example. There it may still be seen.



As decided upon by the D.-G.

All sport was, of course, eventually abolished as the Government decided that the entertainment provided by them in the evening was sufficient for human needs. These entertainments, I must point out for the benefit of posterity, consisted and still consist of moral and intellectual uplift dramas written by synthetic dramatists devised by the B.B.C. technical experts.

Graded and Degraded

It was not long before further interference with our daily liberties took place, and we were and still are all compelled to rise from our beds in the morning at the word of command barked from the television screen opposite our beds by an individual somewhat reminiscent of my father's prismatic description of the old-time Sergeant-Major. Severe punishment is meted out to all those who do not spring to it smartly. Once out of bed we are compelled to go through a brutalising routine of physical exercises still under the harsh voice and baleful glare of the B.B.C. official. This finished, and our baths taken by numbers in the same manner, breakfast is taken, consisting of a Government tablet containing the necessary number of proteins and carbohydrates for the day's needs. This is, of course, the last as well as the first meal of the day. Breakfast over, scholastic

Radiocrazy—

studies (adult and juvenile) commence and last throughout the day since all necessity of earning a living has long since been abolished, our clothes as well as our food being provided by the Government.

Soon we were all graded into various categories according to our intellectual capacity as revealed by the universal system of psycho-analysis developed by the B.B.C., general listening was forbidden, and fixed wavelength receivers were doled out by the Government, the wavelength being allotted according to the mental category of the listener; he was thus unable to obtain any of the intellectual sustenance intended for anybody in another category.

But no matter in what category a person was placed, he was compelled to have a visaphone—or combined sound and sight instrument—hanging from each wall of every room, and in the garden as well. Thus throughout every moment of his life, whether sleeping or waking, he was under the protective eye of a B.B.C. official.

With regard to our physical well-being, I may mention that ill-health of any kind was definitely made a criminal offence in 1977. It did not take long for the B.B.C. to establish a regular medical inspection service, and now we are examined every morning through the visaphone by a B.B.C. medical man.

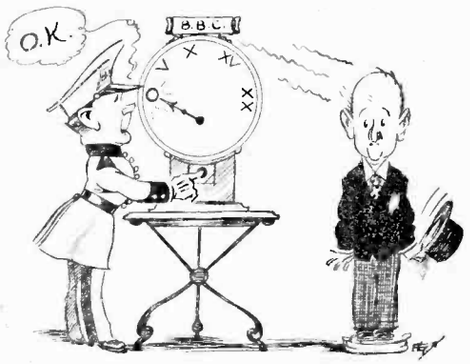
Birds, Beasts and Flowers

Naturally such old-fashioned methods of diagnosis as temperature taking and auscultation have long since been abandoned in favour of radio methods, which consist in measuring the ether-wave absorption of any suspected organ and comparing it with its normal absorption. Carefully tabulated data concerning the inner working of every citizen are kept in the medical archives of Broadcasting House.

It seems hardly credible that our weather, owing to what must be conceded was a really marvellous development by their technical experts, is now absolutely under the control of the B.B.C. Instead of going through the old-world custom of reading a weather forecast, which, judging by its reliability or lack of it, was apparently obtained by the study of the chief announcer's hand made by an old-fashioned palmist, the Corporation now issues the exact barometer and thermometer readings, wind velocity, etc., which have been decided upon by the Director-General. This is announced in the general orders of the day which are broadcast the previous evening.

I well remember the shocked but naturally suppressed feelings of the populace some twenty years ago, when the fiat went forth for the demolition of Westminster Abbey and similar buildings on the ground that they did not comply with the artistic requirements of the B.B.C. A similar futile outcry arose when the countryside was denuded of all trees, flowers, and other forms of vegetation, synthetic articles taking their places. Birds, feathered or otherwise, were replaced by loud speakers in the substitutes for trees.

The site of Westminster Abbey is to-day



All thoughts picked up.

occupied by a chromium plated steel structure in which the remains of the outstanding personalities of the B.B.C. are entombed. The site of St. Paul's is taken up with a similar mausoleum for the Directors-General.

It is fifteen years now since the edict went forth that all our streets and cities were to be renamed after famous B.B.C. officials.

The last straw has been the invention of the thought machine, whereby the thoughts of each individual are picked up and transmitted to the B.B.C. It was indeed fortunate that before this final calamity occurred I had already installed this metallic underground chamber, effectively screened from all Government spies for the simple reason that, as yet, none of the experts has invented any method by which ether waves can penetrate thick metallic plates. This naturally accounts for the decree forbidding the use of metal in the construction of buildings.

What will be the outcome of it all I don't know, but something vast and cataclysmic is needed which will make the French Revolution appear like a Sunday School treat. Oh for the dear old days of Arcady in 1933 or thereabouts when our mis . . . . [Here the manuscript is torn.]

DISTANT RECEPTION NOTES

SIDEBAND splash is now by far the worst bugbear of the long-distance man equipped with a sensitive and selective receiving set. He may have, for instance, no difficulty in separating Katowice—one of the most reliable of European stations—from its wavelength neighbour, Athlone, no kind of interference being observable. But the moment the Irish station begins to transmit speech the unintelligible splutterings of sideband splash ruin the reception of Katowice.

The same is true of many another pair on adjacent wavelengths: the Poste Parisien and Breslau, the North Regional and Langenberg, the Scottish Regional and Hamburg, Heilsberg and Bratislava are all examples. The sad part of it is that the trouble is mainly due to hopeless over-modulation by transmitting stations during spoken items, and that very little can apparently be done with the best of receiving sets to improve matters.

The listener in all parts of Europe has shown emphatically that he wants to be able to hear foreign stations when the local programme is not to his liking. It is surely the duty of the broadcasting authorities in the many countries of Europe to ensure that the performances of a first-rate set are not unduly handicapped by delinquencies on their part. This matter should be thoroughly thrashed out at the forthcoming conference of the U.I.R.

The Berlin Relay continues to give a good account of itself on 283.6 metres, though there is still no official information regarding any increase in power, or the *solus* use of the nominal common wavelength by this station. If any reader has been in the habit of skipping over 283.6 metres, thinking that it could not possibly be worth while spending time in tuning to a group wavelength, I hope that he will give the Berlin Relay a trial on one or two nights during the present week, for it is often by far the best medium for the reception of the excellent Berlin programmes.

What exactly is the power output of the Hungarian station using officially the wavelength of 209 metres, though at the present time its transmissions make a closer approach to 210 metres? In some lists it appears as a mere fraction of a kilowatt, whilst in others it is shown as many times as much. It certainly sounds like several kilowatts!

Atmospherics Mar Long Waves

I was amused to read recently in a lay paper that, though American reception might provide certain thrills, it was hardly for the man in the street, since it demanded almost uncanny feats in the way of fine tuning. Anyone who has heard WCAU, WPG, WIOD, WTAM, WTIC, or KDKA on a night when conditions were favourable may be excused a smile on reading such statements. These stations, and often a good many others, are far easier to tune in than most European stations, for their strength is amazing, and one has not the difficult task of separating them from powerful wavelength neighbours.

The big changes that we have experienced recently in temperature and in the barometric level have produced a certain amount of atmospherics, which have had at times an adverse effect upon the reception of long-wave stations. Still, we can hardly complain, for Huizen (Hilversum programmes), Zeesen, Radio-Paris, and Kalundborg have been coming in with fine strength both in daylight and after dark. Motala, too, is very well heard, though Warsaw has been, perhaps literally, a little under the weather.

The evils of sideband splash notwithstanding, it is a poor set nowadays that cannot give its user a choice of at least a dozen alternative programmes of genuine entertainment value on the medium waves on any evening of the week. My own "star" list at the moment is: Nürnberg, Hörby, Trieste, Turin, Hilversum (Huizen programmes), Bordeaux Lafayette, Genoa, Milan, Brussels No. 2, Strasbourg, Toulouse, Stockholm, Rome, Prague, Florence, Munich, and Budapest.

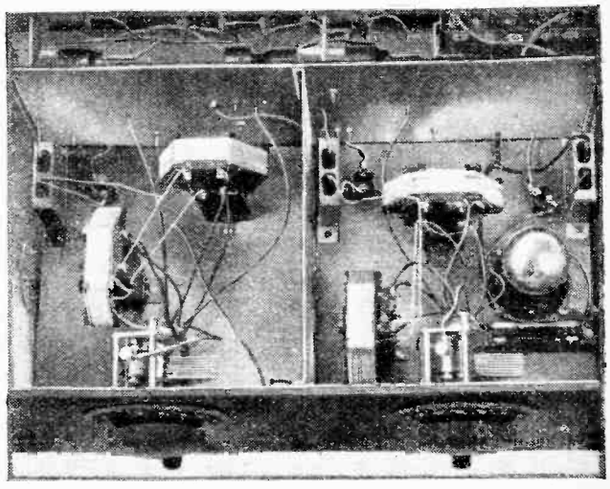
D. EXER.

The H.F. Amplifier

Progress—Past and Present

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

THE ever increasing demand for selectivity has evolved an H.F. amplifier in which more stages are used, though each has a smaller stage gain, this being the price paid for easier tuning control. For the future the author predicts the extensive use of iron-cored tuning coils and the introduction of the variable-mu pentode in place of its tetrode counterpart.



Part of an early screen-grid set, in which the neutrodyne style of construction was still used. Stage-by-stage screening made ganging practically impossible.

DETECTORS are of several types, but all, without exception, have one common characteristic. None of them will operate satisfactorily unless the signal applied to them is reasonably large. The exact numerical value of the high-frequency voltage necessary to enable the detector to give an audible signal is not, perhaps, susceptible of precise definition, but it is quite certain that the average foreign station delivers to the set a signal that falls far below the necessary intensity. For reception of such stations it is, therefore, essential to insert, between the aerial and the detector, one or more stages of high-frequency amplification.

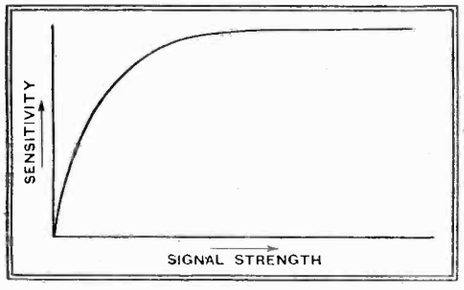


Fig. 1.—Typical sensitivity curve of detector. The sensitivity, though both high and constant for strong signals, is vanishingly small for weak ones.

A valve may be regarded as a device operated by a voltage applied to its grid, and releasing in response to this a corresponding current in its anode circuit. This current, in order to be made available for operating the next valve in the chain, must be caused to set up a voltage by making it pass through an impedance, and this, in the interests of efficient amplification, will naturally be made as high as possible. The only known means of building up an impedance high enough to offer adequate opposition to the flow of high-frequency currents is by the use of a tuned circuit. The history of high-frequency amplification is, therefore, largely the history of the evolution of the tuned circuit and of the valve to be used with it.

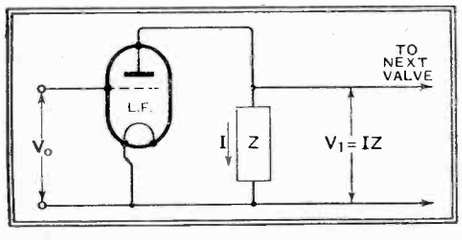


Fig. 2.—Simplified scheme of amplifying stage. The received signal voltage Vo causes a current I to flow in the anode circuit: the voltage V1 dropped by the passage of this through the impedance Z operates the next valve. The ratio V1/Vo is the stage gain.

In the early days of broadcasting the simple tuned-anode circuit of Fig. 3 was the greatest favourite, the valve used with it being of very low efficiency according to present-day standards. The coil L2 was a plug-in coil of one type or another. Owing to the capacity between the grid and anode of the valve no appreciable amplification could be attained before the stage went into self-oscillation. There was, therefore, no incentive to improve the efficiency either of the valve or of the tuned circuit, and for some years practically no progress at all was made.

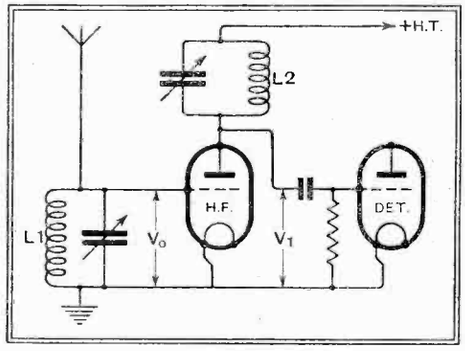


Fig. 3.—A practical interpretation, on 1924 lines, of Fig. 2. This is the "tuned anode" circuit. Note that H.T.+ is earthed for signal voltages so that the voltage V1 exists across L2.

The introduction of the neutralised stage, in which the anode-grid capacity of the valve was balanced out in some such way as is indicated in Fig. 4, marked the beginning of true amplification at high frequency, for it then became possible for the first time to take advantage of valves and tuned circuits of high efficiency. Much work was done at this time, both on valves and coils, coils especially coming in for a great deal of attention. Their importance was enhanced by the fact that the valves at that time in use would only give really satisfactory amplification when the tuned circuit following them had the lowest attainable losses. Very carefully made high-frequency transformers, with secondaries of Litzendraht on formers of large diameter, were the order of the day. A gain of forty-five times in a single stage was attained in the "Everyman Four" receiver (1926), and later receivers of similar pattern gave stage-gains running up as high as sixty times, the increase being due to improvement in valve characteristics.

Advent of Ganged Tuning

The arrival of the screen-grid valve, in which the anode-grid capacity is reduced to trifling dimensions by the interposition of the screen, led, though not immediately, to the disappearance of the neutralised triode stage. At first the development of the amplifier proceeded on the old lines, tuned circuits of the customary very high efficiency being used, and yielding, with the new valve, unprecedented amplification. In some cases the resulting gain was so high that it was necessary to resort to neutralisation even when using a screen-grid valve, as in the "Record Three" receiver (1929), in which a gain of 500 times in a single stage was attained.

Up to this time the use of more than two tuned circuits in a receiver had been exceptional, but the continually rising power of transmitters now began to make higher selectivity necessary. The increase in the number of tuned circuits required for this resulted in the appearance of sets with three, or even four, tuning dials, making them quite unfit for operation by

The H.F. Amplifier—

any but an expert. The next step, which began to be seriously considered early in 1930, was to link all the tuning condensers together on a common spindle and drive them from a single knob.

The Position To-day

As soon as this method of tuning became popular it was found necessary to abandon the high-efficiency tuned circuit, for these require a deadly accuracy of tuning that can only be attained with individual tuning dials. The earlier type of construction, in which large screening-boxes were used, each enclosing a complete stage with coil, tuning condenser, and wiring, was no longer necessary when coil efficiency was reduced, and it was found that coils individually screened in metal containers, though poor compared with the coils of neutrodyne days, could be made as efficient as is compatible with ganged tuning. The development of these led to the production of the multi-section gang condenser used to-day, and to the final emergence of the style of set-construction using screened components that now is almost universal.

Where do we stand to-day? What have we gained, and how much have we lost, in this complete metamorphosis of the high-frequency side of the receiver?

Quite evidently very much has been gained in convenience, both of construction and operation. One may say that selectivity, too, has been enhanced, because a receiver with three or four tuned circuits has become a practical proposition only since the introduction of ganging.

From the point of view of amplification per stage, modern practice is not particularly impressive. Nor does it need to be, for the demands of high selectivity have necessitated extra tuned circuits, with the result that an extra screen-grid valve is used in all ambitious sets to provide the necessary coupling between the extra circuits. We use, in fact, two stages of amplification as against the single stage that would have been used a few years ago in a set of similar pretensions. Consequently, the gain between aerial and detector is more, not less, than in the receiver of earlier days; it is more, even, than could be squeezed out of a single stage to-day by the combination of the most refined tuned-circuit technique with the most efficient of modern valves.

A set designed on the lines popular in 1929, but equipped with modern valves, would contain one stage only. The gain between aerial and detector would probably be less than 350 times, and could hardly exceed 1,000 times even with construction of the most meticulous laboratory standard. The selectivity would be that of only two tuned circuits, which, though of high efficiency, would not give overall tuning so sharp as three less ambitious coils. Ganging would be so difficult as to be impossible, tuning less sharp, and sensitivity lower on the older design, while the saving of a valve and its associated components would certainly be insufficient recompense for the extra cost of the more elaborate screening required and the vast amount of additional work in construction. In addition, the merely moderate selectivity of the older design, being due to two extremely sharply tuned circuits, would be accompanied by more loss of high notes than is involved in the higher selectivity of the modern set, with its three or four more heavily damped coils.

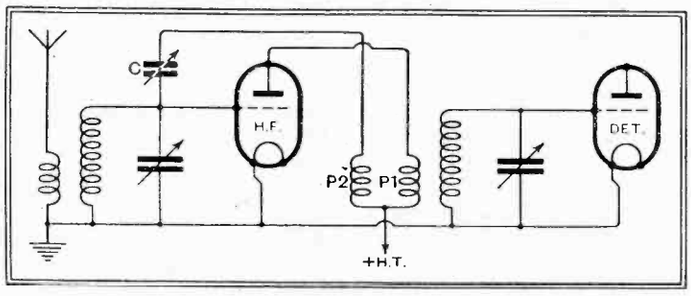
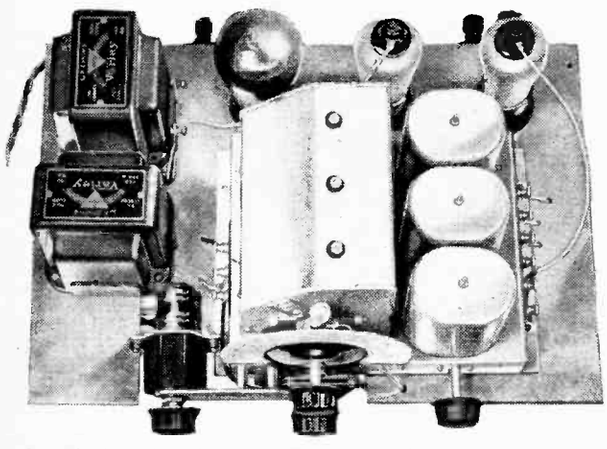
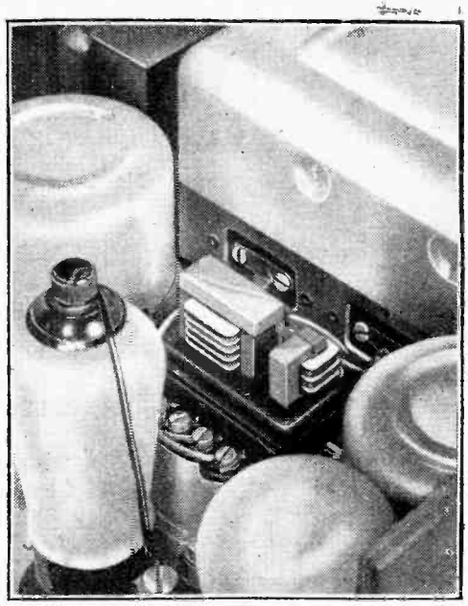


Fig. 4.—A typical neutralised stage. The voltage across P1 feeds energy back through the valve to the grid circuit, but this is balanced out by the energy fed from P2 through the tiny condenser C.



A typical modern layout, with multi-section gang condenser and screened coils as a single unit.

On balance there can be little doubt that the modern trend, which is to rely upon the valves for adequate amplification rather than upon the coils, and using two stages in preference to squeezing the last ounce of amplification out of a single stage, has everything in its favour. In this connection it must be remembered that the efficiency of modern valves is so high that the gain yielded by a screened-coil stage amounts, if tuned anode or tuned grid is used, to well over 100 times in a mains set and some 60 to 70 times in a set using the less efficient battery valves. When a step-up transformer or tapped coil replaces tuned anode some amplification is deliberately sacrificed in the interests of additional selectivity, but the gain per stage that remains still exceeds that of which we were vastly proud only a few years ago.



Portion of Ferrocart III receiver lately described in this journal, showing iron-cored coils to which its high selectivity is due.

In a word, the position is that in taking advantage of the efficiency of the modern screen-grid valve it has not been used as a means of pushing stage-gain up to record-breaking figures. Instead, we take our profits in the form of convenience and simplicity of construction, as ease of operation through ganging the tuned circuits, and as selectivity through the increased number of tuned circuits that can be handled in a ganged set.

Prophecy is notoriously dangerous, but it would seem that for sets demanding moderate gain and selectivity the high-frequency amplifier in its present form will continue to offer the best and cheapest design. For more ambitious sets the new iron-cored coils, as used in the Ferrocart III receiver, offer a means of enhancing amplification or selectivity very considerably indeed, though their characteristics inevitably require a high standard of accuracy in ganging. In the most ambitious sets of all the complexities of the tunable amplifier become so great that the fixed-tune amplifier of the superheterodyne provides the most practical solution.

In valves, present indications are that a drop rather than a rise in efficiency is the probable future trend, though the variable-mu screened pentode, now popular in America, may be introduced in this country, and may offer some modest improvement over the variable-mu tetrode.

We have seen two high-frequency stages used to do the work of one, and to do it both better and more conveniently. The future may perhaps find us using three quite low-gain stages where now we use two of moderate gain, leading to sets which will be at least as compact, rather more selective, decidedly more sensitive, and probably no more expensive than their counterparts of 1933.

NEWS of the WEEK

Current Events in Brief Review

New Long-wave Station

A 1-kilowatt broadcast transmitter has begun tests on 1,920 metres at Blaj, in Roumania.

Bach Interval Signal

LEIPZIG'S new interval signal is a gramophone record of the main theme of the great Bach fugue founded on the letters of the composer's name.

Mancunian Chats from Paris?

THE Manchester Chamber of Commerce is considering the question of advertising Manchester and its trades by means of talks from Continental radio stations.

New German Broadcasting Chief

DR. KRUCKOW, the successor to Dr. Bredow as Commissioner of German Broadcasting, has announced his intention of reorganising the service on a non-political basis. Apparently even the German Government is realising that too much official use may be made of the ether waves, the tendency being to lose listeners.

The Crystal Decline

SOME 97 per cent. of Germany's listeners vouchsafed particulars of their receiving apparatus for the purpose of the recent radio census. The results show that 74.8 per cent. of listeners use sets with from one to three valves, while 18 per cent. possess larger receivers.

Only about 7 per cent. now use crystal sets as compared with 16 per cent. two years ago.

Frankfurt's New Relay

TRIER, the new German 2-kW station on the River Moselle, is relaying the Frankfurt programmes on the same wavelength, namely, 259 metres. The fundamental frequency is generated at Frankfurt, and although both stations have valve-controlled tuning forks, that at Trier acts, not as a frequency producer, but simply as a check on the frequencies coming over the line from the main station, eliminating any noises from neighbouring lines. A new 5-kW. station is shortly to be opened at Freiburg im Bresgau, and this, too, will be operated from Frankfurt in the same manner.

Vatican Tells the World

NOWHERE is modern radio more keenly studied than at the Vatican, where the Pope recently inaugurated the new ultra-short wave service to Castel Gandolpho. His Holiness has now been presented with a magnificent radio-gramophone by the Marelli workers of Milan. In accepting the gift the Pope spoke of the great usefulness of radio in the conveyance of personal messages all over the world. Indeed, radio had made it possible for the proclamation of the Holy Year from the lips of the Pontiff himself to be heard in the most distant parts of the earth. Messages of thanks had been received at the Vatican from Peking, Shanghai, New Zealand and San Francisco.

"Ultra Shorts" in the Air

"GENERAL FERRIÉ" is the name of a new French airship which will shortly start from Le Bourget on a voyage of wireless research over Equatorial Africa.

The special problem to be tackled by this flying laboratory is the use of ultra-short waves in aerial navigation.

Empire Broadcasting on a Film

MR. M. A. WETHERELL, F.R.G.S., proposes to apply the acid test to Empire broadcasting during his forthcoming expedition through Nigeria and the Cameroons. The object of the expedition is to follow the route taken by Livingstone and to make a film entitled "Queen of the Okoyong." The explorer will take with him a standard Marconiphone 255 portable superhet, and during the trip it is intended to make a sound film of a party picking up Empire broadcasting on the set, reproducing the signal on the sound track of the film.

This film, which should demonstrate very effectually the possibilities of reception in the African Zone, should help to bring home to English cinema audiences the thrills of picking up the Mother Country in the heart of the jungle.

Radio and the Music Trade

WIRELESS, which was to ruin the piano and organ industry, seems to have had an opposite effect in France, where M. Fernand Oury, president of the Piano Manufacturers' Syndicate, declares that wireless and the gramophone have benefited the music trades by their helpful propaganda.

The effect has been similar in this and other European countries.

How Inventors Work

ONE of the most impressive tableaux at the Daily Mail Ideal Home Exhibition will be that of Senatore Marconi at work in his cabin on his yacht *Elettra*. Visitors will also see Michael Faraday in his simple laboratory in Albemarle Street. These tableaux will form part of a special feature designated "Rooms of the Scientists."

The Exhibition opens at Olympia, London, W.1, on Wednesday, March 29th.

Nice Protests

ALL Nice, according to a correspondent, is indignant at the refusal of the French Postmaster-General to permit the use of a land line between the Juan-les-Pins station and a studio which has been established in the great Riviera resort. The P.M.G. recently forbade the use of a line for relaying the Nice Carnival through the Juan-les-Pins station and thence to Poste Parisien. The Deputy-Mayor of Nice, supported by full-page newspaper headings, has sent a solemn protest to the French Government.

A THOUGHT FOR NEIGHBOURS? Violin practice which only the executant can hear is made possible with the Vierling electric violin, which can be played through a valve amplifier and headphones. Two magnetic pick-ups are used for the strings and another for harmonics. This instrument may shortly participate in an all-Europe electric music broadcast.

How They Listen

EXACTLY 16,809,562 homes in the United States were equipped with wireless sets on January 1st last, according to a special trade survey, constituting 56.2 per cent. of the total number in the country. There has been an increase of 4,760,800 in three years.

The District of Columbia claims the highest percentage of set owners, with 88.7, while New Jersey and Rhode Island follow with 83.1 and 82.1, respectively. New York can claim 79.4 per cent. of its homes as radio-equipped.

No Tax

THE adversaries of the wireless tax in France appear to have gained the first round in the contest, for the proposed taxes on crystal and valve sets no longer figure in the forthcoming budget.

After the Truth

WHAT caused amateur radio? What are its effects on the community as a whole? These questions form the substance of a survey now being carried out by the Sociology Department of the University of Minnesota in co-operation with the American Radio Relay League.

Indestructible "Mike"

A NEW microphone which will stand the assaults of the most temperamental artistes, which will come up smiling after being deliberately thrown on the floor or immersed in water, has been designed by the Brush Development Company of Cleveland, U.S.A. The sound element is a Rochelle Salt cell.

We now await a microphone which will *not* stand up to everything that is said to it.

Switzerland's "Italian" Studios

THE studios at Lugano, which are intended for use with the new Swiss regional station at Tessin for the Italian-speaking population, are already being employed for certain programmes from the two existing stations in Switzerland. This will explain why listeners may occasionally hear Italian spoken from either Beromunster or Söttens.

D.C. to A.C.: Compensation for Consumer

A JUDGMENT of special interest to wireless users in districts where the electricity supply is changed from D.C. to A.C. was given last week by Mr. Justice Goddard in the King's Bench Division.

Mr. Lakeman sought compensation from the Chester Corporation owing to the change over to A.C., which rendered his battery-charging plant useless. The Corporation, however, contended that they were called upon to pay only the cost of altering the consumer's apparatus, and that if, as here, the apparatus was one which could not be altered they were not obliged to pay anything, except perhaps the scrap value of the apparatus rendered useless. The Corporation had, in fact, offered the applicant £2 as the value of his old apparatus.

His Lordship, in giving judgment, read the Corporation's arrangement with the Electricity Commissioners as meaning that the Corporation must put the consumer into the position of having the same facilities for carrying on his business with the new alternating current as he had had with the old direct current.

The applicant was given judgment for £41 17s. 6d., including £7 due to interference to his business during the process of changing, together with costs.

DETECTION

Yesterday and To-day

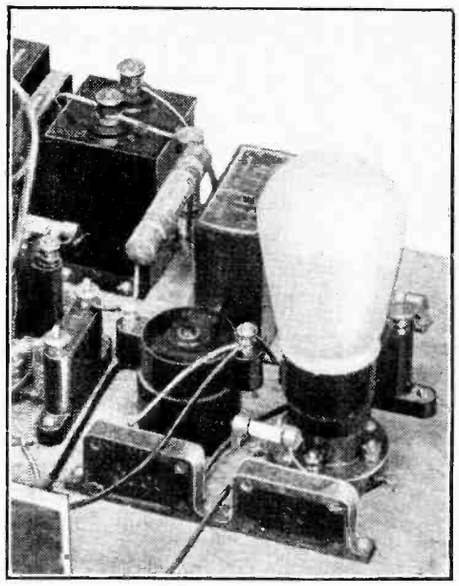
THE history of the detector takes us back 40 years, and tracing its development to modern times makes interesting reading. The detector has passed through many vicissitudes, from the coherer to the Fleming diode and thence to the triode and tetrode. Strangely enough, the diode is returning to favour.

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

THE design of receivers has passed through so many changes during the last forty years (Yes, dear newcomer, *forty*) that only one element has remained common to all —the detector. Even tuning was not incorporated until Sir Oliver Lodge thought of it in 1898. The detector is of first importance.

The name detector is perhaps not quite the best that might have been chosen; that is to say, it does not in itself declare very clearly its purpose in life. So, first of all, let us consider what the perfect detector ought to do, so that we may be in a position to know how nearly perfect (or otherwise) are the detectors we happen to have got.

It is, of course, part of the ABC of radio that the sound waves to which the human ear is responsive must be borne on carrier waves of much higher pitch (or frequency, or shortness of wave-length) in order to be transmitted over great distances, and that at the receiving end something must be used to respond to the carrier waves and to present them to our human sense in something approximating to the original form.



A typical modern power-grid detector stage with associated components.

This process is accomplished, in practice, by rectifying the carrier wave; that is, suppressing one-half of every wave, so that the variations in height of, say, the upper halves, which carry the desired sounds, are not neutralised by the equal and opposite variations of the downward halves.

Some Antique Methods

There are very many types of rectifier, but some of them are, like our cars, unresponsive to radio-frequency waves, and are thereby ruled out. The ideal, clearly, is a rectifier which is like a turnstile; letting the approved positive half-waves through without any delay, deduction, alteration, or reluctance, and presenting a complete and uncorruptible barrier to each and every negative half-wave. This perfect separation of the sheep from the goats is never obtained in this imperfect world. The sheep are unable to get through without leaving a little of their fleece behind, and a certain amount of goat hair is found among the wool.

This would not matter so very much if the imperfection were consistent, because the resulting loss could (since the introduction of the valve) be easily compensated by a little extra amplification; but a common failing of rectifiers is a reluctance to operate the turnstile smartly when only weak applicants for admission appear, and the result is that when the carrier wave is feeble the rectified current is very feeble indeed, and when the carrier is strong the increase in rectified current is out of all proportion stronger. A "square-law" rectifier is of this type, but some are even worse still. The "straight-line" or "linear" detector is one in which the rectified output is exactly proportional to the carrier-wave input.

In Fig. 1, A is a square-law characteristic, B is a fairly common type which begins badly but straightens out later, C is a perfect linear type, and D is also linear, but better than C because it is steeper, i.e., it introduces less resistance (loss) than C.

Leaving the more antique forms of detector unmentioned (but see Fig. 2), the crystal was very simple, cheap, and compact, but had curve A tendencies, and, moreover, was decidedly temperamental and moody in character. Hence the whisker-tickling that seemed inseparable from it. The first valve, the Fleming or diode type, now returning to popularity, was much more certain (after manufacturers had mastered the art of vacuum) and was a B-type detector, which could be made to give very good freedom from distortion by making the normal carrier strength run well up the straight portion. When introduced in 1904, however, people were not interested in quality of reproduction, but in being able to hear anything at all; so when De Forest put a third electrode in the valve, so that it could be used as a stage of amplification as well, it was adopted *nem. con.*, and ever since then we have been accustomed to expect from a detector not only detection, but amplification, too. A good deal of confusion of thought has resulted. Thus a valve which happens to have a high amplification factor is called a good detector, whereas it may be vastly inferior in that respect to another valve in which the rectifying properties are not so well boosted by the amplification. That is a parable of life.

Grid *versus* Anode Detection

The two competing types of valve detector-cum-amplifier—anode-bend and grid-leak—are so well known as hardly to need description. In the anode-bend type the grid is biased negatively so as to prevent grid current from flowing in any circumstances, and to make the anode current small until the carrier wave is applied. It is usually a close approxima-

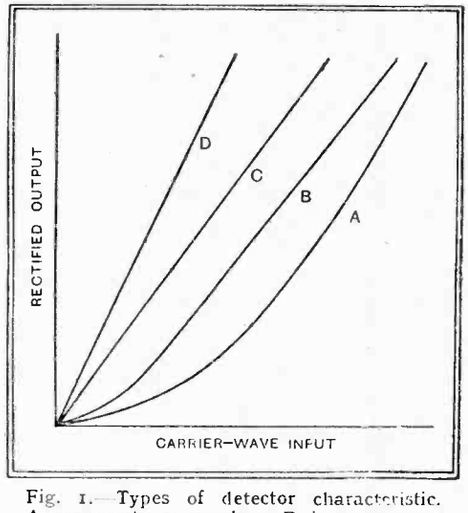


Fig. 1.—Types of detector characteristic. A represents square-law, B is a common type which starts badly but ends up well, C is linear, as is also D.

tion to a square-law rectifier, though when used in the American fashion, with a very large input, it tends to curve B type. Rectification is not complete, nor is it free from distortion, but owing to the absence of grid current it was supposed

Detection—

that it introduced very little loss on the input side. It was found later that the advantage in this respect might often be nullified under working conditions by reflection from the anode circuit back through the interelectrode capacity of the valve ("Miller effect"). And when in the early days carrier waves were weak, this type was very insensitive, as one would judge from curve A.

So the grid-leak type in which the grid and filament forms a diode rectifier and the resulting output is amplified by the valve as a whole became popular, because it is linear almost from the start, and therefore sensitive to weak as well as to strong waves. Then, too, the conditions of operation lead to the amplifying action being more effective than in the anode-bend type.

Screen-grid Valve as Detector

But as stations became more powerful, and pre-detector amplifiers more effective, the grid-leak detector got a bad name for distortion. Actually it was a perfectly good detector all the time, but the amplifying department was failing to cope with the increasing rectified outputs.

Furthermore, the new need for selectivity found a weak spot in the grid-current loss, which damped the tuned circuits. So the anode-bend type swung once more into favour.

Then articles in *The Wireless World* explained clearly what was really wrong with the grid-leak type, where the causes of distortion lay, and how they could be eliminated, and in this country, at least, the anode-bend was finally thrust into outer darkness. It is now used in America.

The distortion due to overloading was overcome by seeing that the valve was given a generous supply of power, so that it could amplify under the somewhat restricted conditions imposed by the necessity for doing two jobs at once. And the distortion due to the grid leak and condenser not acting smartly enough at the high audible frequencies was even more simply overcome by selecting sensible values for them, which are now more or less standardised at 0.25 megohm and 0.0001 mfd. respectively.

For a time, and provided that things were so arranged that the mean carrier-wave amplitude applied was just right, it did (and still does) quite well under the name "power-grid" detector.

If the amplitude is too small it runs into the lower bend and distorts. If it is too large it demands impracticably large anode current and voltage to handle it without overloading So it must be just right, like the middle-sized bear's bed.

Latterly the screen-grid valve has achieved some popularity as a detector; strictly speaking, it is not as a detector that it is judged, but as an amplifier. It may be used as an anode-bend, grid-leak, or power-grid detector, and as such is very much the same as an ordinary triode. But the amplification may be very much greater. Whether this is worth the somewhat greater cost, and whether one can make any good use of the amplification when one has got it, depends on circumstances. What is an unquestionable merit is that the Miller effect is absent, thanks to the internal screening, and so the valve throws much less damping and mistuning on the previous tuned circuit—a valuable concession when selectivity is at a premium.

All this time the poor goats have been kept waiting outside. But some kindly disposed enthusiasts who can spare the cost of an extra valve turnstile adopt a method for turning the goats into sheep (by means of a centre-tapped coil) and pushing them in through a second turnstile, to swell the useful flock. This method is alluded to in technical circles as push-pull detection, and, besides the advantage of doubling the output, it also renders largely unnecessary the usual filter or by-pass to waylay the residual H.F. currents left over after rectification has taken place.

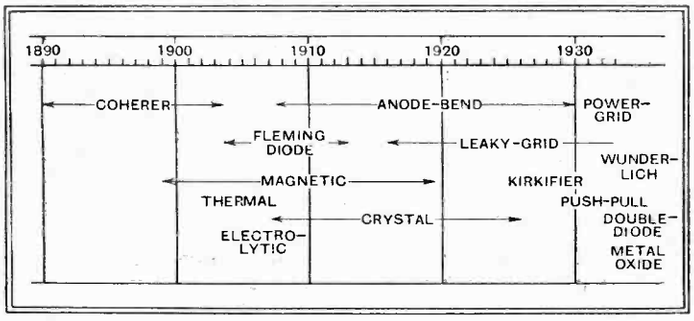


Fig. 2.—Chart showing approximately the periods during which various types of detectors flourished.

The Birth of A.V.C.

And that is about where we stood until recently. Now there are again signs that important developments are afoot and that the old order perisheth. Valves are improving, so that the necessity for a large step-up between the H.F. amplifier and the grid of the power valve no longer exists. Any large amplification between these two, such as is given by the modern rectifier-cum-amplifier, may be a positive embarrassment. The H.F. amplifier can put out ten, twenty, thirty or more volts, whereas the output valve gives us its two or three watts in the loud speaker with very much less than this applied to the grid. So history repeats itself yet again in the thirty-year-old Fleming diode, which is very nearly a linear detector when worked at a sufficiently large amplitude.

This is rendered all the more essential because broadcasting stations now often modulate up to 100 per cent. or near it, and unless the curved portion of the characteristic is a very small part of the whole, serious harmonic distortion is introduced.

Then, again, automatic gain control (it should *not* be called *volume* control, because the very object is to keep the volume constant, whereas a volume control is used to vary the volume) is now a practical proposition, and hinges largely on the ability of the detector to feed back something like twenty or more volts to control the H.F.-amplifier valve grids.

Metal Rectifier Possibilities

This can be and is done by a diode (push-pull or full-wave, as in the Murphy superhet), but there are innumerable schemes, with and without special valves, many of which have been described in *The Wireless World* in past months.[1] The Wunderlich valve is an American idea with this in view, consisting of a double-diode and triode amplifier in combination, retaining the merits of them both.

But why keep talking about valves? Thirty years is a long reign in the radio kingdom, where revolutions are constantly breaking out in the columns of the lay press, and our friend the metal-rectifier is already appearing as a possible rival.[2] He may take some time to establish his claim, so it would be unwise to withdraw loyalty to the valve dynasty prematurely. But it has been shown that, by suitably modifying the construction of the metal-rectifiers with which we are familiar in power units and battery chargers, it is possible to overcome the disability which has hitherto confined them to very low frequencies. As far as the more elaborate superhets are concerned it may be expected that metal-rectifiers will score heavily in the near future. They have incontrovertible advantages for this particular work. But for "straight" sets and those of the less "powerful" types no extensive change in technique seems to be indicated at present, except, perhaps, the use of multiple valves which include a diode. Existing types are perhaps more numerous than ever, and a choice can be made to fit in with any set of conditions.

Whether diode- or metal-rectifier, we are now again able to judge detectors on the old basis, unmixed with amplification. And, according to the standards of perfection laid down at the start, we are nearer the ideal, both as regards efficiency and absence of distortion. The latter we certainly want; the efficiency need hardly be pressed further, because we have amplification enough and to spare. Perhaps the last word will be with convenience and cost.

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[1] "Automatic Gain Control," Sept. 23rd and 30th, 1932; "Automatic Volume Control—Is It Worth While?" Aug. 12th, 1932; "Practical Automatic Volume Control," Jan. 6th and 13th, 1933.

[2] See "The Westector," *The Wireless World*, March 3rd, 1933.

BROADCAST BREVITIES

By Our Special Correspondent

New Dance Band Scheme

"DANCES from the Shows" may be a forthcoming feature by the B.B.C. Dance Orchestra. I hear that Henry Hall is working on the idea following the enormous success of John Watt's "Songs from the Shows"—a feature which always brings an appreciative mail to Broadcasting House.

Famous dances from stage successes of the past decade should provide material for many programmes by the B.B.C. Dance Band.

Craigantlet?

A CORRESPONDENT who has been watching the B.B.C. mobile transmitter, now seeking a site for the Ulster Regional transmitter, tells me that the vehicle is quite firmly entrenched on the Hollywood Hills close to Craigantlet—the famous motoring test hill.

The news does not surprise me, for I happen to know that the B.B.C. engineers have been casting acquisitive eyes on this Craigantlet site for a considerable time.

Secrecy Over Droitwich

Nothing, however, has been decided upon in regard to the Ulster site, and I can forgive the B.B.C. for reticence in the matter, but why the secrecy over the Droitwich site? Everyone knows that Wychbold, near Droitwich, was chosen for the new high power station, but we have yet to receive the official announcement that the site has been bought. Considering that the purchase was effected several days ago, the announcement seems overdue.

After all, you (if licensed) and I both helped to pay for it.

Hush-Hush Plans

The B.B.C. draughtsmen are now busy on the Droitwich plans. The general feeling is that something very much out of the ordinary in station design is called for to house the B.B.C.'s most powerful transmitter. Within the next few weeks the plans may be published, at least in part, but at the moment everyone is sworn to secrecy.

Home of Mystery

Broadcasting House is a home of secrets; everyone walks guiltily on tip-toe. As one man put it to me, "the place is like a dook's mansion with the dook dead upstairs."

Coming Shortly

Western Regional will probably disturb the ether before the end of the month with its initial tests, though the transmitter is not expected to begin a regular public service until June.

Then, and not till then, Western National will begin testing.

Will the Waves Clash?

I wonder whether there will be some mutual interference between the London and Western Nationals? Both will be using the same wavelength, viz.: 261.1 metres, and although the engineers are fairly confident that no heterodyning will take place, I shall feel happier on the point when their theory has been proved in practice.

The argument is that London National sends a weak signal westwards. But suppose Western National sends a strong signal eastwards?

A Musical Play

"THE Castle on the Hill," to be broadcast on March 14th (National) and 15th (Regional) is a musical play by Denis Freeman and Martin Lubbock, based on the Bolshevist post-war rising in Hungary.

Robert Radford

ROBERT RADFORD, the famous bass singer, whose death occurred last week, was not a frequent broadcaster, but he did appear in studio opera. The last occasion was in November, 1929, when Radford sang at Savoy Hill in the opera "Louise."

The Men in the Tower

PEOPLE who work in the central tower of Broadcasting House are, I hear, beginning to envy workers in underground safe deposits and other comparatively open-air spots. Not only do the B.B.C. music librarians and publishing department labour all day by artificial light, they also breathe only the specially prepared air which is pumped up from the automatic ventilators.

When Viscount Bridgeman, the new vice-chairman of the B.B.C., was making his recent tour of the building, he expressed concern at the conditions under which the "tower people" worked.

They will be released from this Tower of Babel only when the B.B.C. can find extra accommodation outside Broadcasting House.

B.E.B.C.

SOME months ago I suggested a new title for the B.B.C., viz., the British Empire Broadcasting Corporation, and when I hear recurring rumours that Mr. Gladstone Murray, the Information Chief, is being pressed to leave England and supervise Canadian broadcasting, the suggested name seems more and more appropriate.

Empire Posts

I believe it to be Sir John Reith's intention to find Empire posts for as many B.B.C. men as possible, and thus hasten the happy day when broadcasting throughout the Empire will conform to B.B.C. ideals even if it does not accept B.B.C. control.

Wait and see!

Sopranos in Musical Squabble

GORDON McCONNEL will give us more studio opera on March 17th (National) and 18th (Regional), the programme consisting of two miniature works by Mozart. The first, "Bastien and Bastienne," which was written at the age of twelve, is a simple pastoral. More sophisticated is "The Impresario," the second opera of the evening, which Mozart wrote eighteen years later. It is really a quarrel, set to music, between two jealous sopranos.

MAKING OUR FLESH CREEP. Scene in the B.B.C. "Effects" room at Broadcasting House, where sounds of clanking chains amid the whine of a sawmill are produced by specialists, who check up the results on headphones.

Talking by Numbers

"RADIOCRACY" has been much talked of recently, and its supposed horrors have been well aired in public places, but I am not sure that those who have laughed at the notion are the fellows who know best.

I write in this morbid strain after a glance at "Inquiry Pamphlet No. 3," published by the Central Council for School Broadcasting, and dealing with "The Evidence Regarding Broadcast Speech Training Collected by the English Speech Investigation Sub-Committee." (Price 6d.)

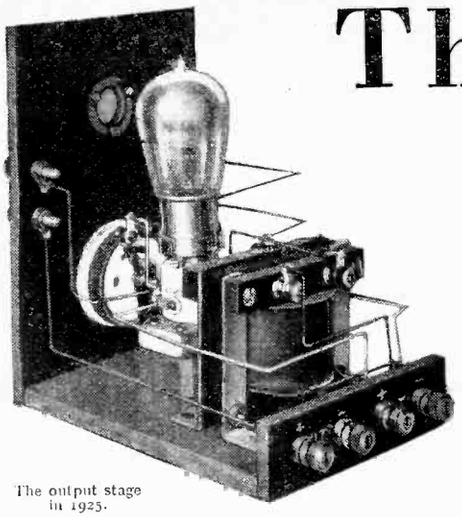
New Speech Outfits

The report tells of the "speech drill" to which groups of children were submitted after hearing the words pronounced B.B.C. fashion on the loud speaker.

Later, gramophone records were taken of words uttered by classes which had undergone the régime and by classes which had not. As Professor Cyril Burt records, "the main result of the experiment—a superior improvement in the class trained by wireless—was statistically reliable."

The aim of the courses is to give the children "new speech outfits"—a commendable aim, but is it really necessary that the B.B.C. should have a finger in the pie?

When all people talk alike it will be a short step to all thinking alike.



The output stage in 1925.

The Output Stage

Have We Reached Finality?

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

WHEN we come to examine the output stage of the modest battery receiver we find that no change in the circuit linking the speaker to the last valve has taken place since the early days of broadcasting. It was with the introduction of mains valves that the output circuit began to become somewhat complicated, and to-day it forms quite a specialised subject. For the future the author holds out high hopes for class "B" amplification.

THE output stage crowns the set, and in this sense all other parts are subservient to it. The high-frequency stages, the detector, and perhaps the first L.F. valve are all engaged in providing the final stage with something to work upon; if this something is faulty the output stage can magnify the fault enormously. Alternatively, it is little use designing a linear detector if the output valve is either incapable of accepting its output or is not properly matched to the loud speaker. The last valve and its associated components are designed to deliver power, and thus differ from the other stages, all of which are voltage-operated.

Having a technique of its own, it is small wonder that the output stage has attracted the attention of the specialist, whose efforts have been rewarded by extraordinarily rapid developments in output-valve design, although, strange to relate, in the smaller type of receiver the circuit linking valve to loud speaker has not changed since the early days of broadcasting.

Feeding the Loud Speaker

In discussing the evolution of the output stage we need not consider any circuit more primitive than that of Fig. 1 (*a*), where the simplest possible arrangement is shown. The loud speaker is connected directly in the H.T. positive lead, and the results are satisfactory enough in battery sets where currents of only small value are flowing. This circuit, which has stood the test of time, is not likely to be superseded where low cost is of primary consideration and where no attempt is made to change from battery feed. However, if an electric lighting supply becomes available, there is a temptation to convert the set to all-mains operation in gradual stages—the first purchase being an H.T. eliminator.

The circuit of Fig. 1 (*a*) now becomes unsatisfactory, and the well-known choke-filter scheme must be pressed into service. This confers the advantage of isolating the speaker from D.C., and high voltages can be used with impunity. Furthermore, the choke serves to decouple the output circuit, and motor-boating is prevented even when the H.T. source has a high internal impedance.

