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Practical Wireless

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Published every Wednesday by
GEORGE NEWNES LTD.
Vol. 3.——No. 59.
NOVEMBER 4th, 1933.
Registered at the G.P.O. as a Newspaper.

EDITED BY F. J. CAMM.

F. J. CAMM'S GREATEST SET IS HERE!

Vol. III. No. 59 EDITOR: F. J. CAMM || Nov. 4th, 1933
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ROUND *the* WORLD *of* WIRELESS

Don't Search for Bremen

THE Bremen relay station, which had been working on various channels on and around its allotted wavelength, has now seen its power increased to 1½ kilowatts. In view of the extra power the 268-metre wavelength has been abandoned, and the station now operates on 227.4 metres, having been synchronized with Flensburg and Hanover. These relays all take the Hamburg programme.

Copenhagen on Short Waves

FOLLOWING the example of Great Britain, Germany, and France, the Danish Broadcasting Company has decided to transmit special programmes for its nationals abroad. Pending the construction of a new short-wave station these will be put out through Skamlebaek, already operating on 49.4 metres; the extra entertainments will follow the daily programme.

New Norwegian High-power Station

THE present 1-kilowatt transmitter at Bergen, which for some time has been broadcasting on 364 metres, is to be replaced by a station of considerably higher power. The plant is being supplied by English works, and will be erected in the course of a few months. Better opportunities will then be given to British listeners for picking up its broadcasts as the new wavelength allotted is 352.9 metres.

Another Height Record

WORK on the Budapest (Hungary) high-power station at Lakihegy is almost completed, and listeners may hear tests being carried out after programme hours. So far, the steel lattice tower supporting the aerial is not entirely built; it is already two hundred and thirty metres high, but eventually will attain the height of three hundred and fourteen metres (973 feet), which should constitute a record for any European station.

And Still They Come

ACCORDING to Roumanian reports, when the new 120-kilowatt station at Bucarest has been brought into operation in January, 1935, the authorities will erect a 20 kilowatter at Brasov. This is the long-wave station (1,875 metres) of which the channel allotment has so annoyed Holland. The purpose for which this second transmitter is being built is for the provision of alternative wireless programmes.

A Boon to the Islanders

THE Portuguese authorities have decided to install small broadcasting stations in the Cape Verde Islands, situated in almost mid-Atlantic, off the Western African coast. There are fourteen inhabited islands in this Archipelago, and, as one high power transmitter would be unsuitable, at least ten or eleven of them will be endowed with small broadcasting plants capable of giving the required service. So far the definite sites of the stations have not been fixed, but it is probable that they will be situated at Sao Thiago (St. Jago), Santo Antao, Sao Vincente, Santa Luzia, Sao Nicolao, Boa Vista, Fogo, Maio, Brava and Sal. All transmitters will work on wavelengths in the lower portion of the broadcasting band.

READER SERVICE

PRACTICAL WIRELESS answers every reader's question Free of Charge.

PRACTICAL WIRELESS guarantees its receivers (when built from our recommended components) to perform in the manner claimed, under a Free Advice Guarantee.

Every worth-while development is first brought to the notice of the home constructor through the columns of PRACTICAL WIRELESS. Only components which readers can purchase are dealt with.

PRACTICAL WIRELESS could not do justice to the vast number of "firsts" to its credit in the small space here available. Several columns would be required. There is hence complete justification for our slogan: "Real, Reliable, and Unrivalled Reader Service."

PRACTICAL WIRELESS is the LEADING HOME CONSTRUCTORS' WEEKLY. It is the Journal with Original Ideas.

United States to Relay Russian Programmes

SATISFACTORY experiments have been carried out by the National Broadcasting Company, in the relay on short waves of the Leningrad and Moscow concert transmissions. It is proposed to effect an interchange of programmes from time to time.

More Powerful Swiss Broadcasts

FOLLOWING a curtailment in the transmitting hours of the smaller relay stations, it has now been decided to hurry on the reconstruction of the Beromünster and Sottens transmitters in order to increase their power to 100 and 50 kilowatts respectively. Such an alteration would increase the range of the broadcasts and permit the closing down of all relays.

America Calling Again

WHEN the B.B.C. presents another "fake" American broadcast on November 16th and 17th. Jack Hylton and his Band will impersonate, in turn, Paul Whiteman and his Orchestra, Vincent Lopez, Duke Ellington and his Band, Guy Lombardo and his Royal Canadians, all of which are great favourites on the other side of the Atlantic. We are also promised a "surprise item from Hollywood."

Listen to Palestine

WHEN the new great harbour at Haifa is formally opened on October 31st, an exchange of messages between the Secretary of State for the Colonies in England and Sir Arthur Wauchope, High Commissioner at Haifa, will be broadcast in the National programme.

Notice

JUST as we go to press Messrs. Catesbys. Ltd., 64, Tottenham Court Road, W.1. have informed us that they market a range of receivers under the trade name of "Orbit." When deciding upon the name of our Orbit Receiver we were unaware of this, and take the opportunity of drawing our readers' attention to the circumstances, so that there may not be confusion between our new set and the excellent range produced by Messrs. Catesbys, Ltd.

ROUND *the* WORLD *of* WIRELESS *(Continued)*

INTERESTING and TOPICAL PARAGRAPHS

The Growth of the Broadcasting Services

ACCORDING to recent statistics, the number of registered listeners in the principal European States is as follows: Great Britain, 5,720,500, of which 36,500 permits are allotted free to blind persons; Germany, 4,535,000, including 536,000 distributed gratis to war invalids and unemployed persons; Belgium, 392,000 (9,000 free); Switzerland, 261,000; Austria, 484,000 (2,000 non-paying); Hungary, 318,000; Czechoslovakia, 573,000 (3,400 free); Roumania, 104,400; Denmark, 514,280 (21,000 free); and Norway, 132,600. For France the total figures are not yet available.

Berlin's Ether Giant

THE 100 kilowatt station which is now under construction at Tegel, near the German capital, may be ready by the end of the year. When it is completed the Witzleben 1½ kilowatter at present in use will be adapted for television transmissions. On December 1st an exchange in wavelengths will take place between Berlin, Mühlacker and Munich prior to the "general post," which is advertised for January 15th, 1934.

Formal Opening of Monte Ceneri

FOLLOWING a complete overhaul previous to its official opening on October 28th, the Lugano (Switzerland) station has resumed its daily broadcasts. It would appear that a definite choice of wavelength has not yet been made, as, at present, the station is working on 1,126.6 metres, and not on 1,153.8 metres, or the channel which it was formerly sharing with Kalundborg (Denmark).

Provisional Austrian Relay

PENDING the selection of a favourable site for the 2 kilowatt Vorarlberg transmitter, the *Ravag* has installed a 500-watt station at Dornbirn which is relaying the Vienna programmes on the same wavelength as Linz (245.9 metres—1,220 kilocycles).

France Secures a Broadcasting Income

FRENCH listeners are generally expressing the fervent hope that the programmes supplied by the P.T.T. network will shortly show an improvement as the amount of tax collected by the State from possessors of wireless receivers to September 1st has reached over *thirty-one million* francs!

News Bulletins on Short Waves

THE German high-power short-wave transmitters at Königs Wusterhausen now broadcast news bulletins daily at G.M.T. 14.00 and 21.00 in the German and English languages through DJB, on 19.73 metres, and at 23.00 through DJA on 31.38 metres; a later edition is transmitted in German, English, and Spanish at 01.45 on 31.38 and 49.83 metres.

New B.B.C. Vaudeville Studio

THE development and extension of the vaudeville and light variety hours in the broadcast programmes has compelled the B.B.C., for the presentation of this feature, to secure larger premises than can be afforded by Broadcasting House. For this reason a temporary lease has been taken of St. George's Hall, London, the home of the Maskelyne magic shows since 1905. The step was made necessary through the loss of the (Wharf) No. 10 studio, which is required in connection with the scheme for the reconstruction of Waterloo Bridge. St. George's Hall will accommodate an audience of over 500.

THE B.B.C.'s NEW STUDIO

The interior of St. George's Hall, which is to replace the famous B.B.C. studio at Waterloo Bridge, known as Studio No. 10.

SOLVE THIS!

Problem No. 59

Blacksmith was very keen on listening to Huizen, and always switched his receiver on for the early morning broadcasts from this station. He only had a three-valve set so that signals were not overpoweringly loud. He noticed, however, that on some mornings the strength was quite good, whilst on other occasions the station could only just be heard. He had his receiver overhauled and found that it was in perfect condition. What accounted for the differences in signal strength? Three books will be awarded for the first three correct solutions opened. Address your entries to The Editor, PRACTICAL WIRELESS, Geo. Newnes, Ltd., 8-11, Southampton Street, Strand, London, W.C.2. Envelopes should be marked Problem No. 59 and posted to reach here not later than November 6th, 1933.

SOLUTION TO PROBLEM No. 58

Although everything was correctly wired, Bradbury had purchased a set of I.F. transformers working on a frequency of 129 kc/s, whilst the oscillator coil was for 110 kc/s. When the I.F. transformers were changed the receiver functioned perfectly.

The following three readers gave correct solutions to Problem No. 57, and books have, therefore, been forwarded to them:

W. A. Newell, 213, Green Lanes, Finsbury Park, N.4.
R. T. Ward, Exeter College, Oxford.
C. L. Philps, Runnymede, Hawkwell Chase, Hockley, Essex.

Two New Spanish Stations

EAJ 33 is the call-sign of a small broadcasting transmitter which has been erected by an association of local newspapers at Tarragona, a seaport in the province of that name on the west coast of Spain, some 50 miles S.W. of Barcelona. The plant, although small and of low power, is strictly modern. The wavelength used is 202.2 metres (1,483 kilocycles). A 250-watt station is also in operation at Bilbao on 203 metres (1,477 kilocycles). Go to it, ye DX ether searchers.

No Women Required

ALTHOUGH some of the German studios have boasted of female announcers in their studio staffs, it has now been decreed by the authorities that a woman's place is in her own home, and except for the conduct of the Children's Hour, on certain days, talks or dramatic productions for which the presence of a woman is a necessity, the German *Fraus* will no longer take any further part in broadcasts.

Hamburg on High Power

WORK on the new Hamburg transmitter is so far advanced that, as a provisional date for its official launch on the ether, January 15th, 1934, has already been fixed. The station will work on 331.9 metres (904 kilocycles). As soon as it has been brought into operation and taken over its regular duties the Kiel relay will be closed down.

Nearing Six Millions

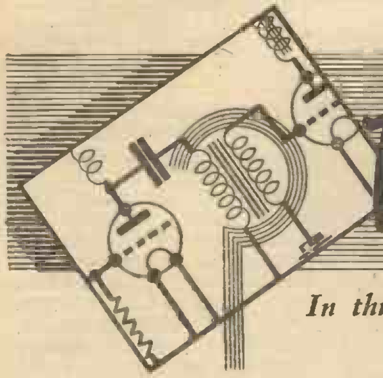
DURING the month of September the Post Office issued roughly 384,500 listening licences, bringing up the total number, less those expired, to 5,720,500, thus making a further gain of over sixty-six thousand. At this rate there should be no difficulty in reaching the six million mark by Christmas.

Economies in Programme Material

IN future, British listeners to the Langenberg, Mühlacker, and Frankfurt stations for the main broadcasts will be able to choose the most favourable of these three channels, as the transmitters will mainly work on the simultaneous broadcast principle. Each city, in its turn, will hold itself responsible for certain features of the day's radio entertainments. A similar amalgamation is foreseen for Hamburg-Berlin-Königsberg (Heilsberg), and Munich-Breslau-Leipzig.

World-Wide Broadcast on Armistice Day

FOR the first time in the history of broadcasting the service at the Cenotaph, on November 11th, will be transmitted simultaneously to all quarters of the earth. The listener in Vancouver will hear it at 3.0 a.m., whereas in various parts of Australia and New Zealand he will have to tune in to the Daventry short-waver between 7.0 and 10.30 p.m., G.M.T. Without doubt, it is an arresting ceremony which the entire British Empire will be anxious to listen to.



Why not Direct Coupling?

In this Article the Author Describes Its Working Principles and Possibilities

By H. J. BARTON CHAPPLE, Wh.Sch., B.Sc., A.M.I.E.E.

HAS it ever struck you that, apart from the tuning arrangements and the valves, the greatest expense involved in building a receiving set generally is due to components used for inter-valve coupling—transformers, condensers, resistances, and the like? And

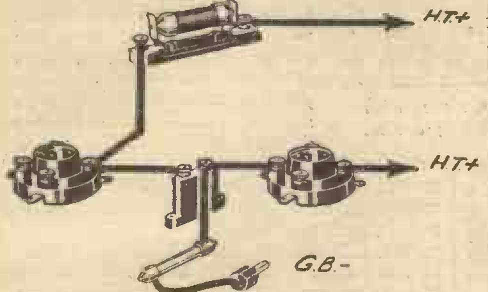


Fig. 3.—How "isolation" is achieved with choke capacity coupling.

have you ever wondered whether some alternative arrangement might not be possible which would reduce expenditure in this direction?

In order to investigate the possibilities of the suggestion it is first of all necessary to obtain a clear idea of the actual functions of all inter-valve couplings. Strictly speaking, the coupling element proper is merely a device for transferring the alternating (that is, radio frequency or audio frequency) voltages developed in the anode circuit of one valve to the grid circuit of the following valve, and in this way permitting the second valve to take the process of amplification a step farther.

A Dual Purpose

The apparatus, or group of apparatus, used for intervalve coupling, however, does something more than that in practice. In the first place, one and the same piece of apparatus frequently acts not only as a coupling device, but also as the actual load in the anode circuit of the first valve. Suppose we take a low-frequency transformer coupling, for example, as shown in Fig. 1. The primary winding is connected in the anode circuit. The alternating voltage developed across this winding causes similar variations in the magnetism of the iron core, and this in turn results in the setting up of a further alternating voltage in the secondary winding, this secondary voltage being applied to the grid of the following valve. Strictly speaking, only the magnetic core of the transformer is the actual coupling component. The primary winding is merely the load in the anode circuit of the first valve. Yet we glibly talk about "transformer coupling" as though the whole purpose of the transformer was to act as a coupling unit.

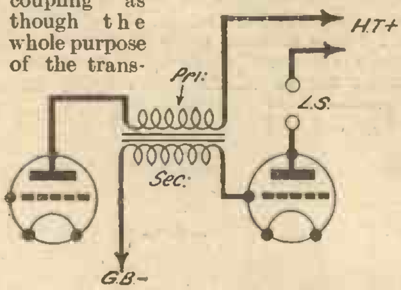


Fig. 1.—Illustrating simply the fundamentals of a transformer-coupled stage.

Again, considering the low-frequency transformer, every listener is aware that most transformers have a step-up ratio between the number of turns on the secondary and the number of turns on the primary. This means, of course, that the voltage developed in the secondary is greater than the alternating voltage available in the primary, roughly in the proportion of the turns ratio of the transformer. The transformer, therefore, acts both as coupling element and as a low gain amplifier.

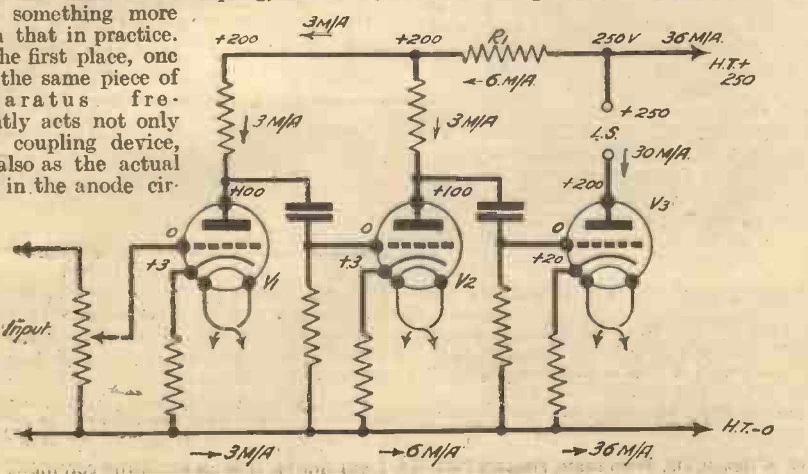


Fig. 4.—The current and voltage distributions in an R.C. coupled amplifier.

For Isolation

But a transformer does even more than this. If you examine the circuit of a conventional receiver, you will observe that the primary and secondary windings of the low-frequency transformer—or, for that matter, of any transformer—form parts of distinct and isolated circuits. This means that the high-tension potential applied to the primary is isolated from the grid circuit of the following valve. This, be it noted, is really the most important of the functions of a coupling device in receivers of standard type, and it is to a great extent because of the necessity of thus isolating the anode circuit of one valve from the grid circuit of the next that intervalve couplings of the types at present in use are essential.