Up to a few years ago practically all the speakers on the market were of high resistance and matched the average output valve automatically; in fact, makers of speakers and valves arranged that the impedance of their respective products were mutually suited. But with the advent of the moving-coil instrument, which has come to be standardised with a robust low-resistance speech coil, matching transformers have become essential. The simple output circuit with which we started is now growing, and contains a choke-filter fed output transformer on the assumption that an H.T. eliminator and a moving-coil speaker have been pressed into service.

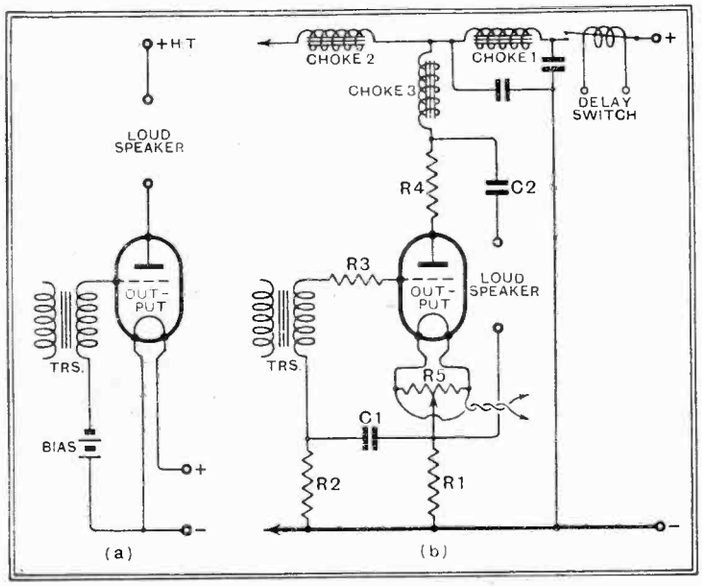


Fig. 1.—(a) The simplest output stage which has stood the test of time. A more elaborate circuit for a modern mains valve is shown on the right (b).

The next logical development is the replacement of the L.T. accumulator by a mains transformer to feed the filaments, but this would hardly be satisfactory unless mains valves and automatic bias were introduced simultaneously. As the mains voltage always fluctuates, self-bias gives a measure of automatic compensation of anode current so that, apart from its convenience, this method of deriving grid potential has electrical advantages as well.

New Technique

Unfortunately, as soon as self-bias is included in the output stage there is a risk of loss of bass unless the grid circuit is decoupled. Here more complications arise as the majority of mains valves are liable to be short-lived if a resistance of appreciable value is connected in the grid-return circuit. A sudden loud passage of music or an atmospheric will cause an excursion into grid current, and the valve may be "triggered" into a state of self-oscillation. The greater the value of the decoupling resistance the more pronounced the effect; we therefore have to be satisfied with some 50,000 ohms which is reasonably effective.

The efficiency of mains valves has increased at such a prodigious rate that it is now possible to obtain sufficient loud speaker volume for the largest of rooms when using a single output valve fed directly from the detector. A certain price has to be paid for such high sensitivity, and various precautions must be taken if no unwanted effects are to occur. It is possible in the larger type of valve that the interelectrode capacities, together with the inductance of short leads to the grid and anode, may cause resonance at a wavelength as low as 3 metres. Parasitic oscillations at this frequency

The Output Stage—

may completely paralyse the valve; non-inductive resistances should therefore be connected to the grid and anode terminals of the valve-holder.

The output circuit is now becoming more elaborate, and it is represented by Fig. 1 (*b*). Here R1 is the automatic bias resistor, R2 C1 the decoupling, and R3 and R4 represent the anti-parasitic resistances just referred to. There is choke-filter feed (CH3.C2) to the loud speaker, and the field coil of the latter is used to provide extra smoothing (CH2) for the H.T. supply. With the delay switch to safeguard condensers and other equipment from the effects of surge voltages when switching on, the modern output stage is now fairly complete.

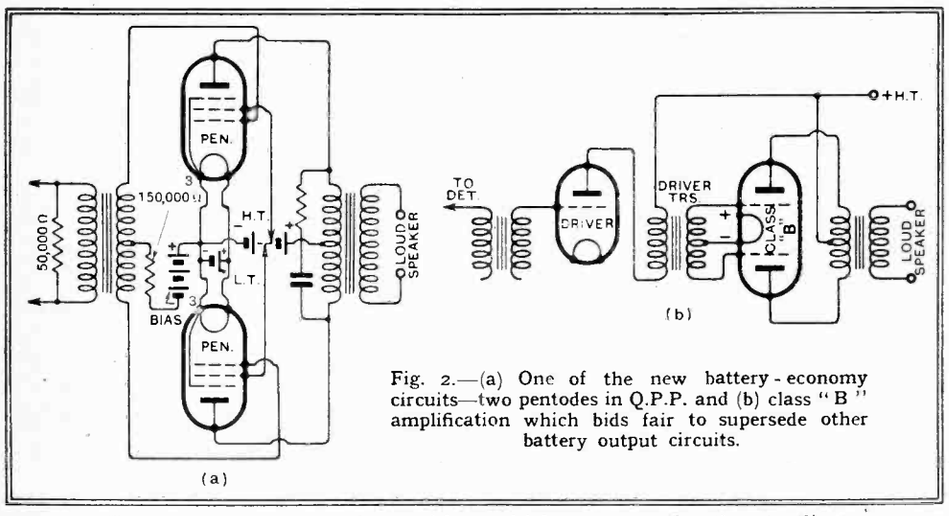


Fig. 2.—(a) One of the new battery-economy circuits—two pentodes in Q.P.P. and (b) class "B" amplification which bids fair to supersede other battery output circuits.

The tremendous strides which have been made in output-valve efficiency are best shown by referring to Table A, which gives the figure of merit of a number of output valves starting with the DE5A valve. The measure of efficiency or sensitivity is defined as the watts energy delivered to the speaker for a given signal voltage applied to the grid.

And what of the future? Prophecy is always dangerous, but it can be stated without fear of contradiction that next season's battery sets will be equipped with one of the new "battery economy" circuits, an example of which has become so popular of late. With the high cost of H.T. current, when mains are not available, the new systems are particularly attractive as there is practically no drain on the battery until a signal is received, and then the current is proportional to the volume of sound from the loud speaker.

TABLE A

Valve	Sensitivity*
DE5A	0.9
DE5	1.8
P625	2.7
PX4	4.4
LP2	8.3
ML4	17
AC/Pen	40
41MP	51

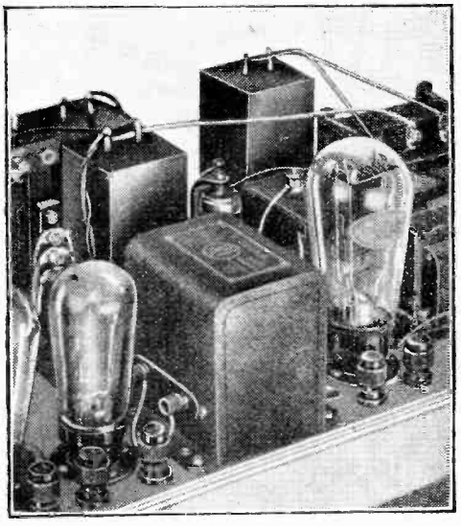
*mW per volt² R.M.S. input.

If the transmissions from the broadcasting station were continuously modulated to 100 per cent. the H.T. consumption would be so heavy that no saving would be shown over the more orthodox methods of amplification. But during talks there is only spasmodic modulation, and with the number of intervals that take place there is, of course, no rise in current; in fact, the *effective average* modulation over a long programme would probably not exceed some 15 per cent. It is this low figure which accounts for the startling economy claims made for Q.P.P.

This push-pull output scheme, the circuit of which is given in Fig. 2 (*a*), gives of its best when two pentodes of the Pen.220A class are used, and "mains output" can be obtained for a surprisingly low working anode current. There is, however, this disadvantage; not only is a large bias voltage required, but some arrangement must be made to discharge the bias battery in sympathy with the H.T. battery otherwise incorrect working conditions may result. The difficulties are not insuperable, and careful consideration of the total H.T. consumption of the set will dictate the best value of shunting resistance to use across the grid battery.

One advantage of Q.P.P. is that with nearly all the valves suitable for this class of amplification, the detector can feed the output stage through a high-ratio transformer without any intermediate valve.

A serious competitor to Q.P.P. in the form of a double output valve is about to find its way on to the market. It has already been extensively used in America, and has come to be known as Class "B" amplification. Here the elements of two triodes are mounted in one bulb, there being pin connections to two anodes, two grids, and a single filament. These triodes, which, in any theoretical discussion, must be considered as separate entities, are used back-to-back in a push-pull circuit, and the signal voltage is allowed to encroach not only into the lower bend of the characteristic, but also into the grid current zone—an area which has hitherto been avoided at all costs in an amplifying valve.



A modern output stage in a mains receiver. The thermal delay switch resembles a valve and is on the left of the main smoothing choke.

New Output Scheme

There is quite a lengthy part of the "curve" in the grid current zone which is straight, but until this new form of output stage was investigated no one dreamed that it would be put to any important use. Most intriguing of all is the type of triode used; owing to cancellation of the curvature effects it is found possible to combine in the single bulb small valves of the detector class, and thus we find ourselves in 1933 in the paradoxical position of reverting to valves which were beginning to be discarded for the output stage as long ago as 1924.

The undistorted output will be nearly twice that from Q.P.P., the double valve will be inexpensive, no grid-bias battery for the output stage is needed (as the valve operates at zero grid potential), and the majority of Q.P.P. components already on the market will be suitable. Thus one's prophecy of popularity in next season's sets seems to be on safe ground. In Fig. 2 (*b*) a skeleton circuit is given.

Class "B" amplification may find application in mains sets, but in this case its qualities are distinctly less attractive, as H.T. current is so cheap. There is also the need for a special mains rectifying valve with better regulation than is possible with the vacuum type.

The advantages, however, of using a power stage where the H.T. current drain is proportional to the signal are so great that further valve developments are almost bound to take place sooner or later.

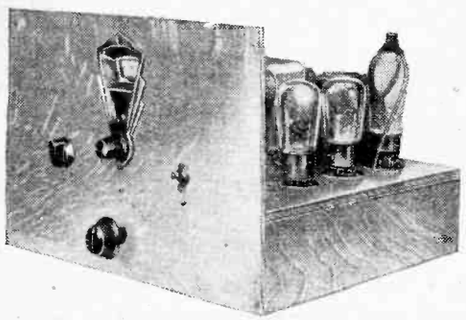
Before any striking advance can be made in output-coupling arrangements we must wait for further loud speaker developments, for it is felt that output-valve technique has outstripped that of the reproducer. Let us leave further prophecy alone and take this opportunity of congratulating the British valve manufacturers, whose present range of output valves is unrivalled by that of any other country.

In Next Week's Issue:—

Adding A.V.C. to the MONODIAL SUPER

A Famous Set now Designed Complete with Automatic Volume Control, or with Instructions for Adding A.V.C. for those who have already Built the Original Model

PROBABLY no refinement in wireless receiver design has ever created so much interest as is being shown to-day in automatic volume control. The advantage of A.V.C. is of the utmost importance to any receiver designed for the reception of distant stations, for it provides constant signal strength on any distant station which formerly came in at varying strength due to the phenomenon of fading. There could be no better set in which to incorporate A.V.C. than *The Wireless World* Monodial Super, and this addition, which we shall describe in next week's issue, puts this receiver still farther ahead of any rival.



Receiver chassis of the Monodial A.C. Super fitted with A.V.C.

Below we publish a complete list of parts required for those who wish to construct the A.C. Monodial complete with automatic volume control, with a choice of either a 2.5 watts amplifier or a 5 watts amplifier. In addition, for the convenience of those who have already constructed the Monodial A.C. Super and wish to add A.V.C., a list of the additional parts required is included.

A.V.C. RECEIVER CHASSIS

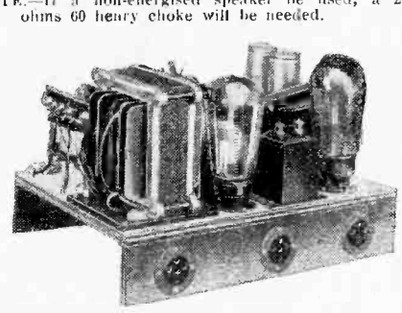
1 **Fixed condenser,** 4 mfd., 400 v, D.C. test — **Dubilier type BB**
1 **Fixed condenser,** 2 mfd., 400 v, D.C. test — **Dubilier type BB**
1 **Fixed condenser,** 1 mfd., 400 v, D.C. test — **Dubilier type BB**
1 **Fixed condenser,** 0.1 mfd., 400 v, D.C. test — **Dubilier type BB**
(Ferranti, Formo, Peak, T.C.C., Telsen)
8 **Fixed condensers,** 0.1 mfd., 500 v, D.C. test non-inductive — **Dubilier type 9200**
(T.C.C., Telsen)
3 **Fixed condensers,** 0.01 mfd. — **Dubilier type 620**
1 **Fixed condenser,** 0.0001 mfd. — **Dubilier type 620**
2 **Fixed condensers,** 0.0005 mfd. — **Dubilier type 620**
(Ferranti, Loewe, T.C.C., Telsen)
1 **Fixed condenser,** 0.0001 mfd. — **Dubilier type 670**
(T.C.C.)
1 **Volume control,** 250,000 ohms, tapered — **Claude Lyons P5-250A**
1 **Potentiometer,** 5,000 ohms — **Watmel**
(Colvern, Claude Lyons, Rothermel)
1 **Semi-fixed condenser,** 0.0005 mfd./0.002 mfd. (Formo) — **R.I. "Varicap"**
1 **5-way insulated connector** — **Wilburn**
1 **Variable condenser,** 0.0005 mfd., 3-gang, screened, superhet. type, with trimmers on the right — **British Radiophone**
1 **Slow-motion dial,** for above — **British Radiophone**
2 **Metallised resistances,** 250 ohms, 1 watt — **Dubilier**
3 **Metallised resistances,** 1,000 ohms, 1 watt — **Dubilier**
1 **Metallised resistance,** 2,500 ohms, 1 watt — **Dubilier**
1 **Metallised resistance,** 4,000 ohms, 2 watts — **Dubilier**
1 **Metallised resistance,** 6,000 ohms, 3 watts — **Dubilier**
2 **Metallised resistances,** 10,000 ohms, 1 watt — **Dubilier**
1 **Metallised resistance,** 30,000 ohms, 1 watt — **Dubilier**
1 **Metallised resistance,** 50,000 ohms, 1 watt — **Dubilier**
1 **Metallised resistance,** 75,000 ohms, 1 watt — **Dubilier**
2 **Metallised resistances,** 100,000 ohms, 1 watt — **Dubilier**
1 **Metallised resistance,** 250,000 ohms, 1 watt — **Dubilier**
2 **Metallised resistances,** 1 megohm, 1 watt — **Dubilier**
(Colvern strip type, Erie, Claude Lyons)
3 **I.F. transformers,** 110 kc. — **Colvern "Colverdynes"**
7 **Valve-holders,** 5-pin — **Clix chassis-mounting type**
1 **H.F. choke** — **Wearite type HFO**
1 **H.F. choke** — **McMichael Binocular Junior**
1 **Battery cable,** 7-way — **Harbros**
1 **Battery cable,** 4-way — **Bulgin**
(Belling-Lee)
1 **Set of B.P. canned coils** — **Varley "Square Peak" BP19**
4 **Ebonite shrouded terminals** — **Belling-Lee type B**
(Burton, Clix, Eelex, Igranic)
1 **Change-over switch** — **Claude Lyons B.A.T. 729**
1 **Switch** — **Claude Lyons B.A.T. 728**
Metal screened sleeving — **Goltone**
(Lewcos, Harbros)
1 **Venesta board,** aluminium faced, 12in. x 14in. x ¾in. — **Peto-Scott**
1 **Panel,** oak faced ply, 14in. x 9½in. — **Peto-Scott**
Plywood ¾in., screws, wire, systoflex, etc., etc.
1 **Screen,** 2¾in. x 2¾in., No. 16 S.W.G. — **Peto-Scott**
Valves: 3 Marconi VMS4, 1 Marconi MHL4, 1 Mullard 164V, 2 Mullard 354V.

2.5 WATTS A.V.C. POWER CHASSIS

5 **Valve-holders,** 5-pin — **Clix chassis-mounting type**
1 **Fixed condenser,** 2 mfd., 1,000 v, D.C. test — **Dubilier type LSA**
1 **Fixed condenser,** 4 mfd., 1,000 v, D.C. test — **Dubilier type LSA**
1 **Fixed condenser,** 2 mfd., 500 v, D.C. test — **Dubilier type BC or LSB**
1 **Fixed condenser,** 1 mfd., 400 v, D.C. test — **Dubilier type BB**
2 **Electrolytic condensers,** 8 mfd. — **T.C.C. type No. 802**
1 **L.F. choke,** 10 henrys — **Sound Sales**
(Ferranti B2)
1 **L.F. choke,** 50/20 henrys — **R.I. "Hypercore"**
1 **Mains transformer,** 210/240 v, 40/100 cycles, 350+350 v, 100 mA, 4 v, 6 amps., centre-tapped, 4 v, 2½ amps., centre-tapped, 4 v, 1 amp., centre-tapped, 4 v, 1 amp., centre tapped, with screened primary — **Challis**
3 **Plugs,** 5-pin — **Bulgin P3**
1 **L.F. transformer** — **Ferranti AF5**
1 **Metallised resistance,** 10,000 ohms, 1 watt — **Dubilier**
1 **Metallised resistance,** 50,000 ohms, 1 watt — **Dubilier**
1 **Metallised resistance,** 700 ohms, 2 watts — **Dubilier**
1 **Metallised resistance,** 1,000 ohms, 2 watts — **Dubilier**
(Colvern strip type, Erie, Claude Lyons)
1 **Venesta board,** aluminium faced, 9in. x 12½in. x ¾in. Plywood ¾in., screws, wire, systoflex, etc., etc.
Valves: 1 Osram PX4, 1 Mazda UU120/350.

NOTE.—The type LSA condenser has had its voltage altered; therefore the original LSA or the present LEC type should be used.

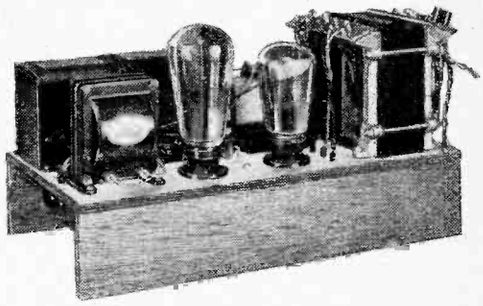
NOTE.—If a non-energised speaker be used, a 2,500 ohms 60 henry choke will be needed.



2·5 watts power unit for the A.V.C. Monodial.

5 WATTS A.V.C. POWER CHASSIS

1 **Mains transformer,** primary with earthed screen, secondary windings 400-0-400, 4 v, 6 amps., c.t.; 4 v, 3.5 amps., c.t.; 4 v, 2 amps.; 4 v, 1 amp. c.t. — **Parmeko**
(Rich and Bundy, Savage, Sound Sales, Tannoy, Bryce, Trix)
2 **L.F. Smoothing chokes,** 28/14 henrys — **R.I. type DY11**
(Varley, Bryce, Rich and Bundy)
1 **L.F. Transformer,** 3½ to 1 — **Ferranti AF5**
1 **Thermal delay switch** — **Varley type EP17**
(Bulgin)
1 **Potentiometer,** 30 ohms — **Claude Lyons, Hum Dinger**
1 **Power resistance,** 2,500 ohms, 10 watts, and holder — **Varley type EP38**
1 **Metallised resistance,** 100 ohms, 1 watt — **Dubilier**
1 **Metallised resistance,** 5,000 ohms, 1 watt — **Dubilier**
1 **Metallised resistance,** 10,000 ohms, 1 watt — **Dubilier**
1 **Metallised resistance,** 50,000 ohms, 1 watt — **Dubilier**
1 **Metallised resistance,** 500 ohms, 3 watts — **Dubilier**
5 **Valve-holders,** 5-pin, under-baseboard type — **Eddystone**
(Clix, W.B.)
4 **Fixed condensers,** 4 mfds., 1,500 v, D.C. test — **Peak**
1 **Fixed condenser,** 2 mfds., 1,500 v, D.C. test — **Peak**
1 **Fixed condenser,** 1 mfd., 500 v, D.C. test — **T.C.C. type 65**
1 **Fixed condenser,** 2 mfds., 500 v, D.C. test — **T.C.C. type 65**
(Dubilier)
1 **Speaker cable,** 4-way
3 **Plugs,** 5-pin — **Bulgin P.3**
2 **H.T. Safety sockets** — **Belling-Lee**
1 **Venesta** ("Plymax" baseboard, 16in. x 8½in. x ¾in.) — **Peto-Scott**



5 watts power unit for the A.V.C. Monodial.

Screws, wire, flex, sleeving, lamp-holder adaptor, wood, etc.

Valves: 1 UU120/500 (Mazda), or Cossor 400BU, or Marconi U.14, or Osram U.14, or Mullard DW4, or Philips 1561, or Six-Sixty SSW120/500.
1 PP5/400 (Mazda), or Marconi PX25, or Osram PX25.

NOTE.—If a non-energised speaker be used, a 2,500 ohms 60 henry choke will be needed.

ADDITIONAL PARTS REQUIRED FOR CONVERTING AN EXISTING MONODIAL TO INCORPORATE AUTOMATIC VOLUME CONTROL

RECEIVER CHASSIS

1 **Valve-holder,** 5-pin — **Clix chassis-mounting type**
3 **Fixed condensers,** 0.1 mfd., non-inductive — **Dubilier type 9200**
(T.C.C., Telsen)
1 **Fixed condenser,** 0.0005 mfd., mica — **Dubilier type 620**
1 **Fixed condenser,** 0.01 mfd., mica — **Dubilier type 620**
(Ferranti, Loewe, T.C.C., Telsen)
1 **Fixed condenser,** 0.1 mfd. — **Dubilier type BB**
(Ferranti, Formo, Peak, T.C.C., Telsen)
1 **Plug,** 5-pin — **Bulgin type P3**
1 **Battery cable,** 4-way — **Bulgin type BC2**
1 **Volume control,** 250,000 ohms — **Claude Lyons type P5-250A**
2 **Metallised resistances,** 250 ohms, 1 watt — **Dubilier**
1 **Metallised resistance,** 2,500 ohms, 1 watt — **Dubilier**
1 **Metallised resistance,** 4,000 ohms, 2 watts — **Dubilier**
1 **Metallised resistance,** 6,000 ohms, 3 watts — **Dubilier**
1 **Metallised resistance,** 10,000 ohms, 1 watt — **Dubilier**
1 **Metallised resistance,** 50,000 ohms, 1 watt — **Dubilier**
1 **Metallised resistance,** 75,000 ohms, 1 watt — **Dubilier**
2 **Metallised resistances,** 100,000 ohms, 1 watt — **Dubilier**
2 **Metallised resistances,** 1 megohm — **Dubilier**
(Colvern Strip type, Erie, Claude Lyons)
1 **Screen,** 2¾in. x 2¾in., No. 16 S.W.G. — **Peto-Scott**
Valves: 1 Marconi or Osram VMS4, 1 Mullard 354V, or 1 Marconi or Osram MHL4.

2.5 WATTS POWER CHASSIS

1 **Mains transformer,** 4 v at 1 amp. C.T. — **Sound Sales**
1 **Choke,** 30 henrys, 400 ohms, 50 mA — **Bulgin LF14**
1 **Valve-holder,** 5-pin — **Clix chassis-mounting type**
2 **Electrolytic condensers,** 8 mfd. — **T.C.C. type 802**
NOTE.—If a non-energised speaker be used, a 2,500 ohm 10 watts resistance will be needed.

5 WATTS POWER CHASSIS

1 **Mains transformer,** 4 v at 1 amp. C.T. — **Sound Sales**
1 **Valve-holder,** 5-pin — **Eddystone type 921**
1 **Fixed condenser,** 4 mfd. (for use in receiver units, see text) — **Dubilier type BB**
NOTE.—If a non-energised speaker be used, a 2,500 ohm, 60 henry, 60 mA choke will be needed.

The Wireless World

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EDITORIAL COMMENT

The Lucerne Plan

Points for Discussion

NO official disclosures have, as yet, been made as to what will be the precise agenda put before the broadcasting authorities of Europe at their Conference which is to be held at Lucerne, probably in May next, but from what information we have been able to obtain it would seem that the purpose of the Lucerne Plan will be to try to clean up the ether and modify the present wavelength plan in so far as it has been found necessary to do so as a result of the increase in power of a number of European stations, and to arrange, also, for the accommodation of some further high power stations which are awaiting wavelength allocation. It is believed that the new Plan will retain the existing frequency separation of 9 kC.

Amongst the proposals to be discussed, one, we undertand, is that there should be an extended use of common wavelengths for stations of low power, especially where these are widely separated geographically. It is apparent to anyone looking through the present list of broadcasting stations of Europe that a good deal could be done in this way and that the effect would undoubtedly be to clean up the ether for the benefit of those stations which are intended to cover a wide service area and, therefore, are of high power. There are at present rather too many little stations on the fringe of big ones, tending to mar reception of the latter.

It has been suggested that proposals may be made for the allocation of certain wavelengths by hours. Such a scheme might be very effective in theory, as a means of overcoming some of the interference difficulties, but if it is intended that certain stations would change their wavelengths at specified times, we anticipate that the scheme would not find favour with listeners, who are now accustomed to tuning in and identifying stations by wavelength, and would find it extremely inconvenient if this process were further complicated by regular changes in wavelength.

A.V.C.

An Addition to the Monodial

IN this issue we describe how to make modifications and additions to *The Wireless World* Monodial A.C. Superhet, in order to provide the set with automatic volume control. Every reader who has built the Monodial will be anxious to make this addition, which we have ourselves had in operation for some time and so can answer for the entirely satisfactory way in which it functions.

There will be many readers attracted to the Monodial for the first time as a result of the incorporation of A.V.C., and in our description we have arranged to meet their requirements by indicating all that is necessary when making a fresh start to build the Monodial with A.V.C. incorporated.

Class "B" Amplification

First Details This Week

EARLY information on "Class "B" Amplification is included in this issue. Special valves have been designed for use with this system and are, in fact, double valves in one envelope. Class "B" Amplification has the advantages that matching of valves is unnecessary, the performance falls very little short of that of much more elaborate output stages, and yet it is substantially more economical both in battery current consumption and in initial cost.

New Battery Output Stage

Class "B" Amplification: The Latest Development

The new Cossor 210B valve with 7-pin base.

HOT on the heels of Quiescent Push-Pull comes Class "B" amplification, another means of procuring mains volume from the ordinary H.T. battery. A glance at the power output figures given in this article will reveal the extraordinary efficiency attainable with the new dual valve, no less than two watts speech being delivered to the loud speaker for a surprisingly small H.T. consumption.

It is safe to predict that Class "B" output will find wide application in future battery receivers.

By F. M. WALKER, B.Sc.

(Chief Valve Engineer, Cossor Research Laboratories)

UP to the present date two main forms of L.F. amplification have been available for the battery set user in this country. The first of these is the ordinary form where the output valve is biased to the mid-point of its characteristic curve. In this case, the anode current drawn from the H.T. battery is steady and does not vary with the strength of the signal applied. In addition, the maximum signal which the valve will accommodate is limited by the fact that no grid current must flow at any instant.

The second system is that of the well-known form called Q.P.P. Here two valves are used in the output stage, and both of them are supplied with bias sufficient very nearly to cut off the whole of their plate current when no signal is being received. The anode current from the H.T. battery is now not constant, but varies in a manner roughly proportional to the strength of signal received. Here again, however, the maximum signal which the valve can handle, and, therefore, the available power which it can deliver to the loud speaker, is limited by the fact that grid current must never flow.

Mains Output

In the form of push-pull amplification to be described, which is known in America as Class "B" amplification, the limitation which is common to the two schemes mentioned above, due to grid current considerations, does not exist. In consequence, the signal handling capacity of the valve is unlimited on this score. In addition, the plate current drain on the H.T. battery is proportional to the strength of signal received, and is not constant irrespective of the signal strength. The net consequence of these two facts is that a system is now available for battery set users which provides an undistorted output of 2 watts or more with an anode current consumption well within the capacity of quite small H.T. batteries. Such an output is, of course, equal to that of a large mains set.

The fact that in previous forms of L.F. amplification the flow of grid current in the amplifying valve means serious distortion, is well known. The exact reason for this distortion is, it is probable, not commonly realised. Grid current in modern valves generally commences to

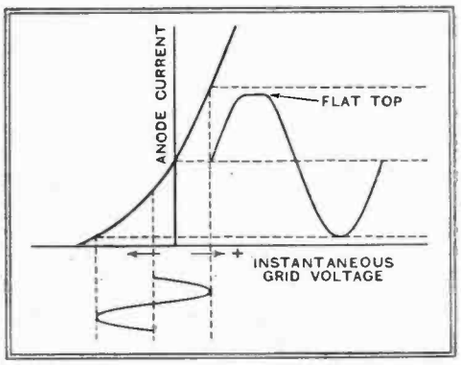


Fig. 1.—Distortion due to grid current flow in an ordinary L.F. amplifier. Note the flattening of peaks of the output wave.

flow when the grid becomes very slightly positive and increases rapidly with increase in positive grid voltage. When such grid current occurs in a set in operation it will, therefore, do so towards the peaks of the positive half-cycles. A high resistance of some form is generally present in the grid circuit of an amplifying valve (L.F. transformer secondary or resistance in R.C. coupling), and this current in flowing through such a resistance will entail a drop in voltage. In consequence, when grid current flows, the form of distortion present in ordinary forms of L.F. amplifiers will be a flattening of the peaks of the waves (see Fig. 1). Another way of regarding this distortion is to consider that the passage of grid current through the grid circuit entails an energy or wattage loss. This conception leads us at once to Class "B" amplification, since in this system a small power valve is used which precedes the Class "B" valve proper, and which is coupled to the latter by means of a special transformer. The function of this transformer and valve is to supply the energy loss mentioned which occurs due to grid current flow, and thus to maintain the wave form in an undistorted condition. This valve is known as the "driver" valve, and its associated transformer as the "driver" transformer.

The Class "B" valve, which has been designed in the Cossor Valve Laboratories for use in battery sets, has two complete sets of valve elements enclosed in one bulb, separate leads being provided for each anode and grid, the filament connections being common. This has been rendered possible by the fact that matching of the two halves of the output is not at all critical, and thus any slight differences between the two halves due to small inherent manufacturing variations do not introduce audible distortion. The valve has a 7-pin base, with the pins arranged so that it is impossible to make wrong connections with the valve-holder. The relative connections to the latter are given in Fig. 8.

The working details of this valve are described later. It is designed in such a fashion that its anode current at an anode voltage of 120 is about 2 mA at zero bias. In consequence, no grid bias

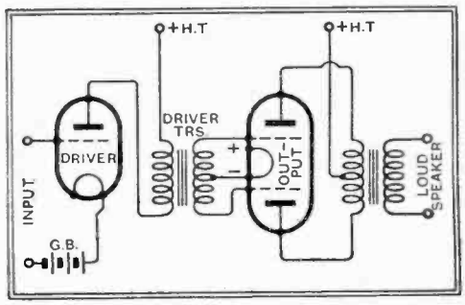


Fig. 2.—Skeleton circuit diagram of the driver stage linked to Class "B" output valve. No grid bias is required for the last valve.

is required to bring the valve to the bottom bend of its characteristic, the point at which it is desired to operate.

New Battery Output Stage—

Referring to the circuit diagram Fig. 2, it will be seen that if at any instant the grid of one-half of the output valve is positive with respect to the filament, the other grid is negative. Thus grid current is always flowing in either one-half of the secondary of the transformer or the other, and, in general, will cause a voltage drop across that half of the secondary in which it flows, and therefore tends to produce distortion of the peaks of the signal voltage waves. The driver transformer must therefore have a secondary winding of very low D.C. resistance (good regulation), being wound of wire such as is used in power transformers. The D.C. resistance of the whole secondary should not exceed in any case 300 ohms, in order that distortion from this cause may be negligible.

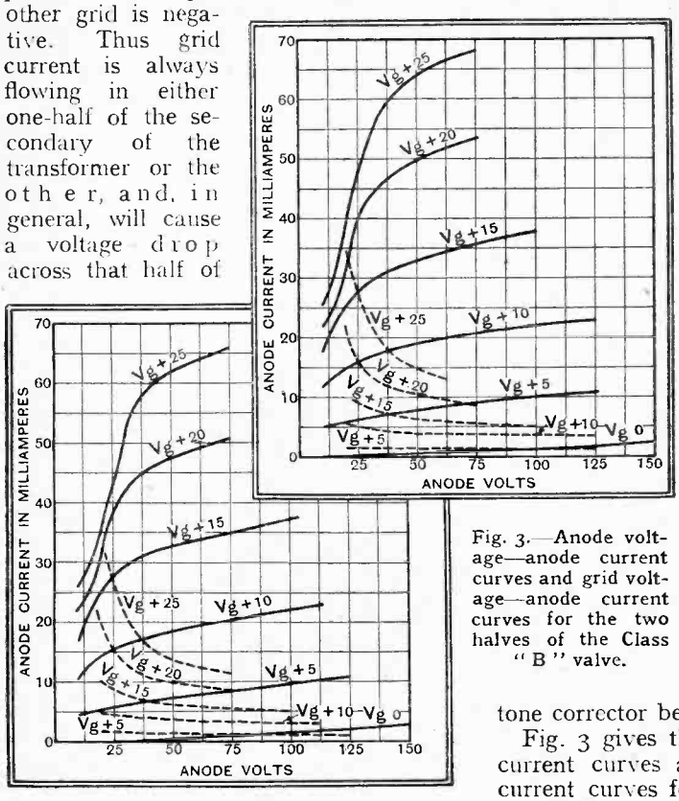


Fig. 3.—Anode voltage—anode current curves and grid voltage—anode current curves for the two halves of the Class "B" valve.

This point is of great importance, and, if it is adhered to, no measurable distortion whatever is introduced at this stage. Except for the design of this transformer, the circuit presents no difficulties. The driver valve is connected as a low-frequency amplifier of the usual conventional type and supplies an undistorted and requisite signal to the Class "B" valve. The output transformer following the Class "B" valve has, of course, a centre-tapped primary and is of the correct ratio to give the load into which the Class "B" valve is designed to work, in relation to the loud speaker impedance.

Since the anode current of the valves passes through the primary of this transformer, and since the peak value of this current may momentarily reach fairly large values, the D.C. resistance of the primary winding should be small, so as to minimise voltage dropping; 200 to 250 ohms is a suitable value. For the same reason the core used should be generous in proportions, the primary inductance being of the order of 20 henrys overall.

Owing to the extreme changes in impedance with frequency of moving iron speakers, these are not recommended for Class "B" amplification. Permanent magnet moving-coil loud speakers are to be preferred, and, if such can be obtained with high enough voice coil impedances, tapped choke output is recommended. Moving-iron speakers may, however, be used if a tone corrector be applied.

Fig. 3 gives the anode voltage—anode current curves and grid voltage—anode current curves for the two halves of the Class "B" valve. Fig. 4 shows the derived dynamic curves of the whole valve for various loads, taken at an anode voltage of 120. The peak allowable anode current for the valve is 50 mA, the peak grid voltage for each half being 20 volts. In Fig. 5 the anode voltage is 90.

The signal voltage to be supplied to the grids of the Class "B" valve across the full secondary of the driver transformer may rise to 40 volts peak. At this point, the lowest impedance is offered by the grid circuit of either half of the Class "B" valve. This impedance is about 2,500 ohms, and owing to the fact that only one-half of the secondary of the driver transformer is in operation at any moment, the effective minimum load into which the valve works is 10,000 ohms if the overall ratio of the driver transformer is 1:1.

The energy which has to be supplied by the driver valve to make up for the energy loss due to grid current flow is at this point about 70 milliwatts. This output can well be given by a Cossor 215P valve biased at −9 volts and with a plate voltage of 120 volts. Its steady plate current under these conditions will be 2½ mA.

Two Watts Output

Fig. 6 shows the A.C. output obtained from the valve at plate voltages of 120 and 90 plotted against anode circuit load, together with the percentage corresponding total harmonic distortion, the grid swing being limited to 40 volts peak. The distortion is almost entirely due to third and odd higher harmonics, as is usual in such forms of push-pull. It will be observed that the optimum load for the valve is about 8,000 ohms plate-to-plate, and that the A.C. output obtainable is 2 watts at a plate voltage of 120.

It would appear at first sight from examination of the valve's dynamic curves that the optimum load is 2,000 ohms. The discrepancy lies, of course, in the fact that only one half of the output transformer is in use at any instant, and hence a multiplying factor of four has to be introduced giving a plate-to-plate load of 8,000 ohms. The effect may be well understood by regarding the primary of the output transformer as a kind of auto-transformer.

The comparatively low load of 8,000 ohms is of great value in output transformer design both regarding cost and effi-

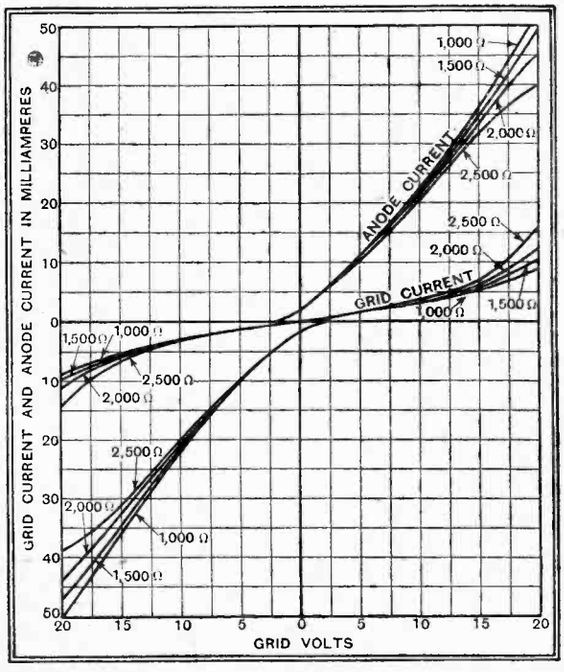


Fig. 4.—Dynamic curves for the whole valve for various loads taken at an anode voltage of 120.

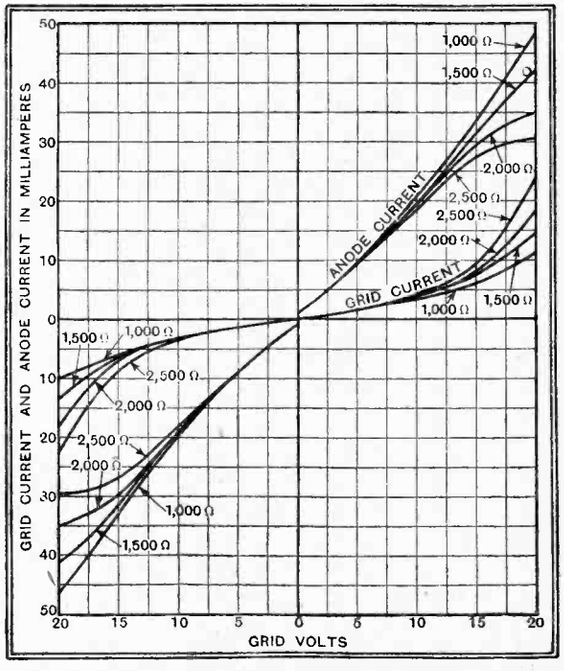


Fig. 5.—Dynamic curves taken at an anode voltage of 90.

New Battery Output Stage—

ciency. In itself it would be regarded by many as perhaps the most vital advantage of the system secondary to low anode current consumption for high A.C. output. There is also, of course, the tremendous advantage of having no bias for the output stage.

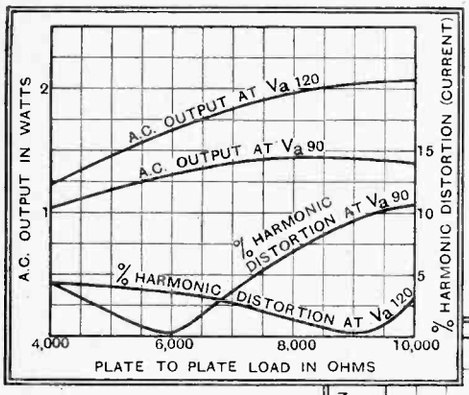


Fig. 6.—(above) The A.C. output and percentage harmonic distortion of the Class "B" valve plotted against plate-to-plate load. Fig. 7. (right) The A.C. output and percentage harmonic distortion plotted against applied signal in peak volts assuming an anode-to-anode load of 8,000 ohms.

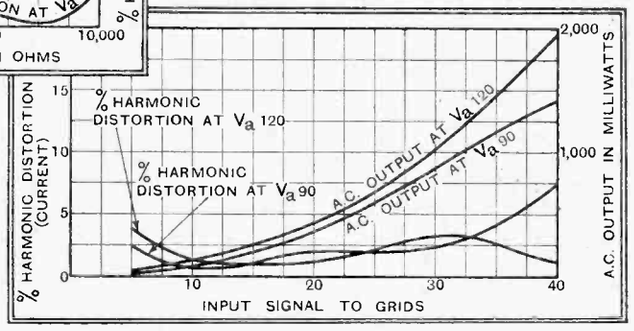


Diagram 7 shows the A.C. output obtainable, and percentage total harmonic distortion plotted against applied signal voltage for plate voltages of 120 and 90 respectively and a load of 8,000 ohms plate-to-plate. From these curves it will be observed that distortion at low amplitudes is not large enough to cause trouble, and that the lower plate voltage of 90 volts also gives satisfactorily pure reproduction.

This latter point is of great importance to set designers. The voltage given by the average H.T. battery after a short period of use, although nominally 120 volts, is actually below this. In all other systems of push-pull output such a drop in battery voltage would entail the readjustment of grid bias (or screen voltage in the case of pentodes) to ensure good quality. If the battery voltage should drop from 120 volts to 90 volts distortion becomes by no means intolerable, even though the Class "B" valve receive its full signal swing; obviously, however, its signal drops owing to the lower voltage on the driver valve, and distortion then becomes quite negligible. Since, at the best, adjustment of grid bias or screen voltage in other systems is a delicate matter, the advantage will at once become evident.

Low H.T. Consumption

The total current drawn by the Class "B" valve and driver with no signal is, at a plate voltage of 120, of the order of 6.5 mA. This does not represent the total drain on the battery, however. Owing to the fact that the valves are effectively working at their bottom bends, the current flowing in the H.T. battery due to the Class "B" valve will vary in accordance with the signal applied. These variations will be momentary, and will reach the full maximum only when 100 per cent. modulation is reached. The average modulation of broadcast stations in general is probably about 25 per cent., and this, combined with the fact that there are many short periods of rest during a programme, will give a very much lower consumption.

Measurements have been carried out, using a silver voltameter, of the average current consumed by the Class "B" valve over a broadcast period of about forty-eight hours of the London National station. The loudest passages were adjusted to swing the grid voltage of the Class "B" valve to the allowable maximum of 40 volts peak. Under these conditions, and with a plate voltage of 120, the anode battery drain is 8.5 mA. Thus to obtain an A.C. output of 2.0 watts the total H.T. consumption will be 11.0 mA., counting the driver valve current. For lower A.C. outputs the consumption will, of course, be correspondingly lower.

Some users may find that an A.C. output of 1 watt is all that is required to meet their taste. In this case the signal applied to the Class "B" valve may be limited to a maximum value of 30 volts peak (grid to grid), and its average anode consumption is 5 to 6 mA. The anode voltage of the driver valve may also be decreased to 100 volts, giving a current consumption of 1½ mA. Thus for an A.C. output stage of 1 watt the total anode current drain is 6.5 to 7.5 mA., whilst for 2 watts it is about 11 mA. These figures should be contrasted with the case of a high-efficiency pentode such as the Cossor 220 PT, which for an A.C. output stage of 1 watt capacity entails a steady anode current drain of 20 mA.

Let us now summarise the great advantages of Class "B" output. This form of amplification is capable of providing an output from a battery set comparable with that of a mains set, and with an anode current consumption which can be provided by ordinary H.T. batteries without incurring the disability of short life. Matching of the halves is not critical, and distortion is negligible. No grid bias is required for the output valve, and the output transformer is quite easy to design as the plate-to-plate load is only 8,000 ohms.

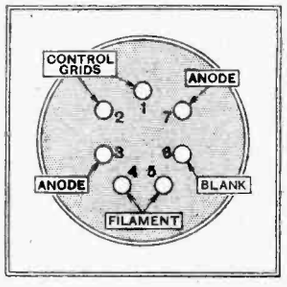


Fig. 8.—This illustration represents a Class "B" valve holder as seen from above, the connections being indicated.

DISTANT RECEPTION NOTES.

THE reception of transatlantic stations continues to be very good and readers who care to try for them may be surprised to find that the optimum wavelength is apparently showing a tendency to increase at the moment. Until recently very little has been heard above about 350 metres, but I can record quite good reception on several nights of WJZ on 394.5 metres and WEAF on 454.3 metres. I have not, though, been able to make much of WLW, the 50-kilowatt station on 428.3 metres. That is rather surprising, for previously when the stations on the longer waves have been receivable I have generally heard WLW well.

In addition to the United States stations quite a number of those in the Argentine can be received on nights when conditions are favourable. So long as the approximate wavelength is known the Argentine stations are easy to pick up and identify owing to the fact that announcements are made in Spanish. Here are the chief Argentine stations, all with an output rating of 10 kilowatts and all hailing from Buenos Aires.

LS9 216 metres	LS8 244 m.	LS2 252 m.
LR8 261 m.	LS5 280 m.	LR9 291 m.
LR4 303 m.	LR6 330 m.	LR2 345 m.

Another Spanish-speaking South American station is XED of Reynosa, Mexico, a 10-kilowatt station using the wavelength of 311 metres.

The more or less informal conference of the U.I.R. at Brussels is now coming to an end and the preparatory work for the Lucerne Conference has been done. Nearly every European country sent representatives to Brussels and the chief task of the conference was to prepare a revised wavelength plan which will be finally discussed at Lucerne.

Long-distance reception has been somewhat affected, particularly during the hours before darkness sets in, by the changeable weather that we have had of late. On certain nights it has been difficult to receive any but the most powerful stations at all well, but luckily such nights have not been numerous. On the whole both the volume and the quality obtainable from long and medium wave European stations show few signs of "that spring feeling" which used to become noticeable at about this time in former years when the average output rating of stations was so much less than it is now.

The long-wave band shows few changes save that Motala has not been too easy to receive well. Warsaw is still rather below normal form.

The big six at the top of the medium-wave band are coming through wonderfully well at present. These are Prague, Florence, Brussels No. 1, Vienna, Munich and Budapest. Beromunster is still jammed, but Rome, Stockholm, Katowice, Langenberg, Leipzig and Toulouse are quite reliable. Other stations that I can recommend are Brussels No. 2, the Poste Parisien, Göteborg, Marseilles, Heilsberg, Frankfurt and Gleiwitz.

D. EXER.

NEWS *of the* WEEK

Current Events in Brief Review

Hot Jazz Banned

HERR RICHARD KOLB, acting Director of Programmes at the Berlin stations, has banned all jazz music of the "hot" variety.

Modernising Blackpool

IT is proposed to form a wireless club in the Blackpool district. All interested in the project are requested to write to Mr. Gordon F. Howard, 43, Cumberland Avenue, Blackpool.

Bullet-proof Broadcasting

PRESIDENT ROOSEVELT, whose broadcast speech was so excellently received in this country, has been presented with a special bullet-proof desk with four microphone points by the Columbia Broadcasting System.

Germans Only

ALL foreigners are now barred from German broadcast microphones in view of the general crisis and, to prevent misunderstandings, all persons using pseudonyms are asked to permit the announcement of their real names.

King of the Castle

A SMALL squad of men suddenly appeared at the Berlin broadcasting house last week and hoisted the Hitler banner. Our Berlin correspondent states that the "Hakenkreuzflagge" is also flying from the Berlin Funk Tower.

New Zurich Studios

DURING the removal of the Zurich broadcasting headquarters to the new studios, the Beromunster station is taking all its programmes from the studios at Berne and Basle. The new Zurich studios will open with a special programme on April 10th.

£2,833

IN the House of Commons last week Sir Kingsley Wood, the Postmaster-General, stated that the number of wireless receiving licences issued during the year 1932 was approximately 5,263,000. The number of prosecutions undertaken during the same year for the use of unlicensed wireless sets was 2,825, and the total amount of the fines and costs imposed was £2,833.

Prize for an Invention

INVENTIVE wireless men may find scope for their talents in a competition which is being organised by the Royal Society of Arts under the Thomas Gray Memorial Trust. The Council offers £100 to any person who may bring to their notice a valuable improvement in the science or practice of navigation proposed or invented by himself in the years 1932 and 1933. The competition closes on December 31st, 1933.

Easy Payments

BECAUSE of the economic crisis, the Yugoslavian postal authorities have introduced a monthly instalment system for the purchase of wireless licences.

Programmes in Braille

THE Braille *Radio Times* in this country is to have a counterpart in Holland, where the Amsterdam Braille Society has produced a wireless programme journal for the blind.

60 kW. from Kalundborg

THE Kalundborg 7.5 kW. transmitter is about to be replaced by a new 60 kW. plant, while Copenhagen, which at present operates on a power of only 0.75 kW., will be increased to 10 kW.

The Virtuous Class

OUR belief that crystal-set owners are fundamentally honest is confirmed by the investigations of the postal authorities at Brno, Czechoslovakia, who, in the course of an "anti-pirate" campaign, have discovered a far higher percentage of offenders among valve users than those who depend on the lowly crystal. Of course, it is more expensive to be virtuous when running a valve set.

Transatlantic Radio Chain

THE first wireless chain across the Atlantic may materialise in May next if present plans are carried out for the flight from Rome to America of between twenty and thirty Italian airplanes. It is proposed that the route should be covered by Fleetwood trawlers stationed at intervals between the Irish Channel and the North of Ireland, Iceland, Newfoundland, and the North Atlantic coast of the United States. The trawlers would be fitted with long-distance wireless transmitters and receivers.

New Swiss Regional

SWITZERLAND'S third great Regional station, that at Tessin, in the Italian-speaking part of the country, is to begin regular service on April 1st next. The wavelength will be 678.8 metres.

Jap Propaganda by Radio

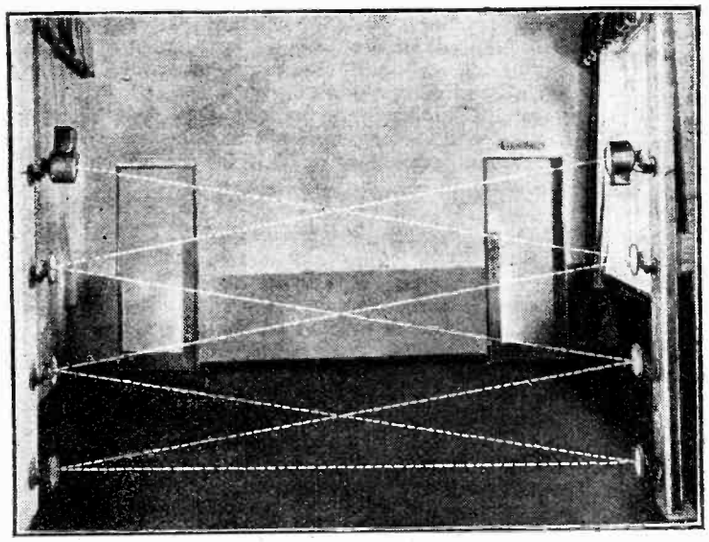
A JAPANESE high-power station for the dissemination of propaganda throughout Europe is a new project, according to a correspondent, who states that arrangements are being made to relay the transmissions from certain German stations.

The "Wave-waker"

THE "wave-waker" is the name given to a new oscillatory valve instrument on which the Belgian Princess Jacques de Broglie and the composer Oboulhoff are putting the finishing touches. It seems that the instrument is played by means of a hand-capacity effect, as in the case of the Theremin.

The Lucerne Plan

THE possibility that the new Lucerne Plan may introduce the time factor in the allocation of broadcast wavelengths is suggested in the Belgian newspaper, *Le Soir*. According to a correspondent who interviewed M. Raymond Braillard, the Technical Secretary of the U.I.R. hinted that in some cases wavelengths might be authorised for certain stations only at certain times of the day. An increase in the number of "common" waves is also probable, though the allocation of these will call for very careful consideration of distance and power.



INVISIBLE FENCE. To counter the tricks of athletic burglars who may suspect the presence of the familiar single infra-red detection device the Siemens and Halske Company of Germany has produced a new equipment in which the ray is reflected to and fro in the directions shown by the dotted line in the picture. The mirrors are, of course, concealed when the apparatus is in use.

Tactful

"SIR,—Will the parents who bought a wireless set to put in baby's stocking at Christmas kindly refrain from allowing baby to twirl the knobs between the hours of 12 noon and 12 midnight."—Extract from correspondence column, *Sunderland Echo*.

Gramophone Test Case

A WRIT has been issued by the Gramophone Company, Ltd., against Messrs. Stephen Carwardine and Co., Ltd., the well-known caterers of London and Bristol, for performing in public, without authorisation, at their restaurant in Bristol, a "His Master's Voice" record, of which the copyright is vested in the Gramophone Company, Ltd.

This action will act as a test case and will be heard at the High Court of Justice in London in due course.

Troubled Waves

IT is sad to learn that the broadcasting stations of Southern Europe are engaged in a kind of guerrilla warfare to prevent the spread of various political opinions beyond the borders of their respective countries. Apparently the broadcasting of any particular point of view immediately sets mysterious forces in operation; indeed, it is suggested that interference which many listeners in this country may ascribe to natural causes, such as atmospherics, and semi-natural, such as sideband splash, are in truth produced by the political oscillators of the warm South.

We refrain from mentioning the names of the countries involved, having no desire to foment international strife, but we feel that the International Broadcasting Union would be serving the best interests of all European listeners by investigating the whole question of deliberate interference between one station and another.

The Leipzig Fair

THE first German commercial receiver using Ferrocart coils was on view at this year's Leipzig Fair (writes a correspondent). The set, which is produced by the well-known firm of Owin, is decidedly in the miniature class, though it covers three wave bands: short, medium and long. This seems a general feature in the latest German sets. Visitors also saw a peculiar radio-gramophone, the Schaub, incorporating the turntable at an angle of about 60° in order to make for compactness. This tilting of the gramophone record does not impair the quality of reproduction.

Home recording apparatus is less popular and was represented by only one exhibit.

The Siemens firm displayed a master clock which is automatically controlled by the Nauen time signal, by means of a single wavelength receiver. They also offered the public a portable reverberation meter and a noise-measuring instrument.

Broadcast Brevities

By Our Special Correspondent

A Broadcasting Film

A GENTLEMAN with a notebook has been making sudden appearances in different parts of Broadcasting House during the past few weeks, asking polite questions and jotting down the equally polite answers. He is a representative of the Empire Marketing Board, and he has been charged with the mission of finding suitable material for a real live talkie.

Desperate Proposal

The job is not quite so simple as might appear, for I hear that, with a few notable exceptions, everybody in Portland Place wants to play a star part in the film. All sorts of outrageous proposals have been made; one man who works at an unromantic office desk far from the glamour of the studios is so anxious to appear on the screens of the Empire's picture palaces that he has offered to stage a fake telephone conversation with anybody the E.M.B. cares to name.

Hopeless Quest

A broadcasting film is certainly needed, if only to enable the listening public to see the interior of Broadcasting House, for the visiting list has had to be closed. Any plain, honest licence holder who wants to see inside "B.H." would find it easier to arrange a tea party with the Llama of Tibet.

Strange Pair

HARRY TATE and Hindemith will be associated in an effort to entertain the public on Friday next, March 24th, when Hindemith's musical work, "The Lesson," is broadcast from London Regional.

"The Lesson" nearly caused a riot at Baden-Baden when it was first performed there in 1929; apparently the emotional qualities of the work overcame the audience during a touching scene in which the hero —an airman dying after a crash—engages in dialogue with a troop of clowns.

In the broadcast version Harry Tate will be the chief clown.

"Stars in their Courses"

THE Blattnerphone and the gramophone are both being resorted to for the very attractive series of broadcasts entitled "Stars in their Courses," which Mr. James Agate, the well-known dramatic critic, will *compère* on twelve Saturday evenings, beginning on April 8th.

Dame Madge Kendal, Sir John Martin-Harvey, Miss Hilda Trevelyan, Mr. Seymour Hicks, Miss Irene Vanbrugh, Miss Fay Compton, Sir Frank Benson, and others whose names are familiar as household words, are to visit Broadcasting House and record on the Blattnerphone extracts from their greatest stage successes.

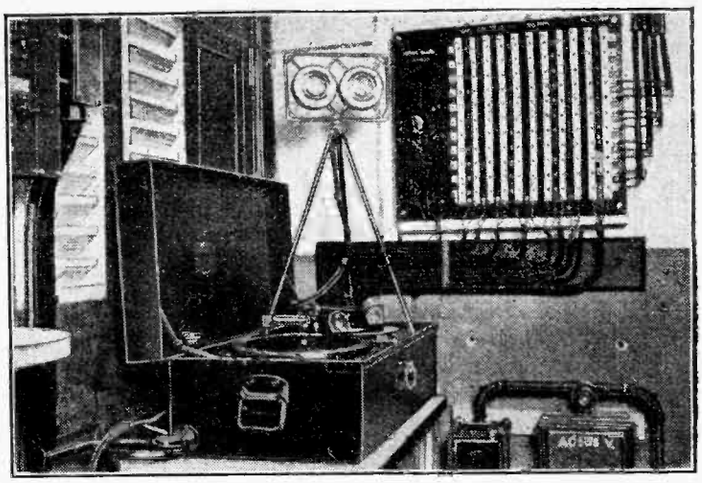
How the Gramophone will Help

Sir Johnston Forbes-Robertson will be represented by an excellent gramophone record; similar records will project the voices of those great artistes of the past, Lewis Waller, Arthur Bourchier, and Sir Herbert Tree.

Miss Sybil Thorndike, who is at present in Australia, has given special permission for the use of a gramophone recording of her voice.

Two Big Concerts

LEST we should hear too much of the B.B.C. Orchestra the Corporation is wisely varying the diet. On April 7th Sir Thomas Beecham will conduct the London Philharmonic Orchestra at the Queen's Hall in the Handel Concerto Grosso in G and the Seventh Symphony, by Schubert. At this concert, which will be broadcast over the National transmitters, Ildebrando Pizzetti will conduct the first performance in England of his celebrated "Rondo Veneziano."



AT THE BLACKPOOL TOWER, famous for its dance broadcasts, the British Thomson-Houston Company has installed what is probably the biggest band and gramophone relay system in the country, giving a total undistorted output of 280 watts. The photograph shows the switchboard, which links up forty-four electro-dynamic speakers and ten microphones distributed over the Tower, Winter Gardens and Palace.

A Famous Choir

On April 8th Regional listeners will hear the Glasgow Orpheus Choir at the Queen's Hall, London, under the direction of Sir Hugh S. Roberton. The Philharmonic Orchestra will also be broadcast on the same evening.

Organ as Orchestra

THE Midland Region is fortunate in having several organists of first-class quality within its area. Relays of their recitals are always popular. One of their number, Bernard Johnson, of Nottingham, is including two of his own compositions, a canzonet and a caprice, in his recital on April 2nd. Constance Collier and he will play the Beethoven Pianoforte Concerto in G minor, the organ acting as substitute for an orchestra.

Blattnerphoned Programmes

"MIDLAND Regional has always aimed at keeping faith with its public," writes Mr. Percy Edgar, the Midland Regional Director, in a letter on the question of Blattnerphoned programmes, to which I referred in the issue of March 3rd. He adds: "In the three industries where industrial noises have had to be Blattnerphoned, the Press have been duly informed and have recorded the fact."

I am glad that the Press has obliged in this fashion, but I still feel that the microphone is the proper channel for explanations of this kind.

A Tribute to the Factories

Mr. Edgar states that, of the twenty-two industrial broadcasts from Midland Regional, only three have been Blattnerphoned. He mentions that the B.B.C. have received the greatest courtesy from the principals of big works, several of whom arranged to have machines running and operatives at work in order that the evening broadcasts should be realistic and convincing.

St. George's Day

ST. GEORGE'S DAY and Zeebrugge Day will be the occasion of a relay from St. Mary's Church, Dover, on Sunday, April 23rd. The transmission opens with the bells of St. Mary's, followed by the service in the church at 11.0 o'clock. At the mid-day ceremony outside the church the Mayor of Dover will strike eight bells on the Zeebrugge bell, which is being hung in the porch of the church specially for the broadcast. The ceremony concludes with the Last Post and Reveille.

In the Concert Hall

DESPITE its description, the Concert Hall at Broadcasting House takes on the intimate atmosphere of a richly illuminated lounge when a Chamber Music Concert is being broadcast. Lamond, the pianist, and Carl Flesch, the violinist, were playing the evening I was there, and they played to us, the audience. The microphone was forgotten. Yet I am told that the concert—all-Beethoven, by the way—came over particularly well.

Probably instrumentalists are well advised to forget the existence of the microphone; singers and talkers, however, are in a different category.

The Artiste and the Microphone

Do we in this country really understand the first thing about microphone technique? Can we project personality over the ether as the Americans manage it?

I am not considering the quality of the personality when I say that the average American broadcaster gets his personality right across the microphone and into the home, whether we like it or not.

A Happy Discovery

Last week we heard those artistes, "The Four Musketeers," an American quartet who treat the microphone with respect, not as a harmless necessary piece of furniture. I saw the glee on their faces when they discovered that they were to do their turn before a Columbia "mike"—the sort they were used to at home. Even little things like that count with the true artiste.

Coaxing the Mike

They caressed that microphone. I watched them coax it, smile at it, withdraw from it for the high notes, come back to it confidentially for the soft tones. (They weren't trusting any control engineer!)

I wish we had some microphone artistes of our own. In the meantime it is worth noting that the B.B.C. are giving The Four Musketeers another "date" very soon.

Practical HINTS and TIPS

AIDS TO BETTER RECEPTION

IT is quite a common fallacy to suppose that the adjustment of a trimming condenser will compensate fully for differences in the inductive values of the various coils included in a gang-controlled receiver. Actually, all that the trimmers can do is to bring the various circuits into resonance at any chosen wavelength; unless all the inductances are accurately matched there is bound to be a more or less serious lack

Long-wave Ganging

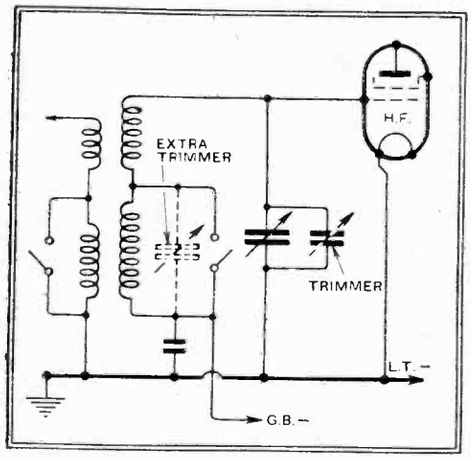


Fig. 1.—An extra trimming condenser for the partial correction of ganging errors on the long waveband.

of alignment at all wavelengths except that at which the trimming adjustment is made.

This applies, of course, to both the medium and long wavebands. But, with regard to the latter, requirements are not usually so exacting, and considerable discrepancies in inductance values may pass unnoticed, except in comparatively rare cases where extreme efficiency is required on this band.

The usual procedure is to adjust the trimmers at a low wavelength on the medium band, and then to assume that everything will be properly aligned for long-wave reception. Whether or not this is so can be easily proved by switching over to the long waves; if signal strength can be improved by adjusting any one of the trimmers we have conclusive proof that the associated circuit is running out of tune with the others.

If it happens that extra capacity (clockwise rotation of the trimmer screw) is necessary to increase volume it is worth while considering the expedient of connecting an extra trimming condenser across the long-wave section only of the associated coil, as shown in Fig. 1.

The presence of this extra trimmer will in no way upset ganging on the medium band, as it is entirely short-circuited by the action of the usual wave-change switch. Neither will it ensure perfect alignment of the circuits, for the reason stated in the opening paragraph. But it may well bring about a worth-while improvement in general long-wave performance by reducing the average extent to which the circuit across which it is connected is out of tune with the others.

A semi-variable condenser with a maximum capacity of not more than 0.0001 mfd. will generally be about right for the purpose suggested.

MANY sets are fitted with alternative aerial sockets or terminals; as a rule, one of these is internally connected directly to a tapping or primary winding on the input-coil assembly, while the other is joined to the same point through a small series condenser. Of course, it is intended that the second terminal shall be used when it is desired to reduce aerial input in order to obtain immunity from interference.

Alternative Aerial Connections

When using *The Wireless World* Station Finder (January 13th and January 27th) with such sets, it is invariably best to make use of the directly-connected and least selective aerial connection on the receiver while identifying stations. The inclusion of a very small series condenser will increase the impedance of the aerial circuit, and may prevent the obtaining of sufficiently well-marked indications by absorption. As soon as an identifying reading has been taken there is obviously no objection to reconnecting the aerial to the more selective terminal if interfering transmissions should make this course necessary.

ONE cannot go very far in matters pertaining to wireless reception without encountering the need for some means of ascertaining definitely whether continuity—or a through metal circuit—exists between two points in a receiver, or between the terminals of some component or accessory. For years past a pair of head telephones and a dry battery have been widely used as a crude but effective form of aural indicator to show conductivity—or the lack of it.

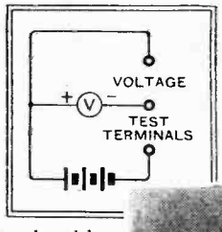
Continuity Tests

But now the headphone has almost disappeared, and as the loud speaker is but a poor substitute for testing purposes we must look for something else from which a continuity indicator can be improvised.

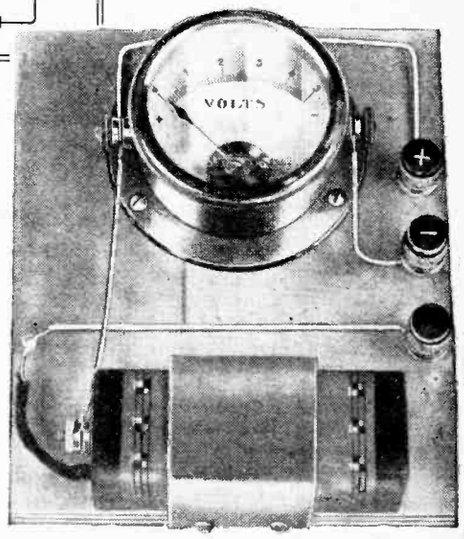
As a relic of the days when their sets were operated from batteries, many readers who have now changed over to "all mains" operation will have a spare low-tension voltmeter, probably reading from 0 to 6 volts, and of the moving-coil type. With the addition of a battery and a few terminals this meter may be converted into a useful testing device, ready for use at any time, and capable of showing continuity through resistances of many thousands of ohms. A 4.5-volt flash-lamp battery is generally suitable for testing, and is, of course, wired in series with the meter and the external circuit.

By arranging three terminals as shown in the accompanying illustration and diagram, the meter may be used either for its normal function of measuring voltage or as a continuity indicator, depending on the terminals to which the external leads are connected.

In a testing unit of this sort we have also a crude form of ohm-meter, but only one that will be reasonably accurate over a limited range of resistance values. The procedure for translating voltage readings on the scale to ohms is first to measure the voltage of the test battery directly, and then to read the voltage indicated with the unknown resistance interposed in circuit. Then subtract "voltage indicated" from "measured battery voltage," and multiply the remainder by the internal



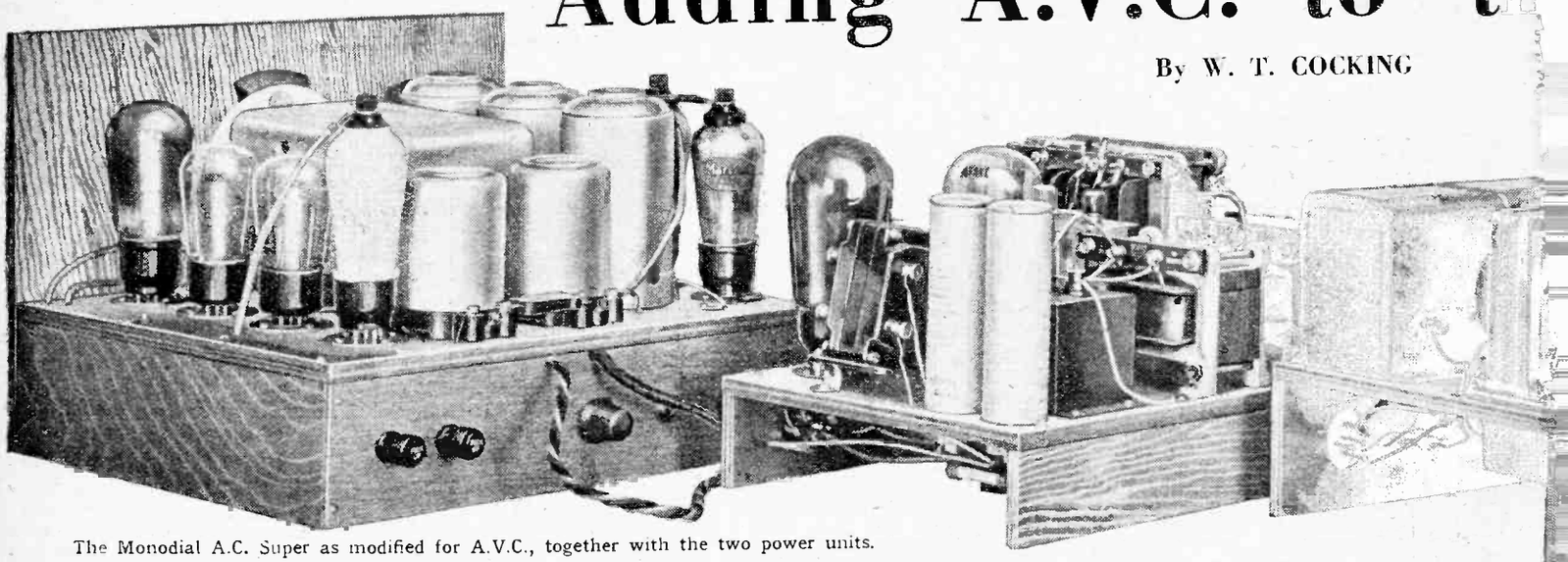
A low-reading voltmeter and a dry-cell mounted as a continuity testing unit. By making connections to the terminals indicated, the meter may be used normally for voltage measurements.



resistance of the meter. Finally, the product of the last calculation, divided by "volts indicated," which will give the value of the resistance in ohms.

Adding A.V.C. to t

By W. T. COCKING



The Monodial A.C. Super as modified for A.V.C., together with the two power units.

Part 1. Modifications Necessary for Converting the A.C. Superheterodyne

FADING is one of the chief obstacles to successful distant reception, and any method by which it may be considerably reduced is bound to be appreciated. In the accompanying article appear details of the first constructional set to include automatic volume control which, it can be confidently stated, removes some 80% of the effects of fading.

SINCE the description in this journal of practical automatic volume control systems, constructors of the Monodial A.C. Super have been clamouring for details of the modifications necessary for the inclusion of this refinement. The high performance of this receiver has led many to feel that fading, and not interference, is now the chief drawback to distant listening, and that the inclusion of an automatic volume control would largely overcome this effect, and so increase the number of stations from which reproduction of entertainment value can be obtained.

The matter has been given very careful attention, therefore, and many practical forms of automatic volume control have actually been tried out in the Monodial, in order to determine the particular type of control most suited to its characteristics. It may be said, briefly, that the square-law[1] control has been found to be the best for this set—partly because it can hold the volume at a more nearly constant level than any other, and partly because it fits in best with the characteristics of the Monodial.

No Fundamental Alterations

Some words of explanation may be necessary regarding the course adopted in describing the first practical automatic volume control system as an addition to an existing receiver, instead of including it in an entirely new design. In the first place, it is thought that, in view of its present unfamiliarity, constructors will be more likely to meet with success in applying it to an existing receiver, which is known to be functioning correctly, than if they have to tackle the problem of getting the system to work in a new and untried set. Secondly, although it is now nearly a year since it was first described, the performance of the Monodial is so far in advance of its time that it is doubtful whether any great improvement could be made to the receiver itself, and, as a result, a new set would vary only in unessentials. Thirdly, so many of these receivers have been built that it is felt that they should not be rendered in any way out of date by being without this latest development of automatic volume control.

The actual work of alteration is not great, and, once made, there is no external apparatus. The alterations involve a certain number of additional components, and the rearrangement of some of the existing parts, but it has been found possible to include all the apparatus on the original chassis without increasing their dimensions, so that existing cabinet work remains unaffected.

The complete circuit diagram of the receiver unit is shown in Fig. 1, and it will be instructive to compare this with the original circuit.[2] It will be seen that there are no fundamental alterations, and the principle of operation is identical with that of the original receiver. Instead of being connected directly to earth, however, the input and H.F. intervalve tuned circuit return leads are each broken, and these circuits completed through 0.1 mfd. condensers C5 and C9. The A.V.C. bias is then applied to the lower ends of the tuned circuits through decoupling resistances.

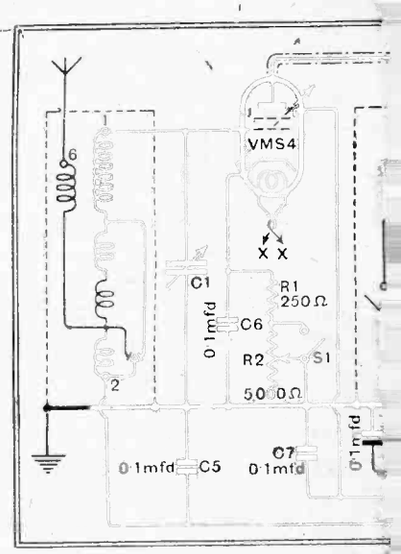


Fig. 1.—Complete circuit diagram of the receiver unit. The 354V valve provides square-law A.V.C.

Each valve is now independently biased, as regards its minimum value, by a resistance in its cathode lead. In the case of the first detector, the resistance R4 is given a value of 2,500 ohms, since a V.M.S.4 variable-mu valve is now employed, and controlled by the A.V.C. system. The I.F. stage has its minimum bias fixed by the 250 ohms resistance R7, shunted by the 0.1 mfd. condenser C14, while the same values are employed in the H.F. stage for R1 and C6 when the switch S1 is closed.

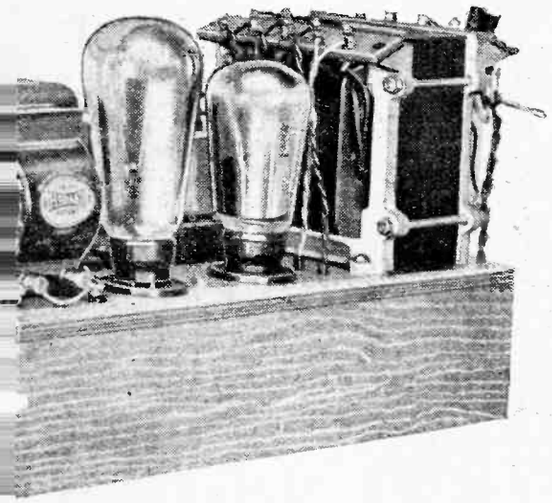
The Noise Suppressor

This switch, which was the Local-Distance switch of the original design, is connected in parallel with a 5,000 ohms variable resistance R2, and both are in series with the bias resist-

[1] "Practical Automatic Volume Control." *The Wireless World*, January 6th and 13th, 1933.

[2] "The Monodial A.C. Super." *The Wireless World*, April 6th, 13th and 20th, 1932, or "The Monodial A.C. Super Booklet."

e MONODIAL



ance R1; the actual component used for R2, incidentally, is the volume control of the original set. The purpose of this arrangement is to act as a background limiter, or noise suppressor, while tuning. It will be appreciated that in the absence of a signal, and with S1 closed, the sensitivity of the set is at its maximum, and atmospherics and local interference are reproduced at full strength. As soon as a signal is tuned in, of course, the sensitivity drops and the background falls to the normal level found with a set having a manual sensitivity control. When actually tuned to a station, therefore, A.V.C. causes no increase of background, but during the process of tuning such a set is definitely noisier, for the sensitivity rises sharply as the tuning is varied between stations.

The additional bias resistance R2 is included, therefore, so that the maximum sensitivity of the set can be limited on occasion. It is recommended that the switch S1 be opened, and at the start of an evening's listening R2 be adjusted to such a value that the background, with the set mistuned from a station, is no greater than can be tolerated. Thereafter, only stations which are stronger than the background will come in at full strength, and these, of course, are just those which are worth while from an entertainment point of view. The resistance is made readily adjustable, since the background level, and hence the usable sensitivity, vary from night to night, and the switch is included so that the resistance can be cut out of circuit in a moment whenever the maximum sensitivity is required, as might be the case when following a strongly fading signal. These two components are fitted to the back of the chassis, since they require only occasional adjustment, but there is no objection to bringing them to the front panel if desired, provided that screened wire be used for the connections.

In connection with the alterations, it should be noted that the I.F. transformer secondary feeding the I.F. valve is no longer returned directly to the chassis, but is taken to the A.V.C. feed. The compensating resistances in the screen feed circuits are now done away with, since they are inapplicable to A.V.C.; their place is taken by a simple voltage divider of fairly low value, and it must be remembered that the 6,000 ohms resistance R9 is of the 3 watts type, while the 4,000 ohms resistance R10 is of 2 watts rating. Owing to the low values adopted for these resistances, the rise in screen and anode potentials at high bias voltages is limited.

The Second Detector

In the detector stage, the chief alteration lies in splitting the anode-cathode by-pass condenser into two series condensers, C16 of 0.01 mfd. and C17 of 0.0005 mfd., from the junction of which the I.F. feed to the A.V.C. valve is tapped off. The detector is now worked at rather a higher signal input than before, and its power handling capacity has consequently been increased by reducing the decoupling resistance R16 to 10,000 ohms. A 1-watt resistance can be used, but as there is a 2-watts resistance available from the original components, this is employed. This decrease in resistance has necessitated an increase in the decoupling condenser C20 to 6 mfd. This condenser is actually made up of two in parallel: the original 2 mfd. type BB condenser, and a 4 mfd. type LSA previously used in the power unit. In this connection it should be noted that the type LSA is unnecessarily good for this point, and it is only used because it is available from the original components. If entirely new parts are used throughout, a 4 mfd. type BB is entirely suitable

Adding A.V.C. to the Monodial—

and cheaper. The LSA condenser will not be available in a conversion of the Monodial used with the Modern Straight Five power unit, so that in this case also a type BB should be used.

The tone corrector stage remains unaltered, save that the grid circuit is now decoupled by the 50,000 ohms resistance R19, and its grid leak is replaced by the manual volume control, which is operative on both radio and gramophone, R18 of 250,000 ohms, and is of the tapered type. Actually, of course, such decoupling is not fully effective in a resistance coupled stage, and the inclusion of the component is more for the purpose of avoiding any possibility of hum due to ripple on the bias resistance than for decoupling proper.

The valveholder originally used for the second detector is employed for the A.V.C. valve, and the second detector is now mounted in the place formerly occupied by the third I.F. transformer. This transformer is fitted beneath the baseboard, being mounted skew-wise on the end supporting batten, in such a position that its trimmers can just be operated. The wiring, furthermore, is sufficiently clear to allow the coil can to be removed for the adjustment of the coupling.

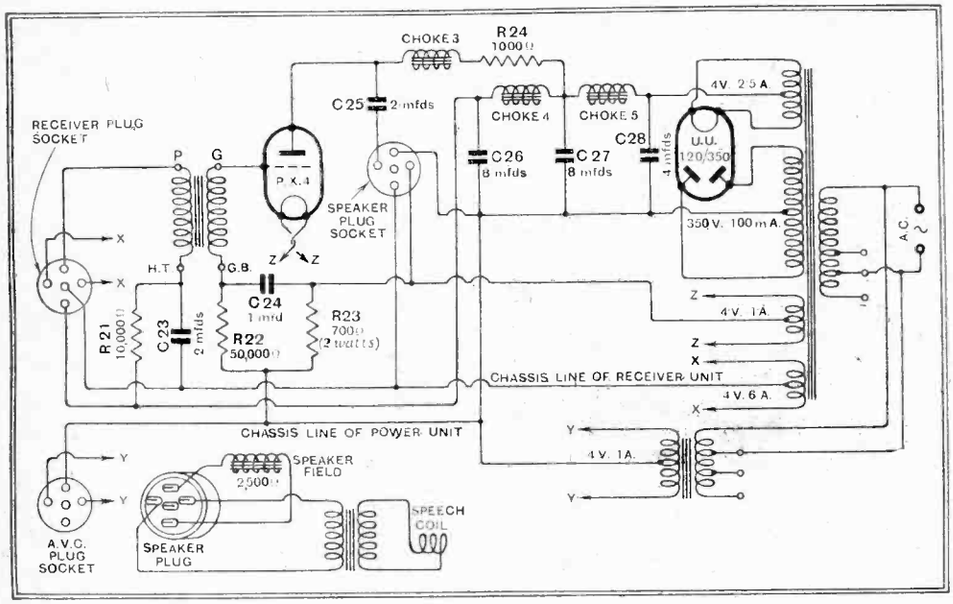


Fig. 2.—In the 2½-watt power unit the speaker field is included in the negative H.T. lead.

Delayed Action

The A.V.C. valve is the type 354V.; its anode is connected directly to earth through a 1 meg. resistance R15, shunted by a 0.1 mfd. condenser C22, and the bias voltages are tapped off from the anode and fed to the grids of the controlled valves through the 0.1 meg. decoupling resistances R11 and R3. The A.V.C. grid is fed directly from the tapping point on the second detector bypass system, and is returned to negative H.T., not the chassis, through a 1 meg. resistance R12. The correct bias to give delayed action to the control is obtained from a tapping on the voltage divider between negative H.T. and the receiver chassis, made up of the 75,000 ohms resistance R14 and the 10,000 ohms resistance R13. This voltage divider is actually in parallel with the speaker field, so that the voltage drop across this is utilised for the operation of the A.V.C. valve.

In the absence of a signal there is no A.V.C. anode current; there is no voltage drop across R15, theretore, and the grids of the controlled valves are at the same potential as the earth line. As a result, their bias is that fixed by their cathode biasing resistances. When a signal exceeding a certain strength is tuned in, rectification occurs in the control valve and anode current flows, its value depending upon the signal strength. A voltage drop is then present across R15, in such a direction as to make the A.V.C. valve anode, and hence the grids of the controlled valves, negative with respect to earth.

The 2.5 Watt-power Chassis

Perhaps the greatest alterations occur in the power unit, for in order to obtain the voltage needed for the A.V.C. valve the smoothing circuits have had to be entirely rearranged. The only voltage available is the drop across the speaker field, and so this is connected in the negative H.T. lead. In this position, however, it contributes little to the smoothing, and it has become necessary to introduce an additional choke. The resistance of this choke must be low to avoid a loss of voltage, and so its inductance is limited, so that considerable increases in the smoothing capacities have also been necessary. The arrangement finally adopted can be seen from Fig. 2. The choke Ch5 is that originally used, but its position on the chassis has been altered, and it has an inductance of some 10H. at 100 mA., with a resistance of 120 ohms. It is now followed by an 8 mfd. electrolytic condenser C27, and the current for the output valve is then tapped off. The remaining 50 ma. of current passes through a 30H. 400 ohms. choke Ch4, after which there is another 8 mfd. electrolytic condenser C26. In connection with this choke, it is important to note that its actual inductance is 20H., although it is rated by its makers to be only 20H. It will not necessarily be satisfactory, therefore, to follow the maker's rating, and substitute a different type of 20H. choke.

In order to supply the heater of the A.V.C. valve, an additional mains transformer, giving an output of 4 volts at 1 ampere, has been included.[3] It will be clear from the drawings how room has been found for this component, and the method of interconnection of the two units will also be clear. The original valve-holder and 5-way cable do not give sufficient connecting points for the new arrangement, for three additional leads are required. Another valveholder is fitted to the back batten of the power chassis, therefore, and an extra 3-way cable makes the connections. Three-way cables are not at present available, but a four- or five-way type may be used with the unwanted leads cut short.

It should be noted that an omission occurs in the list of parts published in last week's issue; this consists of a Bulgin 30H. 50 ma. choke, type L.F.14.

(To be concluded.)

PARTS ORIGINALLY USED BUT NO LONGER REQUIRED

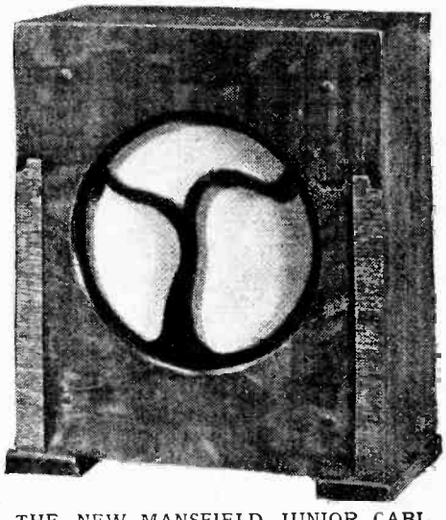
Receiver Chassis.

2 Metallised resistances, 1 watt 100 ohms
1 Metallised resistance, 1 watt 6,000 ohms
1 Metallised resistance, 1 watt 7,500 ohms
1 Metallised resistance, 1 watt 25,000 ohms
1 Metallised resistance, 1 watt 250,000 ohms
1 Fixed condenser, 0.001μF. **Dubilier Type 620**

2.5 Watts Power Chassis

1 Fixed condenser, 2 mfd., 500 v. D.C. test **Dubilier L5B**
1 Metallised resistance, 25,000 ohms 3 watts

[3] It should be noted that if the complete set is being built from new components, two transformers are unnecessary, since the large transformer can be obtained with an additional winding.



THE NEW MANSFIELD JUNIOR CABINET, specially designed to house the P.M.S. loud speaker incorporating the latest type of magnet system. Made by the Whiteley Electrical Radio Co., Ltd., Victoria Street, Mansfield, Notts, the price of the complete cabinet loud speaker with output transformer is 29/6.

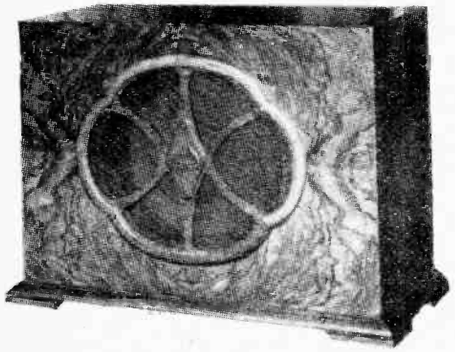
LABORATORY TESTS

H.M.V. "SUPER POWER" LOUD SPEAKER

DESIGNED originally for use with H.M.V. receivers and radio-gramophones, this permanent-magnet moving-coil unit is now issued for general use in an attractive walnut cabinet, together with a universal input transformer. The transformer may be adjusted for low-impedance triode or pentode output valves, for a push-pull output stage, or may be omitted altogether where an output transformer is already incorporated in the set.

The four-claw permanent magnet is fully twice the size of those used in the popular types of moving-coil units, and the sensitivity is correspondingly greater. A one-piece laminated linen diaphragm is employed, and the apex is pressed to form a shoulder for fixing the speech coil and to centre it in the air gap. The periphery of the diaphragm is mounted on a velvet surround giving more than the usual degree of freedom.

The bass resonance is at about 70 cycles, and above this frequency the output falls slowly to 1,200 cycles, rises to 2,500 cycles, and then falls gradually to 5,000 cycles, after which there is a relatively sharp cut-off. The general reproduction is full and mellow, and irritating background noises in radio and needle scratch in gramophone reproduction are absent.



H.M.V. "Super Power" permanent-magnet loud speaker model 174.

The price is £7 10s., and the makers are the Gramophone Co., Ltd., 363-367, Oxford Street, London, W.1.

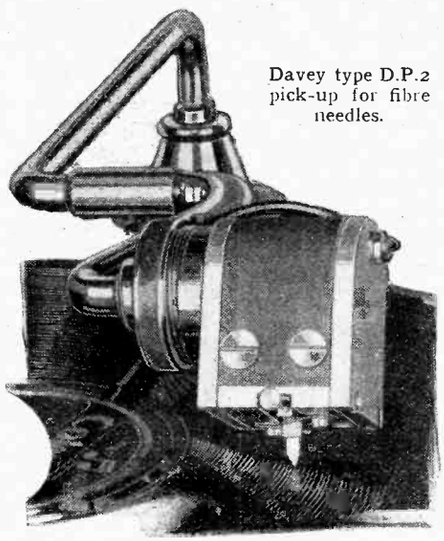
THE DAVEY FIBRE NEEDLE PICK-UPS

THE gramophone enthusiast and connoisseur of fine records, whose experience goes back to the days before the introduction of electrical recording and reproduction, is a staunch advocate of fibre needles. He prefers the delicacy and smoothness of tone associated with the fibre needle to the hard brilliance and occasional harshness of the steel needle, and finds that, provided the record is properly cleaned, wear is negligible even though there may be a tendency to stiffness in the sound-box. Where the record collection includes favourite interpretations which are no longer issued, the latter consideration acquires added weight.

The Davey D.P.2 pick-up admirably fulfils these special requirements. A hollow armature of triangular cross-section pivoted on knife edges and centred by independently adjustable springs accommodates the fibre needle. The poles are of nickel-iron alloy, and the pole pieces are laminated. Two sectionalised formers surrounding the pole

NEW RADIO PRODUCTS REVIEWED

pieces carry the pick-up coils, which terminate in insulated terminals in the side of the substantial permanent magnet. The armature movement is free, and a wide air gap ensures freedom from harmonic distor-



Davey type D.P.2 pick-up for fibre needles.

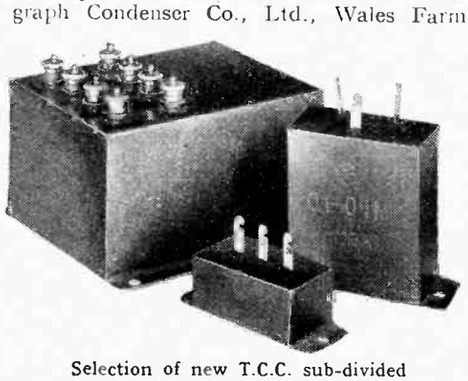
tion. Damping is provided by grease packing at the tip of the armature.

On test one of the first features to attract favourable comment was the exceptionally low mechanical noise from the pick-up head. The quality of reproduction is admirably suited to the reproduction of chamber music and solo voices, and there does not appear to be any lack of "top" when playing orchestral records. The output characteristic is smooth, and there is no trace of any armature resonance. Taking the output at 1,000 cycles as the datum, the curve is 11 db. up at 50 cycles, 5 db. up at 500 cycles, 5 db. down at 2,000 cycles, 10 db. at 3,500 cycles, and 20 db. down at 5,000 cycles, which is virtually the cut-off. The average output is of the order of 0.1 volt R.M.S.

Made by E.M.G. Hand-Made Gramophones, Ltd., 11, Grape Street, London, W.C.2, the price of the pick-up alone is £3 10s., or complete with carrier arm £4 10s.

T.C.C. BLOCK CONDENSERS

HITHERTO the sub-divided block condensers of the type used extensively by manufacturers have not been readily obtainable by the home constructor. The Telegraph Condenser Co., Ltd., Wales Farm



Selection of new T.C.C. sub-divided block condensers.

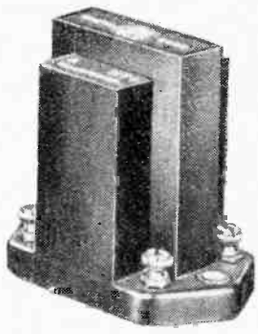
Road, North Acton, London, W.3, have now decided to augment their already extensive range of condensers by some sub-divided types. Of particular interest is the 0.01+0.01 model suitable for use as a suppressor of modulation hum. It is tested at 1,000 volts D.C., and the price is 2s. 6d.

There are two 0.1+0.1 mfd. models, of which the type 125A is built up from four 0.2 mfd. condensers, two in series being employed in each half of the unit. This ensures a high factor of safety, and this model is rated at a working voltage of 500 A.C., and its price is 4s. 6d.

There is also an 8-mfd. block sub-divided into 4+2+2 mfd. condensers with a common negative terminal. The 4-mfd. section is tested at 750 volts D.C., while the two 2-mfd. units are tested at 500 volts D.C., and the price is 14s. 6d. Finally, we have a 12-mfd. block arranged as 4+4+2+2 condensers with a common negative, and the working voltage is 250 D.C. in each case; the price is 17s. 6d., and it is listed as the type R.M.12.

R.I. DI-FEED TRANSFORMER

THIS is one of the latest additions to the range of intervalve transformers made by Radio Instruments, Ltd., Purley Way, Croydon, and it has been introduced to meet the demand for an inexpensive component of small size suitable for direct connection in the anode circuit of a valve passing up to 4 mA. of anode current. The measured inductance of the primary was found to be 25 henrys when no D.C. is flowing, 15.5 henrys with 1 mA., 10.7 henrys with 2 mA., 8 henrys with 3 mA., and 6.5 henrys with 4 mA. of D.C. The step-up ratio is 1 to 3½.



R.I. Di-Feed intervalve transformer.

By employing a core of high permeability, described as "K" metal, a satisfactory inductance has been obtained with a comparatively small quantity of wire, consequently the self-capacity of the windings is low, and the amplification of the higher frequencies is maintained at a good level. Measurements show that at 8,000 cycles the amplification is but 2.5 decibels lower than at 1,000 cycles, but there is a slight falling off in the bass when the transformer is connected in the anode circuit of a valve passing some 2 mA. of D.C. At 100 cycles the amplification is lowered by approximately 7 decibels, but this will not have a very marked effect on the reproduction, as there will still be an ample bass response to preserve a reasonably good balance.

Considering the price of this component, namely, 7s., its performance is most satisfactory.

oooo

CHANGE OF ADDRESS

In the review of the Eeles transformer on March 3rd the maker's address should be C. W. Eeles, 14, Gertrude Street, Limerston Street, Chelsea, London, S.W.10.