Isolation is obtained in different ways in different types of coupling. Thus, in a transformer, as shown in Fig. 1, the isolation is due to the use of two separate windings, impulses being transferred from one winding to the other by means of magnetic coupling.

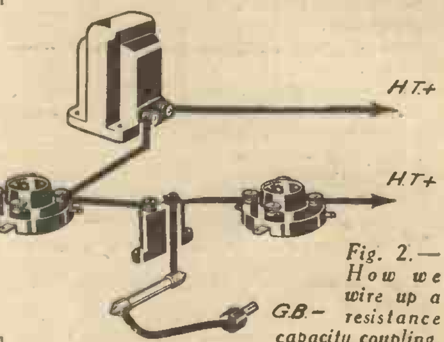


Fig. 2.—How we wire up a resistance capacity coupling.

In resistance capacity coupling, and in choke capacity coupling (see Figs. 2 and 3) on the other hand, isolation is achieved by a series condenser separating the anode circuit of one valve from the grid circuit of the other. Alternating signals are passed by the condenser, but the direct high-tension voltage is not transferred.

Now from the very earliest days of broadcasting, intervalve couplings have been under suspicion as the means of introducing a certain amount of distortion, and some listeners still imagine that most of the distortion from which they suffer is due to this cause. In those early days there were certainly good grounds for such suspicion—transformers, especially the cheaper types, were very prone to saturation, while the correct design of resistance capacity units was not properly understood.

(Continued overleaf)

WHY NOT DIRECT COUPLING?

(Continued from previous page)

To-day, the quantitative design of circuit components is on a much better basis, and I will go so far as to say that, using standard components, the amount of distortion due to intervalve couplings is negligible compared to that caused by the overloading of valves —particularly high-frequency valves and detectors, or by endeavouring to get more out of a set than it is designed to give.

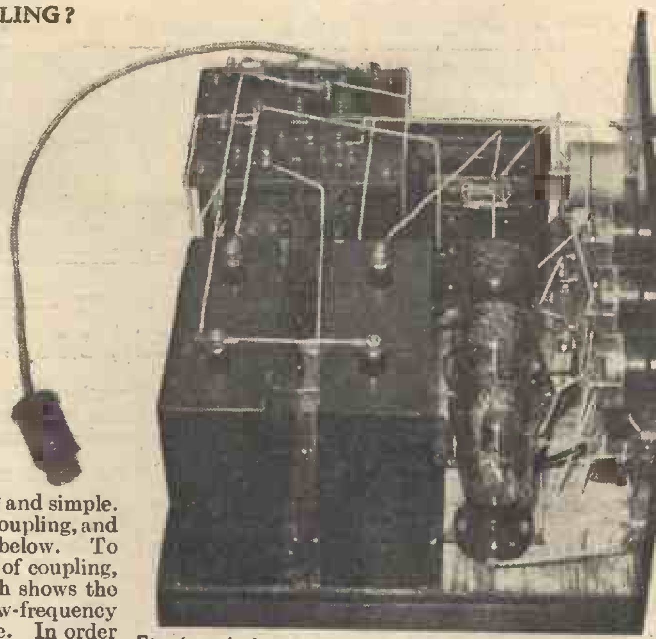


Fig. 6.—A direct-coupled amplifier of three stages with a mains feed to the potentiometer voltage dropping device.

A Suggested Scheme

It is, however, interesting to know that a method exists, and has been used, which does away with any apparatus intended to act as a coupling pure and simple. This scheme is known as direct coupling, and a brief account of it is given below. To grasp the principle of this form of coupling, we will first study Fig. 4, which shows the connections to a three-valve low-frequency amplifier of the A.C. mains type. In order to avoid any tendency to distortion due to the presence of iron cores which may become saturated, resistance capacity coupling is frequently employed, and this is the method illustrated in the diagram. For the sake of simplicity I have omitted all the decoupling condensers and just shown the bare skeleton circuit, including automatic biasing resistances. Further, I have indicated the actual voltage with respect to earth at every point in the diagram.

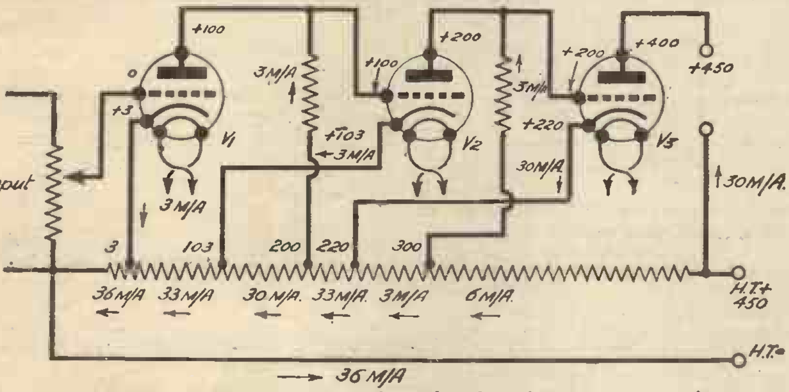


Fig. 5.—Using a voltage drop resistance in order to distribute the current inter-valve potentials.

You will observe that a maximum high-tension voltage of 250 is assumed. Allowing for a 50-volt resistive drop in the loud-speaker winding, the anode of the output valve will be at a mean voltage of 200 above H.T.—and the cathode, say, at 20 volts above H.T.—while the grid, due to the existence of the grid leak, is at zero potential, *i.e.*, 20 volts below the cathode.

Next, a loss of 50 volts is allowed for in dropping resistance R_1, giving 200 volts at the top ends of the two anode resistances. In each of these there might be a drop of 100 volts, giving 100 volts at the anodes of the first two valves. Each of these valves has 3 volts grid-bias obtained by raising the cathode voltage 3 volts above H.T.— by means of biasing resistances, and the grids of these valves are, of course, at zero potential.

Why it Works

The whole amplifier works, of course, because there is a steady difference of potential between the cathode and the grid of the various valves to accommodate the signal voltage applied to each grid; a large difference of potential between cathode and anode of each valve to maintain the anode current; a load in each anode circuit across which the varying anode current causes an alternating voltage, and a coupling condenser to transfer this alternating voltage to the grid of the next valve. In Fig. 4 the amount of current, in milliamperes, flowing in each branch of the circuit, is indicated.

Having agreed that the circuit works solely on account of the correct differences in potential existing between the different points in the circuit, we can now turn to Fig. 5, which shows in skeleton form a so-called direct-coupled circuit.

Here you see that a high-tension supply of 450 volts at the total current of 36 milliamps is provided, and across it is connected a resistance which can be tapped at any point. (In practice, this resistance would be made up of a number of fixed and adjustable units, but for the purpose of explanation we will consider it as a single resistance.)

It is clear that there will be a voltage drop along this resistance and that any voltage between zero and 450 can be obtained by making a tapping at a suitable point. At a point near the negative end a tapping is taken to the cathode of the first valve, which is thus 3 volts positive. Then at a point which gives a voltage of about 200, a further tapping is taken through an anode resistance to the anode of the first valve, and from the anode a connection is taken direct to the grid of the second valve. Allowing, as before, 100 volts drop in the anode resistance, the anode of the first valve, and the grid of the second valve will both be at 100 volts above H.T.—.

In order to give the correct negative bias on the second valve, therefore, the cathode connection for this valve must be taken at a point which gives a potential of 103 volts, and to obtain the correct difference of potential between the cathode and anode of the second valve, the tapping to the anode resistance of V_2 must be taken at a point which gives approximately 300 volts, which, allowing as before, 100 volts drop in the anode resistance, makes the anode 200 volts positive, or nearly 100 volts positive with reference to the cathode.

Similarly, because the grid of the output valve is 200 volts positive, its cathode must be at 220 volts positive to secure the necessary 20 volts bias, while the anode is maintained at 400 volts positive, *i.e.*, approximately 200 volts relative to the cathode.

The voltages at the various tapping points are given on the diagram, and also the currents flowing in the various branches, and it is interesting to compare these with the network for the conventional diagram in Fig. 4.

For and Against

It is clear that no distortion would be introduced in such an amplifier when correctly adjusted. Why, therefore, is not this arrangement more widely adopted?

In the first place, the overall efficiency is very low. Instead of drawing from your H.T. unit 36 milliamps at 250 volts, you draw 36 milliamps at 450 volts, that is almost twice as much power, the excess

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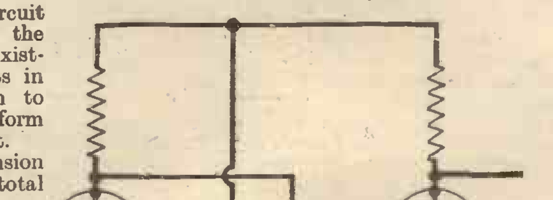


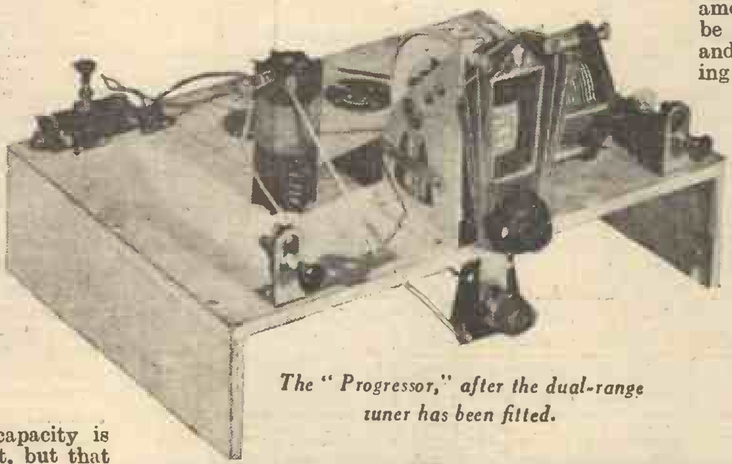
Fig. 7.—An early type of battery-coupled amplifier.

This is the Third Article in This Series, and in it FRANK PRESTON, F.R.A., Describes the Construction of an Efficient Dual-range Tuner. Although one of a Series, the Article is Complete in Itself.

IN the last article I described a number of experiments which you could carry out in respect to reaction control. If you have followed through them you will, no doubt, have gained a considerable amount of experience and useful knowledge regarding this aspect of receiver design. Provided that you are sufficiently interested in reaction experiments I would suggest that you might try the effect of varying the number of turns on the reaction coil, and also try the effect of moving the coil into different positions whilst using the differential condenser as control.

> **SPECIAL NOTE**
>
> **Since the first article was published under the above heading it has come to our notice that some constructors have found difficulty in obtaining the Telsen tuning condenser and drum drive specified. This is due to the fact that these components are not now being made, and although some dealers have them in stock, others are unable to supply. In view of this difficulty we take this opportunity of pointing out that the "Universal Log" tuning condenser and "Baseboard Drum Drive," made by Messrs. Jackson Bros., can be used instead with every satisfactin. In this case a "Mounting Bracket" of the same make will be required upon which to mount the condenser.**

If you do this you will, no doubt, discover that a particular number of turns, situated at a fairly critical distance from the tuned winding, give optimum results. I do not mean that under those conditions reception will, of necessity, be louder, but that you will obtain a smoother control over high-frequency feed-back (reaction, in other words). The ideal to aim at is to obtain such a compromise between the number of turns and their distance from the tuned winding that the detector valve goes into oscillation very, *very* gradually. By this I mean that there should not be a sudden "plop" as the condenser capacity is increased past a certain point, but that the valve should go into and out of oscillation without any sound other than a faint "breathing." Besides this, the optimum setting of the reaction condenser should not vary within more than very narrow limits at different positions of the tuning dial.



The "Progressor," after the dual-range tuner has been fitted.

NEXT WEEK'S EXPERIMENTS WILL DEAL WITH DECOUPLING.

For the reception of nearby stations critical reaction control is by no means essential, but it is of more importance than anything else when making an attempt to receive over long distances with a simple two or three-valve set. From this you will realize the necessity for careful "balancing" of the reaction circuit. If you find that, no matter how you adjust the position of the moving coil, reaction control is still "fierce" or "ploppy" you might try a smaller or greater number of turns on the winding. First of all reduce the number to about 80; you will find that the coil must then be placed almost directly over the end of the ebonite former before the set can be made to oscillate, but the nicety of control might be improved. If this alteration results in an improvement, try reducing the number of turns still more; if the reverse is the case, see what alteration an increase, up to 120 or so, will do. A tremendous amount of useful information can be gained from these simple tests, and if you take your experimenting at all seriously I would recommend you to make a few notes of the results obtained under different conditions.

Alternative Grid Leak Connections

There is another little thing I would like you to try in connection with these reaction experiments. The grid leak is at present connected from the grid of the detector valve to low-tension positive—try connecting it to the negative lead instead. This only involves the transference of the connecting wire from one

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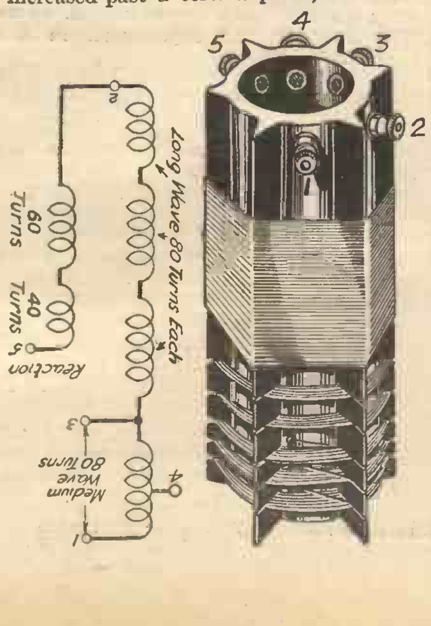

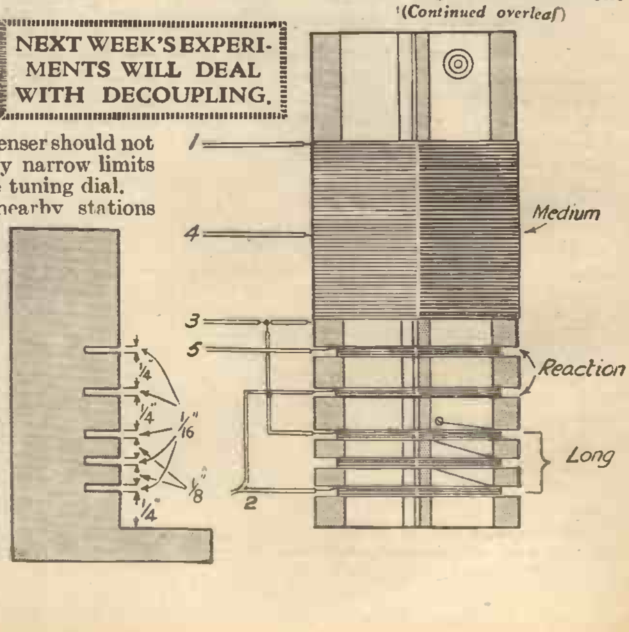

Fig. 1.—On the left is a sketch of the finished tuner and a circuit diagram; on the right dimensioned constructional details are given.

(*Continued from previous page*)

filament terminal on the valve-holder to the other. Most present-day valves give better results with the positive grid-leak connection, but there are exceptions, and in any case there is no harm in trying it both ways. In all probability it will be found that the negative grid-leak connection makes reaction control somewhat smoother, but at the same time reduces signal strength to a certain extent.

Making the Dual-range Tuner

When you feel quite satisfied with the reaction adjustments, I am going to ask you to make a complete dual-range tuner. This will remain a permanency in the set, so it should be made as thoroughly and carefully as possible. The same ribbed ebonite former as before will be used, and in addition to this we require five small terminals (the 6 B.A. size is most convenient) and an ounce of 36-gauge enamelled wire. Remove the existing winding and then the former can be marked out for the slots which are required for the long-wave and reaction windings. Also make five ⅛in. holes near the end of the former between the ribs. All constructional details for the tuner are clearly shown in Fig. 1 and the dimensions should carefully be followed. You will see that there are five slots to be made at varying distances along the ribs, and the positions of these are most easily marked by means of a cardboard template made to the dimensions given in Fig. 1. Lay this along each rib in turn and mark off the positions with a scriber or the point of a centre punch. You can then make the slots quite easily with a sharp saw—either a hacksaw or tenon saw will serve equally well since the ebonite is comparatively soft.