Gecophone Superheterodyne "Overseas" Model

Three Wave Ranges, 13/30, 30/80, 200/560 Metres. C.W. or Telephony Reception

General:—*A.C. mains five-valve superheterodyne for short and medium waves. Interchangeable coils. Sockets for external loud speakers and gramophone pick-up. Teak cabinet and moisture-proof insulation throughout.*

Circuit:—*Anode bend S.G. first detector, oscillator, I.F. amplifier, S.G. leaky grid second detector, power pentode. Full-wave valve rectifier. Single-circuit aerial tuning on short waves, band-pass filter on medium waves.*

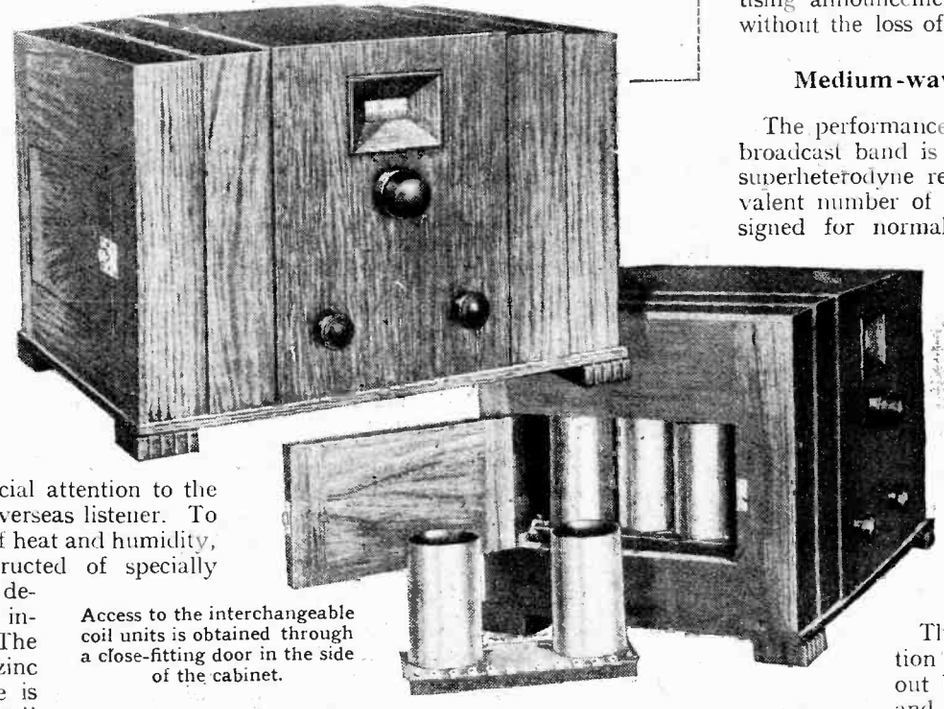
Controls:—*(1) Main tuning with illuminated dial, calibrated in degrees. (2) Volume control and on-off switch. (3) Compensating condenser (short waves only). (4) Switch for heterodyne reception of C.W. signals.*

Price:—*£25 4s. Chassis only, £23.*

Makers:—*The General Electric Co., Ltd., Magnet House, Kingsway, London, W.C.2.*

THE establishment of the Empire Broadcasting Station and the inauguration of regular programmes to the Colonies was an event of first importance to British subjects in all parts of the world. Situated in many cases thousands of miles away from the nearest broadcasting station, and with atmospherics making reception on the longer wavelengths impossible for months on end, the only means of broadcast reception in the tropics is through the medium of the ultra-short waveband.

Any commercially produced receiver specifically designed for short-wave reception is certain to find its way into countries the climate of which would very rapidly bring about the disintegration of the ordinary type of broadcast receiver as we know it in this country. Accordingly, the G.E.C., in producing their latest short-wave superheterodyne receiver, have paid special attention to the requirements of the overseas listener. To withstand the effects of heat and humidity, the cabinet is constructed of specially treated teak, and is designed to prevent the ingress of insects. The chassis is heavily zinc plated, and wide use is made of "keramott" moulded insulating material for coil formers, etc., as this is found by experience to stand up well to the rigours of a tropical climate.



Access to the interchangeable coil units is obtained through a close-fitting door in the side of the cabinet.

The circuit is perfectly straightforward, and consists of an anode-bend first detector, separate oscillator, one I.F. stage, leaky grid second detector, and power pentode output valve. In view of the need for compact wiring on short waves and the difficulty of ensuring reliability under tropical conditions of complicated switch mechanisms, interchangeable coil units are employed for each of the three wavebands. On the two short-wave ranges a single tuned circuit in the aerial provides adequate selectivity, but on the medium-wave band an inductively coupled band-pass filter is employed. A row of contacts running along the edge of the coil base effects the necessary change in the circuit in each case. Coils for the oscillator are, of course, included in each unit.

An unusual feature of the circuit, and one which is invaluable on the ultra-short waves, is the provision at the back of the set of a "C.W." switch, by means of which the I.F. stage may be made to oscillate. A fixed condenser of a few micro-mfds. couples the anodes of the I.F. and the second detector, and the switch earths a centre screening electrode when continuous wave signals are not required.

The main tuning control is provided with direct and slow-motion drives, and the dial has a finely graduated 100-degree scale with a hair-line indicator free from parallax.

On short waves the set handles just as easily as on the medium-wave broadcast band. The stability of tuning is remarkable, and it is possible actually to touch the aerial lead without appreciably altering signal strength. During the period of our tests the 13/30-metre band was not very productive, but there was plenty of activity on the 30/80-metre band. Space does not permit a catalogue of the number of stations received; readers will probably be more interested in the performance at long range from the point of view of programme value. At the first attempt three American stations, Schenectady (31.48 metres), Pittsburg (48.86 metres), and Bound Brook (49.18 metres), were received at good loud speaker strength. For a period of nearly two hours from 11 p.m. onwards the programmes from the two latter stations, which were principally occupied with talks and advertising announcements, could be followed without the loss of a single word.

Medium-wave Performance

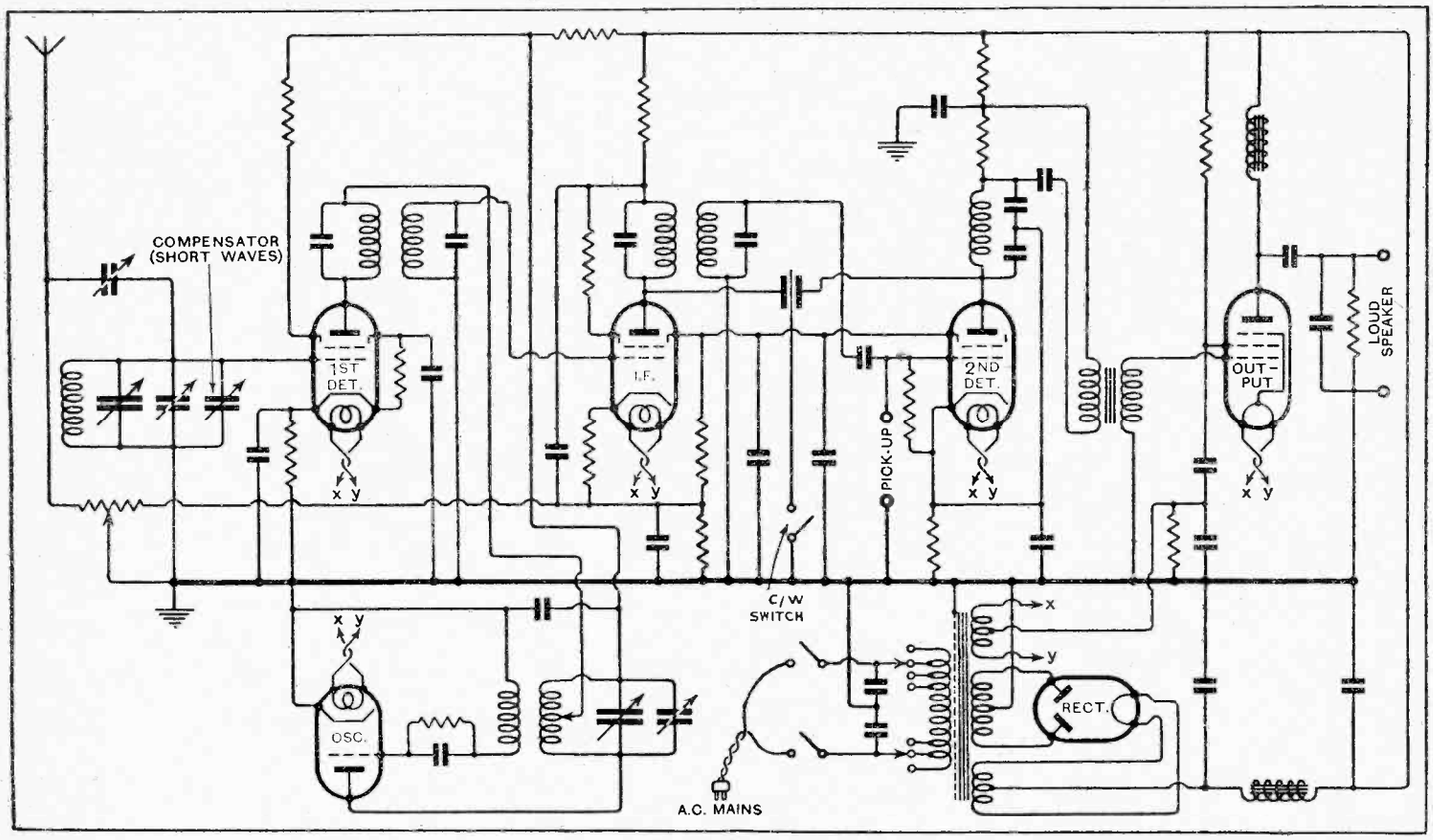
The performance on the 200/560-metre broadcast band is quite equal to that of superheterodyne receivers, with an equivalent number of valves, specifically designed for normal broadcast reception. Only one channel is lost on either side of the two Brookmans Park stations at a distance of five miles, and the range is limited only by the ratio of signal strength to the atmospheric background. Two second-channel interference whistles were prominent, but the remainder were of negligible volume.

The quality of reproduction is clear and crisp, without being deficient in bass, and in addition to its many other rôles the receiver might justly claim that of a quality reproducer for the local station. The power output is of the order of 2 watts, and a moving-coil loud speaker is definitely worth while.

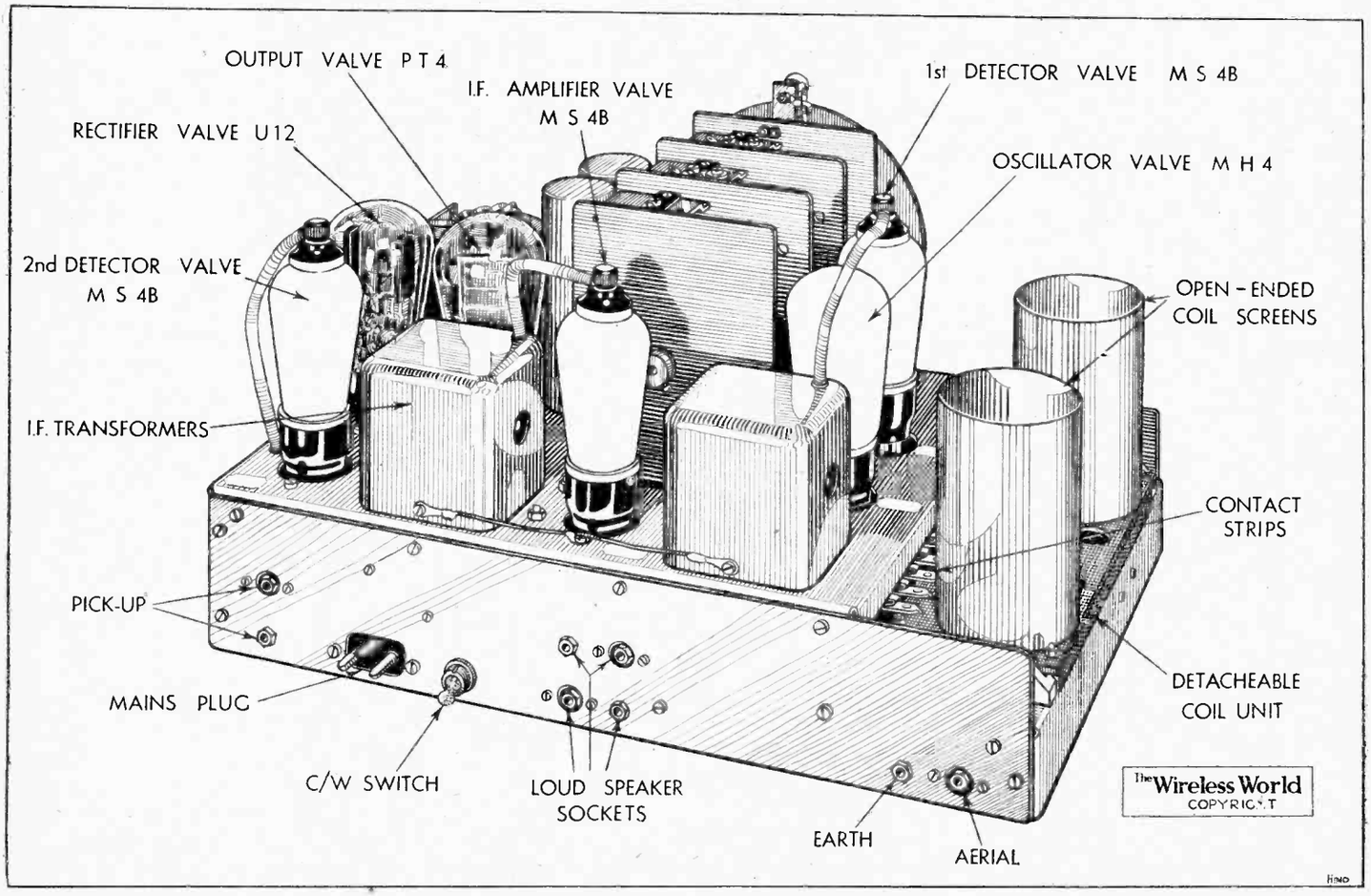
The hum level was fair, but could be noticed when the speaking voice was reduced to a natural volume level. Subsequently it was discovered that the mains transformer laminations were contributing the greater part of this noise—a small point for which the cure is obvious.

Finally, a word of praise concerning the service manual. In view of the fact that the set may have to be maintained miles from the nearest service agent, instructions complete down to the smallest detail are given, and there is no reason why anyone with an elementary knowledge of electricity should not be able to keep the set in commission.

Short-wave Superheterodyne for the Tropics



Circuit diagram of the G.E.C. "Overseas" superheterodyne receiver for ultra-short waves. On the medium waveband a two-circuit filter is employed in the aerial circuit.



The chassis is easily removed from the cabinet for inspection. Sockets are provided for two external loud speakers in parallel.

LETTERS to the EDITOR

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

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

Broadcasting in the Highlands

I AM interested to read the comments of your special correspondent in your issue of February 24th, under the heading, "Broadcast Brevities," on the subject of the allocation of a new additional wavelength for the service of Highland listeners.

I agree that the Highlands "have been poorly served by the B.B.C. in the past." The position is worse than that. The Highlands have no proper service at all. Those of your readers who are interested should consult page 43 of this year's "B.B.C. Year Book," when the position will be seen at a glance.

The B.B.C. charter states that the Corporation is set up in the National interest. They have already admitted that their service falls short of their obligations, so far as the North of Scotland is concerned. Further, when Droitwich transmitter is completed, they have admitted, too, that the twin-transmitter scheme will have to be largely modified.

Your correspondent should not, therefore, write of the "waste of a good wavelength" north of the Caledonian Canal, when that calamity actually exists elsewhere.

No exception has been taken to the erection of the new B.B.C. Short-wave Empire transmitter for service to the thinly populated outposts of Empire. It is the thinly populated parts which need wireless most, and it is for the B.B.C. to honour the trust committed to their care by giving a service to the North of Scotland. I am sure no decent, fair-minded Englishman will deny this obvious duty to the Highlander, who pays his share towards the Empire transmitter. Charity begins at home. Highlanders do not ask for charity, but fair treatment only.

ANDREW MURRAY, Provost.
Town House, Dingwall.

What Does the Public Want?

IF "Diagnostic" lived in the Isle of Wight he would appreciate a selective set that can reach out to all the main European stations, as Daventry is the only British station that is reliable and worth listening to; the others on the broadcast band suffer from fading and distortion. Compared with foreign stations the British stations seem to be played through cotton-wool; band orchestras from the studios are badly balanced, and lack the crispness of foreign orchestras, especially from Germany; in fact, the only British programmes worth listening to are the outside broadcasts from places like the Queen's Hall and the Grand Hotel, Eastbourne.

I consider Broadcasting House a big mistake and not worth the money spent on it. As regards foreign stations, Radio Paris, Berlin (Konigswusterhausen), Fécamp, Leipzig, Breslau, Brussels, Rome, Huizen, Muhlacker, and Prague are all good stations, and can always be relied upon. I may say my views are typical of all my friends who use wireless. The main opinion is that the average of the B.B.C. is below these other stations, both as regards quality and variety of programme.

J. L. DYER.
Isle of Wight.

IT is obvious that "Diagnostic's" "personal observations" have been made over a very small area and most probably close to one of the newer B.B.C. transmitters.

The B.B.C. transmissions are of no use to me, and without the Continental programmes 10s. would be a dear rate to pay.

The best transmission from B.B.C. aerials here is Scottish Regional, but it transmits a programme, which is mostly American jazz, or discord called modern classics, with very little harmony or entertainment, and even these items are spoilt by effects or drums.

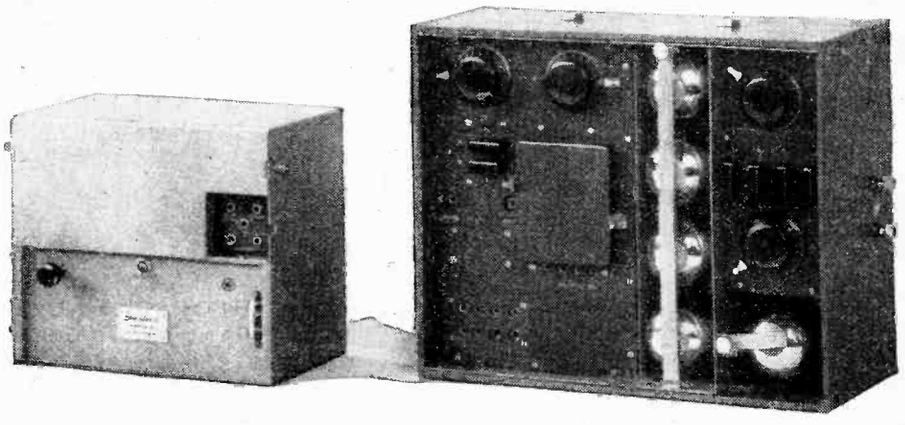
In this district, which is, I imagine, fairly representative of about half of the British Isles, the B.B.C. quality is quite definitely inferior to most Continental stations. At 60 miles S.W. of London's transmitters both programmes are horribly distorted by a peculiar fading of a nature not obtained on any other stations that I am able to receive.

During the ten years that I have used radio I have had many receivers, and now use the "W.W." Baby Super, and always find something to suit me from the Continent of very good quality and value.

Chichester. FREDK. A. FITCH.

MANUFACTURERS make the type of set that past experience has shown to be the most likely to sell! as so few local station sets are offered it is safe to assume that the demand is proportionately small. The demand for long-range receivers is real, and there is a good solid reason at the back of it. Men do not, as is suggested, spend the extra two pounds, or ten pounds, for a long-range receiver just for the satisfaction of being able to feel that they really could receive foreign stations if at any time they should ever happen to want to. I disagree, too, that the excuse for the long-range receiver is based on the two assumptions (1) that the B.B.C. programmes are inferior to foreign ones, and (2) that foreign programmes can be received with as good a quality as the locals. I doubt if any but the few simple souls who believe all the advertisements they read have ever assumed anything of the kind. The average man buys a long-range receiver, if he can afford it, because he knows quite well that, excellent as the B.B.C. fare is, it will not always be to his taste.

For, say, three-quarters of the listening time the B.B.C. provide excellent fare, and with as much choice among the national and various regional programmes as their resources will allow, but for one-quarter of the time they provide fare that is likely to leave the majority of their listeners dissatisfied. This is such a wise and far-sighted policy that it is hard to believe that it is accidental: it must be deliberate. Broadcasting of to-day is a miracle compared with



THE CONQUEST OF EVEREST. Portable transmitting and reception equipment supplied by Standard Telephones and Cables, Limited, to the Ruttledge 1933 Everest Expedition. The receiver (on left) and the transmitter (right) are for use at the base camp, and will communicate with Darjeeling.

that of ten years ago, and there is no slackening in its progress. This progress could not have occurred unless there was a public demand for it. Because the ordinary man has never been quite satisfied with the radio he has had and has all the time been willing to spend a little bit more in the hope of getting something better, he has been both subsidising the industry and putting a premium on enterprise and invention. The progress of broadcasting will continue for just so long as the ordinary man is not quite satisfied and is willing to spend a bit more in the hope of getting something better. The B.B.C. most certainly are keeping this spirit alive, and the proportion of satisfying and dissatisfying listening time is so nicely adjusted, particularly in respect to time and programme material, for keeping it alive, that I, personally, shall never believe it to be accidental. D. F. VINCENT.

Reading.

"DIAGNOSTIC'S" letter (in January 27th issue) appears to me as if he were trying to throw a monkey wrench into the machinery just to see the sparks fly. And I would condemn him for it to using a crystal set *only*—if at all.

Listeners, I believe (in this case) to be divided into two parts, the essentially foreign and local listener. Granted that, the second may receive *better* reception (though it be not always appreciated), their numbers comprise those showing a lack of breadth of view, a lack of desire to hear anything else than the usual stereotyped local items—or those suffering from an unfortunate lack of funds.

The foreign programme listener, however, secures a broader view, a greater variety, and truly *alternative* programme (which are still denied us by the B.B.C.).

Personally, I have sought foreign programmes since the Eiffel Tower put them out on 2,500 metres. But these programmes now come to both one's front and back doors and I derive much pleasure from them, though overcrowding detracts. With super-het., band-passing, etc., this is partly overcome, and also the quality much improved, so comparing favourably with perhaps any except the local station.

The manufacturer, then, should build for both classes (local and foreign listeners), just as he does for mains and battery users.

Ealing, W.13. DEEXER.

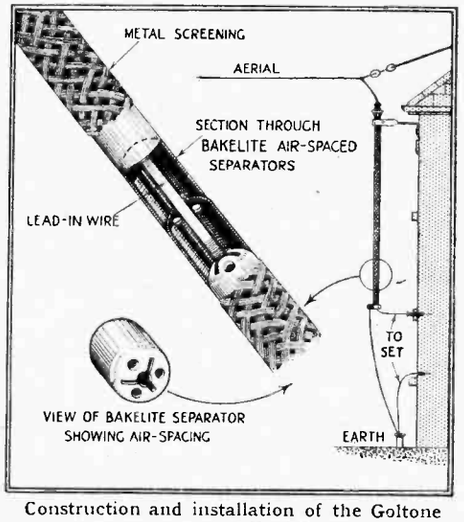
AS an owner of a super-het. and other sets, I feel justified in confirming much of what "Diagnostic" has to say. I insist that the value of entertainment derived from wireless is much overrated and that manufacturers and designers, together with the B.B.C., have duped us. There is a snag in evidence which they have yet to discover. I am one of the public. What do I want? Constant, reliable, undistorted reception, and if there is a set on the market to do this I have yet to hear it. The editor infers there is. I can prove there isn't, and that is the gist of "Diagnostic's" article. He considers the public should have more stability and well-nigh perfect sound, and I for one agree with him, considering the high price one has to pay, to say nothing of the fixed licence. The public have been sold pigs in pokes and have made the best of the swindle. "You may bluff some of us for some of the time, and some the whole time, but not all of us all the time." Some months ago we tried out a mains set which was reputed to bring in fourteen stations. It had the wonderful moving coil, etc., and the price was £12. We got the local and nothing more. This is an example of many. You are doing a real service to the listening community by opening your enterprising paper to such a grievance. Why it has not been brought forward before is a mystery to me. Referring to the National programmes, I consider them lacking the happy medium. They swing from vile, cat-wailing jazz to monotonous symphony concerts, week in, week out, the same syllabus. One wonders the directors do not get sick of it themselves. Where are the brass bands, the light variety items that are so popular? It is high time certain listening martyrs had a seat on the B.B.C. As truth and quality go in a small compass, I trust they will be the final factors in this discussion, and not the remarks of the majority, as so often happens. Here's to better quality, better reception, and better programmes.

"SEARCHLIGHT."

Boscombe, Hants.

GOLTONE SCREENED DOWN-LEAD

IT has been conclusively proved that a great deal of electrical interference reaches our receivers by re-radiation from the household wiring system. Recent work by independent authorities has led to the conclusion that the field of interference pro-



Construction and installation of the Goltone screened down-lead.

duced in this way does not extend far from the building, but that the aerial downlead is particularly likely to be affected.

Up to the present time it has been impossible to apply the obvious remedy of shielding the down-lead, for the reason that ordinary screened wire has an excessive self-capacity. With commendable enterprise, the firm of Ward and Goldstone, Ltd., of Pendleton, Manchester, has now produced a special form of low-capacity cable for this purpose. A series of bakelite thimbles, articulated on the "crocodile spine" principle, are used to centre a rubber-insulated conductor in a metal-braid cover.

A practical test, made under conditions where interference is normally heavy, proved highly successful. Signal strength was reduced to a slight extent, but, with a receiver having a margin of sensitivity, this is not serious. What really matters it that the signal-to-noise ratio was improved to a more-than-acceptable extent; indeed, certain forms of interference disappeared entirely.

Low-capacity screened cable of this sort cannot be cheap; a 30-foot length costs 36/-, but in many circumstances it is well worth its cost.

CLUB NEWS

Golders Green and Hendon Wireless Society

MR. ALEXANDER BLACK'S recent talk on "Tone Correction," before the Golders Green and Hendon Radio Scientific Society, aroused great interest. Various methods were described and illustrated by means of frequency records, visual indication being obtained by means of the valve voltmeter and aural effects with dual moving-coil loud speakers.

Mr. F. E. Henderson, A.M.I.E.E., of the G.E.C., recently lectured on the "Vari-mu Valve," describing the great advantages of the valve in pre-detection volume control.

Mr. J. C. Emerson, B.Sc., dealt in a recent paper with direct-coupled amplifiers.

All communications should be addressed to the President: Lieut.-Col. H. Ashley-Scarlett, D.S.O., 60, Pattison Road, London, N.W.2.

All About the Cathode Ray

"THE Cathode Ray Oscillograph" formed the nucleus for an entertaining evening at a recent meeting of the North Middlesex Radio Society. The lecturer was Mr. G. Parr, representing the Edison Swan Electric Co., Ltd., and he had brought with him interesting apparatus and many lantern slides. Numerous experiments were carried out, and the audience were shown how the cathode ray was projected and how it could be controlled by magnetic or electric fields.

Hon. Secretary: Mr. E. H. Laister, Windflowers, Church Hill, London, N.21.

Choosing a Subject

ANOTHER new idea was exploited by Slade Radio at a recent meeting when, in the absence of the appointed lecturer, Mr. Peck offered to fill the vacancy and allowed members to choose the subject of discussion. Five subjects were proposed, and two were ultimately agreed upon by vote, namely, "Screen-grid Valves as Detectors" and "Quiescent Push-pull." On the first topic details were given of coupling, rectification, quality, amplification and reaction. The second subject aroused great interest. Details were given of the quiescent push-pull circuit, and the use of transformers and eliminators was discussed.

Hon. Secretary: 110, Hilaries Road, Gravelly Hill, Birmingham.

Manufacturing Superhets

MEMBERS and Associate Members of the Crewe and District Radio and Scientific Society spent a very interesting evening on Tuesday, February 14th, when Mr. Hornby, of the Philco Radio and Television Corporation, lectured on the "Manufacture of the Philco Superheterodyne." Mr. Hornby clearly explained the action of the automatic volume-control applied to Philcos main sets, also the new "Push-pull" output stage incorporated in the battery model.

Anyone interested is invited to communicate with the Hon. Secretary: Mr. R. Peach, 84, West Street, Crewe.

L.F. Circuit Phenomena

AT a recent meeting of the Smethwick Wireless Society Mr. Valentine, of the Mullard Wireless Service Co., Ltd., lectured on various L.F. circuits. By using a dual-gramophone amplifier the lecturer demonstrated the different effects produced by various couplings between valves and between output valve and speaker.

Hon. Secretary: Mr. E. Fisher, 33, Freeth Street, Oldbury, near Birmingham.

A Debatable Point

"PENTODES *versus* Triodes" was the intriguing title of the lecture given by Mr. G. Parr, of the Edison Swan Electric Co., Ltd., at a recent meeting of the Catford and District Radio and Television Society. The keenness with which the lecture was followed could be judged by the vigour of the discussion, in which the speaker was never at a loss to answer the various questions put to him.

Hon. Secretary: Mr. H. W. Floyd, 38, Como Road, Forest Hill, London, S.E.23.

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.

Anode Current

AT first sight it would seem perfectly simple to measure the anode current of a screen-grid valve; all that one has to do is to remove the existing connection to the anode terminal (which is nearly always accessible) and to interpose the milliammeter between this terminal and the connection which normally joins it to the H.F. coupling device.

But in practice the interposition of the meter and its wiring will generally provoke uncontrollable H.F. oscillation, due to stray coupling to other circuits. This is the experience of a reader who has an A.C. set in which the internal connections are inaccessible, and we are asked to suggest a simple way of checking self-oscillation while measurement is being made. It is hoped to avoid the need for removing the receiver chassis from its cabinet.

Self-oscillation will be prevented if either the grid or anode coils of the valve to be dealt with are short-circuited. Of course, it may happen that these coils are also inaccessible, and in this case it will probably be equally effective to short-circuit the grid of the valve to the earth line (or metal chassis). In cases where the valve is biased in the usual way by the voltage drop across a resistor in its cathode circuit, this plan is quite permissible. If the current measurement is to be accurate, bias voltage must not be changed.

Triodes in Q.P.P.

A HIGHLY economical system of Q.P.P. amplification, in which three-electrode valves are used, was described in *The Wireless World* for February 24th. An output stage planned on these lines is applicable to almost any battery-operated receiver; provided that the output valves do not require a greater negative bias than about 15 volts, the use of an intermediate stage may be avoided, and the detector may be arranged to feed the push-pull output valves directly, using a high-ratio transformer.

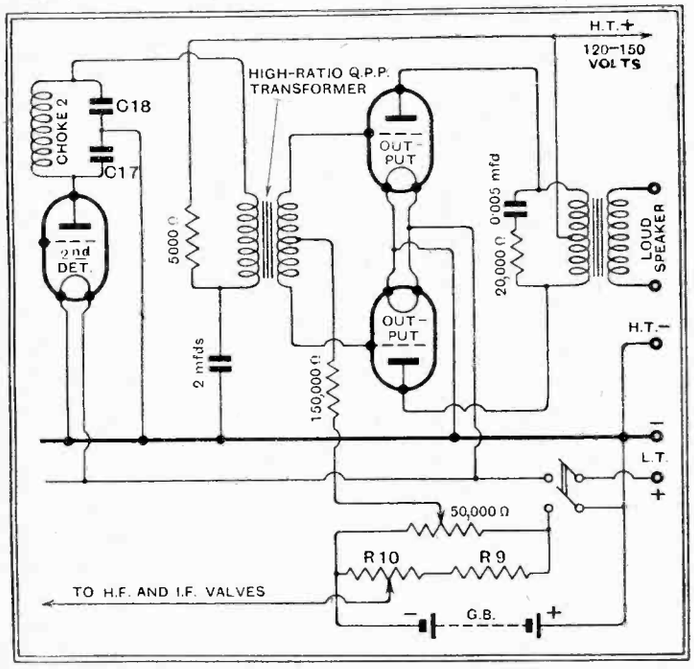


Fig. 1.—The output stage of the "All-Wave Monodial," as modified for the Q.P.P. system with three-electrode valves.

This brief statement will serve to answer the main questions of a reader who is about to build the "All-Wave Monodial Superhet," and who wishes to substitute Q.P.P. amplification with triodes. He intends to use Osram L.P.2 valves, and to operate them with an anode voltage of about 150.

For his guidance we give in Fig. 1 a circuit diagram showing the modifications necessary for the "All-Wave Monodial"; in this diagram those components which will still be used have been given their original reference lettering.

With regard to grid bias adjustments for the push-pull output valves, it will be noticed that an extra 50,000-ohm potentiometer is shown. At a pinch this component could be dispensed with, but for reasons that have already been explained, it is a highly desirable adjunct.

Electrolytic Condensers

A SUGGESTION to the effect that an electrolytic condenser becomes ineffective at high audio frequencies because its internal resistance then predominates, seems to be based on a fallacy. It is not the *capacity*, in itself, that is important, but the *impedance*, which should not be allowed to exceed about 100 ohms at any frequency. A combination of capacity and resistance in series, forming an impedance which is low enough at the lowest frequency, cannot be greater at any higher frequency, and is therefore bound to be satisfactory.

To take figures relating to an actual condenser, the impedance measured at 50 cycles was 90 ohms, corresponding to an apparent capacity of 35 mfds., and at 800 cycles, 22 ohms, or an apparent capacity of 9 mfds. The actual capacity was 36 mfds., and the resistance 21 ohms. So, although at the higher frequency the condenser behaves mainly as a resistance, it is at the same time actually a better by-pass than at 50 cycles, when it acts as a nearly true condenser.

Bias from D.C. Mains

WE are all familiar with A.C. mains sets and D.C. mains sets; even those which work interchangeably on either system are not altogether unknown. Now we are confronted with a proposal to operate a receiver simultaneously from both A.C. and D.C. sources of supply.

The position is this: A querist who operates his A.C. receiver from 200-volt D.C. mains through a rotary converter proposes to replace his existing output valve by one having a considerably greater power output, and requiring more anode voltage than that at present in use. The existing power equipment is just capable of satisfying the demands of the new valve, so far as anode supply is concerned, but there will be no surplus for "free" grid bias; about 30 volts is required for this purpose.

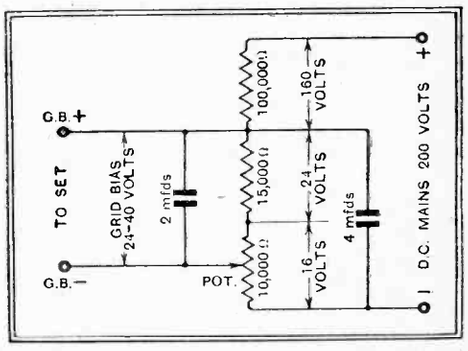


Fig. 2.—Grid bias voltage from D.C. mains: an arrangement applicable only in special circumstances. The voltage distribution across the potentiometer elements is marked.

We are asked to say whether in these circumstances the necessary bias voltage can be obtained from the D.C. mains without prejudice to the operation of the set. It is desired to have some control of the actual grid voltage applied to the output valve.

Although this arrangement is unconventional, we can see no serious objection to it, and suggest the arrangement shown in Fig. 2. This consists of a semi-variable potential divider, allowing variations of grid bias voltage between 24 and 40 volts. Smoothing is effected by one element of the potentiometer in conjunction with a 4-mfd. condenser.

It should be pointed out that the set should not be directly earthed; unless a double-wound aerial-grid transformer is employed, a condenser must be inserted in the earth lead.

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.

The Wireless World

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EDITORIAL COMMENT

Automatic Volume Control

An Essential Fitment

IT is not too soon to contemplate what is likely to be the general trend of design of receivers of next season, and one thing appears to us abundantly clear: that designers have a very busy time immediately ahead of them if they are to be ready for next season with new receivers which will do justice to the wealth of intriguing new valves and circuit arrangements.

From the point of view of the sensitive set designed to receive a choice of foreign programmes, the most outstanding development is undoubtedly the provision of automatic volume control. There are various methods of applying it to choose from, but whatever the system the general result of its incorporation in a sensitive modern receiver is the same; even those stations which hitherto faded up and down to such an extent as to make reception scarcely worth while are receivable at constant strength and often comparable with what is termed "local-station" reception in quality.

Automatic volume control is, in our view, of such importance to every set claiming to be more than a "local-station" receiver that we cannot help believing that next season there will be but a poor market for any receiver of this type which does not incorporate it in some form.

We complete in this issue the description of how to apply A.V.C. to the Monodial A.C. Super; there could be no more suitable receiver for the purpose, for from the point of view of distant reception at good quality it is unsurpassed and its extreme sensitivity leaves a margin of amplification sufficient to cover almost the worst examples of fading.

There are many readers who may not feel prepared to embark on the construction of an elaborate set until they have tested out the advantages of automatic volume control in some less ambitious form first. We think, therefore, that a little unit which we shall describe in next week's issue should achieve wide popularity. This is an automatic volume control unit costing only a few shillings to construct, which is applicable for use as an addition to any receiver with an efficient H.F. stage.

Every reader who has not already tried out some form of automatic volume control will want to try this unit, which is the first constructional device to provide for A.V.C. with existing sets.

Midget Sets

Are They Worth While?

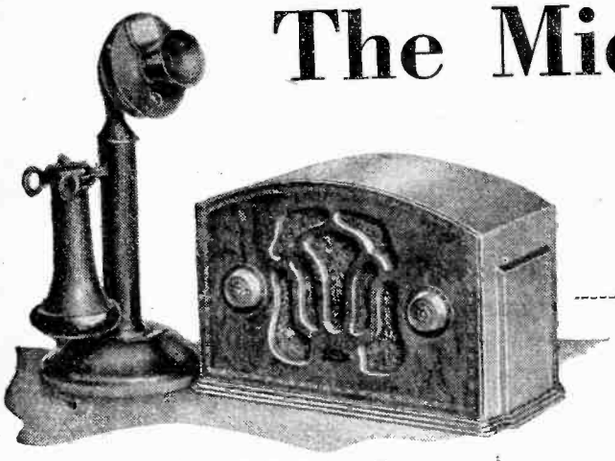
THERE has been almost a stampede amongst manufacturers in America in recent months to devise something new in the way of radio sets, so as to tempt buyers who are by no means as plentiful as before the American financial crisis.

One of the products of these efforts is the midget set, a complete receiver designed on the smallest possible lines, incorporating the loud speaker and having the additional novelty of operating from both D.C. or A.C. supply. An article on these sets from an American correspondent appears in this issue, and although it is implied that the enthusiasm for this type of set has now almost died down, it is possible that with our varied electric supplies it may find favour in this country. Unfortunately, however, it would appear that size rather than quality of reproduction has been made the first consideration in design.

The Midget Universal Mains Set

The Latest American Innovation

By KEITH HENNEY, New York



The Pierce Airo—a complete receiver with built-in speaker.

ENORMOUS sales of a new type of midget receiver workable without alteration from A.C. or D.C. mains have helped to revive the American radio industry in the midst of national depression. In view of this "midget" craze it is pertinent to ask whether such a set would find favour over here. At all events details of the new valve technique afford interesting reading.

AT a time when the American radio market seemed utterly dead, a new craze has revived it, the craze of the universal D.C.-A.C. set; a receiver that cares not to what kind of power circuit it is connected, a receiver employing some of the newest circuits and valves, so that it is bound to interest British manufacturers and listeners.

Almost overnight it has developed into a full-fledged industry in which those builders of sets that had small plants, small overheads, and no warehouses filled with obsolete receivers could capitalise. Thus it is that comparatively unknown manufacturers have been able to do over a million dollars' worth of business, and, in fact, have seemingly exhausted the market before the big companies could get under way.

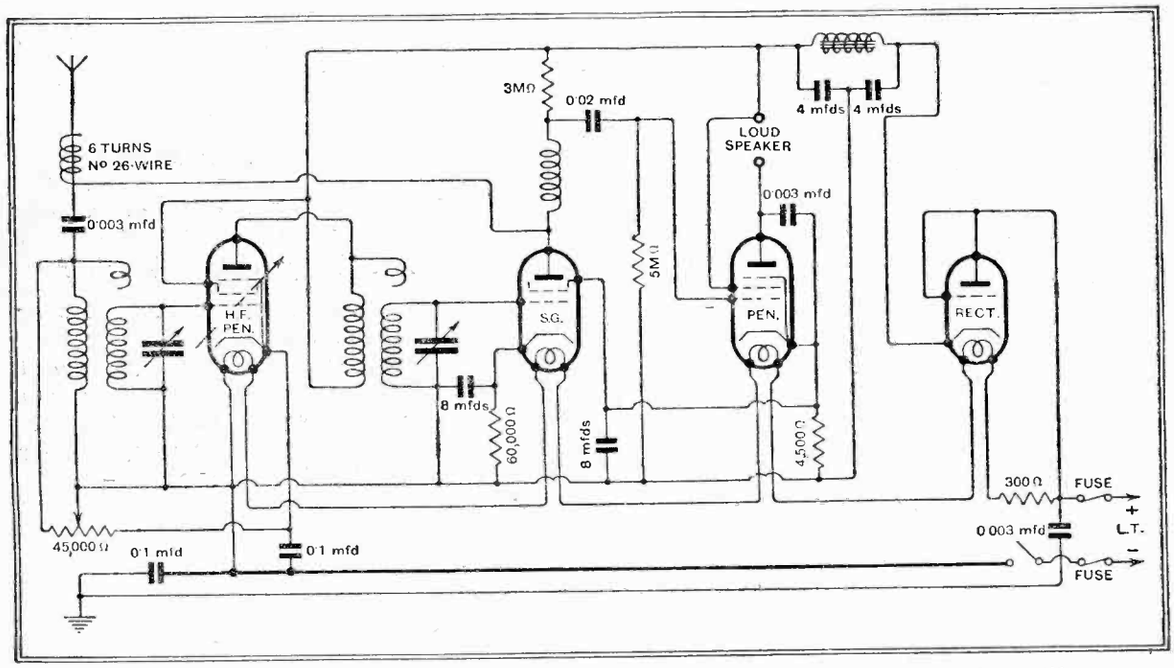
Just what it is about these tiny cigar-box sets, or vest-pocket sets, as they are often called, sets which will operate from either D.C. or A.C., that so impresses the public, one cannot say. Certainly it is not the D.C.-A.C. feature, for but 5 per cent. of the population of the United States live in D.C. districts; certainly, it is not the fidelity of response of the newest batch of midgets, for there is so little bass that it might as well be absent completely. It must be that people have wanted very small, easily portable, and fairly good-looking sets. The public was apparently tired of sets made to look like a mantle-clock and actually reminding them of a tombstone. It wanted wireless that looked like wireless, and in the universal set it got it. Soon the market was surfeited with models from half a dozen companies.

In the English market, with the problem of many kinds of power, the circuits employed in these American midgets ought to be of interest. There is no reason why a really high-class receiver of high sensitivity, selectivity, and fidelity cannot be built using the same principles. In America the circuits and valves are used to make cheap sets, but the principles may come into general practice. Another season may tell this story.

The Kadette introduced by International is made in a bakelite case in several colours. The listener can take his choice. At the start of the craze he paid 25 dollars for the set; the dealer made 10 dollars on each one sold; if he cut this price he lost his franchise. This was unusual in the American market, where dealers have been educated by their manufacturers to cut prices. Furthermore, the manufacturer in this case maintained his price; again, an unusual procedure. Usually, the manufacturer no sooner gets rid of a batch of sets to his dealers than he cuts the price from under the dealer and announces a new model. Therefore, the action of International pleased the dealer, and the public; and, because the little set had great novelty value, it sold.

It is said that about one million dollars' worth of the sets have been sold; one manufacturer in New York City, hitherto almost unknown, has sold nearly 100,000 of the sets. Now there are many of them on the market, the price is being cut widely, and the fad is nearly over. But its influence will last some time, especially as its circuits are of considerable importance.

How does the universal set work? In the first place, new valves made the set possible. It utilised valves designed originally for car receivers. The valves are all of the heater type, using 6.3 volts and consuming 0.3 ampere. The universal sets use four of these valves, all the filaments being operated in series. The first valve is almost invariably a 39 (equivalent to the British H.F. variable-mu pentode, described elsewhere in this issue). The detector, which immediately follows this single-stage amplifier, is a 36, which is a screen-grid valve. This drives a pentode which works into a

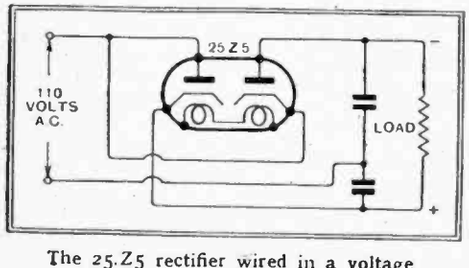


The Crosley Totem set with screened H.F. pentode; an indirectly heated triode acts as mains rectifier.

The Midget Universal Mains Set

magnetic type of loud speaker. Finally, there is a rectifier, usually a 37, also belonging to the automobile series of valves, a triode with grid and plate connected together.

The rectifier (and this is of interest to the English manufacturer) stays in the circuit, whether the receiver is operated on D.C. or on A.C. On A.C. it acts, of course, as a half-wave rectifier, furnishing energy to a filter system which smooths out the bumps and passes along to the other valves their plate power. But on D.C. the rectifier merely acts as a resistance in series with the plate circuits of the other tubes. If the set is plugged into the D.C. line properly, the plate of this rectifier tube will be positive, and, of course, current will flow through it. But if the set is plugged in the wrong way round, nothing at all happens. The set is therefore really universal, operating on either D.C. or A.C. without any changes whatever. Universal sets have, of course, been on the market in England for some time, but in this case use has been made of a high-voltage rectifier.



The 25.Z5 rectifier wired in a voltage doubling circuit.

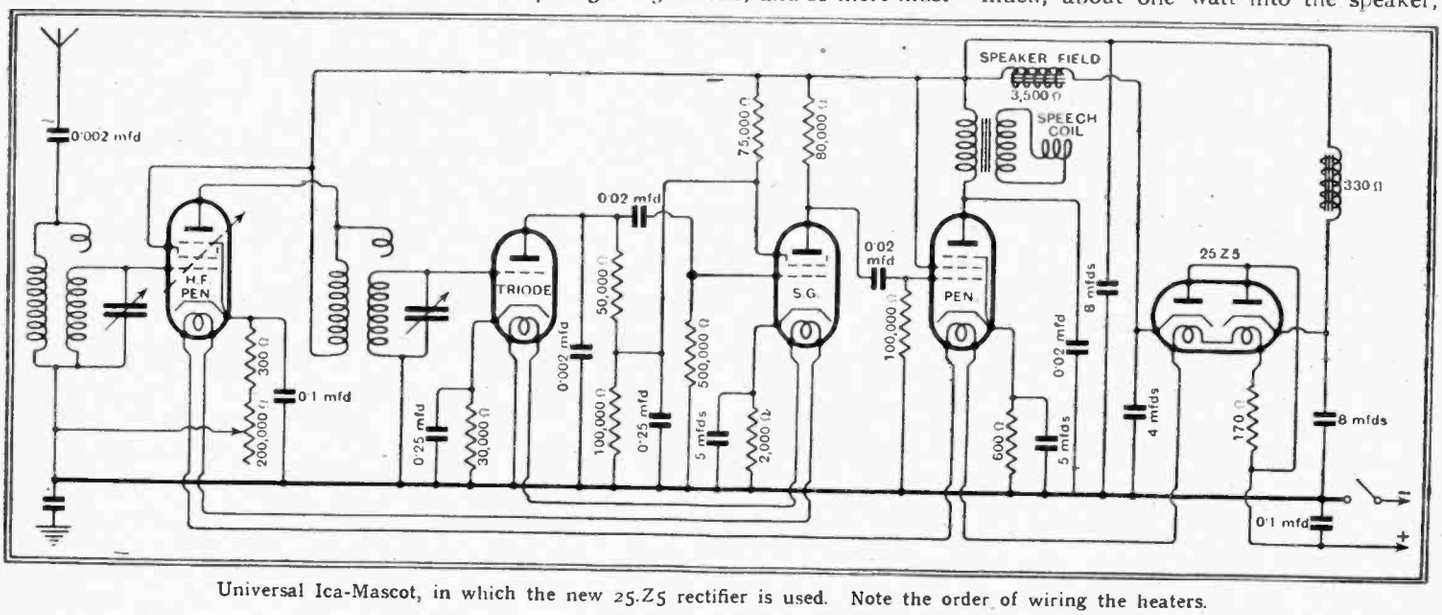
Some manufacturers have adapted this central design to work on other voltages; either 32 volts for farms with their own lighting plants, or on 220-volt circuits. When the set operates from 110 volts the four 6.3 volt valves in series only account for 4 × 6.3 or 25.2 volts, and so there must be some additional series resistance so that the string of valves can be put across the 110-volt line. This resistance is of the order of 300 ohms, and must dissipate about 27 watts. If the set is to operate from 220 volts, more voltage must be wasted in this series resistor, but that is not a difficult problem. This is the most usual circuit.

In some cases there is a gaseous rectifier resembling the older Raytheon tube, except that this tube is usually a half-wave rectifier. In other cases a special plug is used on D.C., which disconnects the rectifier system. In still another case a relay operates when the set is plugged into D.C., and this relay opens the rectifier circuit. Such complications are rare, however, and there seems little likelihood that many receivers will be built using them. After all, the simplest circuits seem to work properly, and so give the greatest value for the least effort and money.

Of course, the bass response in these little sets is very poor. Therefore, there is little need for expensive filtering. A single choke with 4-mfd. electrolytic condensers at either end furnishes the required smoothing.

Nearly always the set operates without a transformer. Of course, on D.C. the transformer could do no good; and on A.C. the voltages available are sufficient to secure appreciable amplification and power. In the average home 110 volts is available, and with the successful efforts toward making valves more efficient there is little need of higher voltages. The power expected of the little sets is not much, about one watt into the speaker, and so the 110-120-volt lines supply plenty of pep.

To increase the sensitivity and selectivity of the receiver, regeneration is employed. This is accomplished either by inductive or capacitative feed back from detector to the H.F. stage, or the coils are so placed that the natural coupling is assisted somewhat by capacitative effects. At any rate, the man who instals the set, or sells it, adjusts it so that the thing does not oscillate, but is pretty near it most of the time, and once plugged into the light socket it is ready for action.



Universal Ica-Mascot, in which the new 25.Z5 rectifier is used. Note the order of wiring the heaters.

CHARACTERISTICS OF VALVES USED IN UNIVERSAL A.C.–D.C. SETS.

Type.	Purpose.	Filament. Volts.	Filament. Amps.	Anode Volts.	Anode Current.	Bias.	Screen Grid Volts.	A.C. Resistance.	Amp. factor.	Mutual Conduct.	Power Output (mW.).	Optimum Load.
36	H.F. Amp.	6.3	0.3	180	3.1	3.0	90	350,000	370	1.05	—	—
37	General Purpose	6.3	0.3	180	4.7	13.5	—	10,000	9	0.9	—	—
38	Power Amp. ...	6.3	0.3	135	9.0	13.5	135	102,000	100	0.975	625	13,500
39	Vari-mu	6.3	0.3	180	4.5	3.0	90	750,000	750	1.0	—	—
25.Z5	Voltage Doubler	25	0.3	A.C. volts per plate R.M.S. = 125; D.C. output current = 100 mA.								

Another Midget Universal mains receiver—the Crosley four-valve Super.

A New Rectifier

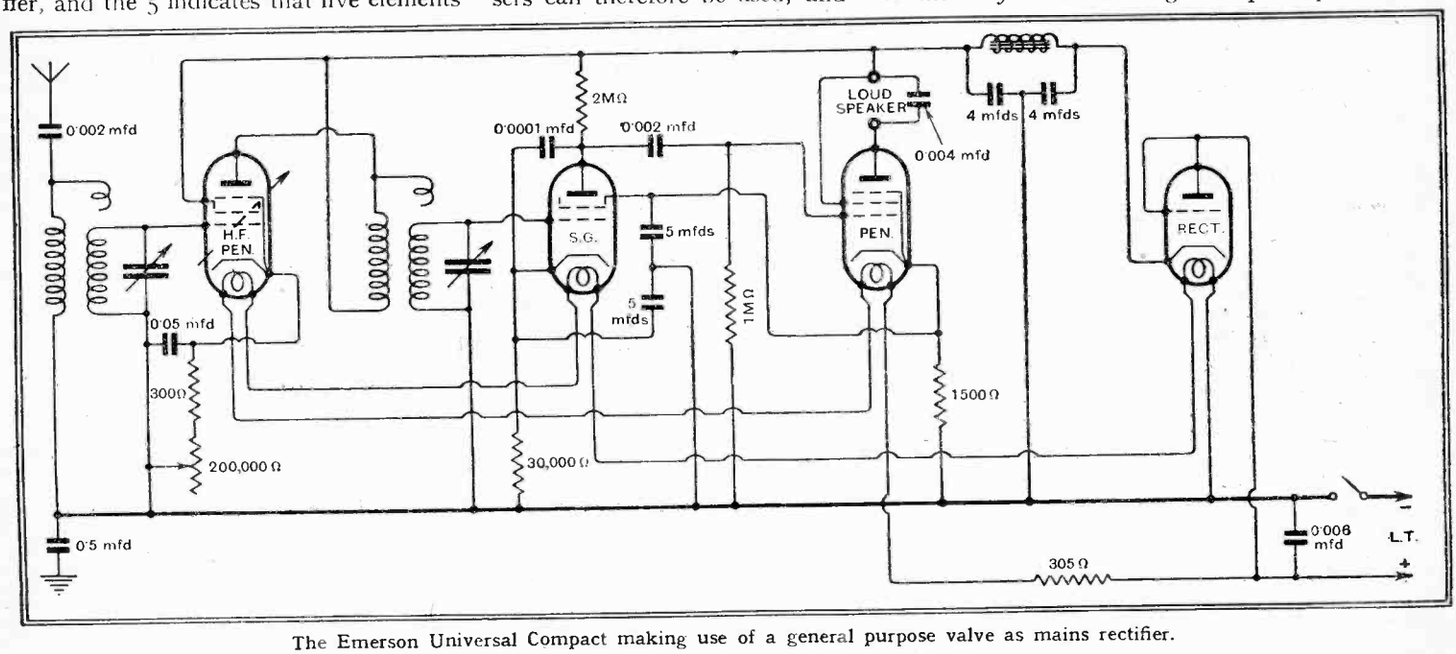
The large loss of voltage and wastage of power in the 300-ohm resistor to reduce the voltage across the valves to the proper value has been overcome to some extent by the development of a new rectifier, the 25.Z5 (this is one of the first valves to use the new American numbering system.

The Midget Universal Mains Set

The 25 indicates that the filament voltage is 25, the Z indicates that it is a rectifier, and the 5 indicates that five elements

greater than with a more conventional circuit, but the voltages they must stand are only the line voltage. Cheaper condensers can therefore be used, and with the

radios were (about 100,000 were sold up to February), a new development threatens their sale. This is a five-valve superheterodyne with much greater pick-up and selec-



The Emerson Universal Compact making use of a general purpose valve as mains rectifier.

are brought out to pins in the base). This valve has two cathodes and two anodes, and all leads are brought out to the base.

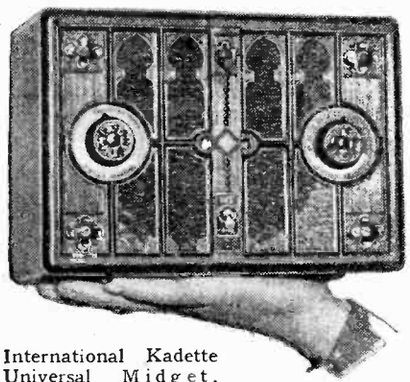
Thus, the valve can be connected as a single-wave rectifier by merely connecting the plates and cathodes together, or it may be used in the conventional full-wave rectifier circuit, or it may be connected in the voltage-doubling circuit used by so many amateurs. In the voltage-doubling circuit 220 volts may be secured from a 110-volt circuit without the use of a transformer, so that another saving has been made, both in cost and in space.

This valve with its 25-volt filament takes care of a considerable part of the voltage used up in the 300-ohm resistor, so that now a 170-ohm resistor is used with less heat to be dissipated.

The capacities necessary to be used with the voltage-doubling circuit are somewhat

proper capacity plenty of current at twice the line voltage is available.

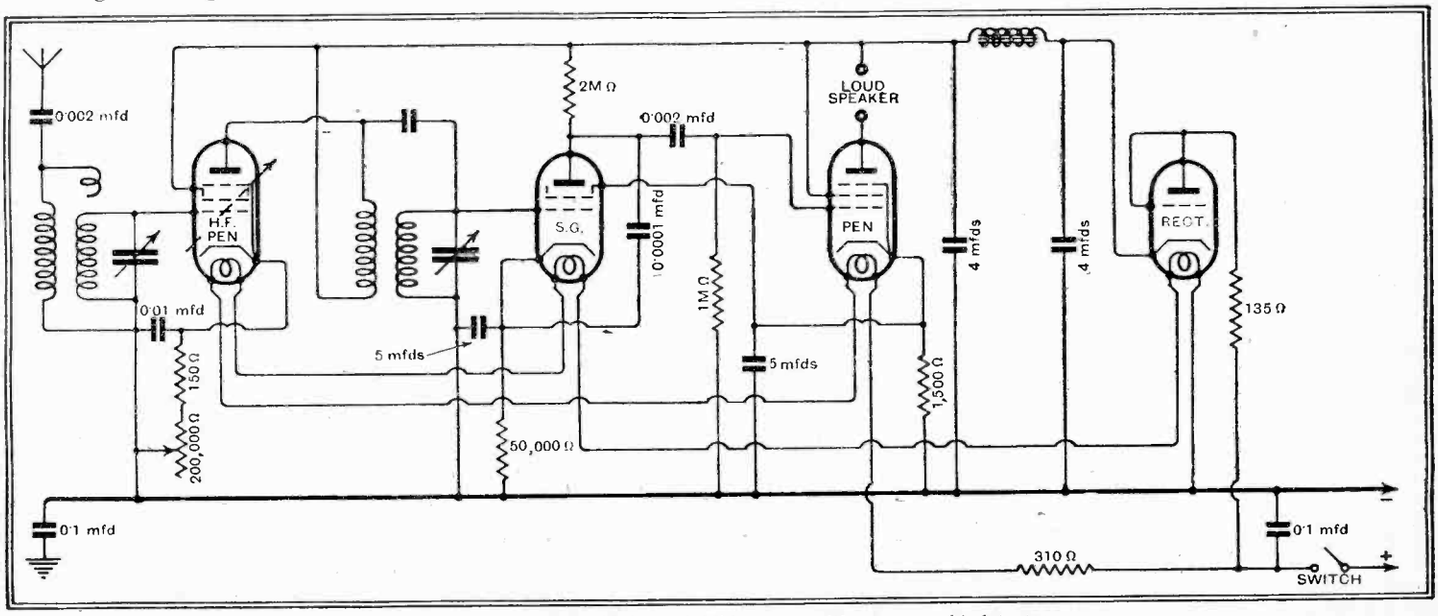
Successful as the 4-valve cigar-box



International Kadette Universal Midget, claimed to be the smallest four-valve receiver in the world. It weighs only 6 pounds and covers little more than the palm of the hand.

tivity than the four-valve tuned radio-frequency set. This, in turn, will be supplanted by a less expensive four-valve super, then still cheaper supers will be available. It is even rumoured that a two-valve super will come along about the middle of 1933. These small sets are made possible by developments in the valve industry. Valve engineers have been successful in combining the functions of two valves into one bottle, with consequent saving of space and set cost.

And so it goes on. The aim is always to reduce the selling price of the set. Competition, and lowered purchasing power of the public in America, forces the industry to lower levels, and at the same time to put more and more efficiency into the receivers. In the case of the universal set, many of the lessons learned will undoubtedly prove of value in future.



International Kadette Universal Midget set with screen-grid detector.

The Screened H.F. Pentode

Its Advantage as an H.F. Amplifier and Detector

The new Mullard SP4 and VP4 valves—the screened and variable-mu pentodes respectively.

IT has long been known that the ordinary screen-grid valve is handicapped by a secondary electron effect which introduces a kink in the characteristic and thus limits its signal-handling capacity. In the screened H.F. pentode and the variable-mu pentode about to become available in this country, this disability is avoided and the substitution of the new valves for their S.G. tetrode counterparts, in both straight sets and superhets., will result in considerable improvement in stage gain and stability.

By T. E. GOLDUP *

THE development of the high-frequency or screened pentode represents a further improvement in high-frequency amplification, and its advantages are not confined to this stage of a receiver.

The screened pentode is similar in external appearance and connections to the screen-grid valve, and may be regarded as a development of the screen-grid tetrode rather than the normal L.F. pentode. By the introduction of an additional grid between the anode and screening grid of the screen-grid valve, the special characteristics of the H.F. pentode are obtained. This grid, as in the L.F pentode, has the effect of removing the negative resistance kink from the characteristic of the tetrode and also gives an extremely high magnification factor together with an adequate slope.

Advantages Over S.G. Valve

The impedance of the screened pentode is generally considerably higher than that of the tetrode, and consequently the sensitivity of the H.F. stage will depend very largely on the dynamic impedance of the tuned circuits. This high impedance of

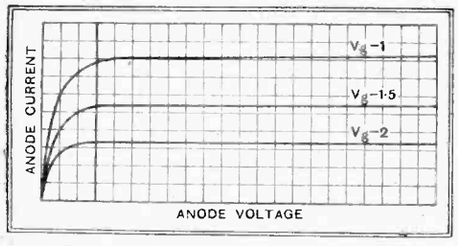


Fig. 1.—Typical characteristic curve of an H.F. pentode. It will be seen that the negative resistance kink, common to the screen-grid tetrode, has disappeared.

the pentode ensures practically unaltered radio frequency characteristics of the associated circuits, and, in addition, if really efficient coils are used, the gain will be very much greater than that obtainable with a tetrode. Even with normal coupling coils, the H.F. pentode will give improved results over a screen-grid valve.

In spite of its very high magnification factor, the pentode has a grid base equal to that of a normal tetrode, although, in general, where signal voltages of varying amplitude are to be handled, the multi-mu pentode would be used, in the same way as the multi-mu screened grid.

Following the usual practice in high-frequency amplifiers, the multi-mu pentode is preferable to the normal type for both high- and intermediate-frequency stages, as it has the additional advantage of sensitivity control by negative bias variation, and has, at minimum bias, a stage gain equal to that of the normal screened pentode.

It is well known that, in the case of the screen-grid tetrode, considerations of secondary emission effects limit the screen voltage to a narrow region. No such restriction exists in the pentode valve, where secondary emission effects have been eliminated, and by suitable variations in auxiliary grid voltage, wide adjustment of the multi-mu characteristics is possible.

The resistance network required to maintain the auxiliary grid voltage at a constant potential, irrespective of bias variation, is similar to that for multi-mu tetrodes.

One of the main spheres of usefulness of the screened pentode lies in its application as detector, and particularly as that of first detector in superheterodyne receivers. It can be used quite satisfactorily with any of the circuits already developed for screen-grid valves, and will give improved results with less critical voltage adjustment.

An efficient, though quite simple, circuit arrangement has been developed which takes advantage of the pentode characteristic, a curve of which is shown in Fig. 1. It will be seen that with low anode voltages (such as 30 volts) on the anode and with normal auxiliary grid and control grid voltages, there is a sharp "knee" in the characteristic curve, and if the valve is operated just above this point, excellent rectification is obtainable with complete absence of re-radiation.

This method of rectification is not possible with screen-grid valves because the negative resistance characteristic gives rise to dynatron oscillation.

Single-valve Frequency Changer

Fig. 2 shows a suitable circuit arrangement for operating the screened pentode as a first detector under the above conditions.

A further important use of the screened pentode is undoubtedly its application as a combined oscillator-detector. Although for this purpose the auxiliary grid coupling method can be employed, cathode coupling using a suitably designed circuit is more satisfactory. Using the former method, with the comparatively small coupling coil permitted by the high amplification factor of the valve, re-radiation is less than when using the most suitable L.F. pentode, previously considered to be most satisfactory in this respect.

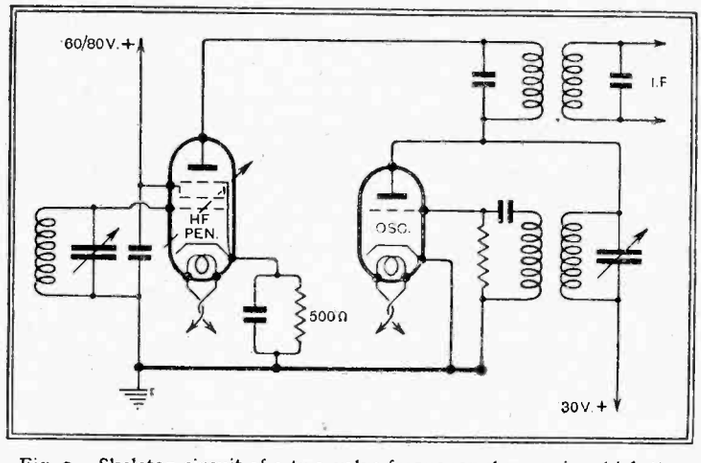


Fig. 2.—Skeleton circuit of a two-valve frequency changer in which the first detector is an H.F. screened pentode.

The prevalent opinion in this country, that cathode coupling causes excessive re-radiation, would seem to indicate that it was not realised how small the coupling coil could be made while still maintaining sufficient coupling for oscillation. A small coil (of about 5 microhenrys for medium waves) gives extremely satisfactory results,

* The Technical Department, The Mullard Wireless Service Co., Ltd.

The Screened H.F. Pentode.

and the re-radiation voltages are considerably lower than those given by any other coupling method. It should be noted that the use of too large a coil may give bad re-radiation.

Fig. 3 shows a circuit arrangement suitable for a cathode-coupled oscillator-detector using a screened pentode.

Used for negative-bend detection, the pentode has the important advantage that larger anode voltage swings are possible than with the screen-grid tetrode. As there are no secondary emission effects the maximum anode voltage swing is practically a constant with normal external anode resistances. Due to the very high impedance, sensitivity is practically proportional to the anode resistance chosen, but the usual limitations imposed by the necessity of retaining the higher audio frequencies must be carefully taken into account.

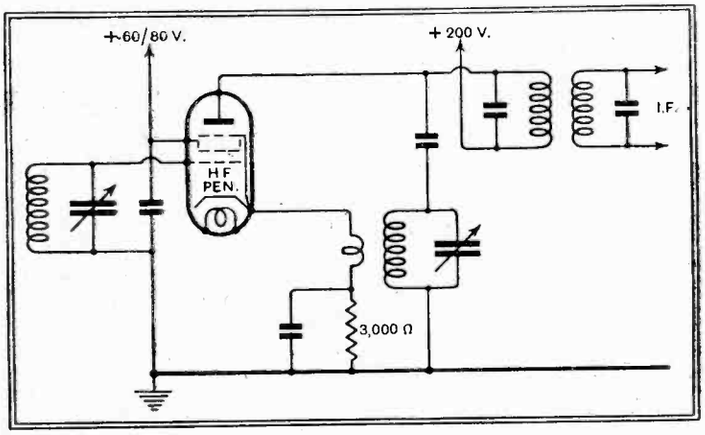


Fig. 3.—The screened pentode as a single-valve frequency changer with cathode coupling.

DISTANT RECEPTION NOTES

IN view of the heterodyne which recently accompanied the Huizen (Hilversum programmes) transmissions one wonders whether alterations have been made in either the Kaunas or the Lahti transmitters. Though the former is rated at 7 kilowatts and the latter at 40, neither is as a rule at all strongly received in this country, nor have there been noticeable heterodynes with Huizen. The interference appeared to be coming from a station on a higher wavelength, and this points to Kaunas as the source of the trouble.

A kind correspondent from Warsaw sends me official particulars of the Polish stations. A week or two ago I referred to the amazing strength with which Katowice was received in this country, and suggested that the output power might be in excess of the 16 kilowatts shown in the lists. My correspondent, who is an electrical engineer, tells me that the unmodulated power of Katowice is 12 kilowatts, or 16 kilowatts when working with average modulation depth. The station is very well situated for providing a large service area, since it stands on high ground, and there are no large conducting bodies in the neighbourhood which might cause absorption.

Improvements are to be carried out at Katowice within the next few weeks with a view to eliminating harmonics, but the power rating will not be altered. I hear that Warsaw No. 2 on 214.3 metres is temporarily out of action. The actual modulated power rating of Lodz, Poznan, and Cracow is 2 kilowatts, whilst Lwow and Wilno (now working on 563 metres) work with 16 kilowatts unmodulated, or 22 kilowatts modulated.

A new station is to be built at Trondheim (495.8 metres) with a power rating of 20 kilowatts, and the power of the Bergen transmitter (364.1 metres) will be increased at the same time also to 20 kilowatts. One rather wonders how these new big stations will be fitted in, for at present Trondheim is separated by only 6 kilocycles from Florence, while Bergen is 3 kilocycles from Fredriksstad, and but one from Algiers on the other side.

Wonderful reception is obtainable at present from Rome, which with even a small set comes through with splendid quality and volume. Other good Italians are Florence and Milan, but Turin and Trieste have suffered badly from heterodyne troubles.

Conditions all round are, in fact, much better than they were a week or two ago, the improvement being particularly noticeable from about 430 metres upwards. Budapest, Munich, Brussels No. 1, Prague, Langenberg, and Lyons Doua hardly ever fail to provide good reproduction. It is a thousand pities that Berömunster is still so often jammed.

Madrid is more worth attention than it was, and Hamburg, which had a long spell of weakness at the beginning of the year, is now an excellent transmission.

Heterodynes, due mainly to wavelength wobble or wandering, are unfortunately rather numerous on most nights. In addition to those mentioned, stations that have been affected in this way are Bordeaux, Leipzig, Katowice, and the Poste Parisien.

On the long waves Kalundborg is still not in very good form, though all of the other well-known stations can be well received in daylight or after dark.

D. EXER.

THE BRUSSELS NOTEBOOK

Wavelength Vagaries during February

AN unknown Russian telephony station operating between Radio Paris and Zeesen supplies the usual element of mystery in the records of the Brussels control station of the International Broadcasting Union for February.

Vienna is continuing its long wave tests, and Moscow Experimental was testing for two days at the beginning of the month on 1,481 metres, possibly in connection with the rumoured 500-kW. station. Two unknown stations have been testing in the neighbourhood of 678.7 metres, the wavelength officially allotted to the new Swiss station at Monte Ceneri, which will shortly begin transmissions on 15 kW.

Conditions on the medium waveband have not improved. Tartu is still clinging to 512 kc. which is perilously close to the shipping wavelength. Palermo on 558 kc. continues to heterodyne Munich in spite of protests. Radio Vitus moved away from Cardiff's wavelength and seems to have decided to remain on the Zagreb wavelength. Bremen appears to be the black sheep among the German stations, for while the Hungarian relay and Valencia adhere to the wavelength which they are supposed to share with Bremen, the German station continues to wobble.

According to the Brussels records, Aberdeen and Newcastle were not as steady as they might have been.

In Next Week's Issue:—

The A.V.C. Unit

Automatic Volume Control for Practically any "H.F." Receiver.

FADING is now the only serious obstacle to consistent and enjoyable long-distance reception; in order to maintain sensibly constant loud speaker volume, frequent adjustment of the controls is often necessary, as compensation for minute-to-minute changes in the strength of incoming signals.

With automatic volume control the receiver may be left in its most sensitive condition with the assurance that, during periods of "peak" signal, the usual distressing overloading will not occur. To cope with fading signals, the necessary sensitivity will be automatically restored as and when it becomes necessary.

The addition of a conventional A.V.C. system to many types of set necessitates a number of alterations, and involves the risk of reducing maximum sensitivity, restricting wavelength coverage, or even of introducing instability. The A.V.C. Unit, on the other hand, is a self-contained unit, connected externally by four leads, and its addition cannot have any untoward effects. It is applicable to "straight" H.F. sets or to superheterodynes, whether battery or mains-operated.

LIST OF PARTS.

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

1 **Valve-holder,** horizontal type — **W.B. "Universal"**
1 **Potentiometer,** 50,000 ohms — **Rotor-Ohm**
(Bulgin, Lewcos, Claude Lyons, Radiophone, Watmel, Wearite)
1 **Resistance, fixed,** 0.25 megohm — **Erie**
(Dubilier, Graham Farish, Loewe, Claude Lyons)
1 **Fixed condenser,** 0.5 mfd. — **Dubilier**
(Formo, Hellesens, Peak, Radiophone, T.C.C., Telsen)
1 **Dry cell,** 1.5 volt — **Ever Ready Size "O"**
(Lissen, Siemens)
1 **Connector,** 5-way — **Wilburn**
5 **Wander plugs,** H.T.−, H.T.+, G.B.+, G.B.−, G.B.−1. — **Clix Type "B"**
(Belling-Lee, Bulgin, Eelex, Goltone, Lissen)
2 **H.T. batteries** (see text).
Wire, sleeving, flexible wire, screws, wood, etc.

NEWS of the WEEK

Current Events in Brief Review

Sporting Offer

MR. S. G. MORGAN (G6SM), 3, High Street, Croydon, Surrey, would be glad to hear from the person who has been using his call sign for tests on 40 metres so that he can forward a batch of reports.

Radio at Paris Fair

RADIO will feature at two forthcoming Paris exhibitions, namely, the Foire de Paris at the Porte de Versailles in May next, and the International Cinematograph, Gramophone and Radio Salon, opening on June 15th next, also at the Porte de Versailles.

Theatre Broadcast Record

GERMAN programme builders probably rely more on theatre and opera broadcasts than those in any other country. During 1932 there were no fewer than 140 relays from theatres and opera houses. The greatest number of relays have been given from the National Theatre in Munich.

Long Waves in Demand

SEVEN countries which are at present restricted to the medium band applied for long waves at the recent Technical Conference of the International Broadcasting Union at Brussels, and will probably uphold their demands at the Lucerne meeting.

There are only eleven long-wave channels available for broadcasting, and these are all in use.

A Melancholy Exam.

"I CAN only describe the results of this examination as appalling," writes the examiner in his report on the June, 1932, Associateship Examination of the Institute of Wireless Technology.

"The candidates almost to a man are illiterate." "They cannot set out an answer to a question involving a numerical result in any intelligible form," "There is no knowledge shown on fundamental principles," are other phrases which occur in the survey.

None of the competitors, it seems, showed the slightest conception of the law of the sine wave. "These," declares the examiner, "are wireless men!"

Programme Exchanges

GERMANY offered the rest of Europe and America 288 broadcast programmes during 1932, and relayed 250 programmes from foreign countries.

The Early Bird

MORNING broadcasts between 7 and 9 o'clock are now a feature at Poste Parisien. Reveillé is sounded at 7 a.m. with lively gramophone music and good-humoured banter by the announcer, followed by a rapid review of the morning newspapers.

The station welcomes "appreciations and suggestions," which should be sent to 116, bis Avenue des Champs-Elysées.

Death Ray Again

EVIDENTLY we were mistaken in our belief that the "death ray" had been decently buried, for a lethal beam answering to this description is being blamed for interference to listeners' sets in the Beckenham area.

It seems that interference is noticed on the long waveband from about 9 p.m. onwards. Post office experts have endeavoured to trace the origin of the noises without success.

Big Ben Impersonated

AN artificial Big Ben has been cleverly contrived for broadcasting regular chimes from loud speakers on the Marconiphone building in Tottenham Court Road, London, between the hours of approximately 8 a.m. and 8 p.m. Unable to secure permission to relay the actual chimes from Westminster, the engineers constructed an electric clock, frequency controlled from Greenwich, with a chime exactly like that of Big Ben himself.

Across Siberia

SUCCESSFUL tests on wavelengths of between 25 and 45 metres have been carried out between Moscow and Shanghai by the Radio Department of the Commissariat for Communications of the Soviet Government.

A Chief Resigns

THE sudden resignation is reported of Herr Schäffer, Chief Engineer of the German Broadcasting System. It is stated (says a correspondent) that the contract between the chief engineer and the Reichs Rundfunk Gesellschaft was dissolved in view of the recent political developments.

Herr Schäffer, who was a Telefunken engineer and designed the early broadcast transmitters, has been a familiar figure at the conferences of the International Broadcasting Union. He joined the R.R.G. in 1929. No successor has yet been appointed.

MAJOR GLADSTONE MURRAY, the esteemed Chief of Information at Broadcasting House, who sailed last week for Canada to reorganise the Dominion broadcasting system on B.B.C. lines.

Noginsk Calling

ONE more Russian station, which, according to Press reports, will "wipe out" British broadcasting, is to start operations within the next few days with a power of 500 kilowatts. The station is at Noginsk, and its wavelength will be 351 metres, within 5 metres of London Regional.

Paris Show : Tenth Anniversary

THE Paris Radio Salon will celebrate its tenth anniversary this year, when it will be held at the Grand Palais, Avenue des Champs Elysées, from September 6th to 17th. Though "international" by title, it will forbid the entry of the products of those countries which do not accord reciprocal treatment to French radio manufacturers.

Have You Tried It?

IN Penang, where the local wireless society has recently held a radio exhibition, the Daventry programme is received about 1/23rd of a second after being transmitted, according to the radio notes in the Exhibition Guide.

The writer advises listeners not to meddle with their receivers when a programme is coming through and adds: "If your hands are itching to twiddle the dials, take up knitting."

Transatlantic Feat on 150 m.

ONE of the most remarkable of amateur contacts of recent years has just been made by Mr. A. Forsyth, who operates station G6FO in Newport. It took place on the 2 m.c. band, where communication was effected with WIDBM of Cape Cod, U.S.A. This contact is remarkable for the fact that G6FO had only 9.7 watts input, against the 220 watts used by the American.

Mr. Forsyth attributes his success to the fact that, during February, conditions favoured east-to-west working.

Luxembourg Testing

THE new 200-kW. station at Luxembourg is now testing with full power daily between 7 and 11 p.m. The wavelength is in the neighbourhood of 1,180 metres.

On Charge

FINED £5 5s. at Sutton Coldfield last week for fraudulently consuming electricity, a landscape gardener was said to have cut a hole in the plaster of the dividing wall between his attic and the next-door house and to have fixed flex to his neighbour's electrical cable. He then, it was stated, advertised that he could charge wireless accumulators.

By Special Request

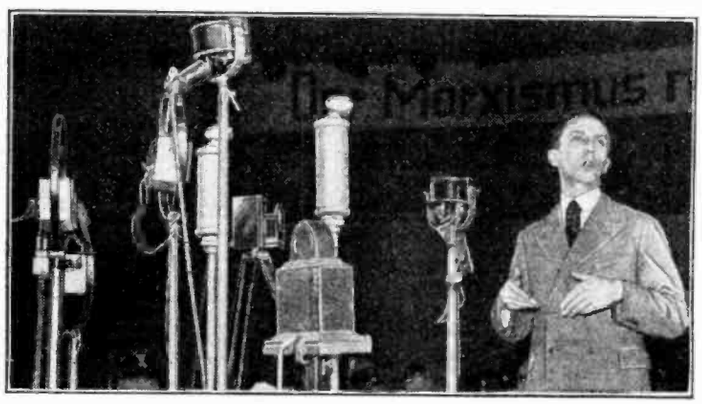
FOLLOWING a reference in *The Wireless World* Club Reports column to a "steam pipe" loud speaker constructed by a member of the Croydon Radio Society, the secretary has been overwhelmed with enquiries from all over the country. To meet the demand for further information, a special meeting is being held on Friday next, March 31st, at 8 p.m., at "The Horse and Groom," Cherry Orchard Road, East Croydon.

President as Radio Dictator

THE American broadcasting stations have unanimously placed all their facilities at the command of President Roosevelt in order that he may be able to use the wires of all networks at any time during the period of national emergency. The broadcasting organisations have thus anticipated the law which enables the President of the United States to commandeer all wavelengths for national purposes.

Meanwhile the order has been relaxed requiring all broadcasting stations to make full use of the time allotted them.

On account of the economic situation certain transmitters have found it difficult to maintain programmes, certain regular clients being unable to pay for sponsored programmes.

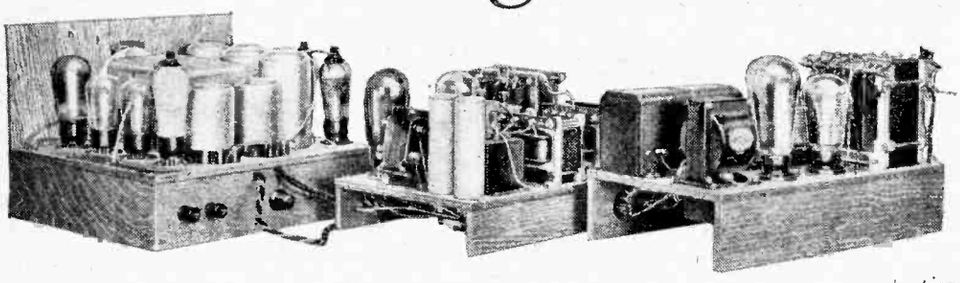


MODERN ORATORY. When Dr. Goebbels, one of the prominent figures in German politics, addressed a meeting in the Berlin Sports Palace a few days ago, nine microphones awaited him on the platform. They had been placed there by the broadcasting authorities, public address engineers and various film companies.

Adding A.V.C. to the M

Part II. Constructiona

By W. T. COCKING



IN the first part of this article, the author explained the circuit modifications necessary for adding A.V.C. to the Monodial. In this instalment constructional details are given together with some notes on the performance to be expected. The importance of A.V.C. in counteracting fading cannot be too highly stressed.

Concluded from page 210 of last week's issue.

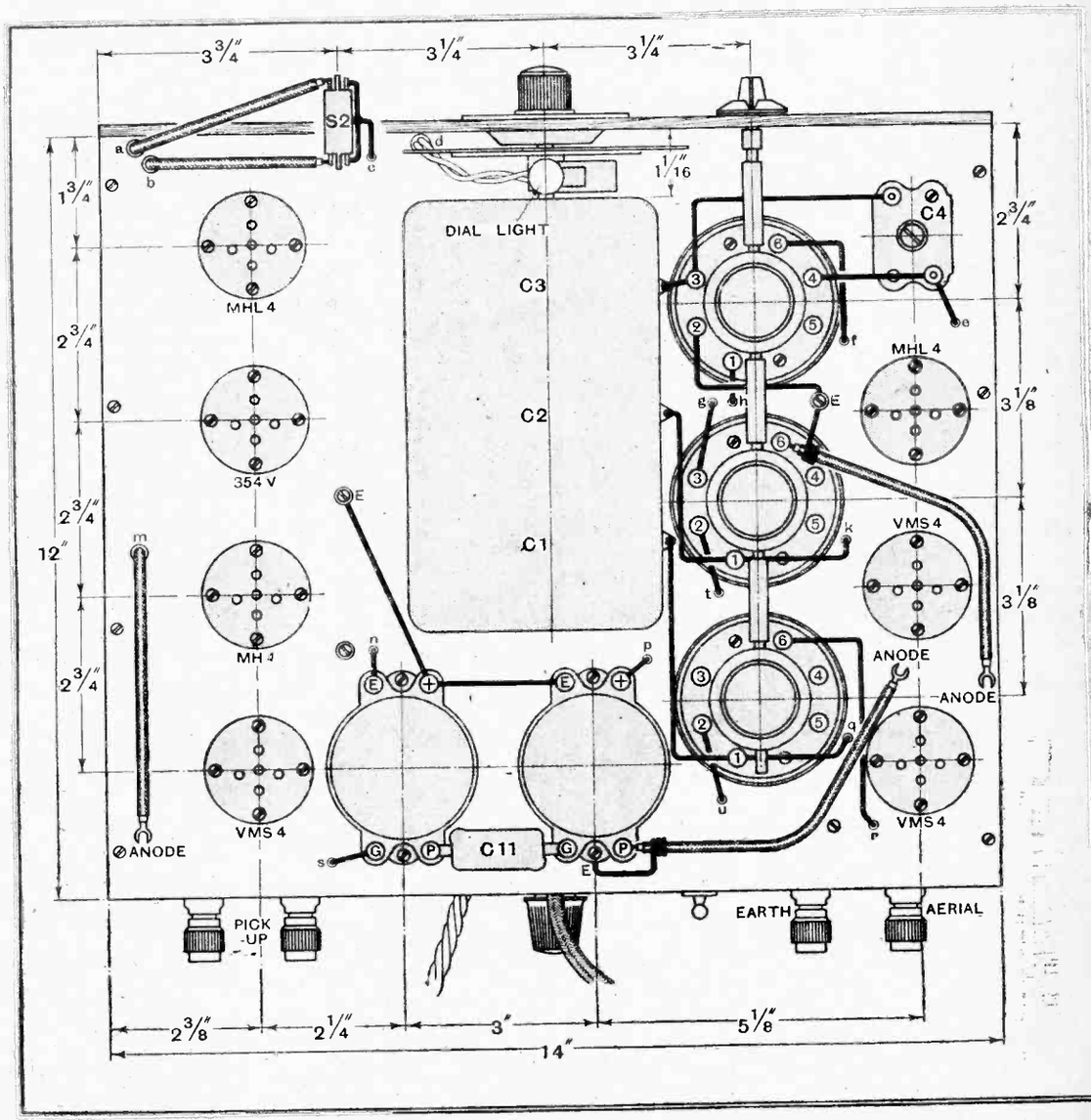
DETAILS of the alterations to the receiver chassis and the 2.5 watts power chassis have already been given, and it remains to treat the 5 watts chassis. This was originally described for the Modern Straight Five,[1] it will be remembered, but many constructors of the Monodial are using it instead of the power unit described specifically for that receiver. In this case, the conversion is considerably simpler, for there is a higher voltage available, and the speaker field can be retained in the positive H.T. lead, where it is fully effective in smoothing. No additional smoothing is thus required, and it is merely necessary to add the additional valveholder for the extra inter-unit cable, the small mains transformer, and to rearrange a few of the connections. The modified circuit diagram of this power chassis is shown in Fig. 3, and the other details will be clear from the drawings.

As in the original designs, it is assumed that the field winding of a moving-coil loud speaker will be energised from the power chassis. Where it is not desired to do this, however, a 2,500 ohms 10 watts resistance must be connected in place of the field in the case of the 2.5 watts chassis, and a 60H. 60ma. 2,500 ohms choke (suitable types are listed by Scott Sessions and Sound Sales), in the case of the 5 watts chassis. With this latter unit, it should be noted, sufficient power is available for energising dual type speakers. These should be each of 2,500 ohms field resistance, and one field should be connected to the usual points, while the other is used to replace R31.

Re-ganging

The operation of the set is the same whichever power chassis be employed, and it must always be remembered that there is a difference of potential of 125 volts between the receiver chassis and the power chassis. These must not be allowed to touch one another, therefore.

After the alterations have been made, it is highly probable that the receiver will require re-ganging; this must be done in the manner described in the original articles, but it will now be essential to include a milliameter as an indicator of signal strength. It is impossible to gang an A.V.C. set without a meter, for the ear can detect no change of volume on operating the trimmers, since this is taken up by the control. The meter used should have a full scale reading of about 10 mA., and be connected in the cathode lead of the I.F. valve at the point "X" of Fig. 1 (see last week's issue) to act as a tuning indicator. In the absence of a signal, it

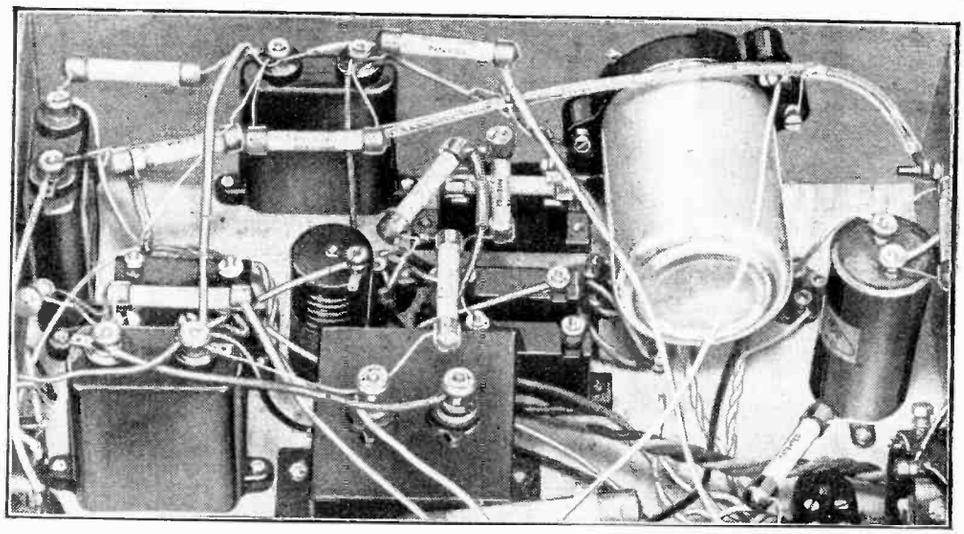


Practical wiring above the baseboard of the receiver chassis.

[1] "The Modern Straight Five," *The Wireless World*, June 22nd and 29th, 1932.

NODIAL

Details and Operating Notes

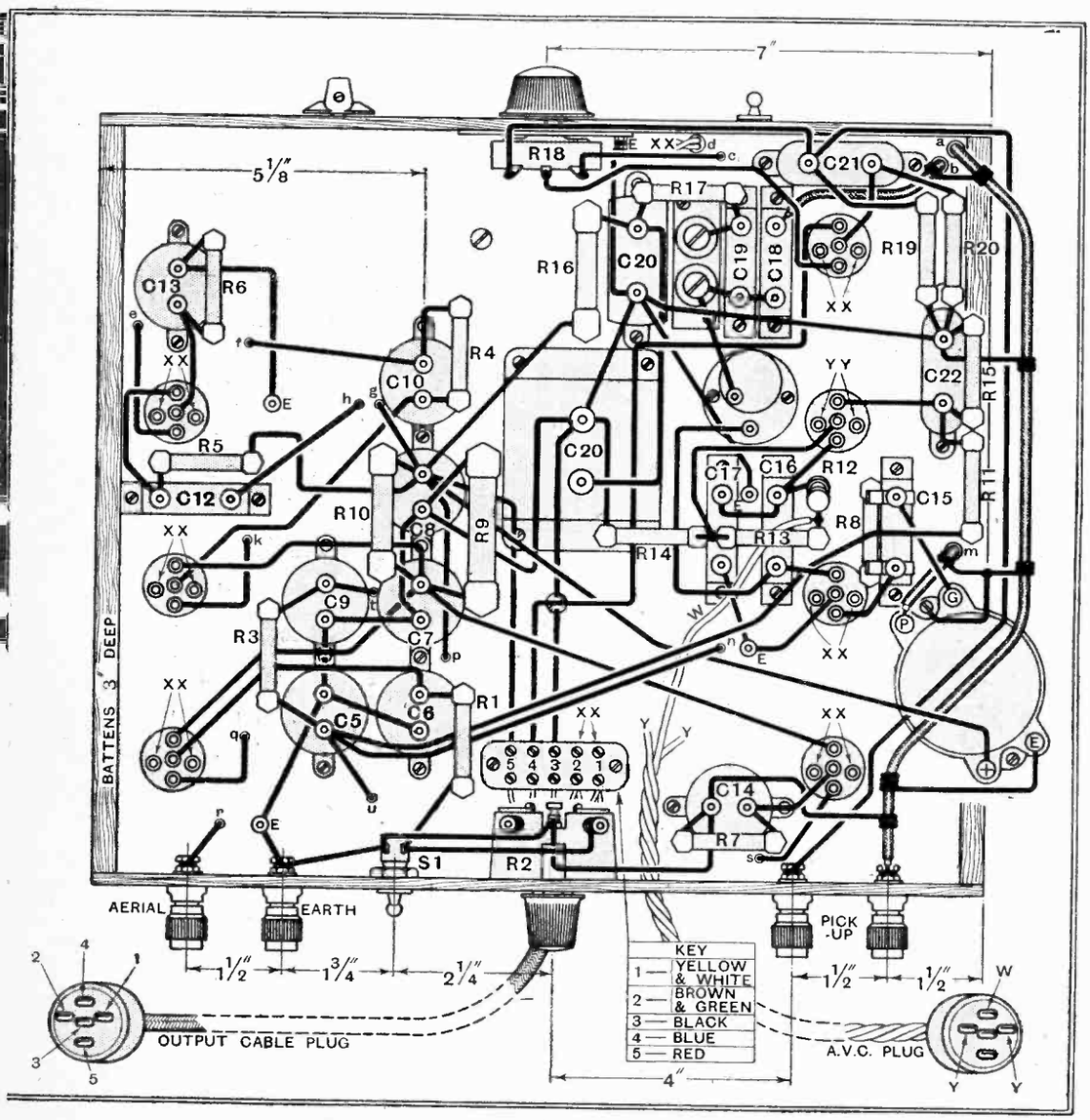


Underneath view of a portion of the receiver chassis showing the chief modifications.

will read nearly full scale—the normal anode current of this stage. When a signal is tuned in, however, it will drop back, and the stronger the signal the greater will be the drop; all trimming adjustments, therefore, must be carried out for a minimum reading on the meter, for this corresponds to maximum signal strength.

In its operation, the control may be relied upon to remove completely the effects of moderate distortionless fading, and, provided that the average modulation depth of the various transmitters is the same, it will hold the volume level approximately constant, regardless of whether the station is distant or a nearby local. The control will, of course, do nothing to remedy any distortion caused by fading, although it will still keep the volume at its normal level. When fading is very severe, it is accompanied by a rise in background noise, and the curious effect is obtained, not of a fading signal, but of a fading background. The control only functions within certain limits, of course, for if the fading be so bad that the field strength drops nearly to zero, the volume will also drop after the set has reached its maximum sensitivity. In general, however, the control may be said to remove 80 per cent. of the evil effects of fading.

It should be noted that fading may be followed on the needle of a meter used as a tuning indicator, for the weaker the signal strength the greater the meter reading. In fact, it will often be found that the needle fluctuates greatly without there being any audible indication of fading, such as would be found in an uncontrolled receiver.



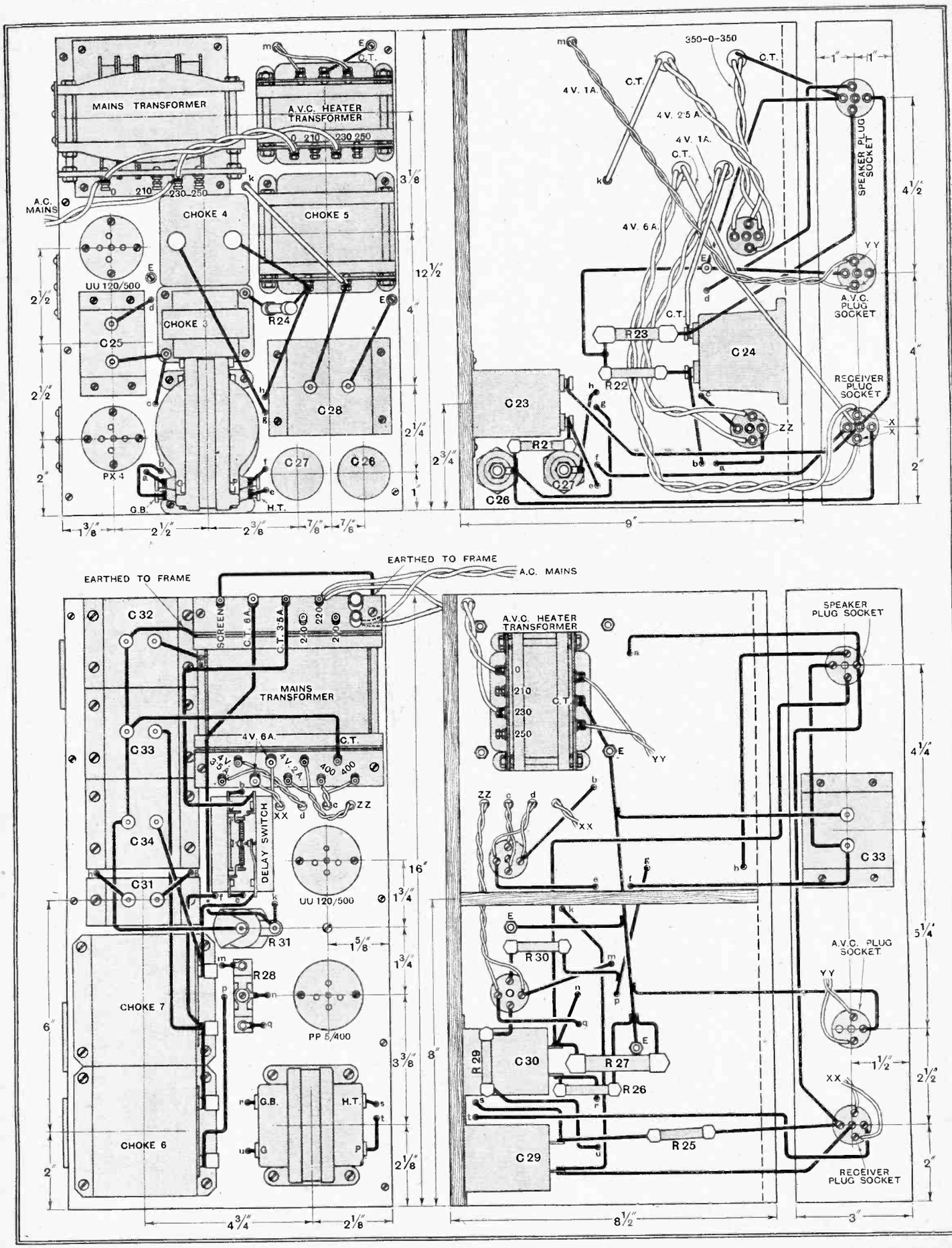
The under-baseboard wiring of the receiver unit.