Medium-wave Winding

Having thoroughly prepared the former, the terminals should be screwed in place and numbered with a pencil or scriber as indicated in the drawing. Now, just below terminal 1 make two small holes (about ⅛in. or so) with a drill, thread the end of the 34-gauge cotton-covered wire through these and leave a length of two or three inches projecting inside the tube. A total of 80 turns must next be wound on the same as with our original coil, but for simplicity we shall only take a single tapping and this will be joined to a terminal for neatness. Before commencing the re-winding, therefore, you should decide which of the tapping points previously tried proved most suitable in connection with your particular aerial-earth system. Suppose the 50-turn tapping was found best; you would then put on 50 side-by-side turns, make a small hole in the section of the former occupied by number 4 terminal, form a long loop in the wire and pass this through the hole. Now you can continue the winding until the eightieth turn is reached, make two small holes below number 3 terminal, cut the wire off to length and thread it through these.

In order to prevent possible confusion at a later stage it will be best to attach the ends and tapping of the winding to the appropriate terminals before dealing with the other windings. Connection *can* be made merely by making a loop in the wire and screwing this up under the nut of the terminal, but a better job will result if the wire is soldered to the end of the terminal shanks. In connecting the looped tapping it is absolutely essential that both "halves" of the loop should make contact with the terminal, because otherwise there would be a break in the winding.

THE NEW PARTS REQUIRED THIS WEEK.

- One ounce "Lewcos," 36-gauge Enamelled Wire
- Five 6 B.A. Terminals.
- One British Radiogram 2-point Push-pull Switch.
- One British Radiogram Component Bracket, type No. 22

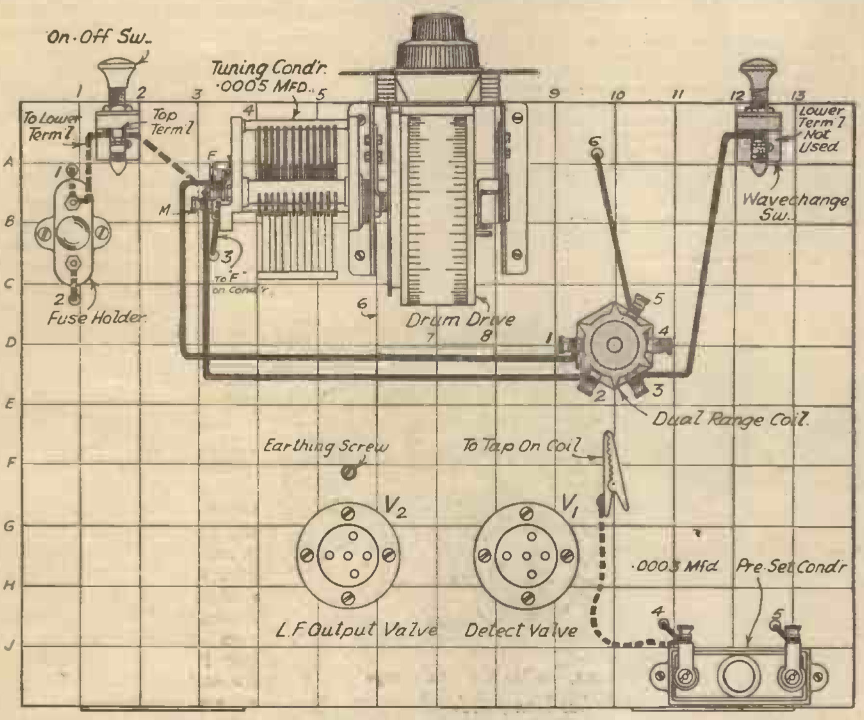

Fig. 2.—Wiring plan of the "Progressor" with dual-range tuner fitted. The wire from terminal 5 on the tuner goes through the baseboard to the reaction condenser.

The Reaction Coil

The reaction winding can next be put on the former. It will be noticed that this is in two sections, although they are both in series and are actually parts of the same winding. The positions shown for this winding were carefully chosen by experiment, so that there would be no need for you to cut a number of slots in the ebonite former in order to find them yourself. At the same time, if you wish to experiment you can certainly do so with ease. The "beginning" end of the reaction winding will be connected to terminal number 2, so you should make a pair of holes below that terminal for anchoring the wire. The winding is in the 36-gauge enamelled wire, of which 100 turns are used in all; there are 40 in the upper, and 60 in the lower, slot. Do not cut off the wire after winding the first slot, but simply carry it over to the second and continue with the winding. The "finishing" end goes to terminal 5 and should therefore be anchored by passing it through suitable holes made below that terminal. It is *perfectly essential* that the reaction coil should be *wound in the opposite direction* to the medium-wave and long-wave sections.

The long-wave winding is again divided up into sections, there being three in this case. The winding is continuous and consists of a total of 240 turns of 36-gauge enamelled wire, of which 80 are placed in each slot. The top end of the coil is joined, along with the lower end of the medium wave coil, to terminal 3; the bottom end goes to terminal 2.

When you have finished making the tuner it should be mounted on the chassis in the same way as the original coil was, and then connected up. You can see the connections in the new wiring plan given on this page, and you can also see that a new two-point push-pull switch is attached to the chassis by means of a third component bracket. Only one terminal on the switch is made use of at present, but the second will be employed at a later stage in our experiments.

The modified set will be operated in exactly the same manner as before, except that long-wave reception can also be obtained by pushing in the knob of the three-point switch. When the knob is pulled out the long-wave winding is short-circuited and the medium-wave coil only is in use. The method of operating the "Progressor" on long-waves is exactly the same as on the lower-waveband, so no difficulty will be experienced in this respect.

Next Week

Next week I shall describe a number of interesting experiments that can be tried on the low-frequency side of the receiver, and give the necessary information to enable you to fit a radio-gramophone switch. I also hope to deal with the question of decoupling and to show how a number of the defects often found in amateur receivers can be overcome at little expense. It will cost only a few shillings to buy all the parts needed next week, and these will serve to take the "Progressor" another step nearer to its final state.

By the way, if you come across any little difficulties whilst carrying out your experiments, or require an explanation of some seemingly peculiar results, remember that the PRACTICAL WIRELESS FREE ADVICE BUREAU is at your service!

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1 Dubilier fixed condenser .0003 mfd type 670		1	0
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1 Igranic L.F. transformer type "Orbit" T.24.B.		5	6
2 Clix chassis type valveholders 4 pin..		1	4
1 Clix chassis type valveholder 5 pin..			9
1 W.B. 2-point on/off switch			10
1 Belling Lee baseboard fuseholder with fuse No. 1034			9
4 Belling Lee terminals A, E, 2 Pu ..		1	0
1 Belling Lee 5-way battery cord with plugs		2	0
3 Belling Lee wander plugs GB, GB—1, —2			5
Connecting wire, screws and sundries..			11
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1 J.B. Nugang double gang condenser without disc drive No. 2050		13	6
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✻1 Polar No. 4 airspaced reaction condenser		3	9
2 Colvern Ferrocart coils types F. 10 and F.3.	1	5	0
3 Dubilier fixed condensers .1 mfd type BS		5	3
2 Dubilier fixed condensers 1 mfd type BS		4	0
1 Dubilier fixed condenser .0002 mfd type 670		1	0
1 Dubilier fixed condenser .0003 mfd type 670		1	0
6 Erie impregnated resistances:—500, 5,000, 10,000, 30,000, 50,000 ohms and 2 megohms		6	0
1 Varley DP44 automatic fading compensator and power puncher.. ..		15	6
✻1 R.I. New Hypermu L.F. transformer 4-1 ratio		15	6
2 Clix chassis type valveholders 4 pin..		1	4
1 Clix chassis type valveholder 5 pin ..			9
✻1 Bulgin toggle type nickel plated on/off switch		1	6
1 Belling Lee No. 1034 fuseholder with fuse			9
4 Belling Lee terminals A, E, Pu, Pu ..		1	0
1 Belling Lee 5-way battery cord with plugs		2	0
3 Belling Lee wander plugs GB, GB—1 GB—2			5
1 Bulgin low consumption dial light bulb			6
Connecting wire, screws and sundries..		1	0
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ALL EUROPE ON YOUR AERIAL

A Tour with Mr. F. J. Camm's Orbit Receiver, the construction of which is described on pages 365 to 368 of this issue—by BERNARD DUNN.

HAVING previously seen the ORBIT and had the many unique and up-to-the-minute features pointed out to me by Mr. Camm, its designer, I was particularly pleased to be given the opportunity of submitting the final receiver to an extended test.

Mr. Camm had told me he was satisfied that this receiver was by far the best of its kind ever offered to the home constructor and that it was the best receiver he had ever designed. Knowing Mr. Camm's phenomenally high standards of comparison, and being fully aware of the tremendous success and popularity of his previous masterpiece, the "Fury Four," I expected to find something really outstanding in this set. I was not disappointed; in fact, I was pleasantly surprised to find so many useful and novel features combined together in a receiver of such modest expense.

Careful Design

Even a cursory examination of the circuit was sufficient to satisfy me that the design had been so carefully worked out that there was nothing left to chance. The idea of automatic fading compensation in so simple an instrument also appealed to me very strongly. Beauty of appearance was another point that struck me most forcibly, whilst the entire absence of unnecessary knobs and gadgets struck a pleasing note, somewhat in contrast to the average home constructors' set which has a multiplicity of knobs scattered all over the panel and even round corners in inaccessible positions. Single dial tuning, with the added refinement of an external trimmer, is a feature of the set that is not by any means unknown in commercially-built receivers, but which is sadly lacking in many designs for home construction.

Then again I was impressed by the unorthodox, yet perfectly practical, design of the "Metaplex" chassis assembly, with the loud-speaker mounted in its rational position along with the rest of the receiver, instead of being pushed into some odd corner of the cabinet or even left right away from the set.

The "clean" component assembly and entire absence of wires on top of the chassis also reminded me more of the truly professional receiver design, rather than the mere placing of a number of components on a flat baseboard in the manner that was popular in years gone by, and which PRACTICAL WIRELESS has always considered obsolete.

But I must not take up time and space by giving my impressions of the appearance of the receiver since you can form your own opinions of this by examining the photographs and other illustrations reproduced on some later pages of this journal. What I do want to talk about are the truly astounding results that the receiver gave when I tried it out on different aerials and under different conditions. My very first test was carried out on Mr. Camm's standard model fitted in the very good-looking console cabinet. I tried it on the aerial in the PRACTICAL WIRELESS laboratories which are situated in the Strand and in the very heart of London's West End. The aerial is about 60ft. long in all and is erected only about 4ft. above the roof; it is badly screened and the lead-in comes down to the laboratories on the second floor. The earth consists of a lead some 20ft. long taken to the only convenient water pipe. I mention these facts so that you may judge the true conditions under which this preliminary test was made, and to assure you that those conditions are just about as bad as any listener is likely to encounter in any part of the country.

In spite of all this, and though the test was made in broad daylight, the first station I received was Midland Regional, and it came in at 101 degrees on the tuning dial. It gave an ample volume on the speaker for really enjoyable reception in the large room, and this despite the fact that reaction was not pushed anywhere near its limit. Whilst listening to this station I took the opportunity of setting the star-wheel trimmer on the gang condenser, and adjusted this until maximum signal strength was given with the external trimmer knob in its midway position.

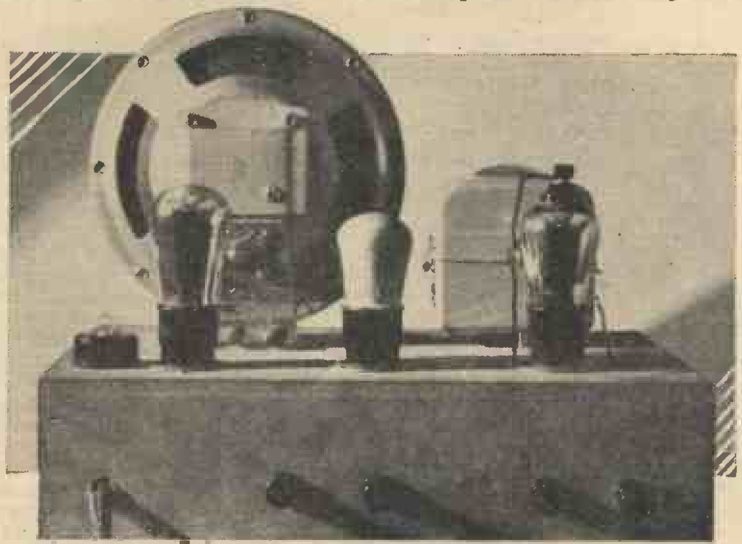
After that I turned the condenser scale to zero, leaving the wave-change switch in the medium-wave position, and then proceeded to turn it up gradually to see what stations could be brought in. The first was Fécamp, at 4 degrees, and this somewhat erratic transmission was received at comfortable (though not too loud) strength. As I knew from past experience that Fécamp generally fades pretty badly, I was surprised to find that there was no sign of any such happening. Perhaps it was because of the automatic fading compensator—I did not know, nor did I expect it to be so good as this. However, I was determined to find out, so I connected up another receiver (this one a five valve mains superhet), bu there were unmistakable signs of slow fading with that set, and so I was quite convinced that the far more satisfactory—though less powerful—reception provided by my receiver was accounted for by the clever use to which the new A.V.C. unit had been put.

Moving higher up the scale I did not find any good transmission until 261 metres was reached, when the London National transmitter came in with real "punch." The 5.15 dance music was being broadcast, and this was loud enough to dance to in any average size room in a house. The quality of reproduction was excellent and I could find no fault with it at all, although every valve in the set must have been well-nigh fully loaded. Thinking that this would be a good station on which to test the selectivity of the set, I carefully noted the "tuning spread" on the dial; it was exactly three and a half degrees—very satisfactory in view of the heavily damped aerial, and quite sufficient for every normal requirement.

After that I tuned in turn to Heilsberg, Hilversum, North Regional, Bordeaux-Lafayette, Breslau, Poste Parisien, London Regional, Mühlacker, Frankfurt, Midland Regional, Athlone, Rome, Langenberg, North Regional and finally to Prague, which came in at approximately 143 degrees on the dial. Every one of these stations was received clear of interference, whilst most of them were at good strength. The weakest were Rome, North Regional and Prague, but the programmes from these stations could be followed with ease.

Going over to the long-wave band, I soon found Reykjavik (1,200 metres) at 45 degrees, and after that, Warsaw, Eiffel Tower, National, Radio-Paris, and Huizen, the latter coming in almost at the top of the dial. Every one of these stations was at excellent strength, and any could be tuned in entirely free from interference.

So as to give the set a fairer test, I took it out into the country to a spot about twelve miles from London and less than that distance from Brookmans Park. The test was also made after dark, so you can imagine the way in which stations simply came tumbling in. All those received during daylight hours were there at considerably greater strength, but additionally, there were at least twenty others which came in sufficiently well to provide good programmes. In view of the fact that I was now using a longer and higher aerial, I rather expected that selectivity might not be quite so good. Actually, I could detect very little difference, and it was still an easy matter to receive any of the more powerful stations entirely free from interference. I did not make a detailed log of the stations received, but on the medium-wave band I counted thirty-five that could be received at "programme" strength. I know this figure is less than that *claimed* for some three-valve receivers, but it is considerably more than I have ever received at similar strength with *any battery set* on the same aerial. In all cases, tuning was delightfully easy, and reaction control was so smooth that it was a sheer joy to use it. I am quite sure that any amateur could receive as many stations as I did after very little experience with the set.



Note from this photograph how all the principal components are tucked away out of sight on the Orbit.

On the long waves I found all the stations that I had previously received on the poorer aerial, as well as another, Zeesen, between the National and Radio-Paris. Signal strength was somewhat greater, and there was no sign of interference, except between the National and Zeesen; I could tune in the latter station at respectable strength, but the National could still be heard as a faint background. Altogether, the "bag" of stations received was, I considered, extremely good—considerably better than with ninety per cent. of battery receivers having less than five valves.

It is always somewhat difficult to tell whether or not an A.V.C., or automatic fading compensation device, is operating, since if signals do not fade, the reason might be attributed either to the device itself or merely to unusually good reception conditions. I had previously checked it by comparing the results from Mr. Camm's with those given by another receiver, but I thought it wise to try yet another method of checking, this time a rather more stringent one. As it has been explained, the idea of the fading compensator is to vary the degree of amplification provided by the V.mu. valve by moderating the grid bias voltage supplied to it. This has the effect of changing the anode current, so I connected a 0—5 milliammeter in the anode circuit of the first valve and watched it carefully when different stations were tuned in. Sure enough, the needle moved freely over the scale, going down slightly when the powerful stations were being received, up on weaker ones, and constantly moving upward and downward on those which normally are subject to fading. I was more than ever convinced that the novel A.V.C. unit was "pulling its weight," and was, in a large measure, responsible for the excellent results which the set gave.