Avoiding Hum

A few words about valve types may be of interest. It is recommended that the V.M.S.4 be employed for the three variable-mu stages, and the 164v. or M.H.L.4 for the oscillator, although here it is often permissible to employ the 354v., M.H.4., or AC/HL as an alternative. The second detector can be a 354v., M.H.4, or AC/HL without affecting the results, but if the specified resistance values are to hold, it is important that the A.V.C. valve be a 354v. If the M.H.4 or AC/HL valves be used instead, it will probably be necessary to change the value of R13, determining the optimum value experimentally, since the current cut-off points of the valves are slightly different.

For the tone corrector, it is recommended that in most cases the M.H.L.4 be used. The exception is where the gramophone pick-up gives only a moderate output, and then the 354v., M.H.4, or AC/HL should be used without changing any circuit values. The amplification with these latter valves is nearly double, and as a result there is a greater

ALTERNATIVE MONODIAL POWER UNITS

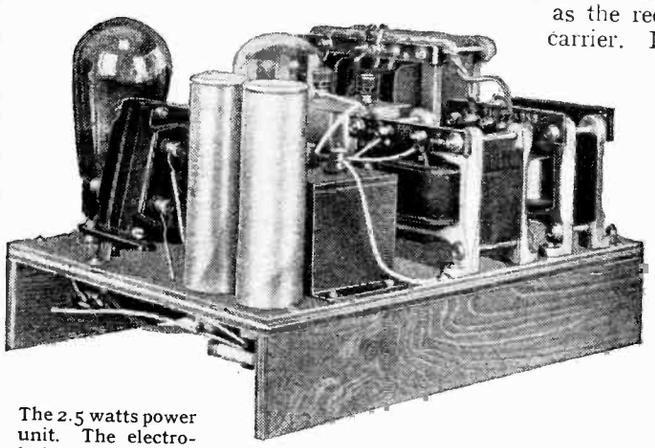


Practical wiring of the 2.5 watts (above) and the 5 watts (below) power chassis modified for A.V.C.

Adding A.V.C. to the Monodial

risk of hum, but no trouble from this was found in the experimental model. Little latitude is permissible in the power unit valves.

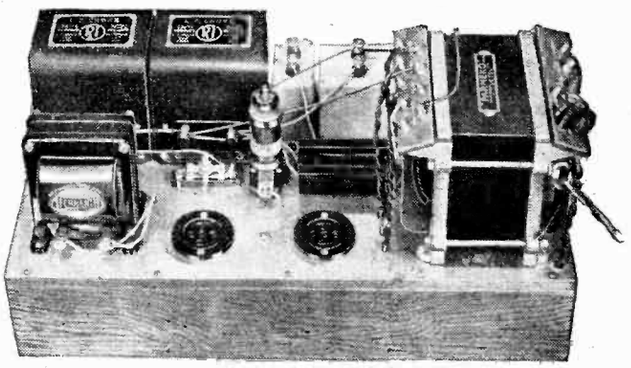
There is just one point in connection with A.V.C. which is worthy of mention. The level at which the second detector input is held depends upon the capacity of C17. If an incorrect value condenser be used at this point, therefore, or if the component be widely different from its rated value, the second detector input will be held at the wrong level. If it be found, therefore, that on all signals the second detector is overloaded, the probability is that C17 has too large a capacity. Conversely, if C17 be too small, the detector output will not be great enough for full volume. Any adjustment should be carried out on the local station, and the value selected should be such that on the strongest station the second detector is just not overloaded.



The 2.5 watts power unit. The electrolytic condensers can be seen in the foreground and the tilted transformer on the left.

One result of fitting A.V.C. to the Monodial is to make the tuning appear flatter. It is not actually so, of course, for all the fundamental characteristics of sensitivity, selectivity and quality are unaltered. The effect is found in all A.V.C. sets, and is due to the rise in sensitivity as the receiver is mis-tuned from a carrier. It is, therefore, more difficult to tune the set accurately to resonance by ear, and it is usually necessary to tune, not for the loudest signals, but for the deepest quality of reproduction. There is no real difficulty in this, and the knack is soon learnt, but there is no doubt that a tuning indicator is a great help, and where the additional cost is not objected to, it is recommended that a meter be permanently wired in the I.F. cathode circuit for this purpose.

A specimen receiver, with its alternative amplifiers, is available for inspection at 116/117, Fleet Street, London, E.C.4.



The 5-watts power unit showing the thermal-delay switch.

Full-size blue prints of this receiver, with the 2.5 watt or the 5 watt amplifier, are available from the publishers at 2/-, post free. When ordering state which amplifier is required.

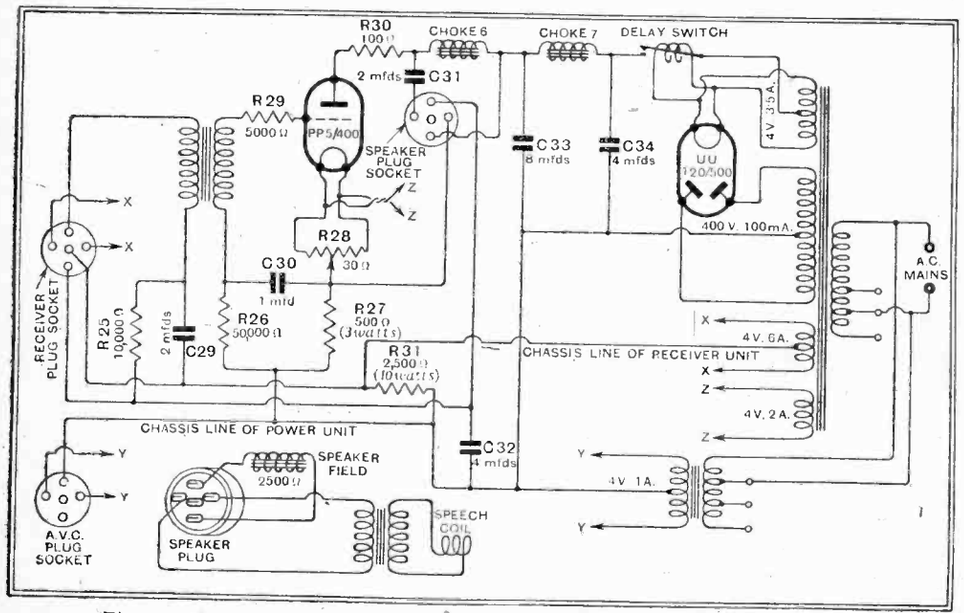


Fig. 3.—The complete circuit diagram of the modified 5-watts power chassis.

A Guide to Applied Voltages and Currents.

Valve.	Anode Volts.	Screen Volts.	Grid Volts.	Anode Current.	Screen Current.
H.F. V.M.S.4.. 1st Det.	210	74	1.6	7.4	0.6
V.M.S.4.. Osc.	210	74	8.5	2.6	0.8
M.H.L.4.. I.F.	96	—	3.6	3.8	—
V.M.S.4.. 2nd Det.	210	74	1.6	7.4	0.6
M.H.4.... A.V.C.	136	—	—	7	—
354v. .... Tone Corr.	140	—	16	0	—
M.H.L.4..	144	—	4.8	5.2	—
2.5 Watts Power Chassis. Output P.X.4 ...	298	—	37	50.5	—
5 Watts Power Chassis. Output P.P.5/400.	440	—	35	61	—

The above figures do not necessarily represent actual voltages, but measured values from the chassis with a 1,000 ohms per volt meter. They were taken with no signal input, so that the currents are maximum values. The mains voltage at the time of testing was 230 volts, and was connected to the 220/230 volts tapping on the transformer.

CLUB NEWS

Captain Eckersley on Free Speech

LIVELY remarks on broadcasting were made by Captain P. P. Eckersley, former Chief Engineer of the B.B.C., at a recent meeting of the Southend-on-Sea and District Radio Society. Captain Eckersley favoured free speech in broadcasting. He suggested that one set of our stations, say the Nationals, should remain as at present, while the Regionals adopted the American principle of free speech.

Hon. Secretary: Mr. Fred Waller, 49, Fermoy Road, Thorpe Bay, Essex.

Short Wave Reception in Public

MR. HALL, of Messrs. Philips Lamps, Ltd., recently surprised a public meeting of the Southall Radio Society with short-wave reception from such transmitters as Moscow, Drummondville (Canada), Rocky Point, and a station in Java. The lecturer explained the autodyne circuit used in Messrs. Philips' short-wave converter.

Hon. Secretary: Mr. H. C. Rayner, 114, North Road, Southall, Middlesex.

Loud Speaker Characteristics

THE Shotts (Lanarkshire) and District Radio Society is enjoying a successful season. Recent demonstrations by the General Electric Co., Ltd., and the British Thomson-Houston Company have aroused great interest. Mr. Cameron, of the G.E.C., demonstrated loud speaker characteristics on March 21st.

Hon. Secretary: Mr. E. M. Thomson, Cwmbach, Shotts.

Glow Discharge Relays

A DEMONSTRATION of glow discharge relays was given before the Woodford and Leytonstone Radio Society on February 16th, Mr. Nixon, of the G.E.C., displaying the new GT1. He first described the GV1 rectifier from which this relay had been developed, proceeding to demonstrate the various applications of the gas-filled relay which, in conjunction with an Osram photo-electric cell, gave a fine control of a small electric motor by varying light values.

Hon. Secretaries: Mr. H. O. Crisp, 2, Ramsey Road, London, E.7, and Mr. W. H. Crown, 1, Thornton Road, London, E.11.

UNBIASED

By

FREE GRID

You have only to listen.

'Phones for Film Fans

I WAS present the other day at the opening performance at an entirely new cinema in a well-known town in the West of England. It was the most up-to-date place of its kind that I have ever seen, and truly elaborate precautions had been taken to make the acoustic properties of the place as perfect as possible.

This was accomplished by the employment of "hollow walls" behind the usual exotic mural decorations. Heavy curtains mounted on rollers after the fashion of the ordinary roller-blind were let down into the "walls" when the place was fairly empty. There were several of these rolled-up curtains, more or fewer of which were used according to the number of people in the house. In this manner it was proposed to keep the acoustic conditions of the building the same, irrespective of the number of the audience.

Unrestrained emotion.

Such arrangements must, I think, be extremely expensive, and, at any rate, many years must pass before all the silent cinema palaces with their poor acoustic properties are demolished in favour of more modern buildings. I do not, however, see the slightest need for us to suffer from poor acoustics during the interim, and cannot for the life of me see why a pair of headphones complete with volume control and fed from the main amplifier cannot be hung at the back of each seat for those who desire to use them.

Apart from anything else, these headphones would be an immense boon to those who have the misfortune to be hard of hearing. Although I am not a great talkie patron, I would gladly welcome them, but in my case to shut out the conversation (?) and unrestrained emotion of the pestiferous females who seem to haunt these palaces of pleasure all day and every day.

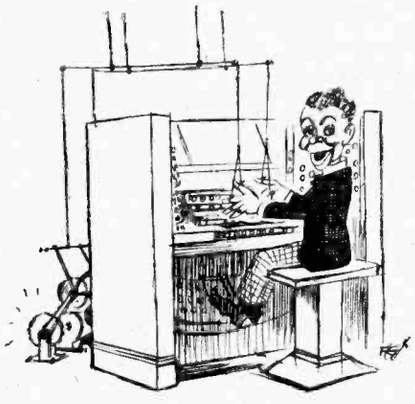
Horrible and Blatant

I WAS interested to see a picture in *The Wireless World* the other week of a so-called electric violin in which the strings vibrate in front of the poles of electric magnets, their energy being thus conveyed electrically *via* an amplifier to a loud speaker. It will be remembered that a correspondent questioned me about the feasibility of this scheme some twelve months ago (March 23rd, 1932), and I pointed out that it would be an excellent idea if it were not for the fact that feline viscera were not made of a magnetic substance.

One way to accomplish the trick would be to use steel strings, though, to my ears, nothing else can sound quite so horrible and blatant as a violin with strings of this sort. To appreciate this fully you have only to listen to the ghastly screechings of the violin wielded by the leader of the average restaurant orchestra. I believe that these individuals die young, worn out by the perpetual effort to make themselves heard above the din of the rest of the orchestra. They certainly succeed.

Curious Organs

THE enormous development of radio and its by-products during the past decade has been responsible for the employment of a very large number of people, but, on the other hand, it must be a matter of regret that its principal by-product, the talkies, has resulted in so many cinema musicians losing their employment. In fact, the only survivor is the ubiquitous organist, and now even he appears to be in grave danger. Indeed, he has already been replaced by a "dummy" in certain cinemas on the Continent, as I discovered recently when I dropped into a picture house with a Teutonic friend on my way home from the East.



Is it coming to this?

We found ourselves in close proximity to the organ console (the console and the immaculately marcelled organist being picked out by coloured flood lights; it was this fact that first drew my attention to the movement of the "organist's" hands).

While I don't profess to be a highbrow musician, it happened that the air that the organ was bleating out was one which even I can knock off, and it did not take me long to see that his hands were playing several wrong notes, and yet, *mirabile dictu*, the organ behind the grille on our right gave no sign of this. More marvellous still, the player at times was not even in synchrony with the music, and his feet appeared to be doing an aimless stroll over the pedals.

My friend, laughing at my surprise, explained the phenomenon was a familiar one. Many cinema proprietors over there, it seems, have found it far cheaper to dismiss the organist and replace the hidden pipes by banks of loud speakers. The music is derived *via* the main talkie amplifier by simply running a "music only" film through the ordinary projector in the operating room. The console is, of course, merely a dummy, and so indeed is the organist, who is usually drawn from the ranks of unskilled labour and provided with a marcel wave and a manicure.

"Valves"

IT is well known that up till fairly recently wireless manufacturers and dealers have been describing the 1-v-1 type of A.C. set with its valve rectifier as a three-valve receiver, and have patiently explained to the enquiring layman the reason why they didn't call it a four-valve set when it obviously had four valves in it. Tiring of such explanations, these much-harassed gentry have latterly let the non-technical public have it their own way, and they now label such an instrument a four-valve set.

According to a letter which I received from a well-known dealer of my acquaintance an entirely new menace has now arisen to disturb their peace of mind in this matter, namely, the vacuum type of thermal-delay switch. This thing has, of course, four legs for fitting into the usual valve holder, and it is exactly the same shape as a valve. The fact that the electrodes don't look like those of a valve, however, simply doesn't wash with the uninitiated, according to my correspondent, as they insist on calling it a valve.

The curious part is that the public have never regarded the ordinary metal rectifier as a valve, although, of course, it actually is one, and, now that they have got something which is definitely not a valve, they insist on calling it one.

BROADCAST

By Our Special Correspondent

The New Organ

IF we hear the first chords on the new organ in Broadcasting House within the next six weeks I shall be surprised. Although most of the pipes have been assembled behind that mysterious-looking grille in the Concert Hall, and the console is in position, the final voicing of the pipes has got to be carried out—a task which will keep the builders busy for quite a long time.

An Official Organist?

Several famous organists are to be asked to give recitals, and among them will certainly be Sir Walter Alcock, organist of Salisbury Cathedral, who prepared the specification.

Whether there will be an official appointment of an "Organist to the B.B.C." is still doubtful; the feeling in Broadcasting House is that the holder of such a post should be Mr. Berkeley Mason, who so frequently plays the Queen's Hall organ at the "Proms" and other B.B.C. concerts.

Famous Foreigners

The B.B.C. will take special pride in the new organ, as it will enable them to invite celebrated foreign executants, such as Marcel Dupré and Gunther Ramin, to broadcast recitals on a fine instrument without the necessity of seeking one outside the Corporation premises.

Why Not?

Given the organ, there will be very few items which the B.B.C. cannot stage within the portals of Broadcasting House, from a cathedral service in the Concert Hall to an after-dinner speech in the canteen.

Football matches could be held on the roof, while the debates studio is always available for prize fights. All that the B.B.C. lacks is a cinema organ.

What about it, Dr. Boult?

Saying It With Silver

IF you guessed that the note of unusual felicity in Henry Hall's voice during the anniversary broadcast last week was traceable to the fact that the "boys" had unexpectedly presented their leader with a silver dessert service, complete with bowl, nut-cracking implements, and bonbons, you were right.

Two hours before the broadcast Mr. Hall was switched over in person to the Langham Hotel, where the presentation took place amid appropriately festive surroundings.

Have You Heard West Regional?

THE new West Regional transmitter can already be heard testing o' nights, and early next month public reception tests will begin. The wavelength is, of course, 309.9 metres, the old Cardiff wavelength, which will be permanently allocated to West Regional.

Both transmitters, Regional and National, will be faded in in the same manner as their predecessors.

That Belfast Site

Never before has the B.B.C. been so lucky as to have a choice of four entirely suitable sites for a new Regional station. This is the case at Belfast, for, besides the Craigantlet site, to which I was able to give first exclusive mention a fortnight ago, three other localities have been tested and not found wanting. I fancy, however, that Craigantlet will be the final choice.

THE FINISHING TOUCH. A *Wireless World* photograph of the striking and much-discussed group of statuary over the main entrance to Broadcasting House. The work, which has been executed by Mr. Eric Gill, represents Ariel and Prospero in "The Tempest." It was first exposed to public gaze on March 14th.

Innovation

THERE are artistes to be found in nearly all categories who made their public *début* before the broadcast microphone, but I fancy that Madame Adeline Genée must be the first to give the world good-bye through the same medium, as she did in the television programme on March 15th. Certainly no one has ever before said farewell by television.

News About News

I AM glad they propose finding a news editor for the Athlone station. The news bulletins have seemed the least attractive feature of the new Irish transmissions.

New Dance Record

CONGRATULATIONS to Ambrose. On Saturday last his versatile dance band completed five years of uninterrupted broadcasting on Saturday nights from the May Fair Hotel. I believe this is the longest period any band has broadcast.

BREVITIES

Chiefs of Information

MR. VAL. H. GOLDSMITH, who is deputising for Major Gladstone Murray as B.B.C. Information Chief during the latter's absence in Canada, is an Assistant Controller of the Corporation and virtually Secretary. Like Major Murray, he has never sought the limelight and is not known, even as a name, to the world of listeners.

Will Major Murray Return?

Officials at Broadcasting House deny that Major Murray will make the Canadian appointment a permanent one. Ostensibly his mission is simply to advise on the reorganisation of Canadian broadcasting on B.B.C. lines, but it will surprise many of his friends over here if the Canadians drop the pilot in a hurry.

The Churchill Speech

WILL Mr. Winston Churchill broadcast from the Connaught Rooms on April 24th? The occasion is the dinner of the Royal Society of St. George.

There seems to be some doubt even now as to whether the statesman, who has more than once crossed swords with the B.B.C., will be permitted an extempore broadcast from a place beyond the reach of the Corporation's schoolmasterly hand.

On Good Friday

THE B.B.C. will on April 14th follow the accepted custom by again relaying extracts from *Parsifal*, to be given by the B.B.C. Symphony Orchestra in the Queen's Hall. The soloists will be Oda Slobodskaya, Walter Widdop, Harold Williams, and Horace Stevens. As usual, Sir Henry Wood will conduct.

Time is Money

THE people who are pleading for a B.B.C. time signal at 7.30 or 8 a.m. may or may not have considered that the innovation would cost a lot of money. It would mean starting up the transmitters at least two hours earlier than at present.

Listeners, of course, may opine that no expenditure is wasted on a loyal public of more than five million licence holders.

Pity the Poor Engineers

It is not, I believe, the expense which worries the B.B.C., but the fact that any extension of the engineers' hours would involve an extra shift. At present the engineers' day lasts approximately fifteen hours, from 9 a.m. to 12 midnight, and this period can be comfortably split up into two shifts.

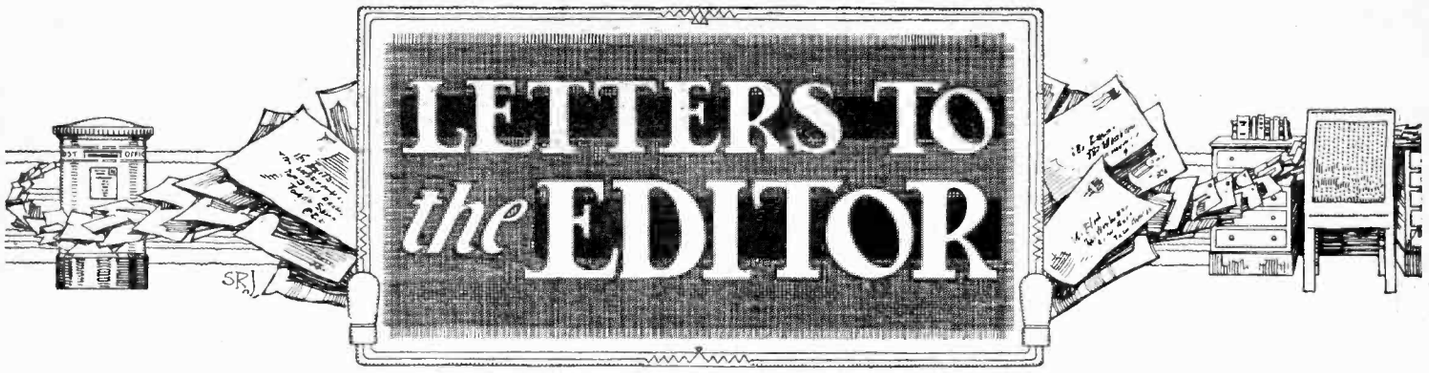
An earlier start, however, would apparently introduce complications immediately; all work and no play would make dull dogs even of the engineers, who are gay fellows as a class, despite present discontents over the salary question.

A Crumb of Comfort

The other day one of the senior engineers showed a titled lady over the Control Room. When the tour was finished the visitor pleasantly asked how long her guide had been on the engineers' staff.

"Seven years," he answered, not without pride.

"Fancy that!" was the rejoinder. "Never mind; you'll be promoted soon."



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.

Empire Listeners and the Blattnerphone

I HAVE read with interest an item under the title "Empire Revolt" in Broadcast Brevities of your number dated December 30, 1932. It may perhaps be rather late at this time to pass any comments, but I must say I cannot agree with the view expressed.

It has been my experience, and others have told me they have made the same observations, that speech via Blattnerphone process is not as clear as speech given direct. The difference is noticeable, and I may say that if atmospheric conditions are none too good the difference may make the programme practically unintelligible.

Reception at four or five thousand miles may be quite good at times, but when it is not good then the Blattnerphone does not improve matters. J. A. MOORE.

Penang, Straits Settlements.

[Our Broadcasting correspondent, commenting on the use of the Blattnerphone for Empire broadcasting, wrote: "Reception is not so pure and clear-cut at two or three thousand miles that a listener can detect whether the programme is first hand or not." We fail to see what alternative method the B.B.C. can adopt for transmission outside normal broadcasting hours in this country. —ED.]

"Broadcast Headlines"

I SHOULD like to disagree with your proposal in a recent leader.

In the broadcast news bulletin, there are many items which, while being of great interest to some people, are considered to be of little importance by others. I imagine that announcers vary in their opinions as much as the rest of us, and I think that many listeners would be annoyed if it were the practice of announcers to give special emphasis to those items which happened to strike them personally as the most important. L. F. ISAAC.

Harpenden, Herts.

What Does the Public Want?

MAY I relate, in brief, my experience as a radio dealer and service engineer regarding "What Does the Public Want"? A few months ago I stocked up with ultra-short-wave components and adaptors in response to the publicity given by large manufacturers and by the technical Press. I did all in my power to interest people in this comparatively new side of radio reception. Maybe I was too truthful about it, but now I find that my energy was more or less wasted. In those few cases where I did succeed in selling a short-wave set or adaptor I find that the interest very soon fell off. Other radio dealers tell me the same story. In this field, it appears, there seems to be a great amount of truth in your correspondent's letter, signed "Diagnostic."

Carluke, Scotland. JAMES FRAME.

The Ferrocart III

SOME time in November last I communicated with you about a three-valve A.C. wireless set, and you were kind enough to advise me to be patient for a little while as you were bringing out something extra good, and I now write to thank you for your advice as, having waited for the "Ferrocart III," I feel more than repaid for my patience.

I have now, I think, completed all adjustments and feel I should like to let you know how superlatively good I find the result; sensitivity is, if anything, better than I anticipated from your own comments, and selectivity is, as you say, surpassed only by a good Super-Heterodyne, and the quality leaves nothing to be desired at all. It will give me great pleasure to demonstrate to a number of doubting acquaintances that it *is* possible to listen to foreign stations with a reasonably quiet background, and at a suitable volume.

One last word about the performance. My flat is in Earl's Court, and I have always considered that I am, if anything, slightly more masked than is usual even in London. I put this down, possibly quite incorrectly, to being immediately between Earl's Court Station and Olympia. My "Ferrocart III" set, however, does not appear to take any notice of what I previously regarded as an obstruction, and I was somewhat astonished last night to hear Juan-les-Pins, reputedly operating on .8 kW., announced so loud that it was necessary to turn it down quite considerably on the volume control. This was followed a short time later by San Sebastian.

There is no doubt in my opinion that you have once again set a standard.

G. LESLIE CROSLAND.

London, S.W.5.

PORTABLE RADIOGRAM. The novel feature in the Schaub radiogram exhibited at the Leipzic Fair is the incorporation of a nearly vertical turntable. The photograph shows the instrument in the playing position.

Automatic Volume Control

I NOTICE that Mr. Scroggie is again (in your issue of March 10th) criticising the use of the term "Automatic Volume Control," on the ground that what is actually varied is the "gain"—i.e., the amplification. But surely this is just what the ordinary volume control does, whether it effects this by varying the grid bias or the screen volts, and yet Mr. Scroggie seems to take no exception to the use of the term "*volume* control" in this case. Further, he states that "volume control is used to vary the volume," as opposed to an A.V.C. whose function is "to keep the volume constant." Here I take issue with him. The ordinary listener uses his volume control to do exactly what an A.V.C. does, i.e., to maintain the volume from his loud speaker at what, in his room and to his ear, is the correct volume, whether he is listening to a distant station or the local, and whether the station is on the crest or in the trough of a fade. Admittedly it is also used to increase the volume for dancing or to decrease it when the baby is going off to sleep, but that is not its normal function. If in the dim future we devise an A.V.C. which automatically reduces volume when the baby is being put to sleep, will Mr. Scroggie then acquiesce in the use of the word "volume," or will he insist on some such name as Automatic Gain and Volume control? Surely we control volume equally by keeping it where it is as by increasing or decreasing it, and so long as we have such a straightforward, obvious and self-explanatory term as "Automatic Volume Control" for goodness sake let us stick to it.

Edinburgh. J. S. BISSET.

Practical HINTS AND TIPS

AIDS TO BETTER RECEPTION

NO wireless constructor should regard his outfit as complete unless it includes one or two medium-sized soft camel-hair brushes such as can be bought for a few pence. The hairs must be mounted in quill, celluloid, or other non-conducting material, and the handle made of wood and tapered at the end.

A Handy Accessory

Innumerable uses can be found for these handy little brushes. Dust and grits, for instance, which collect with alarming rapidity on all exposed surfaces and may eventually cause loss of signal strength and selectivity, will cling readily to the soft hairs, and can then be transferred to a soft duster without the slightest danger of short-circuits or displacing the internal wiring.

By holding the brush at the "wrong end," the handle is invaluable for retrieving nuts and terminal heads which have an uncanny habit of dropping out of reach into the "works" while adjustments to internal wiring are being made. All that is necessary to save time and temper is to use the brush to manœuvre the loose nut into a convenient upright position, jab the tapered end of the brush firmly into its middle, and pull it out. When the time comes to replace it on the terminal shank, there it is, conveniently stuck on the end of the brush handle, ready to be screwed back into position in a few seconds, the handle being eventually released as the nut is screwed down on to the terminal shank and the connection finally tightened with a pair of pliers.

THE Power Radio-Gram. (*Wireless World*, January 27th and Feb. 3rd, 1932) is admirably suited for high-quality reception of the local stations; in fact, it was designed expressly and solely for this purpose. No H.F. amplification was included in the original receiver.

An H.F. Stage for the Power Radio-Gram.

Probably a number of readers are now desirous of using the receiver at greater ranges than was originally anticipated, or, through some local restriction, they are unable to erect an aerial of efficient type. In cases such as these the benefits of a stage of variable-mu H.F. amplification are considerable, and, further, it will enable a number of the more powerful Continental stations to be received.

Usually the addition of an H.F. stage to an existing receiver is a matter fraught with considerable difficulty, but the problem is greatly simplified by the adoption of a Radiopak unit. The arrangement suggested for such an addition is shown in Fig. 2, and, beyond the Radiopak, only a few components are necessary. The by-pass condensers should be of the non-inductive type, and, except where otherwise indicated, the fixed resistances can be of 1 watt rating.

Some care should be exercised in the disposition of components, and it is recommended that the parts shown in Fig. 1 should all be built together as a unit, and the output joined to the input of the L.F. amplifier. This is likely to prove more satisfactory than an arrangement which keeps to the existing layout for the detector stage components. The reference numbers on the circuit diagram, it should be noted, refer to the original components of the Power Radio-Gram.

No difficulty should be met with in the power supply, since the existing equipment is quite capable of meeting the small extra demands upon it without any serious drop in voltage. Since the H.F. valve anode current varies greatly with the volume control setting, however, it is necessary to use ganged potentiometers in order to prevent an excessive rise in anode voltage at low volume settings. The sliders of the potentiometers should be arranged so that they move together in the manner indicated on the circuit; that is to say, so that they are both at the earth ends together.

The minimum bias resistance of the H.F. valve can be varied between 50 ohms and 250 ohms. Where only moderate amplification is needed the latter value can be used, and there should then be little risk of instability. Greater amplification will be with a 50-ohm limiting resistance, however, but more care must then be taken with the layout of components if instability troubles are to be avoided.

MANY sets, unknown to their owners, are operating with a detector valve in an almost chronically overloaded condition. In other words, the detector is being worked in such a way that the maximum undistorted output obtainable from it is insufficient to load the output valve. Distortion introduced in this way is insidious, for the reason that it is of a type to which the ear soon becomes atrophied. The trouble is one to which receivers without an intermediate L.F. stage are particularly susceptible, and it is rather more likely to occur with a triode output valve than with a pentode.

Detector Overloading

The presence of detector overloading may be suspected when the set fails to respond readily to its sensitivity control—reaction, S.G. valve bias, etc.—after a certain point is reached. Signals that are initially very weak become stronger, but others, just below the intensity required for full output, do not respond to the control in the proper manner.

Apparent sharpness of tuning is also a good guide. If weak signals tune sharply, but strong ones, corresponding to approximately full volume, can be heard at the same strength over a much wider angular displacement of the tuning dial, it is reasonable to suspect that the detector is at fault.

Failing emission in a valve may be responsible for this trouble; if it is not an increase in detector H.T. voltage should be tried as a cure. If the maximum available H.T. voltage is already applied it may be possible to improve matters by reducing the value of the decoupling resistance; one often tends to be over-generous in these matters.

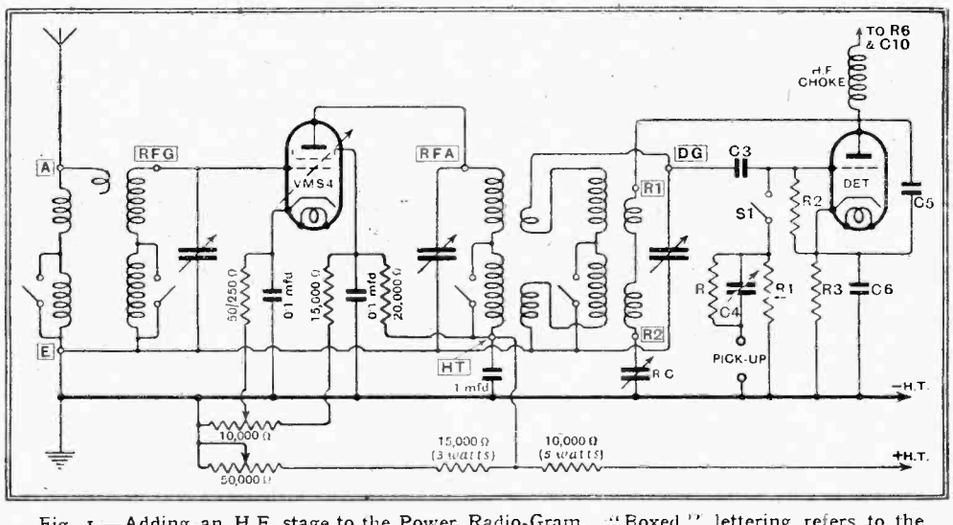


Fig. 1.—Adding an H.F. stage to the Power Radio-Gram. "Boxed" lettering refers to the terminals of the "Radiopak" unit.

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.

Anode Current Variations

A READER who is not quite satisfied with the behaviour of his receiver has noticed that the reading of a milliammeter, inserted in series with the anode of the detector valve, changes considerably as the pick-up volume control knob is rotated. A circuit diagram of the receiver is submitted, and we are asked to say whether these changes of anode current are indicative of a fault.

It seems just possible that the detector valve, when converted into an amplifier for gramophone reproduction, is being operated with insufficient negative bias. If grid current is flowing, a change in the grid circuit resistance, as brought about by rotation of the volume control, will produce a change in grid voltage, and so a corresponding variation in anode current will take place. A more likely explanation is that the detector valve is faulty; very probably it is "soft." A valve that is defective in this way will pass reversed grid current, and its effective grid potential will be altered by any variation of resistance in the grid circuit.

Due to the fact that the pick-up (see Fig. 1) is in shunt with the volume control

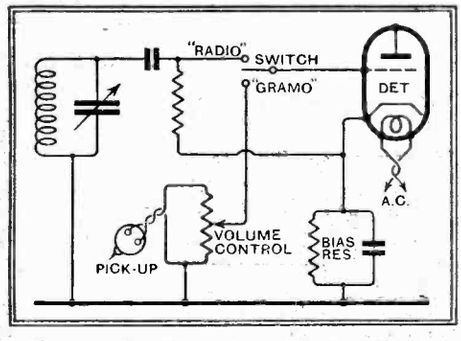


Fig. 1.—Operation of a pick-up potentiometer alters the amount of resistance in the grid circuit, and so, under incorrect conditions or with a faulty valve, may give rise to changes in anode current.

potentiometer, the variations in grid circuit resistance will be limited, but they may be quite sufficient to give rise to the effect under consideration.

The Trimming Condenser

IN all gang-controlled receivers it is natural that some of the circuits should tune more sharply than others, due to the fact that the amount of damping applied to each of them is apt to differ considerably. For instance, the grid circuit of an H.F. valve is usually lightly damped, and one would expect that the adjustment of the trimmer that controls this circuit would be comparatively sharp and well defined. But there is another aspect of the matter. The capacity change in a trimming condenser is by no means proportional to rotation of the adjusting screw. At low capacity settings, the change in capacity per turn is relatively small.

This, we think, accounts for the effect noticed by a correspondent, who is somewhat perturbed to find that H.F. grid circuit tuning is apparently not so sharp as he had expected. In asking our advice, he adds that the condenser in question is nearly "all out," and this, we think, helps to explain the matter.

A.V.C. with a Diode

A QUERIST, whose receiver includes a diode detector preceded by two H.F. stages, has realised that long-distance listening would be vastly more pleasant if some means of overcoming the effects of fading could be included. He asks us to suggest a simple way of fitting automatic volume control which will not necessitate any radical alterations in the receiver.

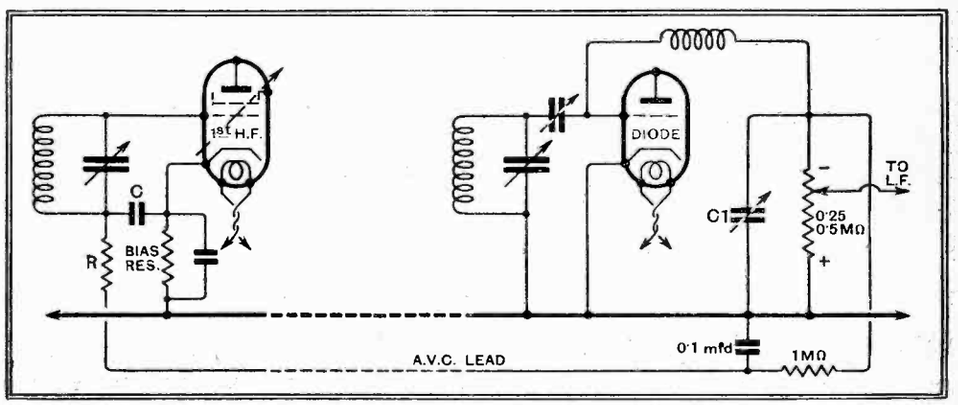


Fig. 2.—Automatic volume control is easy to apply to a "2-H.F." set with diode detection.

The fact that diode detection is included should simplify our correspondent's task, and it would appear that this receiver is particularly well suited for the addition of A.V.C. We suggest that he should adopt the circuit arrangement given in Fig. 2, and that the first H.F. valve only should be controlled.

Referring to our diagram, R and C represent the decoupling resistance and condenser, which we presume will already be included in the H.F. valve grid circuit. The condenser C1 is the by-pass capacity normally associated with the diode load resistance; it might be permissible to omit this condenser entirely if it is found necessary to shield the A.V.C. leads in order to maintain stability. The capacity of screened leads would replace that of the condenser.

An experimental alteration in the value of the existing decoupling resistance R should be tried if the automatic control is found to act too slowly or too quickly. Apart from this, an abnormally high resistance may be necessary to prevent instability.

High-magnification Valves

ALTHOUGH he is quite satisfied with the performance of his H.F.-det.-L.F. A.C. receiver, a querist asks if its sensitivity could be improved to any appreciable extent by replacing the present detector valve by another having a much higher magnification factor; the A.C. resistance of the new valve is somewhat higher than that of the existing detector, and its mutual conductance about the same.

Our reader's set is controlled by a ganged condenser, and we think it likely that, as a result of making the proposed substitution he may find that the stray capacity across the detector grid circuit will become excessive; this is because the input capacity of the valve he thinks of using is high. Otherwise there is no great objection to the change, but we are inclined to think that the result of making it will be disappointing.

Resistance-coupled Amplifiers

WHEN anything goes wrong in a resistance-coupled amplifier, one is always inclined to suspect either the coupling condensers or the grid leaks. A correspondent tells us that his receiver, which includes this form of L.F. amplification, has worked well for some time, but of late quality has deteriorated; reproduction has become unpleasantly shrill, low notes are entirely lacking, and the general volume level is greatly reduced.

This effect would be readily accounted for by the development of an internal disconnection in one of the coupling condensers—a fault that, though rare, is by no means unknown. If this fault exists, impulses would be transferred to the succeeding circuit only by virtue of stray capacity, and this capacity would have such a low value that the lower audible frequencies would not be passed on to any appreciable extent.

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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EDITORIAL COMMENT

A Unit for A.V.C.

A Simple Addition to Your Set

WE have from time to time during recent months stressed the importance of automatic volume control, and have expressed the view that next season any receiver for which the claim is made that it is suitable for the reception of foreign stations, will find a poor market if automatic volume control is not incorporated; but we need not wait for next season to try out automatic volume control, even if we are not ready to make a new set at the moment, for in this issue we give the first design for a practical A.V.C. unit, which can be added externally to practically any type of receiver suitable for distant reception.

When new valves suitable for incorporating in new receiver designs where A.V.C. becomes an integral part of the set are available, we hope to be able to show their application in complete constructional receivers, but until this unit was produced there was nothing available with which to demonstrate automatic volume control without making some drastic alterations to an existing set.

The information given in the article makes it abundantly clear how effective this little unit is in performing the job of overcoming fading of distant stations, and, in addition, preventing the burst of strength from local stations as we tune through them.

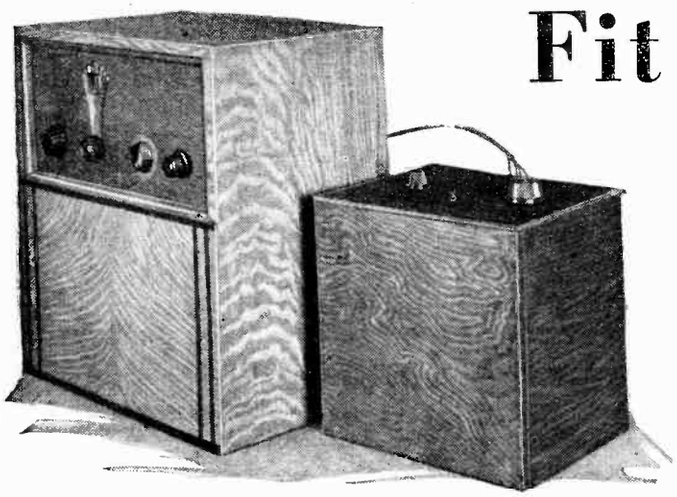
Whilst the popularity of foreign listening has steadily increased with improvements in the selectivity and sensitivity of sets, coupled with the progress made in the foreign transmitting stations themselves, A.V.C. goes one better and lifts foreign reception on to practically the same plane as local-station listening, and all that is required is that the distant stations should not be so extremely weak as to result in distortion during the worst periods of fading. We particularly commend to our readers the A.V.C. unit described in this issue; it costs very little to construct and probably, in many cases, most of the essential components will already be available in the "spare parts" box.

Wireless and the Car

Will Built-in Sets be Popular?

A VERY interesting article appeared in *The Autocar* of March 17th, discussing the advent of wireless in cars, particularly in cases where the set is a built-in accessory. *The Autocar* emphasises the fact that although in America and Canada built-in wireless sets fitted to cars have achieved great popularity, no British manufacturer has, as yet, produced any evidence of interest in meeting the possible demand for such sets here. It is pertinent to enquire whether British manufacturers ought not to have got down to this question themselves, rather than permit whatever market there may be for this apparatus to be met from abroad.

Our own view on the design of a receiver for car use would be that the car should be fitted with the necessary apparatus to provide the electric supply at standard voltages for a transportable set, which could then be used either in the car or in the home. To fit up a set so that it is not capable of being detached from the car for use elsewhere makes car wireless a luxury which is out of the reach of the majority of motorists. Incidentally, permanent fixing makes it necessary to have a broadcast licence specially for the set, whereas a separate licence is not necessary for a portable set used with a car.



Fit A.V.C. to your Receiver

A Simple Additional Unit

AN effective "monitoring" device which, without any attention, will automatically maintain the receiver in whatever state of sensitivity is necessary for dealing with signals of widely varying strength.

By H. F. SMITH

ALTHOUGH automatic volume control is thought to be mainly applicable to super-sensitive sets, and especially to superheterodynes, much less ambitious receivers stand to derive benefit from its use. Sets which depend largely on reaction for their sensitivity are notoriously susceptible to the ill effects of fading; with the help of A.V.C. they may be operated with reaction fully advanced, and with the assurance that distressing overloading will not take place when signal strength rises to maximum. Distant transmissions may then be enjoyed without constant readjustment.

The present unit is intended to work with almost any set of the "straight" or superhet type having one or more stages of H.F. or I.F. amplification. It is also necessary that a resistance of 10,000 ohms or more should be included in the detector anode circuit. This means that the unit is suitable if the existing detector is coupled to the L.F. amplifier by a resistance, a resistance-fed transformer, or where there is an anode decoupling resistance of fairly high value.

The problem of designing a unit for use with a variety of existing sets is vastly different from that of evolving a control to be included as an integral part of one particular receiver. Methods which need a connection to the grid of one of the receiver valves are to be avoided for various reasons, and so the system in which D.C. voltage changes on the anode of the detector are made to operate the control valve has been chosen.

This system is by no means new; in fact, it was one of the first to be devised[1]; rearranged to suit modern conditions, it has proved to be entirely satisfactory.

Referring to Fig. 1, it will be appreciated that when a carrier wave is rectified detector anode current falls, and so the point marked X becomes more positive with respect to the earth line, due to the reduced voltage drop in R1.

Now consider the action of the A.V.C. valve. The bias battery GB, of which the voltage may be adjusted roughly by tappings and critically by the potentiometer R3, is interposed in order to balance out the positive voltage which would otherwise be applied from the source of H.T. to the A.V.C. grid. In addition, a little extra negative voltage is needed in order to stop entirely the flow of anode current in the valve under "no-signal" conditions. When a carrier is tuned in, the A.V.C. grid becomes less negative, and so anode current flows through the resistance R4, across which a controlling bias voltage, dependent on signal strength, is developed. Thus, until equilibrium is reached, we have a state of "push-pull." Detector anode current is tending to fall, but the signal voltage which gives rise to this fall is prevented from rising by the desensitising effect of the A.V.C. The resistance R2 is a safety device, and prevents instability.

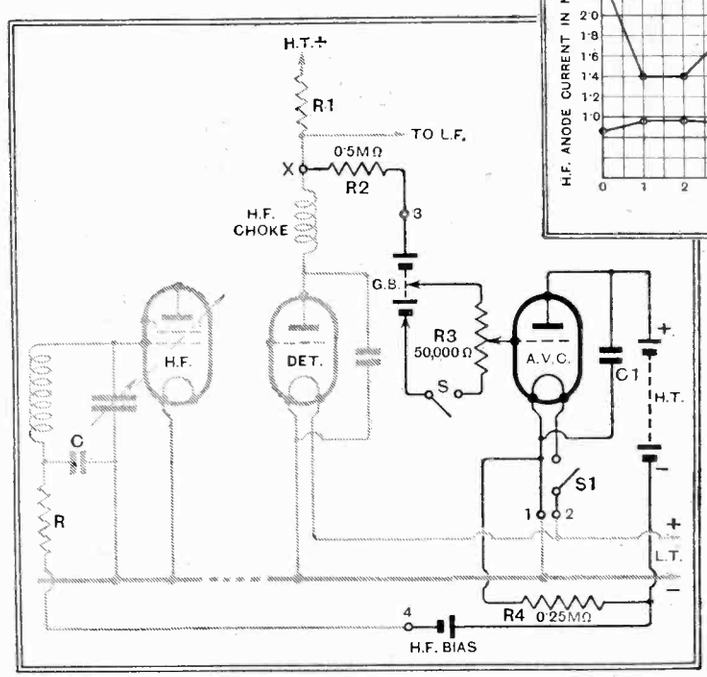


Fig. 1.—Circuit diagram of the unit (in full lines). Connections to a typical receiver are shown. Numbered points refer to the terminal block through which connections between receiver and unit are made. Switches S and S1 are linked.

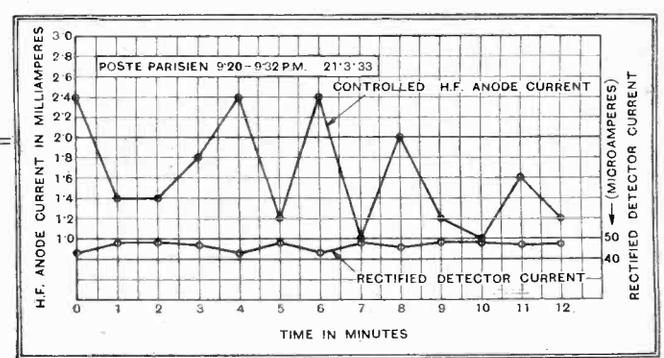


Fig. 2.—How the A.V.C. unit compensates for minute-to-minute fluctuations in signal strength. This graph, taken under practical conditions with a simple I-v-I receiver, shows that detector output was maintained at a sensibly constant level except when signals faded below threshold strength.