Conclusions

I concluded my tests on the set with a feeling of great satisfaction, and in the full knowledge that this latest set of Mr. Camm's eclipses not only his previous receivers, but every other I have ever tested having no more than four valves. The receiver is without doubt a set that every home constructor should make a special point of building; it is eminently modern and cannot become obsolete for a very long time to come.

OPERATING THE ORBIT FROM THE MAINS

To enable the ORBIT to be used with the electric mains, we have designed two units, one for D.C. supplies and one for A.C. supplies. These units are of such a size that they may conveniently be placed by the side of the receiver inside the cabinet and thus take the place of the batteries. There is no hum from either unit, and the voltages which are supplied are such that the valves work at their optimum points. These units will be fully described in subsequent issues, and those who wish to use the ORBIT with the mains can go right ahead with the construction of the receiver with the full knowledge that there will be no necessity to carry out alterations when the mains units are fitted.

The Cost

We have no doubt that to many readers one of the principal considerations when a new receiver is introduced is the cost. It is obviously useless to describe a receiver which employs the latest devices if the cost is prohibitive. On the other hand, it is quite as useless to cut out important features just for the sake of introducing a cheap receiver. In the ORBIT we have managed to incorporate the latest practice with the great feature of low cost, and you will see from the advertisements in this number that the complete kit for this set may be obtained for only five guineas. When you bear in mind that in addition to range, power, selectivity, and high-class reproduction, you are getting a receiver which overcomes fading difficulties, you will agree that the cost is most moderate. No economies can be effected without seriously impairing the efficiency of the ORBIT, and we are certain that when you have made the receiver you will agree that it is really low in cost.

ADDITIONAL COMPONENTS REQUIRED FOR MAINS OPERATION.

LIST OF COMPONENTS FOR THE ORBIT D.C. MAINS UNIT

One Peto-Scott "Metaplex" Chassis, 10in. by 7in., with 3in. runners.
One Bulgin Skeleton Smoothing Choke Type L.F. 17S.
One Dubilier Type BE316 Block Condenser.
Two Dubilier Type BS 2 mfd. fixed condensers.
One Bulgin 50,000 5 watt Potentiometer Type V.C. 11.
One Dubilier 30,000 ohm metallised resistance.
One Dubilier 5,000 ohm metallised resistance.
One Bulgin Twin Fuse Holder, Type F.11.
One Heayberd Mains Flex and Adaptor.
One Bulgin Toggle Switch
One B.R.G. Component Bracket No. 22.

LIST OF COMPONENTS FOR THE ORBIT A.C. MAINS UNIT.

One Peto-Scott "Metaplex" Chassis, 10in. by 7in., with 3in. runners.
One Heayberd Type W.20 Mains Transformer.
One Westinghouse Metal Rectifier, Style H.T.5.
One Bulgin Skeleton Smoothing Choke, Type L.F.17S.
One Bulgin 50,000 ohm 5 watt Potentiometer, Type V.C.11.
One Dubilier 30,000 ohm Metallised Resistance.
One Dubilier Type BE316 Block Condenser.
One Dubilier 6 mfd. Electrolytic High Voltage Condenser.
Two Dubilier Type BS 2 mfd. fixed condensers.
One Bulgin Twin Fuse-holder, Type F.11.
One Heayberd Mains Flex and Adaptor.
One Bulgin Toggle Switch
One B.R.G. Component Bracket Type 22.

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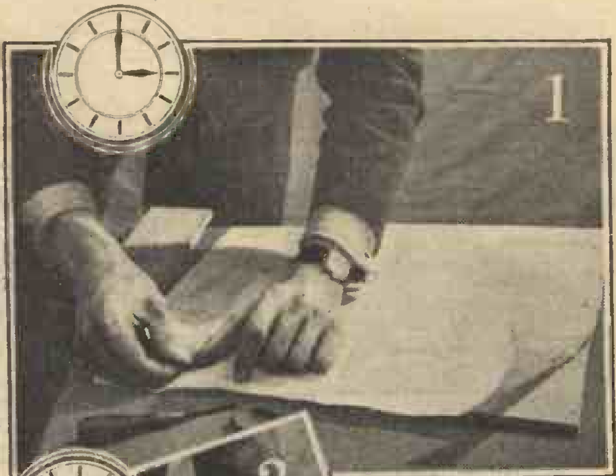

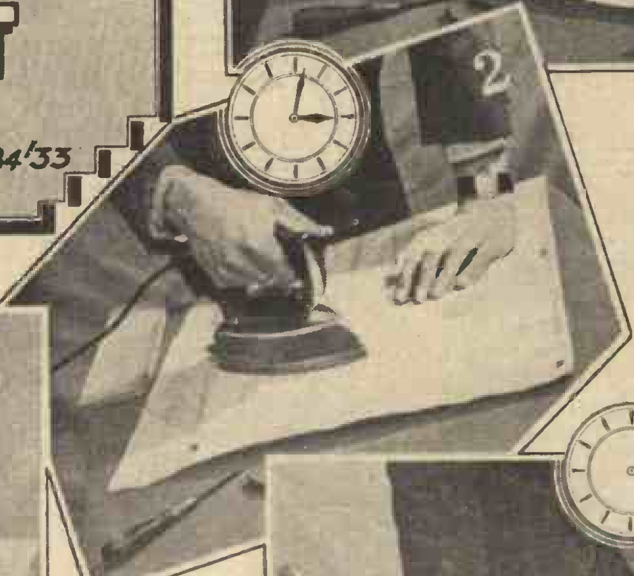

First of all pin the transfer print ink side downwards on to the chassis, as in the top photograph. Next apply a warm flat-iron as in the illustration to the left. This will cause the design to be transferred to the chassis, clearly indicating the position of all wires, components and holes.

The above photograph shows the transfer being applied to the underside of the chassis and one of the side runners.

The illustration to the right shows the transfer being removed. Note that the design now appears on the chassis.

(Left).—Re-assembling the chassis.

(Right)—Mounting the components in the positions indicated on the chassis.

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Send a postcard for our new Catalogue which describes all our products.
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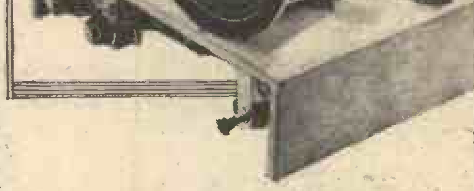
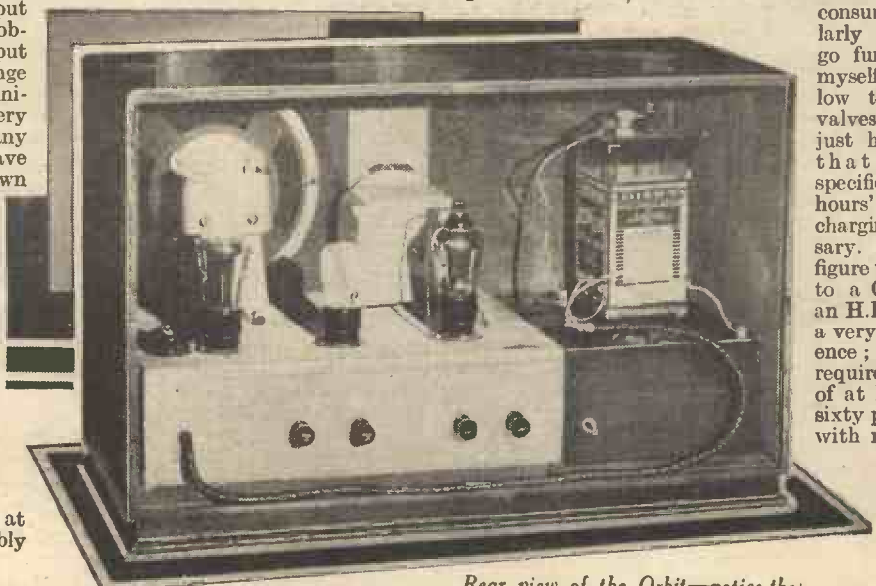


IN designing a revolutionary receiver like the Orbit there are many points to watch, and it is not sufficient merely to produce an instrument which is easy to build and which sets a new standard of performance. Nor is it sufficient to select the components to ensure a low initial cost. All these things have received scrupulous attention in designing my Orbit, but another point which is of extreme importance has also been given most careful consideration—I refer to the RUNNING COSTS ! A set which swallows the juice—like a poorly-designed motor car —is dear at any price !

I was determined that the set should be economical with current, because I know that constant replacement of high-tension batteries is a most expensive business. This is one reason why I kept down the number of valves to three and did not fit a Class B output stage. My idea was to obtain an ample signal output combined with long range and good quality for a minimum expenditure of battery power. Without making any sacrifice of efficiency I have succeeded in bringing down the high-tension current consumption of the receiver to a figure of between 10 and 12 milliamps, which is even less than that taken by the majority of very ordinary three-valvers. As a result of this the double-capacity high-tension battery specified will definitely give upwards of four months' useful service ; if you only listen in for a few hours a day you can expect the battery to last at least six months and probably longer.

Only 12 milliamps H.T. Current Consumption !

Only ½ an ampere L.T. Current Consumption !



Rear view of the Orbit—notice the "clean" lines.

Efficiency is the Keynote of the Orbit

How has this undoubted saving in running expenses been effected ? Purely and simply by designing the circuit on the most efficient lines and by choosing the components that I know to be most efficient for the circuit. I could not have done this if I had specified alternative parts, since it would be impossible to determine what would have happened when a thousand and one different combinations were possible. I have used a pentode valve because this is the most efficient low-frequency amplifier obtainable. When I say it is the most efficient I mean that it will give a greater output for any given input, and with a smaller amount of H.T. current, than will any other.

I have also used a short-base variable-mu high-frequency amplifying valve. This is a comparative newcomer to the valve market and, like all other V.M.s, its anode current is proportional to the bias voltage applied to its grid. With my receiver the bias voltage is dependent upon the strength of the signal being received and therefore the current is less when listening to the local stations than when a distant programme is being enjoyed—just another instance of efficiency with economy.

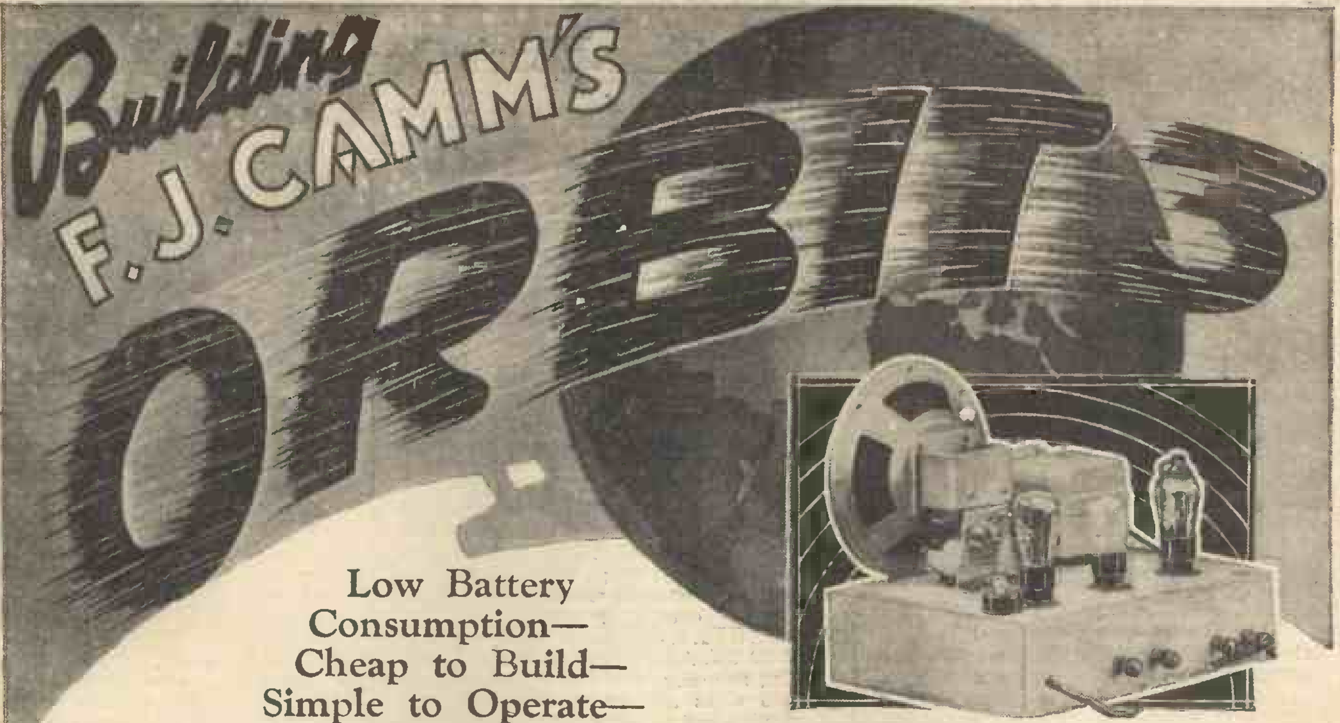
Even the detector valve contributes its share towards the reduction in running costs. It is operated at the lowest anode voltage with which its full efficiency in the circuit can be secured, and the actual current taken by this valve is too small to be considered.

Low Tension

I have said that the high-tension current consumption is particularly low, and I would go further by repeating myself in regard to the low tension. The three valves together consume just half an ampere, so that the accumulator specified will give sixty hours' service before recharging becomes necessary. If you compare this figure with that in respect to a Class B set having an H.F. stage you will see a very appreciable difference ; the latter set will require a filament current of at least .8 ampere, or sixty per cent. more than with mine. By this I do not mean in any way to belittle the Class B valve, but merely to stress the fact that when a combination of maximum efficiency and maximum economy are desired, the pentode valve (especially the Cossor high-efficiency pentode which I have used in my latest receiver, cannot possibly be bettered.

Features of my latest receiver are economy of upkeep, low first cost, ease of operation, automatic fading compensation

DESCRIPTIVE FEATURES AT A GLANCE



Low Battery Consumption—Cheap to Build—Simple to Operate—Long Range—Automatic Fading Compensation

If you are interested in the fundamental and theoretical aspects of the Orbit, you will read elsewhere the appropriate articles on these subjects. Here, I want to describe in detail the process of assembling and wiring the receiver. Let me start by saying—with rather a feeling of pride—that I have worked out the design so carefully and so thoroughly that you cannot find any difficulty whatever in making a set which will do all that I claim for it, and which is bound to give you an immense amount of satisfaction. I BACK THE ORBIT WITH MY PERSONAL GUARANTEE, WHOLEHEARTEDLY AND WITH ENTHUSIASM, FOR IT IS MY BEST YET. I would not say this if I were not perfectly sure that this latest set of mine is the best of the many hundreds I have designed during my long association of the amateur wireless constructors' movement—an association which goes back to pre-War days. The more critical you are of constructional, practical, and the finer points of design, the more pleased will you be with this set. I am a severe critic myself, and the design and performance of every Practical Wireless receiver must not only be meticulously accurate, but in its final form also capable of passing my most stringent tests.

In addition to designing the set on such lines that it can be built up without difficulty, I have gone a step farther BY MAKING ALL ARRANGEMENTS WITH MESSRS. PETO-SCOTT TO SUPPLY THE "METAPLEX" METALLIZED WOODEN CHASSIS COMPLETELY DRILLED WITH EVERY HOLE THAT IS REQUIRED. All that remains for you to do is to transfer the complete wiring plan (MY NEW AND PROTECTED TRANSFER-PRINT SYSTEM) on to the chassis, mark the components and wire up by "following the lines." IN OTHER WORDS, THE TRANSFER PRINT SHOWS NOT ONLY THE POSITIONS OF THE PARTS, BUT ALSO EVERY WIRE. Having the wires marked out on the chassis, you have only to join the actual leads between the points which are clearly marked. I have actually saved you hours of constructional work in this set, and saved you money by careful elimination of unnecessary components, knobs, and mere impedimenta.

The method of using a transfer print is fully described on another page, so I need only say now that it will be found most convenient first of all to remove the left-hand side runner of the chassis in order to transfer the coil positions and connections on to it without any difficulty. The runner can be taken off merely by taking out the three screws by means of which it is attached to the baseboard and the two that are used for attaching the thinner back of the chassis. After doing that you can turn the chassis upside down, place the runner side by side with the baseboard and then apply the transfer with a warm iron.

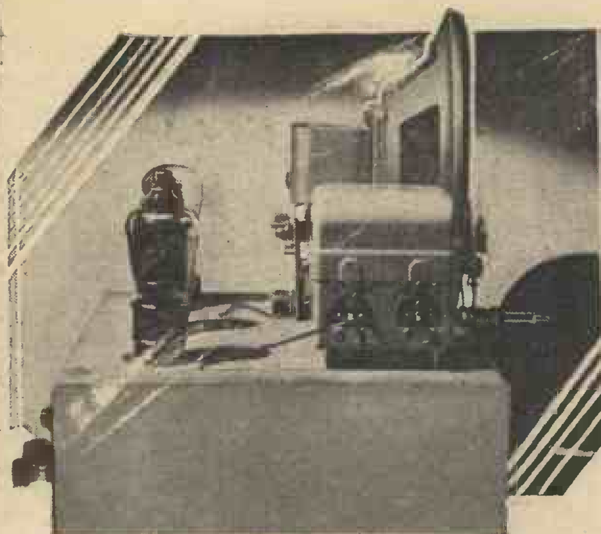
Next put the chassis right side up and transfer the above-chassis layout. Once the impressions have been made you can proceed with the simple and interesting task of mounting the various components. It is best to do this in a logical and systematic manner in order to avoid any unnecessary waste of time. I have experimented with different methods of procedure, so I can tell you exactly which is most convenient. Start by fitting the Colvern "Ferrocart" two-coil assembly on the side runner by means of four $\frac{3}{8}$in. brass screws. After that you can fix the Clix valve-holders in place with $\frac{3}{8}$in. screws. You will see that two holders are of the four-pin type whilst the third is a five-pin one; do not mistake these, but carefully notice that the five-pin holder is the one at the left when looking at the underside of the chassis.

The Lissen L.F. transformer, T.C.C. fixed condensers, Varley A.V.C. unit, and Bulgin grid-bias battery clip come next, after which you can attach the two B.R.G. component brackets, and finally the Belling-Lee terminals. It is essential that all four terminals should be insulated from the chassis, and this is arranged for in the simplest possible manner by fitting

(Continued overleaf)

OUR GREATEST SUCCESS

This Year's Outstanding Receiver for Home Constructors



CLEAN LAY-OUT!

(*Continued from previous page*)

the insulating washers (supplied with the terminals) underneath the square nuts.

Before refixing the side runner with coils attached you must mount the J.B. "Unitune" tuning condenser. This is easily done by means of the three long screws found screwed into the feet when the component is first taken out of its box. It will be found better not to mount the W.B. Microlode speaker until all wiring has been done, since it can then be kept out of the way and safe from any possible damage.

Ultra-simple Wiring

When all the parts have been fixed in position you can turn your attention to the wiring. Since this is so clearly marked on the chassis, further explanation will not be required by the more experienced constructor, but I know full well that the ORBIT will be the first set to be built by thousands of people, so I must describe the method of wiring in detail. I am not going to give you point-to-point connections and I have not had a coded plan prepared; these things are rendered unnecessary and are entirely superseded by my TRANSFER-PRINT system. INSTEAD OF, AS IN THE OLD SYSTEMS, having mentally to visualize the positions of the wires and components and then transmit them to the receiver, you HAVE EVERY WIRE MARKED IN PRECISELY THE POSITION IT IS TO OCCUPY.

Just as in mounting the components, so in wiring there is a systematic procedure which you should follow if you wish to do the job in the least amount of time. Make a start by attaching sufficiently long lengths of B.R.G. connecting wire to those terminals on the "underside" of the coils (that is, to terminals numbered 5, 6, 7 and 8 on the F. 3 coil and 5 on the F. 10). This is done before the side runner is screwed into position again and saves the difficulty of working in a confined space later. Now the runner can be fixed in place and the coil leads joined to the appropriate terminals.

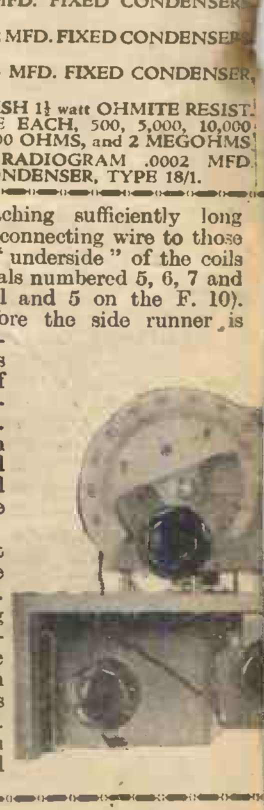
After this the rest of the wiring can be proceeded with. Start by connecting up the filament terminals on the three valve-holders with two parallel lengths of connecting wire. To do this you should first of all

EASY TO OPERATE

AUTOMATIC FADING COMPENSATION

THE COMPLETE LIST OF PARTS FO[R]

- ONE PETO-SCOTT METAPLEX CHASSIS, 14in. by 10in. by 3in.
- ONE JACKSON BROS. "UNITUNE" 2-GANG CONDENSER.
- TWO COLVERN "FERROCART" COILS, TYPES "F.10" and "F.3," on Baseplate.
- TWO CLIX 4-pin AIR-SPRUNG VALVE-HOLDERS.
- ONE CLIX 5-pin AIR-SPRUNG VALVE-HOLDER.
- THREE T.C.C. .1 MFD. FIXED CONDENSERS, TYPE 50.
- TWO T.C.C. 1 MFD. FIXED CONDENSERS, TYPE 50.
- TWO T.C.C. .0002 MFD. FIXED CONDENSERS, TYPE S.
- ONE T.C.C. .0003 MFD. FIXED CONDENSER, TYPE S.
- 6 GRAHAM FARISH 1½ watt OHMITE RESISTANCES; ONE EACH, 500, 5,000, 10,000 30,000 and 50,000 OHMS, and 2 MEGOHMS
- ONE BRITISH RADIOGRAM .0002 MFD. REACTION CONDENSER, TYPE 18/1.



The Lay-out of the ORBIT

THREE or four years ago it was the custom to build a receiver on a flat baseboard with all the components arranged in the most convenient manner and the wiring running from point to point in a rather higgledy-piggledy manner. Anyone who has looked at the inside of a modern commercial receiver will have been struck by the immense difference between the arrangements of the parts to-day and yesterday. What can you see of the components in a modern set? Beyond the valves and, in some cases, the coils, there is nothing but a neat looking metal chassis, inside of which are all the smaller parts with the wiring. Now examine the photograph of the set, and I am sure you will not hesitate to place this in the category of the most modern of receiver layouts. A completely screened condenser, three valves, an enclosed fuse-holder, and a loud-speaker comprise the total exposed parts. It is surely well-nigh impossible to have a cleaner arrangement. The chassis, although of wood, is a special product sprayed with metal and known as Metaplex, and therefore possesses all the advantages of the metal chassis which is used by all the better commercial manufacturers to-day. The advantages gained by this method of assembly are two-fold. Firstly, dust and similar troublesome particles of metal, etc., are definitely excluded from the apparatus, with consequently reduction in the risk of noisy reception. Secondly, the risk of pick-up on the wiring from a powerful local station is removed and selectivity thereby improved. A most important feature from the constructor's point of view is that the receiver is ABSOLUTELY COMPLETE on its chassis. That is, when the valves are plugged into their sockets, the chassis may be stood on the work-bench or table and the process of testing carried out and all the necessary adjustments made, after which the assembly, without any difficulty whatsoever, may be placed straight into its cabinet. Those readers who have built other receivers will appreciate the advantage of this, as it often happens that the speaker has to be temporarily wired to a set whilst testing, then disconnected while the set is placed in its cabinet and the set then does not seem so good when everything is in its place. When the entire assembly is complete, however, there is no possibility of troubles arising, and you can see exactly how things are going before assembly.

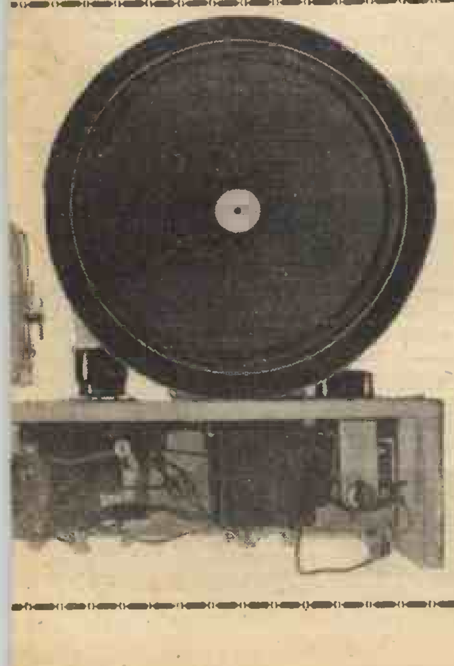
From the photographs of the complete receiver in its cabinet it will also be seen that the receiver sets a new style in home-constructed receivers in that it can be adapted to employ matched speakers. Two frets are cut in the cabinet, and the controls are situated in the centre of these. Thus the receiver, as described, may be placed into the cabinet, and the second fret left unused, or a second speaker may be purchased and mounted behind this. The advantages are surely too obvious to need emphasis. Sufficient has been said to show that in the layout, as well as in all other features, the ORBIT is an example of the very latest radio practice.

Specially Designed for Economy and High Performance

EASY TO BUILD

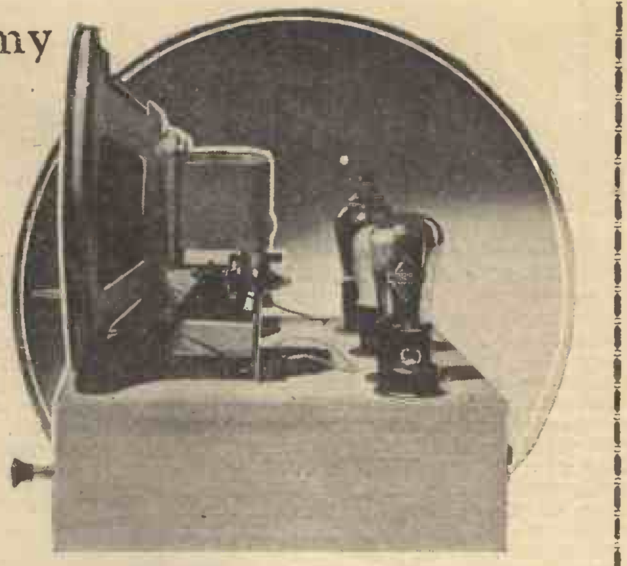
LOW BATTERY CONSUMPTION

MR. F. J. CAMM'S LATEST RECEIVER.
ONE VARLEY AUTOMATIC VOLUME CONTROL UNIT.
ONE LISSEN "TOREX" L.F. TRANSFORMER.
ONE BULGIN GRID BIAS BATTERY CLIP, TYPE No. 5.
FOUR BELLING-LEE TERMINALS, WITH INSULATING WASHERS, TYPE "B"; MARKED "A," "E," "P.U.," "P.U."
ONE BELLING-LEE FIVE-WAY BATTERY CORD ASSEMBLY.
THREE BELLING-LEE WANDER PLUGS MARKED "G.B.+" "G.B.—1" and "G.B.—2."
TWO COILS BRITISH RADIOGRAM CONNECTING WIRE.
SHORT LENGTH FLEX, SCREWS, ETC.
ONE W.B. P.M.6. "MICROLODE" LOUDSPEAKER.
ONE PETO-SCOTT CABINET.
THREE COSSOR VALVES, TYPES 220 V.S., 210 DET., and 220 H.P.T.
ONE LISSEN 9-VOLT GRID BIAS BATTERY.
ONE LISSEN SUPER 120-Volt H.T. BATTERY.
ONE EDISWAN 2-Volt 30 a.h. ACCUMULATOR.



cut off a piece of wire about half an inch longer than the distance between the terminals on the two end valve-holders. Then bare one end by scraping away the insulation with a blunt knife; lay the wire in position and mark off the distance to the second valve-holder; scrape away the insulation for a distance of rather less than half an inch. Now attach the end of the wire to the end terminal and the bared portion to the middle one, after which it can be cut off to the exact length required and the other end bared, before being secured to the terminal.

After that I recommend you to start at the right-hand side of the chassis and work towards the left, taking all the wires in turn. There is one little point that might not seem quite clear, which is that the fixed resistances are not actually attached to the chassis, but are supported by their own connecting wires. It might also not be fully understood that one wire is joined to a holding-down screw on the coil assembly; this is for the purpose of earthing the screening covers of the latter. One wire is taken to a bolt passing through the base-board of the chassis, so that it makes contact with the upper (metallized) surface.



NOTHING OBTRUSIVE!

All the wires except two are attached to the appropriate terminals by forming a loop and screwing the nut over this. A variation occurs in respect to the two leads going to the gang condenser, however, since terminals are not provided on that component, and in consequence the leads are soldered to the connecting tags fitted. If you are not accustomed to soldering, do

(Continued on page 368)

Fitting the ORBIT into its Cabinet

AFTER you have given the ORBIT a preliminary test and adjusted the condenser trimmer, you will wish to fit it into its most attractive cabinet which I have specially designed for the purpose. This is of an entirely new design, with a number of novel features which are described on page 371.

The front of the cabinet is so arranged that the three main controls (tuning, wavechange, and reaction) fit exactly in the centre between the two distinctive speaker frets. Due to this arrangement the final appearance is particularly neat and symmetrical, as you can see by examining the photographs.

Actually, the receiver itself fits right up against the right-hand end of the cabinet (as seen from the front) and so leaves an ample space for batteries at the other end.

There are two ways of locating the positions of the holes required for the controls, the simplest of which is to make use of the dimensioned front view of the chassis given on this page. The other is to fit the set in the approximate position which it is to occupy and then mark off the centres for the various holes on the inside of the cabinet. In either case the general method of procedure is the same.

If you propose to make use of the drawing it will be best first of all to check the dimensions of your receiver in order that you can make perfectly sure that all the components and mounting brackets are in their exact positions. Next find the centre of the front panel and mark off the height of the tuning condenser spindle. This position can be used as a basis for all the other dimensions, and the centre of the dial escutcheon can be marked at the correct height above it. After that you can locate the centres of the other four holes before preparing to drill them out.

In marking out care should be taken not to scratch the highly polished surface of the cabinet, and for that reason it is safer to make the lines on the inside or on a paper template. They can be drawn with a pencil, after which a small hole (about 3/32in.) should be made at the centre of each. Holes of the actual size required can then be made from the front of the cabinet with a brace and suitable bits without any danger of scratching or otherwise damaging the cabinet. The largest hole is that for the tuning condenser escutcheon and this should be 1½in. diameter. Use a centre bit for preference and go about half-way through the panel from the front; then complete the hole from the back so as to avoid any splitting of the edges. All the other holes can then be made in a similar manner with a ⅜in. bit; this size is greater than the diameter of the spindles, but allows the nuts of the mounting bushes to fit into the wood in order that the spindles may be allowed to project sufficiently far from the front of the cabinet.

When the holes have been made, fit the set into the cabinet and attach the loudspeaker unit to the front panel by means of four ½in. screws. After that the necessary knobs can be attached to the spindles.

THE CONSTRUCTION DESCRIBED

(Continued from previous page)

not "fight shy" of these connections, for they can be made by passing the bared ends of wire through the small holes in the soldering tags, making a loop and nipping this up tightly with a pair of pliers.

The Belling-Lee battery cord assembly can be dealt with last of all, and these leads are best connected by tightly twisting together the strands of fine wire forming the flex and making a loop of correct size to fit nicely over the terminal shanks.

After all the wiring has been completed the W.B. speaker unit should be mounted on top of the chassis. It is held in position by two ⅜in. screws and is so placed that the front of the cone is just in line with the front edge of the chassis. The two flexible leads coming through the holes marked 4 and 5 on the baseboard are then joined to the outside terminals on the speaker, the centre (red) one being left free.

You can now place the valves in their holders in the order shown on the upper surface of the chassis. The flexible lead which passes through hole number 3 is joined to the terminal on top of the variable-mu valve.

Connecting the Batteries

Before fitting the receiver into the cabinet it will be just as well to connect the batteries and give it a preliminary trial and to make the few simple, initial adjustments. The grid bias battery fits into the Bulgin clip on the underside of the chassis and the wander plug marked "G.B.+" should be placed in the positive socket. Plug "G.B.—1" goes into the "4.5 volts" socket, and "G.B.—2" into the "1½ volts" one.

Next connect the L.T. spade terminals to the positive and negative accumulator terminals The "H.T.—" plug should then be fitted into the negative socket on the high-tension battery, when "H.T.+1" and "H.T.+2" plugs are inserted into the "60 volt" and "120 volt" sockets respectively.