The unit, complete with its batteries, may be mounted in a simple wooden box (that illustrated measures 9in. wide, 7½in. deep and 9in. high). Having assembled the parts, it must be decided which valves are to be controlled. In a 1-H.F. set there is no choice, but with two H.F. stages one may control either the first valve or both. In a superheterodyne the H.F. valve, the I.F. amplifier, and sometimes the first detector, may be controlled.

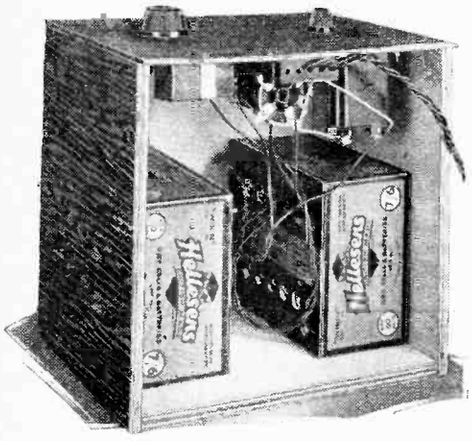
Hardly any alteration need be made to the receiver. The resistance R2, though a part of the control, is mounted in the set, and joined to terminal No. 3 of the unit by a flexible lead.

The grid return leads of the controlled valve, or valves, are merely joined to terminal No. 4 instead of to their normal source of bias voltage (see Fig. 1). Unless the decoupling components C and R are

[1] See "The History of A.V.C." in this issue.—ED.

Fit A.V.C. to Your Receiver—

already fitted in the set, it will generally be necessary to add them; values of 0.1 mfd.



Rear view of the unit, with batteries in position.

and 0.5 to 1 megohm will be about right. In a battery set all that one usually has to do is to remove the H.F. bias leads from the G.B. battery and connect them to the unit.

It is desirable that the controlled valves should be of the variable-mu type, although the unit will work, but not at its best, with ordinary S.G. valves. With a battery set, the A.V.C. valve will be fed with L.T. current by connecting its terminals Nos. 1 and 2 across the L.T. battery or the L.T. bus-bars of the receiver. The extra valve, which may be of the "H.L." or general-purpose type, must of course operate at the same filament voltage as the receiver valves, or a resistance will be necessary.

To make initial adjustments, a weak signal should be tuned in with the A.V.C. switch at "off." Then, having switched on, the grid bias positive plug is inserted in the most positive socket, and the bias plug marked -GB1 in Fig. 3 is joined to a negative socket, the remaining GB plug being left temporarily free. Bias should now be roughly adjusted by moving the -GB1 plug progressively from socket to socket until a point is reached where signal strength is restored to approximately its original value.

Having found this rough adjustment, the potentiometer should be put into operation by joining -GB1 to a point 6 or 10 volts more negative than the original adjustment, the other plug (-GB) being then joined to a slightly less negative point than that of the original rough adjustment. With the potentiometer slider at one end of its travel, the receiver will be insensitive; the knob should now be rotated slowly from that point until full sensitivity is just restored. For complete control this will be the correct operating point, but if a little delay is to be introduced, the knob should be rotated a shade further to give excess negative bias. The potentiometer adjustment is easily mastered, and it should be realised that it determines to a large extent the average level at which signals will be produced; very often it will replace a manual control entirely.

An H.T. battery of 60 volts will be satisfactory in many cases, but often a rather higher voltage is desirable. The grid bias battery needed depends entirely on the set; 60 volts will be ample for most battery-fed receivers, but in some mains sets the detector works at over 100 volts actually on its anode; this pressure must, of course, be balanced out, and a few extra negative volts must be available. If the exact voltage is not known, it can easily be determined by trial; until sufficient negative bias is applied, the set will be completely lacking in sensitivity.

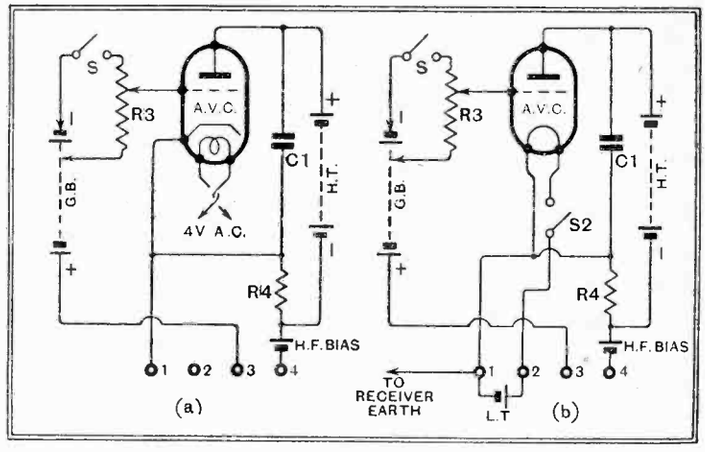
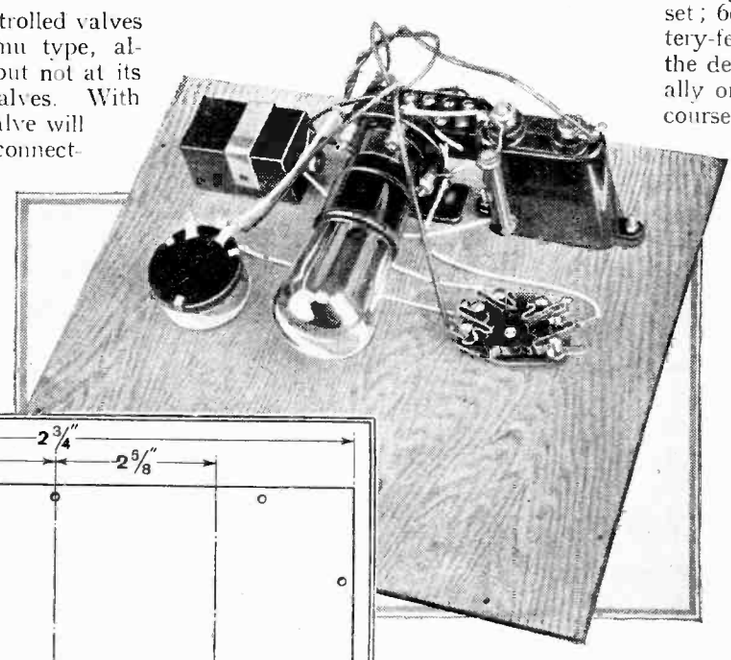


Fig. 4.—Practically no alterations are necessary when the unit is operated with an A.C. mains set, although an indirectly-heated valve may be used.

For use with A.C. mains receivers, an indirectly-heated valve may be fitted to the unit as shown in Fig. 4 (a); if it is preferred to use an L.T. battery connections will be as in Fig. 4 (b). The H.F. bias limiting cell should be omitted when the controlled valve or valves normally obtain a minimum bias from a resistance in their cathode leads.

Those who are unfamiliar with A.V.C. may be reminded that no system can compensate in any way for a fading signal when it falls below the threshold value at which the control becomes operative. This point is shown graphically in Fig. 2; when readings were taken at 0, 4 and 6 minutes, this limit was reached, and it was only then that any appreciable changes in detector output occurred.



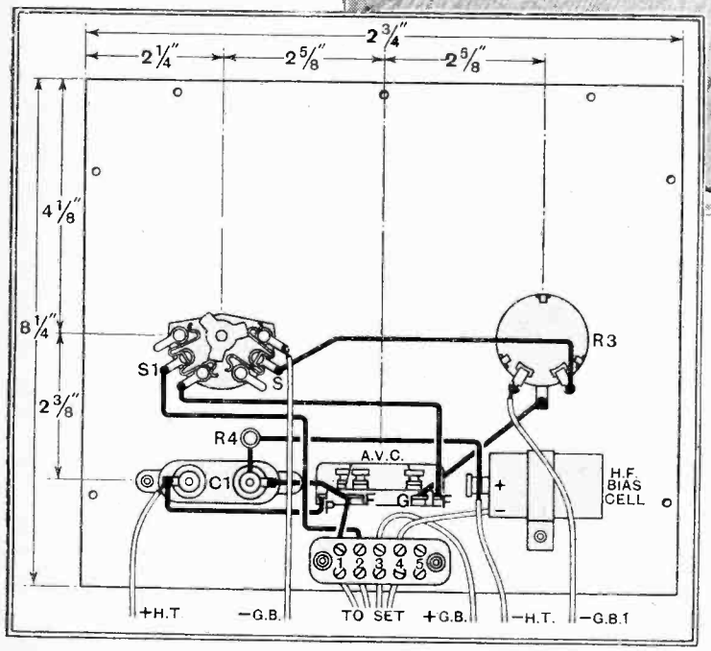


Fig. 3.—Mounting of components on the underside of the top panel, and (below) practical wiring plan.

A specimen unit is available for inspection at 116–117, Fleet Street, London, E.C.4.

LIST OF PARTS

1 **Valve-holder**, horizontal type — **W.B. "Universal"**
1 **Potentiometer**, 50,000 ohms, **R3** — **Rotor-Ohm**
(Bulgin, Lewcos, Claude Lyons, Radiophone, Watmel, Wearite)
1 **Resistance, fixed**, 0.5 megohm, **R2** — **Erie**
1 **Resistance, fixed**, 0.25 megohm, **R4** — **Erie**
(Dubilier, Graham Farish, Loewe, Claude Lyons)
1 **Fixed condenser**, 0.5 mfd., **C1** — **Dubilier**
(Formo, Hellesens, Peak, Radiophone, T.C.C., Telsen)
1 **Dry cell**, 1.5 volt — **Ever Ready Size "0"**
(Lissen, Siemens)
1 **Connector**, 5-way — **Wilburn**
5 **Wander plugs**, H.T.−, H.T.+, G.B.+, G.B.−1, — **Clix Type "B"**
(Belling-Lee, Bulgin, Eelex, Goltone, Lissen)
2 **H.T. batteries** (see text).
Wire, sleeving, flexible wire, screws, wood, etc.

The History of A.V.C.

An Old Idea Harnessed to Modern Needs

AUTOMATIC volume control, in its popular application to broadcast receivers, is of comparatively recent date. Naturally the first applications were to receivers for telegraphy reception, and here it did not matter if the control was effected on the modulated signal after detection. For the reception of music, however, it is desirable, in order to avoid a flattening out of the reproduction, that the automatic volume control should operate on the strength of the carrier wave and be unaffected by the degree of modulation.

ALTHOUGH automatic volume control is comparatively new as applied to broadcast receiving sets, it ranks as a more or less time-worn expedient in the older arts of line telegraphy and telephony. That is to say, so far as its application to the problem of "fading" is concerned.

The conductivity of a line-wire changes considerably under different climatic conditions. Extremes of temperature and of moisture produce different attenuation losses, which must be compensated if a reasonable level of speech or signal strength is to be maintained.

Perhaps the first solution was to provide a separate pilot line, through which control signals were sent from time to time, in order to allow the amplification at repeater stations to be supervised manually and readjusted as and when required.

Some fifteen years ago a system was developed in which this operation was performed automatically by means of a variable potentiometer arranged in the input circuit of the amplifier valves. As telephone lines are usually grouped together, it is a simple matter to set aside one circuit for control purposes.

An Early Scheme of A.V.C.

The pilot line forms one arm of a Wheatstone bridge, which is provided with a polarised relay across one diagonal and a source of E.M.F. across the other. Any abnormal change in attenuation unbalances the bridge and brings a small motor into operation to shift the potentiometer tapping until the new conditions have been met.

A system of this sort is not, of course, suitable for broadcasting where one is dealing with a modulated carrier wave instead of ordinary L.F. signals. Also, it must be borne in mind that alterations in the ether channel, such as those which give rise to ordinary fading, occur much more rapidly, and erratically, than the slow climatic variations which are the chief concern of the line engineer.

In broadcast reception the common practice is to utilise the rectified carrier-wave as the source of a special biasing-voltage, which is led back to control the sensitivity of the H.F. stages. The signal or modulation components are, in general, not suitable for this purpose, because they tend to flatten out the pianissimo and fortissimo passages to the same dead level of sound. Of course, if a sufficient time delay is included, the modulation components may help to cope satisfactorily with slow fading, such as is met with on some of the longer wave stations.

A noteworthy attempt to utilise the detector output to control the performance of preceding H.F. valves dates from 1923, and although originally devised as a means for reducing "static" and other interference in a commercial wireless telegraph system, it appears to disclose the fundamental principle of automatic "gain" or volume control as utilised to-day in broadcast sets.

As shown in Fig. 1, the voltage developed across a resistance R in the output of a leaky-grid detector valve is led back to bias a pair of valves V1, V2 connected in shunt to the aerial and tuned input circuits. The result is to apply a variable damping to these circuits as the anode-cathode resistance of the auxiliary valves V1, V2 is altered by the change in the grid bias.

Principle of Operation

Heavy atmospherics—or a strong interfering signal—which tend to throw the grids positive, will reduce the internal resistance of the valves V1, V2, and so diminish the efficiency of the input circuits. In effect, the arrangement gives a certain degree of automatic volume control, though not specifically designed for this purpose.

Perhaps the first definite attempt to tackle the problem of fading along modern lines is that shown in Fig. 2, which dates a couple of years later, in 1925. The circuit is a superhet, and energy is taken from the second detector stage D2 by a series circuit L, C tuned to the intermediate frequency, and fed to an amplifier V1.

The amplified output is first rectified by a valve V and then applied through a resistance R to control the grid bias of the high-frequency stages H.F. and

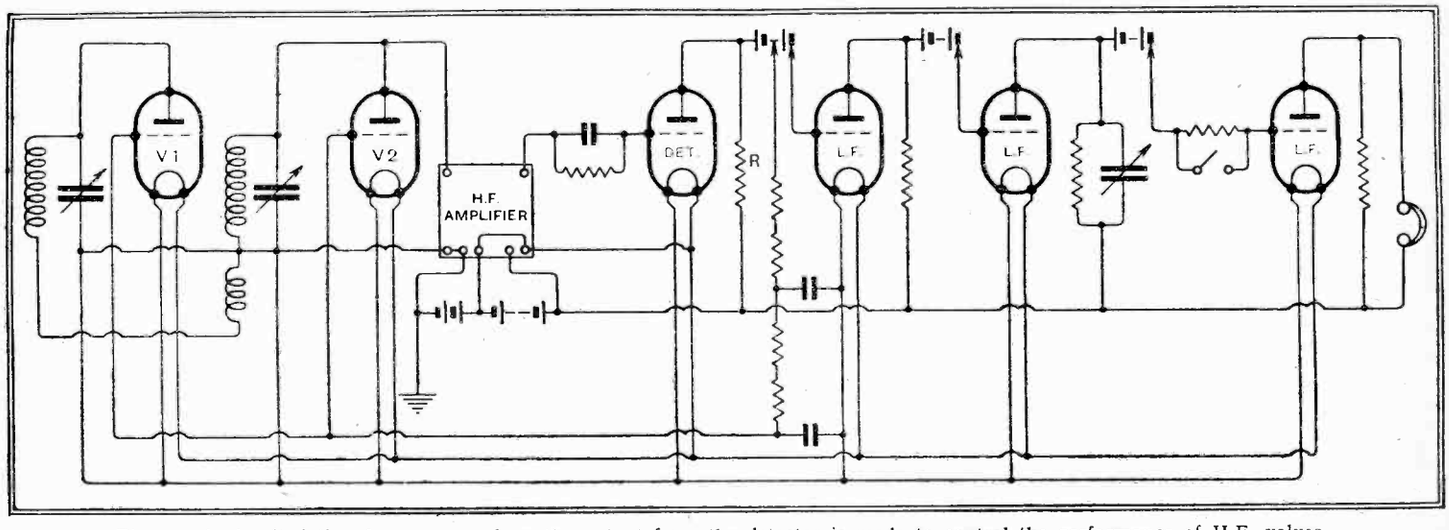


Fig. 1.—A circuit dating from 1923, where the output from the detector is made to control the performance of H.F. valves.

The History of A.V.C.—

H.F.1. Here the rectified carrier-wave is definitely used to effect automatic control, and may in fact be used to suppress any signals below a predetermined value—which is, of course, the principle of the modern system of Q.A.V.C.

From this point progress becomes more rapid, and in 1926 we find a system in which the control voltage is used to bias a valve—functioning as a variable impedance—in one arm of a Wheatstone bridge. The input is applied to one diagonal, and the output is taken from one of the arms of the bridge through a transformer. Here, again, the primary application is to line telephony, but the object of attaining a uniform high-quality transmission over a wide frequency band is deliberately kept in view.

A few months later—early in 1927—we find the circuit shown in Fig. 3, which includes the modern principle of amplified A.V.C. The output from a leaky-grid detector V is fed to a resistance R, and the voltage produced, after amplification in a direct-current amplifier V1, reappears in the resistance R1, from which it is applied to bias the high-frequency stages H.F. and H.F.1. A variable tapping affords an additional "manual" control of volume.

In the same year we discover an appreciation of the desirability of combining "visual" tuning means with sets fitted for A.V.C., and also a disclosure of the use of a "diode" rectifier for obtaining both signal and A.V.C. voltage from the same valve. Further, it is shown how the principle of A.V.C. may be applied to eliminate the effect of fluctuations in the main supply voltage.

Since 1927 the number of circuit arrangements designed to provide A.V.C. have been legion. In some cases "mechanical" control is utilised, but mostly the control is wholly electrical. The former type is hardly suitable for ordinary broadcast reception, since the small power available demands the use of very delicate instruments.

One illustration may perhaps be given, in which a milliammeter is inserted in the output circuit of the detector valve and is fitted with a moving vane, which also forms one of the vanes of the aerial tuning-condenser. This, on the face of it, is more ingenious than practical.

The electrical systems are almost entirely based on the principle of varying the grid bias on the H.F. valves, using the rectified carrier-wave for the purpose. Here the depth of modulation affects the output to some extent, i.e., a station with 80 per cent. modulation gives a signal twice as loud as one with only 40 per cent. modulation.

In some cases the output from the L.F. amplifiers has also been utilised, although, as previously stated, this tends to soften loud passages and strengthen weak ones unless the control is deliberately "delayed," in which case it is ineffective for "rapid" fading or when the set is tuned through a strong station. The period of "delay" is fixed by applying the control voltage to a condenser through a series resistance, so that the time taken by the condenser to charge comes into account.

Owing to the tendency to produce cross-modulation, the use of a variable grid-bias did not in practice prove very satisfactory prior to the introduction of the variable-mu valve. Even with the variable-mu valve, A.V.C.—to be a really practical proposition—demands a generous range of control voltage, of the order of 40 or 50 volts, as compared with the 5-10 volts originally used with the ordinary screen-grid type of valve.

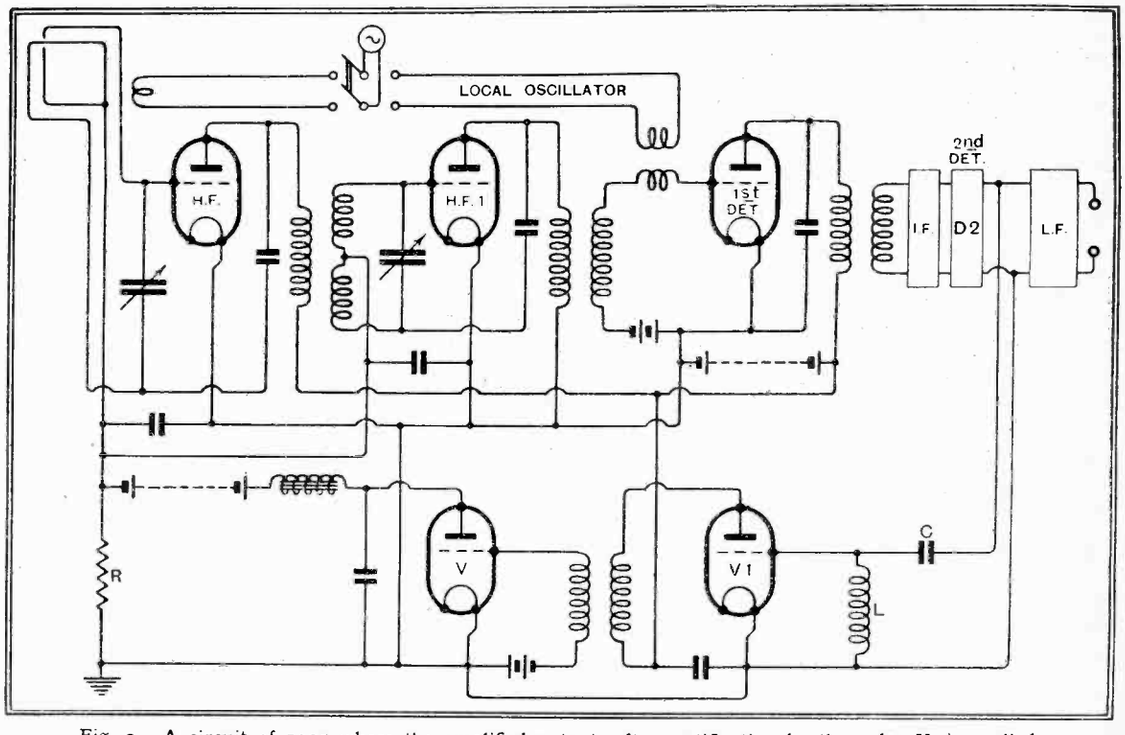


Fig. 2.—A circuit of 1925 where the amplified output, after rectification by the valve V, is applied to control the grid bias of H.F. stages.

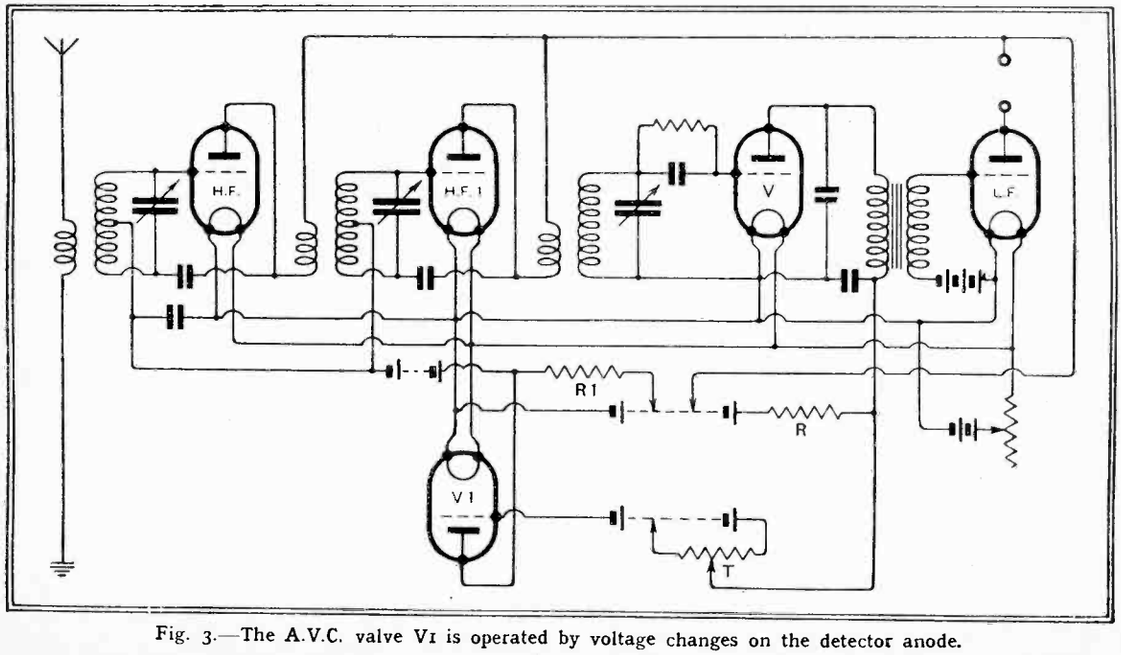


Fig. 3.—The A.V.C. valve V1 is operated by voltage changes on the detector anode.

UNBIASED

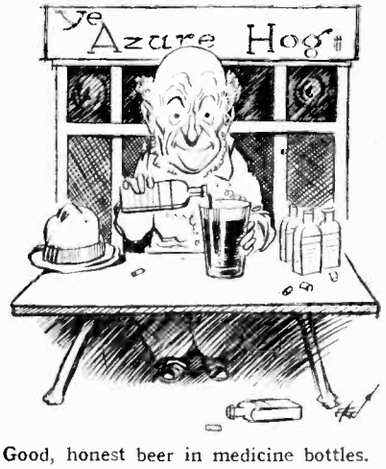
A Cabinet Question

HOW gratifying it is to see that at least one or two set manufacturers have had the courage and foresight to break away from the conventional style of "table-top" receiver! I refer, of course, to the type in which the loud speaker is housed over the tuning controls. Sets of this shape have always annoyed me, personally, for the simple reason that I consider them ugly, unwieldy and topheavy; thousands may think otherwise.

It will be remembered that this sort of set first appeared at the 1931 exhibition, as the result of the incorporation of the loud speaker into the receiver. What really set me against them was not the shape, but the fact that cabinet makers were permitted to dictate to British set manufacturers what shape the new type of set should take; in fact, they openly boasted about it.

The result was, of course, that all set manufacturers were compelled to follow each other like sheep in the matter of design. It is just as though brewers allowed bottle manufacturers to compel them to market good, honest beer in medicine bottles.

The new oblong shape with the loud speaker at one end is, to my mind, far more pleasing to the eye, and its shape far less difficult to fit into an odd corner of the average house. I do hope, however, that the change in shape *is* the result of initiative shown by a few set makers, and that the real explanation is not that they are being led by the nose once more by the cabinet makers. If this is so, my present mellow feelings toward the new shape will turn malignant. I suppose we must wait until this year's exhibition opens, and then, if there is a plethora of oblong sets, we shall know that once more the cabinet makers are calling the tune.



Good, honest beer in medicine bottles.

Experiments highly successful.

I Am Warmly Thanked

THIS new screened aerial wire about which everybody is talking is going to be a boon and a blessing to a very large number of people affected by interference of the type re-radiated by their own mains. It will confer no benefit, however, if the noise emanating from the loud speaker is not due to this particular cause.

A case in point came to my attention the other day; fortunately, the householder had not yet spent his money, and happily I was able to prevent him doing so by a simple test which showed that a screened down-lead would not solve his particular problem. Luckily, he possessed a garden hose of the first quality, and, cutting off a suitable length, I threaded through it the down-lead of the lowered aerial. The next requirement was foil from cigarette packets, but, as he was a non-smoker, we were delayed for a time until the maid ran round to purchase a few dozen "tens."

It was a simple matter to wrap the hose in tinfoil and hoist the whole contraption aloft. Our experiments were highly successful; the disturbance still persisted, thus proving that the interference was not coming in *via* the down-lead. The owner of the installation warmly thanked me for saving him the expense of buying a length of the special down-lead for his experiments. Incidentally, he has enough coupons from the cigarette packets completely to reclothe his wife and family. All he must buy is a new hose.

In the Surgery

A WELL-KNOWN radio scribe has been telling his readers that when undergoing a minor surgical operation under a local anæsthetic in New York some time ago he insisted on having with him a radio set to distract his attention while in the shambles.

Having first-hand knowledge of American programmes as dished up to New Yorkers I can only suppose that he got the idea from those Chinese dentists who apply thumbscrews to their patients as a counter-irritant.

Why Not Folding Radio-grams?

BUILDERS in this country seem to be vying with each other in the production of smaller and yet smaller houses, so that there is no room to swing even a kitten, and a Manx one at that.

By FREE GRID

This state of affairs is seriously affecting the popularity of radio-gramophones, according to a radio dealer to whom I have been talking. Being in a district where these new houses are going up overnight, he used vigorous language in denouncing radio manufacturers who have so far failed to cater for this large potential market for smaller and more adaptable radio-gramophones and console receivers. He got me so interested that I gladly accepted his invitation to visit a neighbouring new estate.

Space was obviously lacking.

After wandering through oceans of mud and using our umbrellas to beat off the hordes of estate agents and others who buzzed around us, we inspected several houses. Although space was obviously lacking for the ordinary type of radio-gramophone and console receiver, there seemed plenty of scope for any intelligent designer to produce suitable instruments.

Can you think of anything more appropriate than to build a radio-gramophone into one of those delightful "compactum" wash-hand stands which one encounters on board ship? The moving-coil loud speaker would take the place of the customary mirror, while the turntable would occupy the place of the basin, and would conveniently fold up when not in use. As for the tuning controls, there would be ample space at the bottom of the mirror, while the heavy mains gear or the batteries would go nicely into the space usually occupied by the waste water receptacle. The dealer who was accompanying me was quite enthusiastic about the idea.

Practical Class "B" Amplification

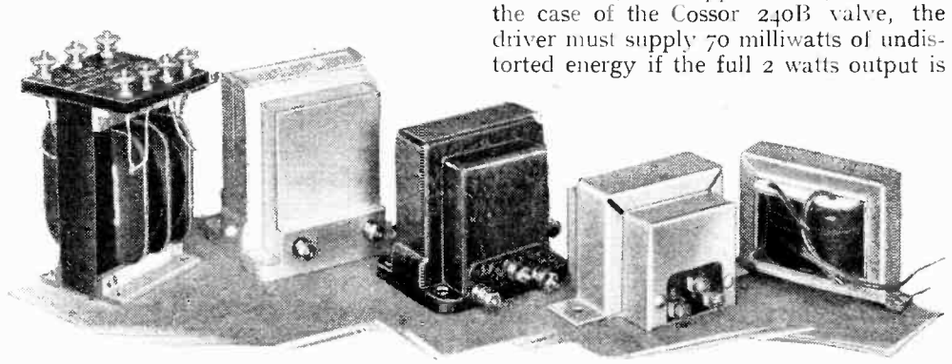
Choosing the Right Components for the Driver Stage

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

IN view of the remarkable performance of the new Class "B" battery valve, both as regards quality of reproduction and power output, it can safely be predicted that this type of output will be included in the majority of future battery sets. The choice of the correct driver valve and the calculation of the driver transformer ratio, among other points, are dealt with in detail in the accompanying article.

SO many technical developments have occurred within the last few months that the most earnest student can be forgiven if he has difficulty in keeping abreast of each one. Take the case of Class "B" amplification, first described in *The Wireless World* but two weeks ago. Although the reader has been given a theoretical explanation of the new system, there are some practical aspects which need consideration. For instance, there are on the market numerous driver transformers necessary for feeding the Class "B" valve, some of which are shown in the illustration. In a number of cases the overall ratio (total turns on primary to total turns on secondary) is 1 to 1, while in others the step-down ratio is 2 to 1, or even 3 to 1, which is equivalent to 4 to 1 or 6 to 1 when we refer the primary to half the secondary, and the question arises as to which is the best type to choose for any given set of conditions.

Before a decision can be made it will be as well to remind ourselves of the somewhat strange conditions obtaining in an output stage where grid current is purposely made to flow. The two valves forming the dual Class "B" valve are each of the comparatively high-impedance detector type, and pass little anode current at zero bias, but, of course, run into grid current as soon as a signal is received. As each grid in turn becomes positive, electrons from the filament are collected by it, thus completing a current path across half the transformer secondary, making a partial short-current across it. Naturally, a complete short-circuit of the secondary would put the two ends at the same potential, destroying the signals entirely. A partial short circuit, on the other hand, merely reduces the signal volts available.

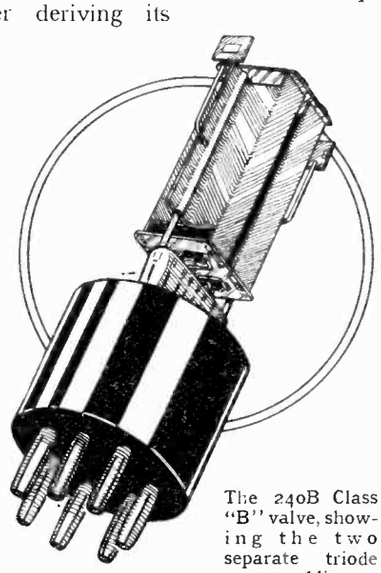


Five driver transformers with ratios from 2 to 1 up to 5 to 1 per half-secondary. From left to right, R.I., Lotus, Sound Sales, Benjamin and Trix.

Now to maintain full volts in face of the current drain through the valve, a source of power must be provided. This is effected by a transformer deriving its power from a small output valve—the two together being known as the "driver" stage. From this it will be clear that output valve technique must be applied to the intermediate L.F. stage which precedes the output stage proper. How much power is required from the driver to make up for the losses incurred when grid current flows round the grid circuit of the Class "B" valve? It is not easy to work this out for ourselves, but the makers of Class "B" valves will always have to supply the figure, taking into account the D.C. resistance of the secondary of the driver transformer, the copper losses, etc. In the case of the Cossor 240B valve, the driver must supply 70 milliwatts of undistorted energy if the full 2 watts output is required from the loud speaker stage.

There are a large number of valves capable of delivering 70 milliwatts when working into the correct load which (where triodes are concerned) should be about twice the A.C. resistance of the valve. In the interests of anode current economy it has been found better to choose a valve rated for, say, 150 to 200 milliwatts and to bias it back until the reduced output is obtained. The type of small power valve with which this is possible nearly always has a gradual bend in the characteristic curve, and so the process of slight over-biasing does not introduce noticeable curvature distortion, especially when the input is small. Where rather more than the optimum bias is applied, the required anode load will, of course, be a little higher than the normal, because the valve's A.C. resistance will be increased.

This will explain why a suitable driver for the 240B is to be found in the Cossor 215 P, which *The Wireless World* Valve Data Supplement tells us will deliver 150 milliwatts at 150 volts H.T., 7.5 volts bias (10 mA. anode current) when working into a load of 9,000 ohms. At 120 volts it will deliver 70 milliwatts when biased to 9 volts, and the anode current will be 2.5 mA., while the load will have to be a little more than 9,000 ohms, say, 10,000 ohms. The most sensitive valve for the driver stage would undoubtedly be one of the high-efficiency pentodes (220 HPT, PT2, Pen.220, or PM22A), but as the cost is just twice that of a small power valve, it is unlikely that it will find wide application.



The 240B Class "B" valve, showing the two separate triode assemblies.

The next problem is the choice of the correct ratio of driver transformer. Before we can tackle this we must know the minimum impedance of the grid-filament circuit of one of the members of the dual Class "B" valve. Obviously when grid current to the tune of many milliamperes is flowing the internal grid-filament path is highly conductive, and is equivalent to a resistance of quite a low value. Actually the figure for the 240B is 2,500 ohms, and as only one half of the valve is in operation at any moment we are at liberty to ignore the other half. The secondary of the driver transformer being centre-tapped acts as a 2 to 1 auto-transformer, so the load across the whole winding is $2^2 \times 2{,}500 = 10{,}000$ ohms. But this is the load we require for the anode of the 215P valve. We are thus left with the simple problem of transferring 10,000 ohms from secondary to primary, necessitating, of course, a 1 to 1 ratio (or as some of the manufacturers put it—a 2 to 1 step-down ratio per half-secondary).

Had the driver valve required a load of 20,000 ohms to give the necessary 70 milli-

Practical Class "B" Amplification—

watts the driver transformer step-down ratio would have to be $\sqrt{2}=1.4$ (or 2.8 to 1 if referred to half the secondary). Again, a driver valve load of 40,000 would be given by an overall step-down ratio of $\sqrt{4}$ to $1=2$ to 1 (or 4 to 1 per half-secondary), and so on. This explains why there are transformers on the market with overall ratios other than 1 to 1.

There are probably a number of readers who will find one watt output sufficient for their needs, in which case the grid swing of the Class "B" valve can be restricted, and a loss of about 35 milliwatts only will have to be compensated. This can easily be handled by a detector-type driver valve consuming about 1½ mA. anode current, which, owing to its high impedance, will require a load of high value—an instance where a 4 to 1 or 6 to 1 step-down ratio (per half-secondary) will be required.

The transformer linking the 240B valve to the speaker must have a ratio such that the load across the primary is 8,000 ohms (or rather more than this if a small driver restricting the output is used).

Take, for example, a speaker with a speech coil impedance of 2 ohms; the output transformer ratio would have to be $\sqrt{8,000\div 2}=63$ to 1 step-down, and a speech coil impedance of 10 ohms would require a ratio of 28 to 1. Fortunately the majority of Q.P.P. output components already on the market are suitable.

It is interesting to note that because the grids of the Class "B" valve rob the anodes of current, the characteristic curves are similar in general shape to those of the screen-grid valve or pentode—this in spite of the fact that each half of the dual valve is a triode. The higher audio frequencies are, therefore, inclined to be accentuated, and compensation is desirable. If, however, the usual filter is connected across the output transformer primary, anode current is consumed for the high notes which are shunted away. It is therefore better to control the tone before the driver valve, as this leads to an appreciable economy in anode current.

As regards the sensitivity of the 240B output valve, a little more than 2 watts can be obtained from a signal of 9 volts peak applied to the driver valve—a highly satisfactory performance.

Class "B" amplification combines two virtues of great importance to the battery user: the first, an efficiency which is considerably greater than any other output stage, and the second, low cost, for the price of the dual valve is only 14s.

ULTRA-SHORT WAVES

THE April number of "The Wireless Engineer" contains two important articles on ultra-short waves. One deals with experimental broadcasting on 7.85 metres, carried out by the Philips Laboratory in Holland, describing the transmitting and receiving apparatus. The other contribution gives constructional details of an ultra-short-wave oscillator.

The issue, in addition to other material, contains monthly abstracts of the world's technical wireless articles, an indispensable service to serious experimenters. Copies can be obtained by order at bookstalls, or direct from the publishers of *The Wireless World*.

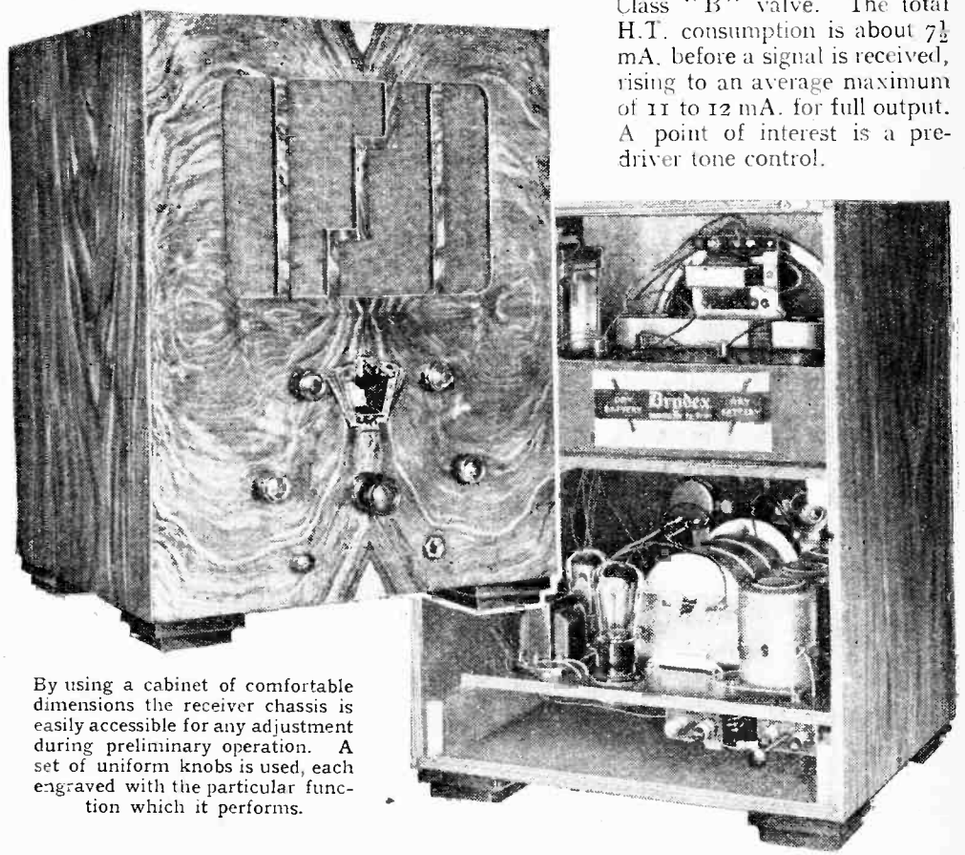
In Next Week's Issue:—

The Class "B" Ferrocart Receiver

A Highly Selective 4-valve Battery Set Giving the Remarkable Power Output of 2-watts

THIS receiver embodies the most advanced technique in battery receiver design. Selectivity approaching that of a superheterodyne is obtained by the use of three Ferrocart coils arranged as a band-pass filter and tapped tuned anode coupling. This, combined with the extremely high sensitivity of the new Class "B" L.F. amplification ensures an outstanding all-round performance. During initial tests no fewer than seventy-two stations were identified on the medium waveband alone, making a total of some eighty stations when the long-wave range is included.

The enormous power output of two watts speech can be obtained either from gramophone record or radio with quite a modest H.T. consumption. There are four valves in all, the first a variable-mu H.F. amplifier, the second a grid detector, the third a driver, and the fourth a dual Class "B" valve. The total H.T. consumption is about 7½ mA. before a signal is received, rising to an average maximum of 11 to 12 mA. for full output. A point of interest is a pre-driver tone control.



By using a cabinet of comfortable dimensions the receiver chassis is easily accessible for any adjustment during preliminary operation. A set of uniform knobs is used, each engraved with the particular function which it performs.

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 Polar "Star"
1 Reaction condenser, 0.0002 mfd. 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 Radiophone type 450.X.
1 On-off switch with distant control Radiophone type 485.Y.
1 3-pt. switch with long throat Radiophone type 630
1 Volume-control potentiometer, 25,000 ohms Wearite Q.V.C. (Bulgin, Radiophone, Watmel)
1 Tone-control potentiometer 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 Dubilier
1 Resistance, 250 ohms, 1 watt Dubilier
1 Resistance, 5,000 ohms, 1 watt Dubilier
1 Resistance, 40,000 ohms, 1 watt Dubilier
1 Resistance, 50,000 ohms, 1 watt Dubilier
1 Resistance, 500,000 ohms, 1 watt Dubilier (Erie, Graham Farish, Claude Lyons)
3 Non-inductive condensers, 1 mfd., 200 v. D.C. working T.C.C. type 50
1 Condenser, 1 mfd., 250 v. D.C. working T.C.C. type 65
1 Condenser, 2 mfd., 250 v. D.C. working T.C.C. type 65
1 Condenser, 0.0001 mfd. T.C.C. type "M"
1 Condenser, 0.0003 mfd 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.+, H.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 lamp switch 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 ⅜in. No. 4 R/hd.; 12 ½in. 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 210.B Cossor

1 Loud speaker with Class "B" transformer Amplion (British Rola, Celestion, Ormond)
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.
Cabinet C.A.C. Cabinets, Ltd.

Simplified Aids to Better Reception

Points About Buzzers

IN the first decade of the present century the test buzzer was used as an aid to the adjustment of coherer detectors, and with modifications in construction and method of application is still used as a handy and, above all, inexpensive generator of feeble oscillations. It is probably the only device that has survived since the early days of wireless.

In spite of the cheapness and low current consumption of present-day valves, the buzzer is still of real practical value for use in energising a radiating wavemeter, and its uses in this direction have recently been described in *The Wireless World*. In addition, there are other but less well-known applications.

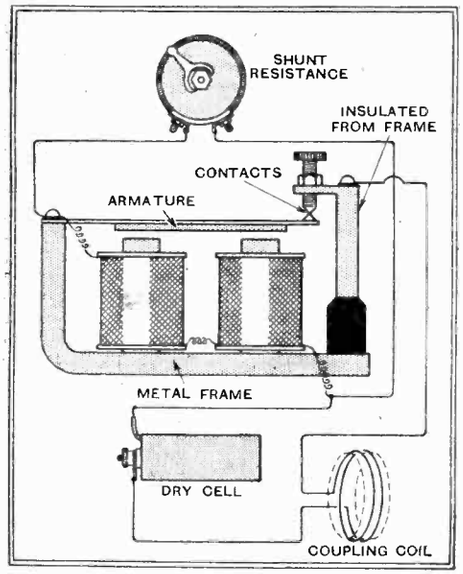


Fig. 1.—Diagrammatic sketch showing the construction and connections of a buzzer. Any tuned circuit in inductive relationship with the coupling coil is "shock-excited" into oscillation at its own natural frequency.

It is rather a pity that "wireless type" buzzers are not more readily available. Still, the ordinary pattern can, with slight alteration, be made to serve, but will generally produce rather too much mechanical noise. To reduce this, a soundproof container can be made, with an absorbent mounting to prevent vibration.

The make-and-break device should operate at a high frequency in order that a distinctive note may be produced. A buzzer that is unsatisfactory in this respect may often be improved by reducing the weight of the armature and at the same time damping its movements by suitably disposed blocks of rubber arranged so that they bear on the armature spring.

In order that a buzzer may be made to "kick" a tuned circuit into oscillation it is necessary to prevent the minute spark which normally occurs at the instant when the vibrator contacts open. To this end the coils are shunted with an absorbing resistance, generally of rather lower ohmic value than that of the coils themselves. Up to a point the strength of oscillations is greatest with a low value of shunt resistance, but here we find the need for compromise. The connection of too small a parallel resistance will prevent the buzzer from starting freely when switched on.

It has recently been found that the buzzer is by no means a "back number" for testing modern sets. Wired as shown in the accompanying sketch, with a two-turn exciting coil connected with long leads, it may be used to energise circuits in which screened coils are used, and is thus suitable for tracing faults stage-by-stage. The coupling coil may be placed inside the screening cover of a coil forming part of a circuit under suspicion. Tests of the I.F. amplifier of a superhet. may be made in the same way, although a few more turns on the coupling coil will generally be needed.

Q.P.P. With Triodes

IT may be pointed out that the quiescent push-pull system of amplification with three-electrode valves, as discussed in *The Wireless World* for February 24th, may be employed in the receiver described constructionally in the issue of January 20th. The sole proviso is that the valves chosen must operate with a grid bias not in excess of about 15 volts, as there is no intermediate L.F. stage. In practice this means that valves of the "low power" class, such as Marconi and Osram LP2, Mullard PM2A, or Cossor 220PA, would generally be most suitable.

Beyond such obvious alterations as the use of four-pin valve-holders, and the fact that provision for close adjustment of auxiliary grid voltage will no longer be necessary, practically no changes need be made. The voltage of the grid-bias battery will depend on the valves chosen, and also on the H.T. voltage to be applied to them; full information on this subject is obtainable from the tables published in the article referred to.

Really Free Bias

ANY desired proportion of the voltage developed across a smoothing choke inserted in the negative H.T. lead may be applied as grid bias; in this way we can get bias voltage that is really "free." The possibilities of this scheme, as applied to A.C. sets, have already been dealt with in this journal; the system is one that might be more widely adopted in cases where it seems to offer any benefit.

In certain circumstances, the same principle may with advantage be employed in D.C. sets. When the supply voltage is low—say, a bare 200 volts—and when the positive main is earthed, the arrangement shown diagrammatically in Fig. 2 has been found satisfactory, and is well worth a trial. At the worst, practically nothing will be wasted, as, in the unlikely event of failure, the components may be rearranged in the conventional manner.

In the circuit in question the smoothing choke is in the negative H.T. lead, and assuming average values, the voltage developed across it will be more than enough to bias a D.C. pentode output valve. Any proportion of this voltage may be taken off by shunting the choke with a potentiometer, to the slider of which the grid circuit is connected.

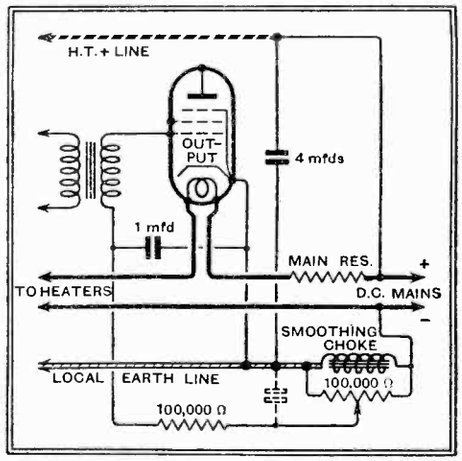


Fig. 2.—Automatic bias without loss of H.T. voltage: an arrangement that is especially applicable with D.C. supplies of 200 volts or less.