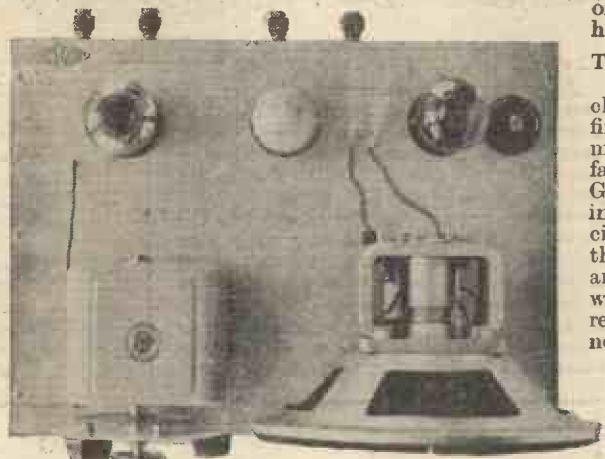
THE COMPONENTS

The Coils

THE heart of any receiver is, of course, the tuning arrangements, for if these are poorly designed the receiver will be useless when trying to receive distant stations working on wavelengths not far removed from powerful stations. The most modern tuning coil is of the powdered-iron core type, and quite naturally we have incorporated this in the Orbit. The particular coils chosen employ Ferrocart cores, and are made by the well-known firm of Colvern.

The A.V.C. Unit

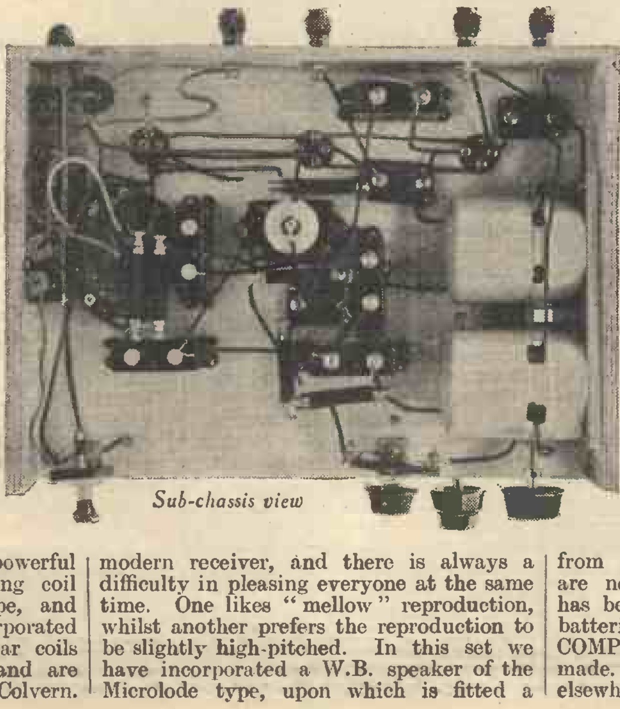
As it was deemed essential to employ an arrangement for removing fading troubles, it was found that a commercial A.V.C. unit could most conveniently be included in the circuit WITH A SAVING IN COST. The unit which is used is manufactured by Varley, and includes an H.F. choke, in addition to a metal rectifier and other components. The cost of these, taken separately, actually works out dearer than the complete unit, so that we have the valuable feature of anti-fading compensation, plus reduction in cost.



Plan view.

The Speaker

A moving-coil speaker is essential in a modern receiver, and there is always a difficulty in pleasing everyone at the same time. One likes "mellow" reproduction, whilst another prefers the reproduction to be slightly high-pitched. In this set we have incorporated a W.B. speaker of the Microlode type, upon which is fitted a matching transformer with adjustable arms. It is thus a simple matter to vary the matching ratio so that the tone may be of the type desired. The arrangement is really intended for correct matching of the load to the valve, but when this is not quite correct a slight modification in tone is obtained, and this forms quite a useful feature for certain broadcast items. In addition, the speaker is of the type which gives not only a high degree of sensitivity, but also a really high-class reproduction.



Sub-chassis view

The Rest of the Components

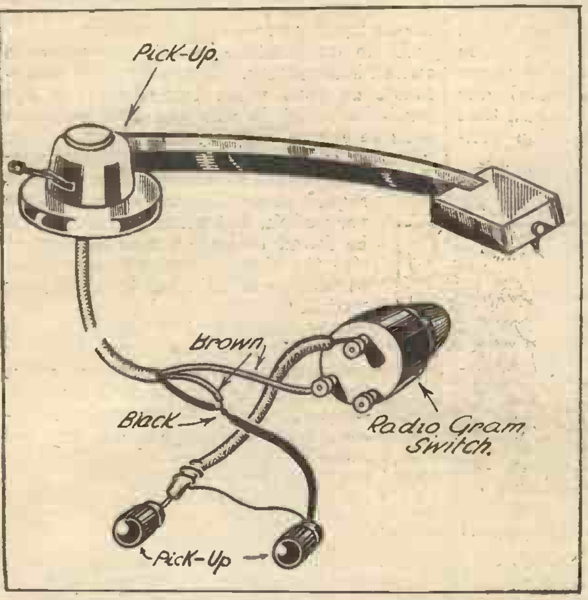
For the rest of the parts equal claims may be obtained. Thus, the fixed condensers are above reproach, made by T.C.C., a name which is familiar to all. The resistances are Graham Farish Ohmites, unvariable in use, and easy to connect into circuit. Clix valveholders ensure that the valves will be firmly held without any risk of noisy operation, and with a semi-floating grip which reduces any tendency to microphonic noises.

BATTERY OPERATION

THE receiver has been designed primarily for operation from batteries. Many readers will no doubt say that this is not up to date, and that a modern receiver should be mains operated. It must be remembered, however, that there are thousands of homes in England where the electric supply mains have not yet been connected, and where, perhaps, it will be many months before there is any opportunity of obtaining supplies from that source. Furthermore, there are many homes fitted with electric light, but where the listener, owing perhaps to unfortunate circumstances, cannot afford a mains receiver, and finds that cheap power obtained from batteries fulfils his needs. Therefore Mr. Camm designed his latest set primarily as a battery receiver, but, during the whole of the experimental period, it was borne in mind that the receiver would have to be eventually arranged so that the electric-light user could employ that source as his power. This portion of the work is dealt with farther on. For operation from batteries, the only requirements are the standard H.T., grid-bias, and L.T. sources, and you will see from the list of parts that these are not expensive items. The cabinet has been designed to accommodate these batteries, and there are absolutely no COMPLICATED ADJUSTMENTS to be made. The full connections are given elsewhere.

Equally Efficient as a Radio-Gramophone

ALTHOUGH I originally designed the Orbit as a wireless receiver pure and simple, to make the set suitable for the requirements of all battery-set users I made allowance for the connection of a pick-up when required, so that the set could be used as an amplifier for gramophone reproduction, and I selected the handsome (and low priced) Peto-Scott Adaptagram cabinet in which to house it. To use the Orbit with a gramophone it is only necessary to connect the pick-up leads to the terminals provided and place the wander plug marked "G.B.—2" into the 1½-volt socket of the grid-bias battery. So as to prevent the possibility of the wireless programme interfering with gramophone reproduction, the tuning condenser should be set to zero, where no station is to be heard.



A diagrammatic illustration of the radio-gramophone connections.

I have not fitted a gramophone volume control to the set itself, partly because I was anxious to maintain the neat lines and simplicity of the arrangement and partly because most makes of pick-up can now be obtained in types which are complete with a tracking arm and integral volume control. This latter system is obviously better and more logical, because the volume control is then a part of the gramophone equipment.

You will also notice that a radio-gram. switch is not fitted to the set. This is because the switch is not often required, and when a complete radio-gramophone is made the switch can be mounted on the motor-board along with the rest of the gramophone portion of the outfit.

The set is capable of giving an ample volume of excellent quality reproduction when used with a good pick-up, such as the Blue Spot specified, and the process of building the receiver in the form of a complete radio-gramophone is just as easy as making the table-model receiver. The only parts required, in addition to those specified for the receiver alone, are listed on this page, and consist of the really beautiful Peto-Scott "Adaptagram" cabinet, a Garrard double-spring gramophone motor, a Blue Spot pick-up, complete with track arm and volume control, a Bulgin rotary radio-gram. switch, and a pair of Bulgin needle cups.

The first thing is to drill the front panel of the cabinet to receive the controls, and this can be done in precisely the same way as is described on page 367 in respect to the console cabinet. The appearance and general lay-out of the complete radio-gramophone can be seen in the photographic illustration on this page, and it will be noticed that the loud-speaker unit is in this case mounted below the receiver and behind the attractive fret provided. It is attached by means of four ⅜in. screws to the non-resonant baffle-board fitted, and is connected to the receiver by extending the two flexible leads which pass through the holes marked 4 and 5 respectively in the chassis.

After the receiver has been fitted, the gramophone motor, pick-up, etc., can be mounted on the motor board. The motor fits in the centre, and the positions of the holes required for fixing purposes are easily obtained from the template supplied with this component. The pick-up is mounted in the back right-hand corner of the board, and its exact location is easily determined by making use of the template-mounting board to which it is attached when bought. As for the Bulgin needle cups, these are most accessible and convenient when placed one in each front corner of the board. The radio-gram. switch should be situated so that the leads from it to the pick-up terminals are as short and direct as possible: the most convenient position consistent with these requirements is on the left-hand side of the motor board.

Here you see the Orbit in the handsome Peto-Scott Adaptagram cabinet.

The connections to the radio-gram. switch are very simple, and are shown in pictorial form. Additionally, I will describe them in few words; the centre terminal is joined to the left-hand pick-up terminal (looking at the back of the set) by means of a suitable length of "Goltone" screened wire; one of the brown pick-up leads is connected to the right-hand terminal on the switch; the other two pick-up leads are twisted together and joined to a length of flex which is connected to the remaining pick-up terminal on the set. The screened lead is to prevent the possibility of low-frequency stability, and a short length of thin bare wire should be twisted round the screening braid and connected across to the second pick-up terminal. Only two terminals on the switch are used and the third is simply left free.

The Adaptagram Cabinet

Incidentally, I might add here that, if it is desired, the Peto-Scott "Adaptagram" cabinet can be supplied already drilled and fitted with all the necessary gramophone components; no extra charge is made for fitting, and only the actual components have to be paid for. Those constructors who have inadequate facilities for carrying out the simple woodworking operations will find the fitted cabinet extremely useful.

LIST OF PARTS REQUIRED FOR THE RADIO-GRAMOPHONE CONVERSION

- One Blue Spot Gramophone Pick-up.
- One Garrard Double-Spring Gramophone Motor, type No. 30.
- One Pair Bulgin Needle Cups.
- One Bulgin Rotary Radio-Gram Switch.
- One length "Goltone" Screened Connecting Wire.

Further Details of the Orbit as a Radiogram will be given next week.

Every PRACTICAL WIRELESS Receiver is guaranteed to perform in the manner claimed.

We undertake to advise every reader free of charge should any difficulty be encountered in the construction or operation of any of our receivers provided that the parts we specify are used.

We specify only the parts used by our designers. We are thus enabled to guarantee our receivers to perform in the manner claimed. There cannot be a standard of performance unless the reader uses the parts specified by the designer.

PRACTICAL WIRELESS exists to serve its readers!

IT'S SIMPLE TO TUNE!

I HERE assume that you have completed the construction of your receiver, and now describe in detail how the controls should be operated in order to obtain optimum results.

You have no doubt observed that the NUMBER OF CONTROLS HAS BEEN REDUCED TO A MINIMUM. There are only four knobs, and no odd ones at the back. There are several reasons for this, chief of which is that the fewer the knobs to be operated the easier it is to make the very best of the receiver's capabilities. I remember quite well that in the earlier days of wireless the average home-made set had a multiplicity of knobs which was in itself sufficient to scare any non-technical amateur. But in those days several controls were essential in order to vary the filament current through the valve filaments, to tune each stage individually, and to adjust the degree of coupling between various coils. All those operations are, however, things of the past, and the controls were only used because efficient ganging and combination of controls were then undiscovered details of design. To-day simplicity must be the keynote and, provided that it goes hand in hand with efficiency, I am perfectly certain that it is appreciated by all constructors.

The Minimum of Knobs

There may still be some constructors who like to "show off" by manipulating half a dozen knobs all at once, but they are surely in the minority. In this receiver I have catered for the person who wants the very maximum degree of efficiency combined with such a degree of simplicity in tuning that stations can be found quickly and without "fiddling" with innumerable gadgets which are supposed to (but do not) add to the sensitivity.

ONLY FOUR KNOBS!

Now that I have given my reason for the comparative absence of knobs on the front of the cabinet I will explain the function of each and how they should be manipulated. Of the three larger knobs appearing in the very centre of the cabinet, the upper is for tuning, the lower left-hand one operates the wave-change switch, and that on the right actuates the reaction condenser.

Here you can see the neatly arranged controls of the Orbit.

The Tuning Knob

The tuning knob will be used most frequently and should be understood first of all. Actually, it is a dual knob, since in addition to the normal one which rotates the moving vanes of both tuning condensers simultaneously, there is a smaller concentric one which is a "trimmer" and acts on the back section of the condenser. Normally the smaller knob is not required, but it can be used when receiving distant stations, should the greatest possible volume be required. By this system of tuning you have all the advantages of the single knob control, combined with the advantages of individual tuning adjustments for the two tuned circuits.

Little explanation of the wave-change switch is necessary. It has a rotary movement, so that when turned to the left (anti-clockwise) it sets the two iron-core coils to the medium-wave position, whilst when it is turned to the right long-wave reception is provided. You will not require to use the wave-change switch very often, but when you do it will be found to have a nice movement and the change from one waveband to another is indicated by a distinct "click."

Extremely Sensitive

Reaction is unnecessary when listening to the more powerful stations, since the set is extremely sensitive, even without it, but on the more distant transmissions it will be found that signal strength can considerably be increased by making a careful adjustment of the reaction condenser. Signal strength is increased in the usual way by turning the knob in a clock-wise direction. If it is turned beyond a certain point oscillation will, of course, set in, but, due to the design of the circuit, this *cannot possibly cause any interference whatever with neighbouring listeners.* As a matter of fact, I have carefully designed the reaction part of the circuit so that control is particularly smooth, with the result that the very "last ounce" can be obtained from the set without any fear that it will suddenly burst into oscillation. There is a gradual and absolutely steady building up of signal strength as the capacity of the reaction condenser is increased.

(Continued on page 375)

OUR TRANSFER PRINT SYSTEM and How to Use It.

MY new transfer print scheme is one which I am certain every home constructor will appreciate. It is provisionally patented (No. 24584/33), but I have merely taken this protective measure to prevent the idea from being copied, a fate which has flattered so many original PRACTICAL WIRELESS ideas. I endeavour to lead progress, not to follow it, to which I hope my efforts in PRACTICAL WIRELESS bear testimony, and in this transfer print scheme I have removed one more source of trouble from construction; for useful as a blueprint undoubtedly is, the possibility of error is not entirely absent. In transferring the eye from the blueprint to the set, it is quite easy for the beginner to connect the wire to the wrong terminal; whereas, with the position of every wire clearly indicated on the baseboard, the process of wiring is considerably speeded up, and there is no possibility of error. You will not have continually to compare the blueprint with your set, and I estimate that the Orbit can be wired up completely in 1½ hours with the transfer print; with a blueprint it would take at least double this time. Another great advantage of the transfer print method is that, if you should decide to alter the receiver, it can subsequently quickly be converted back again to the original scheme.

The transfer print will iron off on to any surface—ebonite, metal, wood, metallized wood, glass, etc., and its application is thus truly universal. I hope my readers will like this new idea for home constructors, and I shall welcome letters letting me know what they think of it.

It is scarcely necessary for me to explain how to use it. The illustrations eloquently do that. The transfer is placed over the chassis (carefully noting which is the front edge), secured with drawing-pins, and a warm iron is evenly applied all over it, allowing the iron to "dwell" a sufficient time to melt the ink. The side runners must, of course, be removed in order to apply the sub-baseboard transfer. The Peto-Scott metallized chassis is supplied completely drilled, and it will therefore be a simple matter to locate the parts on it.

The use of the transfer print will ensure that every component occupies *exactly* the same position on the chassis as it does on my Orbit. Unwanted "strays" and pick-up, due to longer leads than in the original receiver, are thus absolutely avoided. I take a personal interest in every receiver built to my designs, and formerly I have stipulated that the parts I specify *must* be used if you wish to duplicate my results. *The transfer print scheme also shows you exactly where to fix them—a feature which is bound to make for uniformity of result.*

If there are any further methods of ensuring that PRACTICAL WIRELESS receivers perform exactly as the original, I shall be the first to adopt them.

THE "ORBIT"

BELLING-LEE SPECIFIED IN "PRACTICAL WIRELESS" BOOM SET

5-way Battery cord fitted with Wanderplugs and Spade terminals, each 2/-

A chain is as strong as its weakest link, a set is as good as its connections.

Belling-Lee Radio Connections have been specified by the Designer of the "Orbit." He calls for :—

1 5-way battery cord, at 2s.

4 R type terminals lettered A, E, Pickup, Pickup, at 3d.

3 Bowspring Wanderplugs lettered GB+, GB—1, GB—2, at $1\frac{1}{2}$d.

Left, R type terminals. Bakelite insulated non-rotating capture head lettered in white; self-bushing special nuts and washers. No. 1003, each 3d.

Right, Bowspring Wanderplug, patent resilient construction, in colours, lettered in White. No. 1046, each $1\frac{1}{2}$d.

The Suppression of Man-made Static

The position of Belling & Lee Ltd.

A great deal of nonsense has been published regarding this subject, both in advertisers' announcements and in various editorial notices and articles. The position of Belling & Lee Ltd. in this matter is as a dispenser making up a doctor's prescription, the "doctor" in this case being the Engineers of the Post Office.

No "proprietary rights" are claimed by Belling & Lee Ltd. for their Disturbance Suppressor. The circuit and details of construction are published in their catalogue, and the Post Office Engineers state that such a unit will deal with 80 to 90 per cent. of interference cases, and 10 to 20 per cent. need additional treatment, such as moving the aerial away from the interference, and screening the lead-in.

The Truth About Mains Disturbance Suppression

The Post Office Engineers say that 80 to 90 per cent. of electrical disturbance is mains carried. Belling-Lee Ltd., are catering for the majority. Their Disturbance Suppressor will not cut out atmospherics, nor will it interfere with incoming signals, but it does its job in a satisfactory manner in 80 to 90 per cent. of cases, and at a minimum cost.

It must be fitted at the source or at the listener's main switch, *not* at the back of the set.

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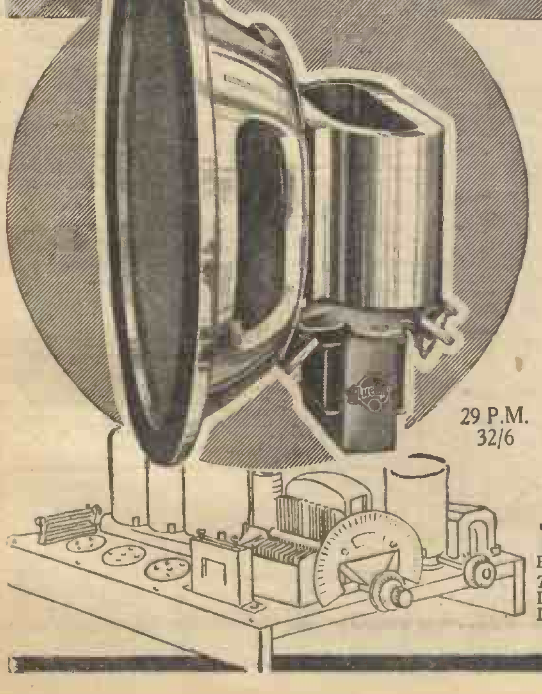

29 P.M.
32/6

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Any Receiver with a Blue Spot Speaker is immeasurably superior.

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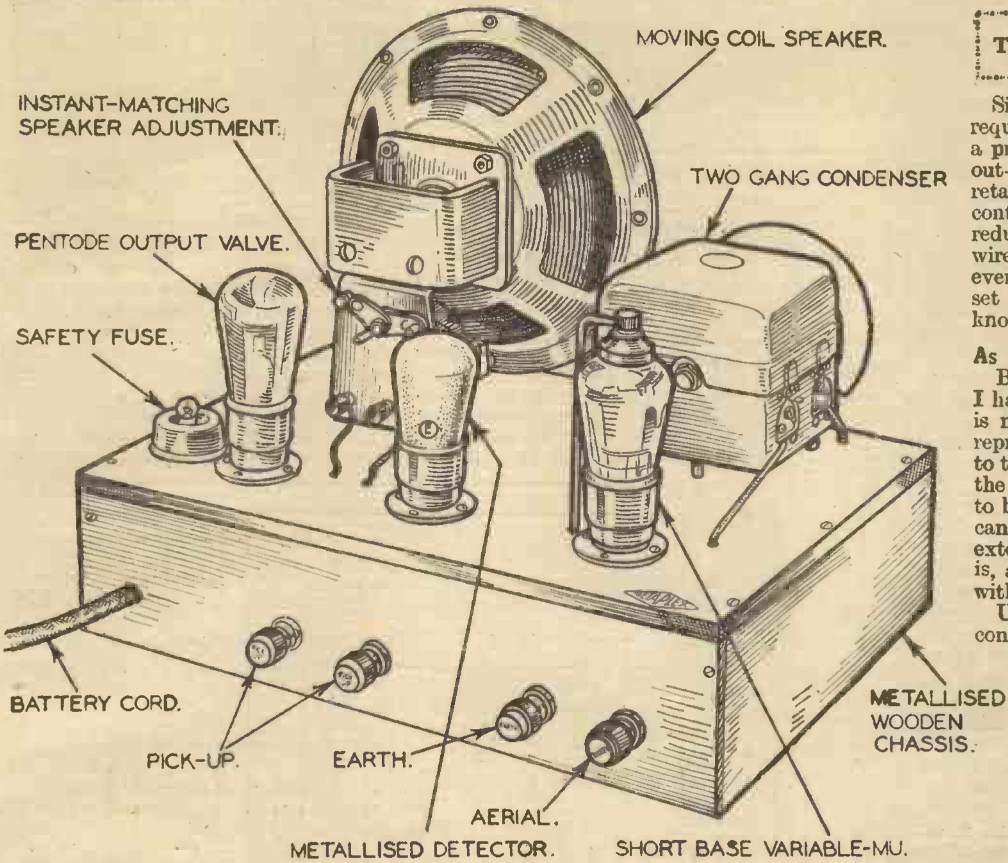
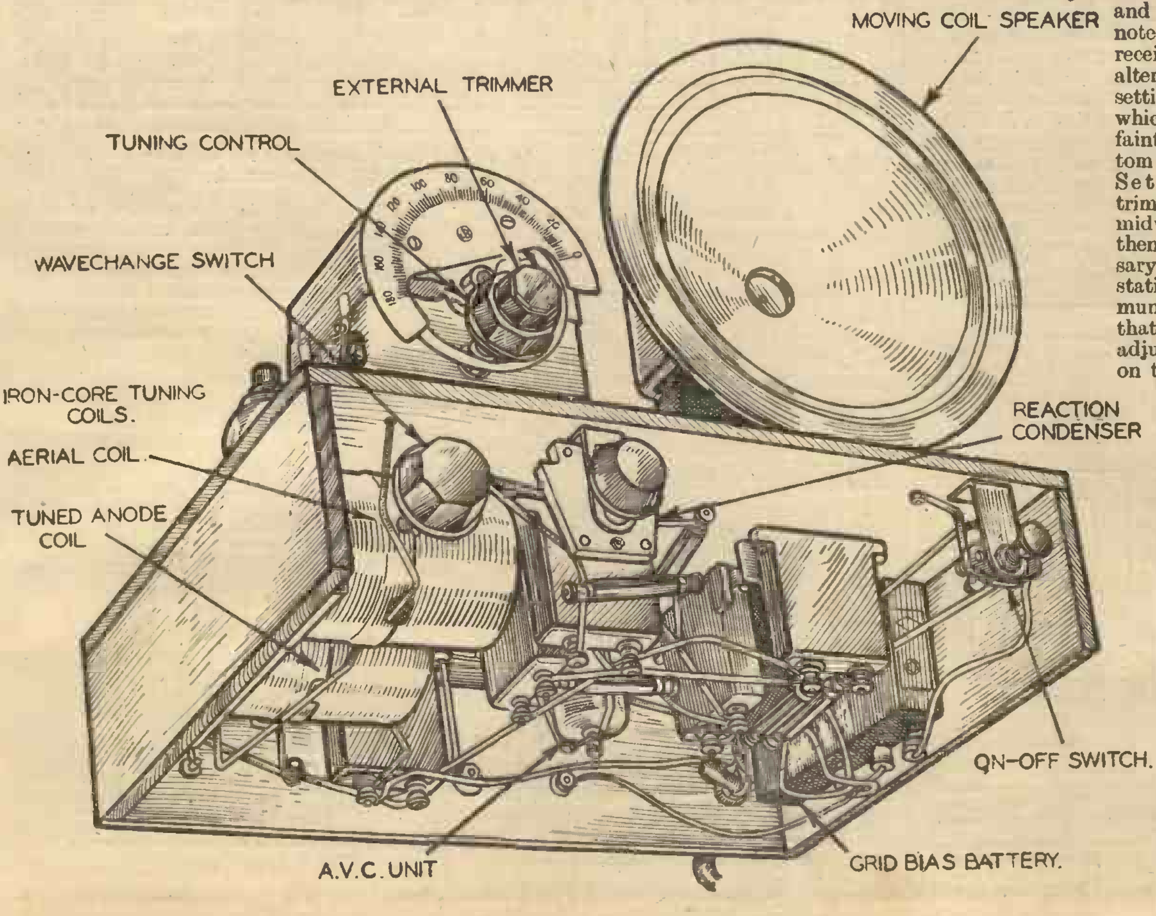
CHECK YOUR CONSTRUCTION AGAINST THESE PICTORIAL DIAGRAMS.





TUNING *(Continued from page 372)*

Since the battery switch is only required at the beginning and end of a programme, it is placed in a more out-of-the-way position, partly to retain the "clean" and symmetrical control arrangement and partly to reduce the length of the connecting wires. Like the other controls, however, it comes readily to hand; the set is switched on by pulling out the knob and off by pushing it in.

As a Radiogram

By fitting pick-up terminals only I have made all the provision that is necessary for gramophone record reproduction without adding either to the expense or neat simplicity of the set. Any reader who wishes to build the receiver as a radiogram can easily do so by fitting a switch external to the set, and this question is, as a matter of fact, fully dealt with on another page.

Up to now I have explained the controls in a general way, so now let me go through the whole process of tuning from the time the batteries are first connected. Pull out the knob of the on-off switch, set the reaction condenser to zero (anti-clockwise), and set the wave-change switch to the wavelength range required. Now turn the main tuning knob slowly from 0 to 180 degrees and make a rough note of the stations received. Without altering the reaction setting, find a signal which is received fairly faintly near the bottom of the tuning dial. Set the concentric trimmer knob to its midway position and then re-tune if necessary to bring the station up to maximum strength. After that, try the effect of adjusting the trimmer on the first section of the gang condenser; this is done by rotating the star wheel which is to be found on the right-hand side of the component.

That is the only preliminary adjustment called for, and once it has been made you can proceed to tune in station after station with the greatest of ease.

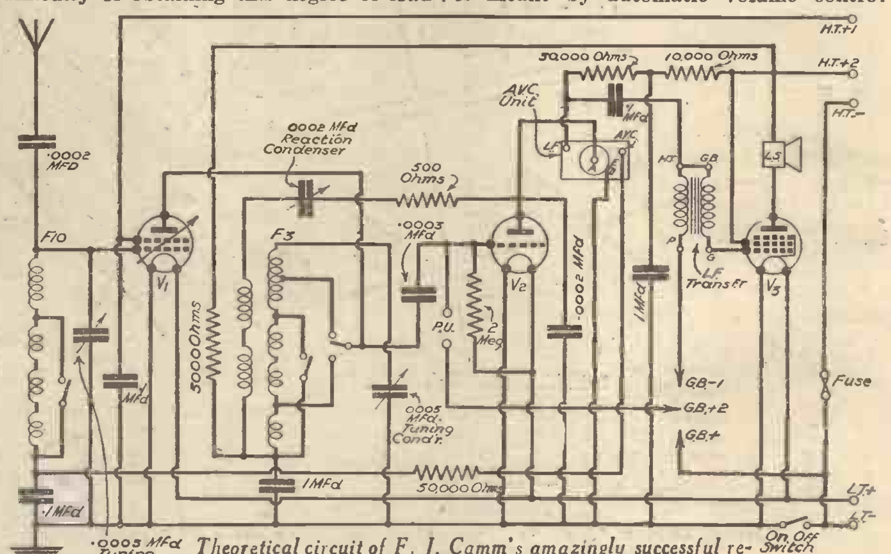
Construction is fully described on pages 365-368.

THE CIRCUIT ANALYSED

Each part of the Circuit of the Orbit—H.F., Detector, and L.F.—is here carefully explained, together with a clear explanation of the Automatic Fading Compensating Device

THE H.F. STAGE EXPLAINED

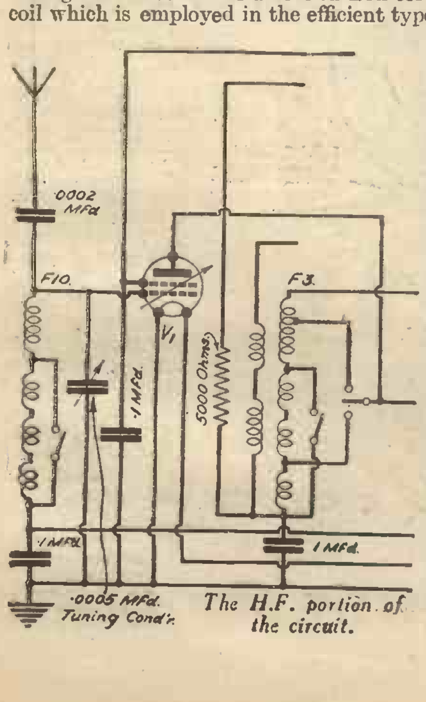
IT has already been stated that the ORBIT employs one H.F. valve, in addition to iron-core tuning coils, but the actual method of employing these components has not yet been detailed. On referring to the theoretical circuit it will be seen that the aerial circuit is direct-coupled, the coil not even being tapped. At first sight one might be inclined to think that such an arrangement could not be selective. It must be remembered, however, that the coil is not of the air-core type, but is one of the modern iron-core coils having a Litz winding. Thus, the selectivity is higher than would be the case with an ordinary tapped coil, with the added advantage that signal strength is naturally greater. The coil is fed from the aerial through a small series condenser in order to assist in the selectivity, and this complete tuned circuit is connected to the first valve, a variable-mu screen-grid. Numerous articles have been published in PRACTICAL WIRELESS pointing out the great advantage of this type of valve. Readers will know how the sensitivity of the valve is increased when receiving a weak station by reducing the grid-bias applied to the valve, and how the powerful local station is reduced to avoid overloading difficulties by increasing the bias on the valve. In this receiver the biasing control is effected automatically through the medium of the A.V.C. Unit, a full description of which appears elsewhere. A manual control has thus been removed and the operation of the receiver simplified thereby. Coupling between the H.F. valve and the detector is effected through the medium of a second iron-core coil which is employed in the efficient type of tuned-anode circuit. It is well known that the maximum amplification from a valve is obtained when the load in the anode circuit approaches infinity. The usual difficulty of obtaining this degree of load is to find a component which offers a constant load at all frequencies. A tuned circuit provides the required optimum load at any frequency to which it is tuned, but generally speaking the valve will oscillate when such a circuit has the same frequency as a similar circuit arranged on the grid side of the valve. When, however, we employ a screen-grid valve and arrange the tuned-anode circuit in a certain way, we can obtain stability, with all the advantages of the tuned anode.



Theoretical circuit of F. J. Camm's amazingly successful receiver, with automatic fading compensation.

How Stability is Obtained

If you refer to the circuit diagram you will see that the anode is joined to a transferable tapping on the coil, a switch changing over the tapping according to the wave-band which is in use. The end of the coil is joined to the H.T. supply *via* a decoupling resistance and the opposite end is joined to one side of the tuning condenser. Instead of joining the other end of the tuning condenser to the end of the coil, however, it is taken direct to earth, thus enabling a ganged condenser to be used, and the moving plates joined to earth.



The H.F. portion of the circuit.

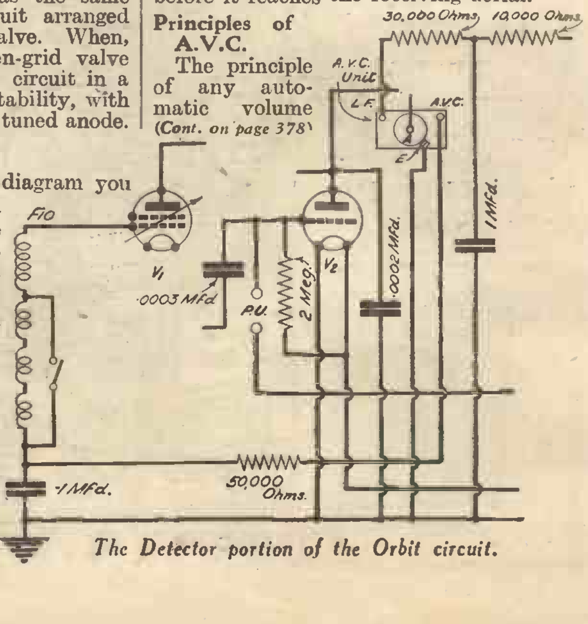
THE DETECTOR STAGE EXPLAINED

THE detector circuit of the ORBIT is of especial interest, chiefly because it is in the anode circuit of this valve that the Varley A.V.C. unit is connected. This unit is called by its makers an automatic volume control, but in the present instance it is not used in the capacity for which it is primarily intended. Before going any farther it might be as well if I explain exactly what is meant by automatic volume control since the term is frequently misused. Real automatic volume control renders the signal strength of every station received precisely the same, no matter over what distance the transmission has to travel before it reaches the receiving aerial.