To prevent hum, grid decoupling components should have approximately the values indicated, as a certain amount of smoothing will be required here. The extra condenser, shown in dotted lines, will not always be necessary; when it is, a value of 1 mfd. will be suitable.

NEWS of the WEEK

Current Events in Brief Review

Free Programme Journal

RUMOURS are continuing that German listeners are to be provided by the State with a free broadcasting programme journal. It is considered that such a step would seriously affect the independent radio papers, of which there are about sixty.

Fifty-year-old Valve

AN exact replica of an Edison valve first designed in the early 'eighties was used recently in a special programme over the network of the American National Broadcasting Company. Edison's patent revealing his discovery of the electronic flow in the vacuum tube was taken out in November, 1883.

S.B. in Italy

THE Italian Broadcasting authorities are following B.B.C. practice by transmitting two programmes simultaneously from Milan. The "Northern Programme" goes out from the new station at Siziano, while from the old transmitter at Vigentino, not yet demolished, programmes are transmitted for Rome and the south.

Radio Mass Forbidden

OWING to the shortage of priests in many French country districts requests have been made that masses might be broadcast and relayed through loud speakers in priestless churches. But the Vatican journal, *L'Osservatore Romano*, lays down the Catholic doctrine that "to accomplish their duty the faithful must be present in a church where the mass is celebrated."

A Processional Innovation

A REMARKABLE radio demonstration marked the inauguration of the Lyons Spring Fair. In answer to a broadcast request from the Lyons la Doua station, all listeners along the path of a public torchlight procession placed their receivers on the window sills so that the spectators enjoyed a continuous concert until the procession arrived. Prominent radio traders provided powerful sets with loud speakers for use in the procession.

Seven Thousand Miles Radio Tour

IN the extension of British radio trade abroad a splendid example has been set by Messrs. Partridge, Wilson and Co., makers of the "Davenset" radio apparatus, two of whose representatives are now touring the Near East by air. Croydon aerodrome was left on Saturday, March 18th, and by the time the plane returns on Tuesday, April 4th, some seven thousand miles will have been traversed.

The tour is the outcome of the suggestion of an Egyptian buyer who visited the firm some months ago.

Potsdam, 1933

KONIGSWUSTERHAUSEN'S interval signal was changed last week to commemorate the national holiday on March 21st. The new signal is the first bar of the old German folk song: "Ueb'Immer Treu und Redlichkeit," as played by the carillon of the Garrison Church in Potsdam.

The signal is reproduced by means of a simple drum of the "musical box" type.

German Broadcasting Under New Control

HISTORY was made in German broadcasting last week when the Post Office relinquished control in favour of a new Ministry of Propaganda under the direction of Dr. Goebbels, who has appointed Dr. Kruckenberg as sole radio commissioner. We understand that the Post Office continues to collect the licence fees and to operate the transmitters, but the new Ministry of Propaganda takes most of the money derived from licence fees, a small percentage being deducted by the Post Office for expenses.

Broadcasting to Posterity

AMONG the recent acquisitions of the British Museum is a matrix of the King's Empire Speech broadcast on Christmas Day, which has been presented by the directors of the Gramophone Co., Ltd. The matrix is made of nickelled copper, and is placed in a hermetically sealed brass panel. This has been added to the collection of matrices which was begun in 1907, when the H.M.V. presented matrices of speeches by Sir Herbert Tree, Lord Roberts, Sir Ernest Shackleton, and the voices of famous opera stars.

Errors in D.F.

AT the I.E.E. Wireless Section on Wednesday next, April 5th, Mr. J. F. Coales, B.A., will read a paper entitled "Errors in Direction-Finding Calibrations of Steel Ships due to the Shape and Orientation of the Aerial of the Transmitting Station." The meeting opens at 6 p.m. at the Institution.

Incendiarism by Radio

UNNECESSARY excitement seems to have been caused in Belgium over an "experiment" in which a fire was started at Landerbrugge, 7½ miles away from a short-wave transmitter. The receiver in the infernal machine contains a diaphragm which, on the receipt of the signal, closes a switch and heats a filament, setting fire to a piece of highly inflammable material.

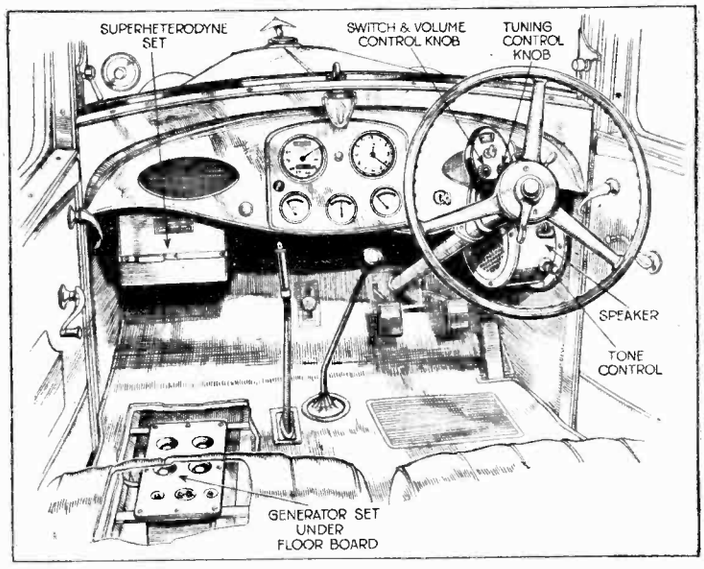
All one has to do, apparently, is to tune in Radio Paris or London National some ten minutes before the opening of the transmission, place the infernal machine on the spot where the fire is needed, and retire immediately.

"Dahir" in Morocco

WIRELESS pirates are now given short shrift in Morocco, where a "dahir" has been promulgated by M. Lucien Saint, the French Resident General.

The "dahir" ordains that every wireless manufacturer, merchant, or retailer must henceforth enter in an official stamped and initialled account book the names and occupations of all persons to whom radio sets, components and accessories are sold.

The radio journals in France regard the new move as a direct attempt to "turn traders into informers."



THE BUILT-IN CAR SET. Elsewhere in this issue comment is made on the new trend of car wireless in which the receiver is an integral part of the equipment. Above is an *Autocar* sketch showing the Philco Transitone on a Vauxhall car.

Television Exhibition

THE Fourth Exhibition of Television and Photo-electric Apparatus will take place at the Imperial College of Science, South Kensington, London, S.W.7, on Wednesday next, April 5th, from 6 p.m. to 9 p.m., and Thursday, April 6th, from 3 p.m. to 9 p.m. On the latter date the Exhibition will be opened by Sir Ambrose Fleming, M.A., D.Sc., F.R.S. There will be special short-wave demonstrations of television.

Cards of admission may be obtained from the Hon. Business Secretary, Mr. J. J. Denton, 25, Lisburne Road, Hampstead, London, N.W.3.

Trade Mark: "Bulgin"

OUR congratulations to Messrs. A. F. Bulgin & Co., Ltd., the radio manufacturers, for having secured the registration of their name "Bulgin" as a trade mark. Only on rare occasions does a surname receive this privilege.

In order to substantiate the claim to originality, the company was required to obtain some hundreds of affidavits from wholesalers, dealers and others, stating that the name "Bulgin" had been used exclusively by the firm for the past nine years.

Photo Cells on Show

NO one interested in the many practical applications of photo-electric cells should omit to visit a special display which opened at the Science Museum, South Kensington, on Saturday last.

The cells on view can be roughly classified into those involving only the detection of light and those concerned with its measurement. In the first class the Exhibition offers a number of working models showing the cells used for counting small packages on a conveyor belt, operating burglar alarms and controlling an automatic door-opener. Cells depending upon the intensity of light are seen operating street-lamp switches and measuring the density of factory smoke.

An effective exhibit shows the use of the sound film in the telephone exchange, a recorded voice announcing "Number engaged," and other phrases.

Fighting the Sponsored Programme

OUT of the welter of conjecture about the proposed formation of a new American broadcasting network to compete with the two existing National systems has come a definite announcement by the Atlantic Seaboard Broadcasting Company. According to our Washington correspondent, this company is about to open up a six-station network between New York and Washington. Mr. Israel Leopold, the President, popularly known as Ed Wynn, proposes to add thirty-seven stations south of Washington and forty between Chicago and Seattle.

Interest is centred on Mr. Leopold's declaration that advertising will be confined to not more than thirty words at the beginning and end of each programme. The announcements will refer listeners to newspaper advertising. This is regarded as the first move towards loosening the stranglehold of the sponsored programme.

The Magnetic Circuit

An Important Principle Simply Explained

By S. O. PEARSON, B.Sc., A.M.I.E.E.

IN making calculations on the iron cores of transformers, chokes, and other electromagnetic apparatus, it is necessary to have a working knowledge of the principle of the magnetic circuit, just as in dealing with electric circuits it is essential to know Ohm's law. And it is the fact that a simple magnetic circuit obeys a law very much like Ohm's law of the electric circuit that makes the study and calculation of a magnetic circuit a comparatively simple matter.

WHEN it is realised that the magnetic circuit obeys a law very much like Ohm's law, it will be appreciated how simple the calculations are for the design of iron-cored components. The author defines the magnetic circuit as that part of an electromagnetic device or piece of apparatus which carries the main magnetic flux. It usually consists of a closed iron or steel alloy magnetic path with possibly one or more comparatively short air-gaps.

Let us first consider the most elementary form of magnetic circuit to illustrate the principle. This consists of an iron ring of uniform section wound with a number of turns of insulated wire, as shown in Fig. 1 (a). When a current is passed through the wire or coil the iron becomes magnetised to an extent depending on (*a*) the current in the coil and the number of turns—that is, on the product of amperes and turns (called the ampere-turns); and (*b*) on the properties of the iron ring, or whatever other type of magnetic circuit is involved.

Magnetomotive Force

The magnetic flux, or total number of lines of force, produced round the iron ring bears a definite relationship to the ampere-turns in the same way that a current round an electric circuit bears a definite relationship to the applied electromotive force. The coil carrying the magnetising current constitutes the driving force which sets up and maintains the magnetic flux. This driving force is proportional to the number of ampere-turns, and is called the *magnetomotive force* (M.M.F.) of the coil and current. It corresponds to the electromotive force of the electric circuit.

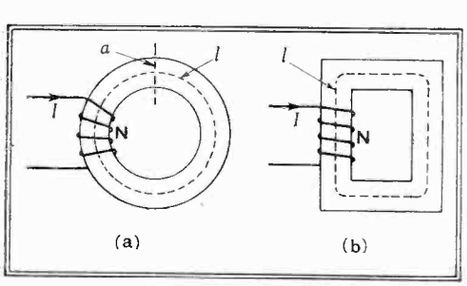


Fig. 1.—(a) Simple ring magnetic circuit, and (b) a common form of rectangular magnetic circuit.

In the practical system of electromagnetic units the M.M.F. of a coil is not actually equal to the number of ampere-turns of the coil, but to 0.4π times this quantity. The origin of the number 0.4π arises from the numerical definition of magnetomotive force. (It is numerically equal to the work done or energy expended when a unit magnetic pole is moved once round the magnetic circuit. 4π lines of force issue from a unit pole, and one ampere is 1/10th of a C.G.S. unit.) So, if the magnetising coil has N turns and carries a current of I amperes, the magnetomotive force is 0.4π NI, and is expressed in *gilberts*.

Turning now to the properties of the magnetic circuit itself, and considering the simple ring of Fig. 1 (a), the total magnetic flux produced will depend, for a given magnetomotive force, on the dimensions of the ring and on the magnetic "conductivity" or the *permeability* of the iron. In the same way as an electric circuit offers resistance to the flow of a current, so a magnetic circuit offers a resistance to the establishment of a magnetic flux within it. This opposition to the magnetic flux is termed *reluctance*, and is usually denoted by R.

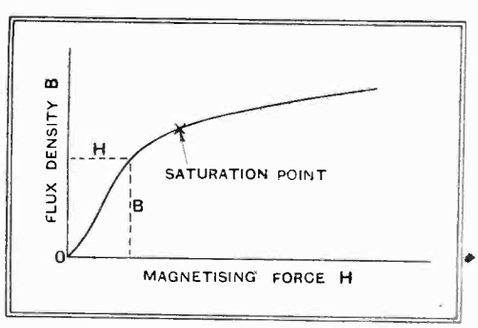


Fig. 2.—Magnetisation curve of iron showing the general shape.

Knowing the magnetomotive force (M.M.F.) of the coil and the value R of the reluctance of the magnetic circuit, the total magnetic flux—that is, the total number of lines of force or *maxwells*—is given by the simple expression $\phi = \frac{\text{M.M.F.}}{\text{R}}$, where ϕ stands for the total magnetic flux. (Compare this with Ohm's law:—$\text{I} = \frac{\text{E.M.F.}}{\text{R}}$).

For a given specimen of iron, the reluctance or magnetic resistance R of the magnetic circuit is directly proportional to the mean length of the circuit, and is inversely proportional to the area of cross-section of the magnetic circuit, taken at right angles to the lines of force. It is assumed that the section is uniform at all points, and in the case of the ring the sectional area is that obtained by cutting radially through one side of the ring. So if l is the mean length in centimetres, as shown in Fig. 1, and a is the cross-sectional area in square centimetres, the reluctance is proportional to $\frac{l}{a}$. The longer the magnetic circuit the greater the reluctance, and the larger the section of iron path the lower the reluctance. This, of course, is the same as the relationship between the resistance and dimensions of a conductor.

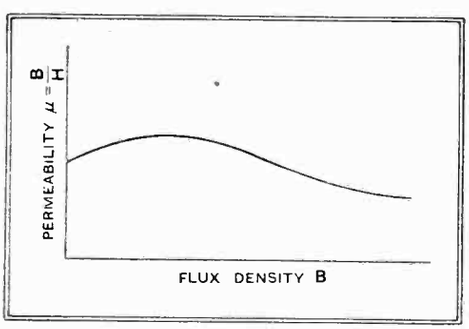


Fig. 3.—General form of the permeability curve of iron and its alloys.

Permeability

The reluctance depends also on the magnetic properties of the iron itself. Some specimens of iron carry magnetic flux more easily than others, and the degree of "magnetic conductivity," if such a term may be used, is known as the *permeability*, and is unfortunately not constant for even a single specimen of iron; it depends on the degree of magnetisation. To define permeability numerically it is necessary to introduce a new term, namely, *magnetising force*. This is simply the magnetomotive force of the coil divided by the length of the magnetic circuit; in other words, the M.M.F. per cm. being $\frac{0.4\pi\,\text{NI}}{l}$, and denoted by H gilberts per cm.

Now, when the magnetising force H is

The Magnetic Circuit—

gradually increased from zero, the resulting magnetic flux *density*, or lines *per sq. cm.* of area of one side of the ring of Fig. 1 rises also, but not in direct proportion. The curve showing the relationship between B and H is usually of the shape shown in Fig. 2. This curve is variously called the "B-H curve," the "magnetisation curve," or the "saturation curve" of the iron. The permeability of the iron, at any particular flux density B, is the ratio B/H at that point, and is usually denoted by the Greek letter μ (mu). Obviously, μ is not a constant ratio, and when plotted against the flux density B gives a curve of the type shown in Fig. 3. It is, however, usually fairly constant over a considerable range of flux densities below the "saturation point." The permeability is really the ratio of the magnetic conductivity of the iron compared with that of air, which is said to have a permeability of unity.

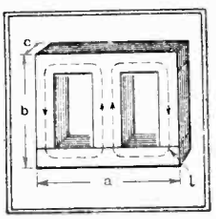


Fig. 4.—Shell type of A.C. magnetic circuit. All windings are carried on the central core.

Knowing the permeability μ, the length l, and the cross-sectional area a of a uniform magnetic circuit, the reluctance is given by $R=\frac{l}{\mu a}$. For an air-gap in a magnetic circuit the reluctance is simply equal to the ratio of effective length (or width) to the area of one of the pole faces, since $\mu=1$.

Example.—An iron ring has a mean diameter of 20 cms. and a cross-section of 10 sq. cms. It has a radial air-gap 0.1 cm. wide cut at one point, and is wound with 100 turns of wire. It is required to find the current necessary to produce a flux density of 10,000 gauss (lines per sq. cm.) in the air-gap (and in the iron) if the permeability of the iron at this density is 2,000.

Total magnetic flux = 10,000 × 10 = 100,000 maxwells or lines. Reluctance of iron portion $=\frac{l}{\mu a}=\frac{20\pi}{2{,}000\times 10}=0.00314$.

Reluctance of air-gap $=\frac{0.1}{10}=0.01$. Thus total reluctance $R=0.00314+0.01=0.01314$. But total flux $\phi=\frac{\text{M.M.F.}}{R}$ lines, whence M.M.F. = 100,000 × 0.01314 = 1,314 gilberts, and this is equal to $0.4\pi NI$, where N is the number of turns and I is the current. Hence the required current is $I=\frac{1{,}314}{0.4\pi\times 100}=10.46$ amperes.

In the case of a composite magnetic circuit in which there are portions with different sectional areas and permeabilities, the reluctance of each part is found separately, and the total reluctance found by addition.

The magnetic circuits of low-frequency chokes and transformers usually take one or other of two forms. The core may be arranged as in Fig. 1 (b), which is known as the core type, or, on the other hand, it may be designed as shown in Fig. 4. This form of magnetic circuit is known as the "shell" type. The magnetic circuit is built up of stampings or laminations of special magnetic steel alloy, such as "Stalloy," the laminations being insulated from each other by means of thin sheets of paper or varnish to prevent, as far as possible, the flow of circulating or eddy currents within the iron itself by the alternating magnetic flux. The flow of eddy currents not only represents energy losses, but results in the lowering of the effective inductance of any winding on the core.

In the case of the shell type all windings are carried on the central core only, and the whole of the magnetic flux passes through this centre limb, dividing into two equal parts, which pass round the two outer limbs, as shown by the dotted lines in Fig. 4. It is common practice for the width of each outer limb, also the upper and lower yokes, to be made half the width of the central limb, so reducing the nett cross-sectional areas of these parts to one-half that of the central core. This arrangement secures the same number of lines of force through each square centimetre of area—that is, the same *flux density*, in every part of the magnetic circuit. This follows, of course, because the flux in each outer limb is just half that in the central core.

When making calculations on a magnetic circuit of this type, it must be remembered that the two outer limbs are in parallel with each other, and that, therefore, the mean length l of one group only of the lines of force must be taken into account when finding the number of ampere-turns. The length l in Fig. 4 can be found very approximately by drawing to scale and measuring, or it may be roughly calculated.

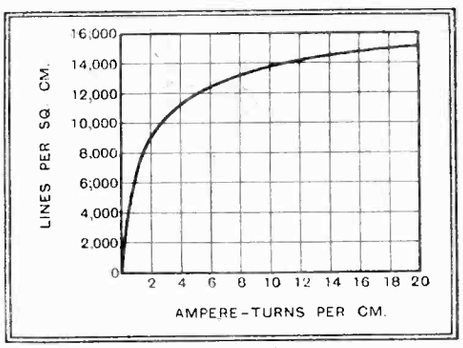


Fig. 5.—Magnetisation curve of silicon-steel alloy stampings.

Now, the makers of transformer stampings usually provide tables or curves showing the number of ampere-turns per centimetre length necessary to produce various flux densities in the particular material, and this greatly simplifies the calculation of the magnetic circuit. Fig. 5 shows a curve for silicon-steel stampings of moderately high permeability; it gives the relationship between ampere-turns per centimetre length and magnetic flux density in lines per square centimetre of area (gauss).

As an example, suppose that the dimensions of the magnetic circuit of Fig. 4 are known, namely, that $a=7$ cms., $b=5.5$ cms., and $c=1.5$ cms. This last is the gross depth across the laminations. The width of the central limb is 1.5 cms., and the widths of the outer limbs and the end yokes are all 0.75 cm. Suppose, further, that the magnetic circuit is made of stampings whose magnetic properties are given by the curve of Fig. 5, and that it is required to find how many turns will be required on the central core to produce a flux density reaching a maximum value of 10,000 lines per square centimetre when an A.C. of 200 mA. value is passed through the coil.

The mean length l of the magnetic path, taken round one side, is about 16.7 cms. From the curve of Fig 5 the ampere-turns per centimetre necessary to produce 10,000 lines per sq. cm. are seen to be 2.8, and so the *maximum* ampere-turns required $=2.8\times 16.7=46.7$. To get the number of turns we must divide this by the *maximum* value reached by the current each half-cycle. Assuming sine waves, the maximum current is $1.414\times 0.2=0.283$ ampere. And so the number of turns required is $46.7/0.283=165$.

How to Find the Inductance

The self-inductance of a coil on a closed iron core is very easily calculated when the relationship between the total magnetic flux and current is known. If ϕ lines of force are produced through the core when the current is I amperes, the self-inductance is $L=\frac{\phi N}{I}\times 10^{-8}$ henrys, where N is the number of turns.

In the present case the gross cross-sectional area of the central limb is $1.5\times 1.5=2.25$ sq. cms. This includes the insulation between the laminations. Assuming the iron itself to occupy about 90 per cent. of the space, the nett section of iron in the centre limb is $2.25\times 0.9=2$ sq. cms. approximately. So, with a maximum flux density of 10,000 lines per square centimetre *in the iron*, the total number of lines is 20,000 at an instant when the current reaches a peak value of 0.283 ampere, the R.M.S. value being 0.2 ampere. The self-inductance with this value of alternating current is therefore $L=\frac{20{,}000\times 165}{0.283}\times 10^{-8}=0.117$ henry.

The inductance is proportional to the square of the number of turns, and so with ten times as many turns, namely, 1,650, and one-tenth of the current (20 milliamps.), the ampere-turns would be the same as before, but the inductance would be 100 times as great—11.7 henrys.

Owing to the fact that the permeability of the iron varies with flux density, the inductance is not a constant, but depends on the R.M.S. value of the current. The presence of a direct-current component modifies the self-inductance value.

BROADCAST BREVITIES

By Our Special Correspondent.

Restlessness at "B.H."

THE power of speech, said the cynic, was given us to conceal thought. Much in the same way the broadcast programmes at the moment are cloaking a restlessness in Broadcasting House which is something more than "that Spring feeling." Inspired hints have reached the daily Press that "certain changes in organisation" are imminent and that these changes "will be obtained by some adjustment of personalities and duties internally."

The Sheep and the Goats

This is certainly a permissible way of describing the separation of the sheep from the goats, but it scarcely tells the whole story. The adjustment consists in dividing the B.B.C. staff into two great divisions, the administrative and the creative. Only now, after many years in setting up the broadcasting machine, is it possible to do this thoroughly.

In the old days the breed was mixed. People were administrative part of the time, when they performed routine duties, and became creative when the programmes demanded it.

One Thing or the Other

It occasioned no surprise that an accountant or librarian should proceed to the studio and sing a song or give a talk. Now we have changed all that and if you serve the B.B.C. to-day you are either a sheep or a goat. You cannot be both administrative and creative. You must be properly labelled.

A Dilemma

The new order is giving rise to some amusing perplexities among the staff. One young lady, whose particular job must go unrecorded, has been described as "administrative" by the Chief of the Section in which she works, while the higher authorities insist that she is creative. This case is typical of many.

What Does it all Mean?

And why the great cleavage? That is the question which causes restlessness. Who would be a sheep, with superior status and hours, if the goat gets better pay?

New Appointments

A "general post" among senior members of the B.B.C. staff seems inevitable. A smaller Control Board is being openly discussed. Sir Charles Carpendale will retire from the Controllership under the age-limit rule in the near future, and his successor must be sought among the "big names" already on the B.B.C. staff.

Despite rumours to the contrary, Mr. Gladstone Murray will probably be back from Canada by the 1st of June.

Down from the North?

The Manchester station has already been a jumping-off ground for promotion to H.Q., so it would not be surprising if Mr. Edward Liveing, the Northern Regional Director, were to take up an appointment soon in Portland Place.

An Empire Ambassador

Within the next few months the Empire Broadcasting service will conclude its experimental period, and the question will be raised of whether the programmes are really appreciated and whether the Dominions and Colonies intend to offer financial recognition. The time is therefore drawing near for Sir John Reith to redeem his recent promise to Mr. Stanley Bruce, the Australian High Commissioner in London, and to send B.B.C. representatives on an Empire tour to establish goodwill and understanding.

It is quite likely that Sir John will send one of his closest associates.

Broadcasting on 3 metres

LEST you should spend all your time searching between 7 and 8 metres for the B.B.C. ultra-short wave transmissions, I ought to disclose the fact that recent tests have been carried out on 3 metres.

As a general rule, however, the engineers confine tests to the 7-8 metre band.

"Ultra Shorts" for Television

The feeling at Broadcasting House is that the "ultra shorts" will be used mainly for television in the near future. Mr. Baird has already secured impressive results with his ultra-short wave transmitter at Long Acre. I was privileged to witness reception at a distance of two miles, and can honestly declare that the image was comparable in clarity with those received over a short land line.

Another National Lecture

AFTER a lapse of many months, another National Lecture is to be heard on April 5th; it will be the first of the year 1933 and the eleventh to be broadcast. The lecturer, Sir Eric Drummond, K.C.M.G., C.B., will have as his subject "The League of Nations." Sir Eric recently retired from the position of Secretary-General, which he had held for thirteen years.

"Limitations of Programme Policy"

IN one sense the B.B.C. Sixth Annual Report is a thrilling document, for it tells of a net revenue of £1,628,738, an increase of £203,388 over 1931. At the same time it is a dull document, oozing bureaucracy at every turn of the page, and only really human when the Governors confess that "the problem of conveying humour purely by oral methods within the limitations of microphone and programme policy has not yet been solved."

I can understand the limitations of the microphone, but what exactly are these "limitations of programme policy"?

"Chu Chin Chow"

"CHU CHIN CHOW" is to be broadcast on the National wavelength on April 17th and to Regional listeners on April 18th. This radio version of Oscar Asche's musical tale of the East has been made by Henrik Ege, and the producers will be Harry S. Pepper and John Watt.

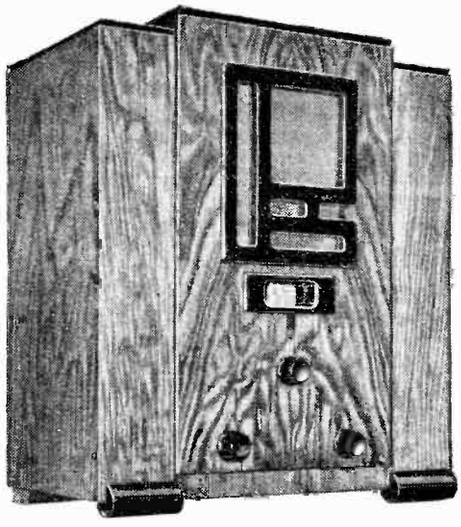
RADIO DRAMA IN ITALY. Recent suggestions that radio drama is moribund find no support in Italy, where plays of all types find favour with listeners. Above is a lively scene in a drama broadcast recently from Turin.

A Correspondence Record

The first announcement that the B.B.C. contemplated a studio performance of "Chu Chin Chow" resulted in the setting up of an unusual record in Broadcasting House correspondence, namely, an avalanche of applications for parts from members of the original cast and of numerous touring companies. The statement published recently that the play is to be revived on the West End stage will not affect the arrangements already made by the B.B.C., for the leading part in the broadcast version is to be taken by Oscar Asche.

Bush Q.P.P. Battery Receiver

A Four-Stage Set with All Modern Features



BATTERY sets are at present very much in the limelight and are fast becoming just as interesting technically as their mains-driven counterparts. Those who cater for listeners without a mains supply are realising that there is a distinct demand for the more ambitious type of set.

The Bush Q.P.P. model differs mainly from the majority of other up-to-date battery sets in that it includes an intermediate L.F. amplifier. Although it is possible to drive a quiescent push-pull output stage direct from the detector, there is never very much margin of safety in such an arrangement; the extra valve undoubtedly provides this margin and at the same time allows the designer greater scope in planning his L.F. inter-valve couplings. It also gives a very acceptable extra measure of L.F. amplification, and certainly increases the effective range of the receiver.

A Flexible Set

There are a number of details in the circuit arrangement to which attention should be directed. Although the accompanying diagram shows a plain capacity-coupled input filter for the medium band, the wiring is so disposed that a certain amount of "top-end capacity" coupling is introduced as well; this helps to prevent falling off in sensitivity at the lower end of the band. On long waves an extra coupling condenser between the high-potential ends of the coils becomes operative.

Another worth-while feature, which increases the flexibility of the set, is the provision of alternative filter couplings; a parallel coupling condenser may be placed in circuit by means of a plug-and-socket connection when extreme selectivity is needed.

Plain tuned anode coupling is used for the H.F. stage, but the combined reaction-sensitivity control system, which is operated by a single knob, is unconventional. Reaction is applied by variation of a resistance, which, as it is reduced in value, simultaneously brings about a reduction in the value of negative bias on the H.F. valve grid. By making the resistance contact brush run off the resistance element at the extreme end of its travel, the bias battery circuit is interrupted without the need for an extra on-off switch. The L.T. battery switch is linked mechanically to the spindle of this variable resistance, and so the operating knob performs three distinct functions.

In the parallel anode circuits of the detector are two 600-ohm resistances, both of which are associated with the reaction system. The first, in series with the by-pass condenser, ensures the maintenance of a sufficiently high H.F. potential on the anode, while the second, in the control circuit, helps to prevent L.F. howling.

After the detector comes a conventional resistance capacity-coupled L.F. amplifying valve, with an H.F. stopping resistance in its grid circuit. The succeeding push-pull stage is coupled by a parallel-fed transformer, the usual anti-parasitic resistance being inserted in the grid return lead. Separate feed leads for the auxiliary grids for each of the high-efficiency pentodes are brought out to the H.T. battery.

Tone control is provided by the simple expedient of fitting a variable instead of a fixed resistance in the compensator circuit, which is shunted across the output transformer primary. This control, together with the others which do not need constant adjustment (external aerial circuit trimmer and filter coupling sockets), are mounted at the back of the receiver.

As befits a set of such aspirations, construction is everywhere beyond criticism, both inside and out, and there is no evidence of skimping. Similarly, the cabinet is soundly made, the design is well conceived and pleasing to the eye.

The valves in the quiescent push-pull output stage are properly matched by the makers, the appropriate auxiliary grid voltages for each valve being recorded in the instruction book. Full instructions for carrying out this operation when valve replacements become necessary are given, and in the event of failure of one of the output valves the makers undertake to rematch the remaining valve. No difficulty should, therefore, arise on this score.

FEATURES

General.—*A self-contained 4-stage receiver (5 valves) for battery operation with an external or built-in plate aerial. Permanent-magnet moving-coil loud speaker; provision for gramophone pick-up.*

Circuit.—*Input band-pass filter; one H.F. stage and grid detector, followed by resistance- and transformer-coupled L.F. stages. Quiescent push-pull output.*

Controls.—*(1) Ganged tuning. (2) Wave range switch. (3) Combined on-off and sensitivity controls. (4) Tone control.*

Price.—*£14 19s. 6d.*

Makers.—*Bush Radio, Ltd., Woodger Road, Shepherd's Bush, London, W.12.*

It is difficult to decide whether sensitivity or selectivity is the most impressive feature of the Bush set. On both counts its performance is well above the average, and is distinctly better than that of many 1-v-1 mains set. In cases where interference is troublesome it is sometimes necessary to work with the looser of the two alternative filter couplings, but only under exceptionally unfavourable conditions. This method of artificially enhancing selectivity, though open to the usual objection that it introduces a slight falling-off in range, is distinctly better than most of the competing methods.

Low H.T. Consumption

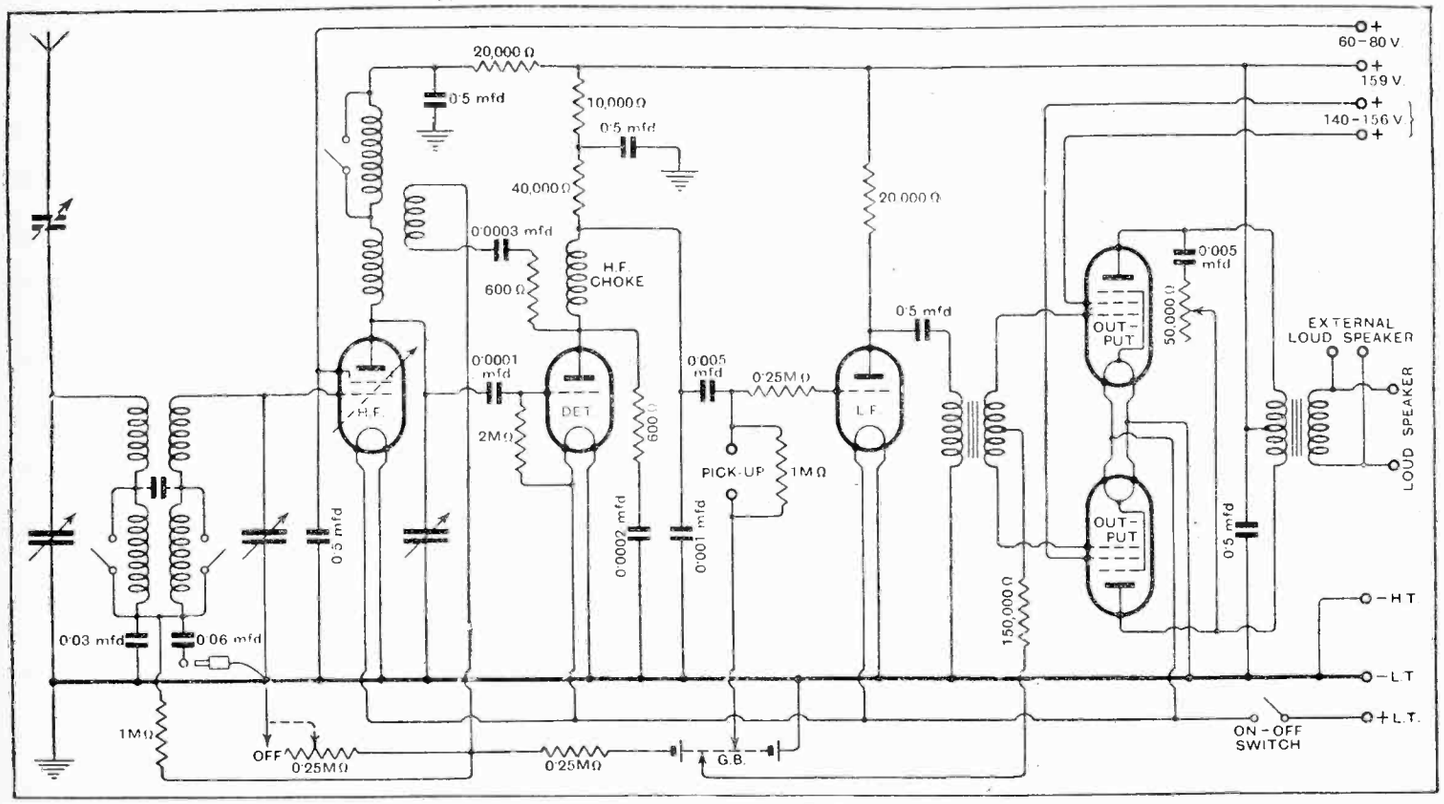
The combined sensitivity-reaction control, which has already been described, was found to work extremely well. Reaction begins to operate at exactly the right point—that at which the H.F. valve bias approaches optimum.

There is no need to sacrifice range for selectivity by using a short aerial, but the set will work very satisfactorily with one if necessary. Indeed, its sensitivity when operated with the built-in plate aerial is sufficient for those who do not require long-distance reception. Worked in this way, the set is, of course, entirely self-contained, except for an earth connection.

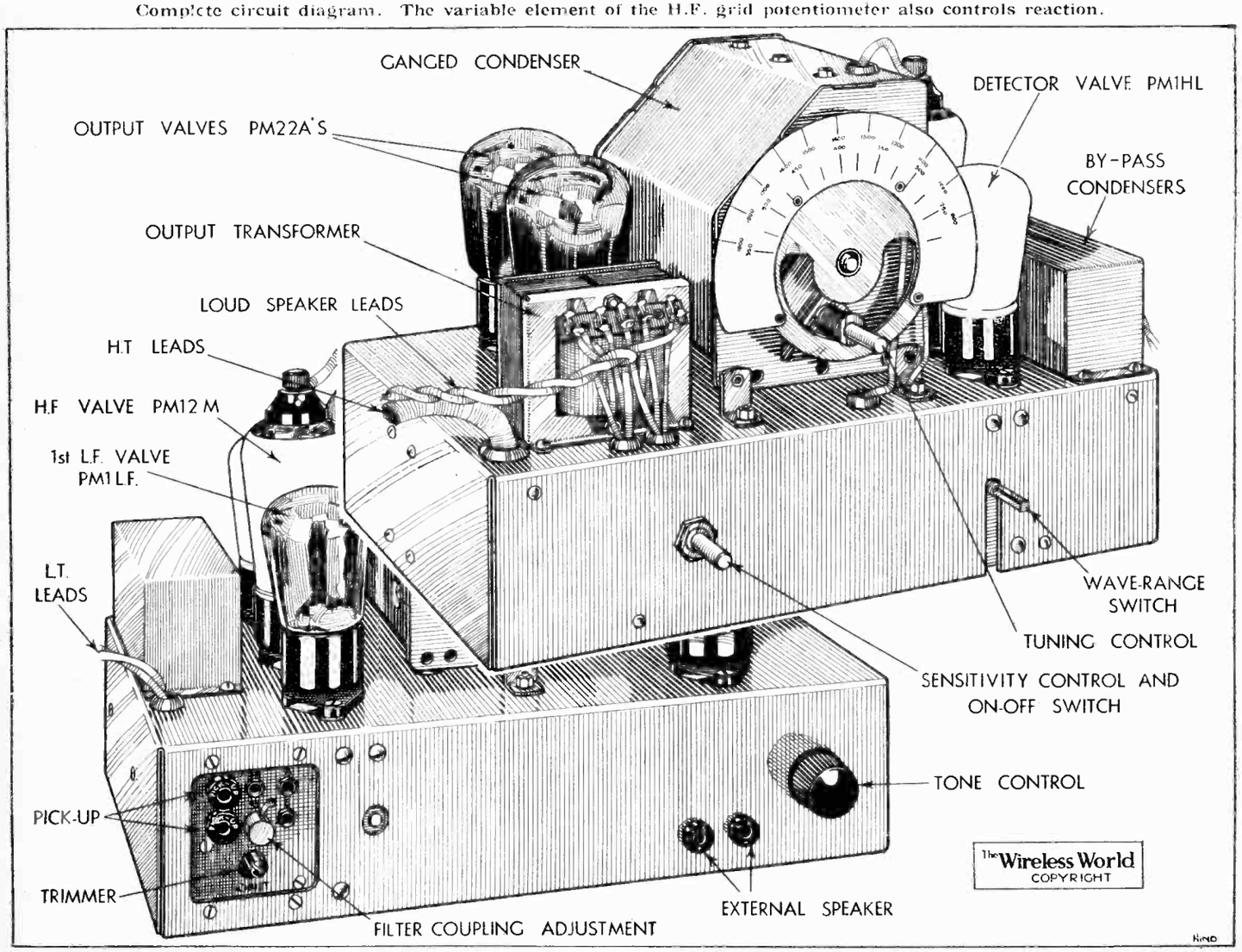
Without any sign of overloading, reproduction at a level that would have been considered impossible a few short months ago is obtainable for a very modest anode current consumption. With regard to quality, the general balance is good, with a fully adequate output in the upper register. There is no obtrusive bass resonance, but perhaps a trace of over-emphasis is given to a band of frequencies between about 100 and 200 cycles. This can seldom be detected, except when listening to certain forms of speech. Piano music—an exacting test—is reproduced exceptionally well.

Economy in anode current at every point has obviously been studied. In the quiescent condition total consumption amounts to about 7½ milliamperes; under working conditions the average current is about 8½ milliamperes.

An Economical Battery Set Giving Ample Volume



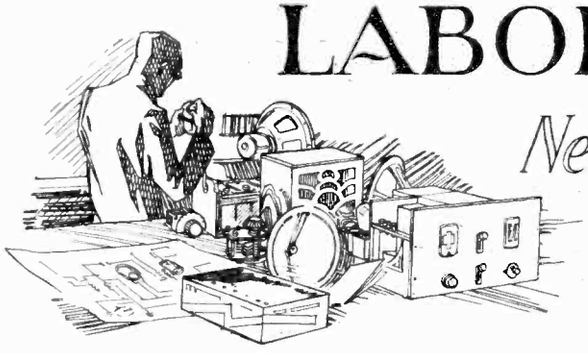
Complete circuit diagram. The variable element of the H.F. grid potentiometer also controls reaction.



Two views of the Bush Q.P.P. receiver chassis showing arrangement of the controls.

LABORATORY TESTS

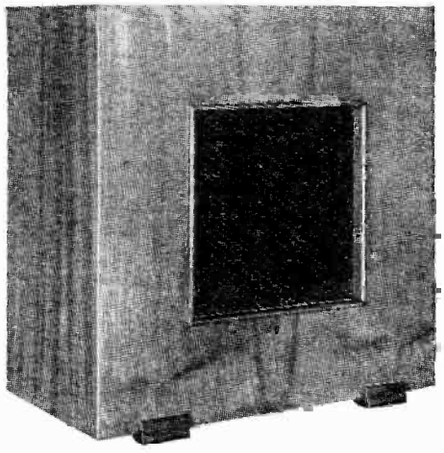
New Radio Products Reviewed



LOCKWOOD LOUD SPEAKER CABINETS

PARTICULARLY well-made loud speaker cabinets, the smallest of which provides ample space for accommodating the majority of moving-coil loud speaker chassis now in general use, are obtainable from the Longley Radio Manufacturing Co., 63, Longley Road, Harrow, Middlesex, at prices which are undoubtedly most reasonable considering the workmanship and the nature of the material employed.

The specimen examined and illustrated here is listed as Type S2, a walnut-finished model costing 22s. 6d., with inside dimensions of 14in. × 14in. × 7⅞in., and having a silk-covered front opening 7¼in. square. Behind this is a removable baffle board ⅜in. thick, in the centre of which is a circular hole 6¼in. in diameter. Since the cabinet is constructed from ⅝in. wood the loud speaker is mounted on the equivalent of a



Lockwood walnut-finished loud speaker cabinet model S2.

board ⅛in. thick, which should go a long way towards eliminating all objectionable box resonance.

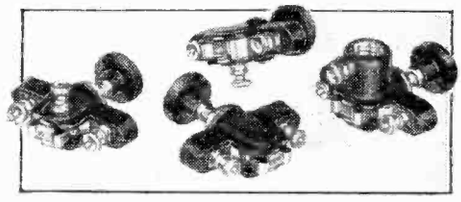
The back, which is removable, is cut from ¼in. wood, and has a number of wide vertical slots, silk-covered to prevent the ingress of dust, and so offers little or no impedance to the sound waves given off from the back of the cone. A mahogany cabinet of equivalent size is available at the same price, while one in oak costs 21s.

There is a larger model made, measuring 17in. × 17in. × 9½in. inside, which in oak costs 28s. 6d., and finished in either walnut or mahogany 30s. each.

"BUSCO" SWITCHES

ALTHOUGH in general design "Busco" switches remain much the same as hitherto, sundry refinements have been introduced into their latest models; also, a few new types are now available. That no marked changes have been deemed necessary points to the soundness of the design as originally conceived, and the particular style of non-rotating and self-cleaning contacts would be difficult to better.

A neat bakelite moulding is employed for the body, the one style serving for all models. The switch is compact and easy to fit, being provided with a single-point fixing and a shoulder and insulating washer for mounting on metal panels.



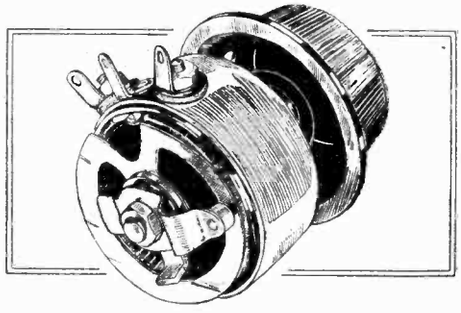
Selection of the latest "Busco" switches.

There are five different types made—a plain battery on-off switch, a three-point model, a single-pole change-over model, a radio-gramophone switch with a long extension rod, and, finally, a fuse-switch embodying a small lamp holder which enables a lamp-type fuse to be included in the H.T. negative battery lead as a safeguard for the valves. The first mentioned costs 1s. 3d., the three-point and change-over types 1s. 6d. each, and the fuse switch 2s. 6d. Fuse bulbs cost 4½d. each. The price of the radio-gramophone model is 3s.

The makers are Busby and Co., Price Street, Birmingham.

PREH POTENTIOMETERS

A NEW range of variable resistances and potentiometers of the type in general use as volume controls are now obtainable from the Preh Manufacturing Co., Ltd., Broadwater Road, Welwyn Garden City. The potentiometers are available either wound to a uniform resistance throughout or



Preh 10,000-ohm wire-wound volume control potentiometer.

fitted with a logarithmic-type resistance element. All models are wire-wound and contact is made by means of a squash-type rocking disc. This is pressed on to the resistance track so that the fine wire is not subjected to a lateral strain, and is unlikely to develop defects due to this cause.

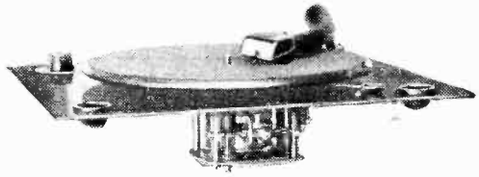
These models are very compact, measuring 1¼in. in diameter and 1in. overall in depth. The resistance is protected by a metal casing to which is attached the single-hole fixing bush. They are rated to handle up to two watts.

We have tested some specimens and find them entirely satisfactory; the measured resistances agree well with the marked values, and they are perfectly silent in operation. Preh potentiometers are made in all the usual values, and the price is 5s. 6d. each.

These components can be obtained fitted with a quick action on-off switch suitable for mains use.

GARRARD RADIO-GRAMOPHONE UNITS

TO facilitate the conversion of existing radio receivers to radio-gramophones, the Garrard Engineering and Manufacturing Co., Ltd., Newcastle Street, Swindon, have introduced a new series of radio-gramophone

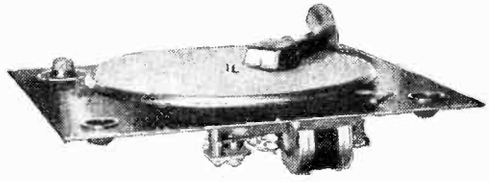


Garrard radio-gram. unit with No. 30 spring motor.

units consisting of a gramophone turntable and motor mounted, complete with the Garrard pick-up and tone-arm, on a bronzed and lacquered rectangular unit plate. All the units are fitted with the Garrard automatic stop and two needle cups.

The electric type can be supplied with the "Universal," No. 202A induction, or A.C.4 induction motors, the prices being £6 8s. 6d., £4 1s. 9d., and £3 15s. respectively. For battery-operated sets, and particularly in view of the introduction of Q.P.P. and class "B" output, units with spring-type motors are also available. The price with the No. 10B double-spring motor is £4 1s. 9d., and with the No. 30 motor £3 3s. A volume control can be supplied with any of the above models at an extra charge of 5s.

The pick-up unit is the same as that supplied with the Garrard record changer unit, and a test report, including the characteristic curve, was given in the November 18th, 1932, issue of this journal. Incidentally, the record changer unit is now available with a "Universal" motor for A.C. or D.C. mains, the price being £10 17s. 6d.



Garrard unit with A.C.4 induction motor.

It has also been decided to market the pick-up and tone arm as a separate unit, the price being 32s. 6d., or with volume control 37s. 6d.