Principles of A.V.C.

The principle of any automatic volume

(Cont. on page 378)



The Detector portion of the Orbit circuit.

DISTANT STATIONS WITHOUT FADING!

How Automatic Fading Compensation is Accomplished on the Orbit

control is that a part of the signal voltage developed in the detector circuit is rectified and applied to the grid or grids of preceding variable-mu amplifiers in the form of negative bias. Thus, as the detector signal voltage is increased by a powerful signal, the V.M. grid bias is correspondingly increased, with a result that the degree of H.F. amplification provided is made less. This, in turn, reduces the signal input to the detector valve; the complete action is to a certain extent self-compensating, and the nett result is, as stated above, that the output from the receiver is maintained at a constant level.

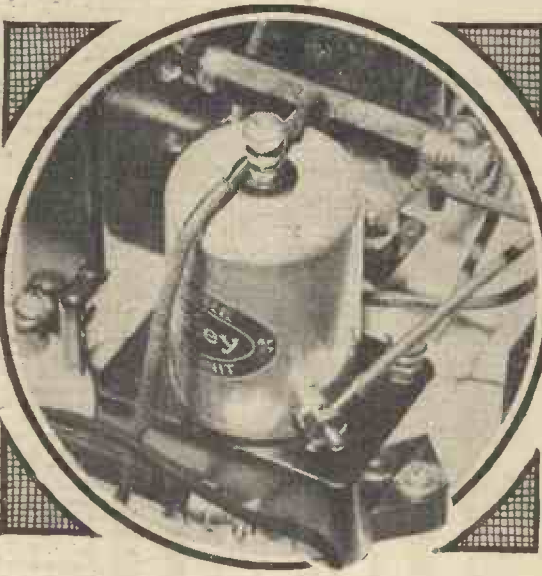
Advantages of A.V.C.

The advantages of automatic volume control are both numerous and important. One advantage has already been quoted, but a far more important one is that the fading of signals is prevented. Those readers who have had any experience whatever of listening to stations more than a few hundred miles away have noticed that at one moment signals can be heard perfectly and the programme thoroughly enjoyed, whilst at the next the volume has fallen almost to the stage of inaudibility. This kind of thing makes distant reception far from enjoyable, and is one reason why many set users have been forced to the conclusion that distant reception is impossible from an entertainment point of view. Fading cannot be overcome, or even reduced in the slightest degree, by making the set more sensitive and employing an additional number of valves, but only by using some system of automatic volume control which functions in the manner which I have previously outlined.

Absence of Fading

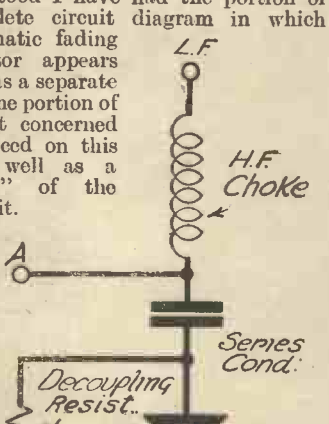
Automatic volume control is a feature that has only been available to the home constructor for a comparatively short time, but it is one which is bound to become universal in the near future; at any rate, on sets which make any claim to modernity. Complete A.V.C., by which I mean the system that successfully makes possible the reception of every station at precisely the same volume level, cannot be obtained with any other than a receiver having upwards of two high-frequency amplifying stages, but many of the advantages accruing from the system can be obtained in a perfectly simple way. By making use of the Varley A.V.C. unit as I have done in this set the terrible bugbear of fading is reduced to a minimum, whilst overloading of the detector valve (and the distortion which must inevitably follow), often experienced with an ordinary type of receiver when listening to the local station, is impossible.

I have briefly explained the benefits conferred by the A.V.C. unit when used in the set as an ANTI-FADING COMPENSATION device—I prefer this name to automatic volume control, since it truly describes the actual function of the ingenious device—so now it will be interesting to consider its method of operation and connection in the circuit. So that the theoretical aspects can more readily be understood I have had the portion of the complete circuit diagram in which the automatic fading compensator appears re-drawn as a separate circuit. The portion of the circuit concerned is reproduced on this page as well as a "close-up" of the Varley unit.



The Varley A.V.C. unit.

The Varley A.V.C. unit is a cleverly designed and patented component which consists of a "Ni-core" H.F choke, a "Westector" high-frequency metal rectifier, a fixed resistance, and two fixed condensers. The high-frequency choke occupies the usual position between the anode of the detector valve and the coupling component, whilst the "Westector" is connected in series with a fixed condenser between the anode and earth. The positive side of this component is connected to earth (and, of course, to the filaments of the valves), so that the rectified current makes the filament more positive. A lead is taken from the negative end of the rectifier through the fixed resistance to the terminal marked "A.V.C." This terminal is actually joined to the lower end of the aerial tuning coil.



Circuit diagram of the A.V.C. unit.

Action of Automatic Fading Compensation Device

Now that you have a clear understanding of the connections inside the A.V.C. unit I can describe in more detail its complete action. In the first place, it will be apparent that some of the H.F. signal currents appearing in the detector anode circuit will be diverted through the rectifier, so causing the valve filaments to become more or less positive. Since the grid of the variable-mu amplifying valve is connected, through the coil and a decoupling resistance, to the negative side of the rectifier, it will be seen that as the filament becomes positive the grid becomes negative in respect to it; in other words, the grid is biased negatively, and the degree of amplification afforded by the valve is reduced.

Now it will be quite apparent that the amount of signal current diverted through the rectifier, and hence the value of the bias voltage applied to the variable-mu valve, is dependent upon the strength of the signals being handled by the detector. As the signal strength becomes greater, so the bias voltage is raised and the amplification of the valve lowered.

Consider, then, that happens when listening to a signal that normally fades and which cannot afford anything like pleasurable reception on an ordinary receiver. As the carrier wave becomes weaker the V.M. valve gives more amplification, but as it increases in strength the V.M. bias is increased and less H.F. amplification is provided. The combined results of these varying actions is that the volume of sound emerging from the loud-speaker remains constant, irrespective of any fluctuations in signal strength caused by fading.

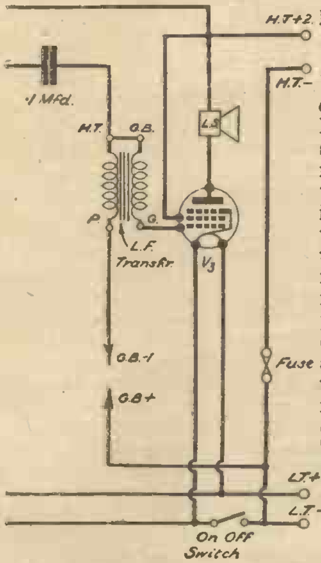
It is sometimes argued that any form of automatic volume control must necessarily reduce the sensitivity and range of a receiver. With some haphazard and badly-thought-out designs this might be true, but so far as this set is concerned it most certainly is not. I have thoroughly tested the receiver both with and without the device, and can say without hesitation that the average volume level of the most distant of stations was just as good with the A.V.C. unit as without it. The *apparent*

(Continued on page 380)

THE OUTPUT STAGE of the ORBIT EXPLAINED

(Continued from page 378)

volume was considerably better with the unit in circuit, since the programmes could be followed through in comfort and without the continual fluctuations in signal strength.



The L.F. portion of the Orbit circuit.

Proving its Worth

You will be interested to know of some definite tests that I tried in conjunction with the automatic-fading-compensation device, and although these are fully covered in the Test Report, there is no harm in repeating them as they are particularly relevant to the subject now under review. Now Fécamp is a station that normally fades very badly in the area in which the PRACTICAL WIRELESS laboratories are situated, so I tuned in this station first on an ordinary four-valve receiver and then on the ORBIT. In the first place, the station was received quite loudly, but the signal strength fluctuated so much that the programme could only be followed by making a definite effort, and certainly not in an enjoyable manner. When the same station was tuned in on the ORBIT (the two tests were, of course, carried out within a few minutes of each other), its transmission could be heard at really comfortable strength and could be enjoyed indefinitely, due to the perfectly steady strength at which it came in. In order that I might satisfy myself conclusively that the automatic-fading-compensation device really was dead right, I repeated the tests with two receivers time after time—IN EVERY CASE THE RESULTS WERE IDENTICAL.

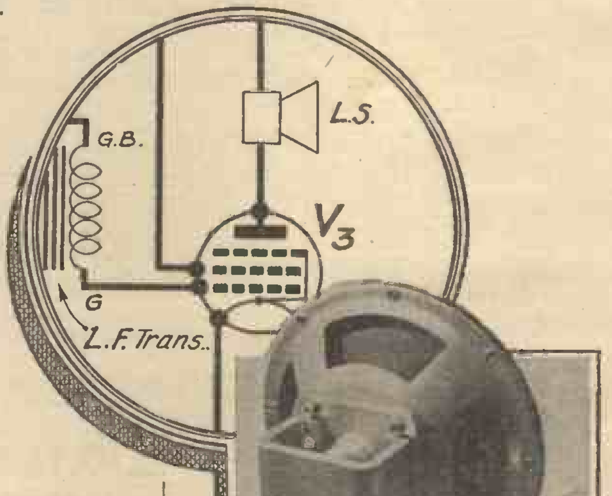
Even then I was determined to leave nothing to chance, so I searched all round the dial on the standard four-valver in an attempt to find a signal that faded so badly that at a normal setting of the volume control it periodically became inaudible. Eventually, I found Poste Parisien on 328.2 metres. Normally this station is received very well indeed and at great strength (it works on a power of 60 kw.), but in this particular instance it was fading very badly indeed; so badly, in fact, that to follow the programme constant adjustments had to be made to the volume control. Upon bringing the Orbit into action, however, an almost perfectly steady signal resulted without any adjustments being called for after the preliminary tuning. I say "almost perfectly steady," because there was undoubtedly a slight variation in signal strength, but this was not sufficient to interfere with the pleasurable reception that was afforded.

If you examine the circuit or wiring plan, you will find that a .0002 mfd. fixed condenser is joined between the anode of the detector valve and earth. The object of this is to smooth out reaction control, but it is actually in parallel with the A.V.C. unit. In view of this it "robs" the unit of some of the current which it would otherwise receive. In other words, it tends to decrease the efficacy of the automatic fading compensator device, although it gives an improvement in another direction. As a matter of fact, the combination of the unit and the particular capacity chosen was found to give the best results under most conditions, but I have found that on stations which fade extremely badly, or when the set is used in a locality notorious for fading, it is better to disconnect the by-pass condenser by removing the wire going from one of its terminals to the .1 mfd. condenser situated just behind it. I have already stated that the combination of A.V.C. unit and condenser is "just right" in the majority of cases, but if you are situated in an unusually "bad" locality you might find it interesting to try the effect of disconnecting the condenser. In receiving Poste Parisien during the tests I referred to above I found that removing the condenser enabled reception at uniform strength to be obtained over indefinite periods.

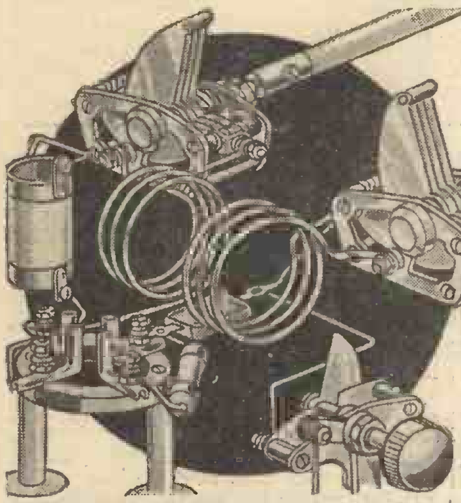
To the best of my belief this receiver is the very first three-valve battery-operated receiver ever offered to the home constructor which includes the undoubted and almost revolutionary refinement of automatic fading compensation. In this, as in numerous other respects, the receiver sets a standard of design which will doubtless be widely copied in the future.

THE L.F. STAGE EXPLAINED

THE Class B stage has received a great deal of publicity lately, and it may at first be wondered why this arrangement is not incorporated in our latest receiver. It is appreciated, of course, that for Class B working, a driver valve and transformer is necessary, with the addition of one complete stage to the receiver. When this set was designed, the question of cost was kept well to the front, and thus, when arranging the output, it was thought most desirable to return to the simple pentode output circuit in order that the total cost of the receiver would be within the pocket of the majority of our readers. It must be remembered that the pentode will deliver sufficient volume for the average home, and if certain precautions are taken the quality at that volume can be just as good as the Class B stage. It cannot, of course, be increased to provide anything like two watts, but it is not everyone who wants such a volume for normal listening. The pentode was thus decided upon, and the coupling between detector and pentode obviously had to be of the transformer type to provide sufficient signal strength. The transformer is parallel-fed, and the primary and secondary are joined together in order to provide an auto-transformer, having a step-up in ratio slightly greater than the transformer itself. This principle has, of course, been explained before to our readers. There is no risk of instability in this stage as the complete anode circuit of the detector valve has been designed to eliminate all H.F. components and is thoroughly decoupled. Thus we have fed to our pentode a pure signal, regulated by the A.V.C. device to be of sufficient strength to provide good volume with all risk of overloading removed, and it only remains to pass this to a reproducing device sufficiently high in standard to do justice to it. We have chosen the W/B P.M.6. Again this is no stranger to our readers. A high-class moving coil, fitted with a neat base so that it may be stood on the baseboard, and provided with an adjustable matching transformer. The two outside terminals are joined to the respective leads, and two arms are then adjusted to provide the correct load for the valve. Surely nothing could be simpler, and at the same time more efficient, than this device. All risk of incorrect matching is removed, and in addition there is the advantage that that matching may be slightly modified in order to give a slight modification to the tone where such is needed. Thus if the reproduction is required a little more on the deep side, or a little more top note emphasis is required, the arms may quickly be moved to provide that effect and as easily replaced when necessary.



The output stage, showing the W/B. Microlode Speaker. You can "match up" in an instant with this ingenious speaker.



Short Wave Section

Further Practical Points on the Technical Side

By MANDER BARNETT

THE recent development of all-wave tuners will no doubt make some of the keen short-wave amateurs give somewhat more consideration to this type of receiver, and to consider what are the possibilities for producing a receiver of this type using home-made coils. The short waves lend themselves particularly well for experimenting with home-made coils as there is usually not very much labour involved therein, and very fine results can be achieved for a very small outlay.

Now, there are a number of arrangements which can be used to produce results which can be quite satisfactory. Roughly, the various arrangements available can be classed under three types; (1) Arrangements in which a number of separate coils are used, selector switches being used to switch one coil entirely in or out of circuit; (2) triple-range coils, in which a number of coils are wound on one former, and by various switching combinations can be made to be operative over at least three entirely separate wavebands, and lastly, (3) plug-in coils, by means of which any wavebands within certain limits may be covered.

An arrangement which, up the present time, has actually received very little attention, but which lends itself very well for amateur use, either with home-made or commercial types of coils, is actually a combination of the second and third arrangements, except that a dual, instead of a triple-range, coil is used. The arrangement is shown in Fig. 1.

Using Coils in Parallel

Short-wave coils are plugged in the sockets 1–4, whilst the coils in circuit are those of a normal dual-range coil. The short-wave coils are actually in parallel with the other coils, and whilst we can change over from medium to long waves, merely by operation of the switch SW, the *whole* of the short-wave bands, right down to about 15 metres, can be covered without any gaps by merely inserting the correct coils in the sockets. Any type of plug-in coil can be used, but the writer suggests that the best type to use here for compactness and easy insertion are the types which have both reaction and tuning coils wound on one former, with the contacts brought out to four pins on the one base. Thus the sockets, 1, 2, 3, and 4 may well consist of the sockets of an ordinary 4-pin valve socket with the coils wound on old valve bases. In arrangements where both medium and short waves have to be covered, the actual method of coupling the aerial to the receiver may be rather a problem, particularly so in the arrangement shown here. However, there is a simple method of overcoming this (our object, of course, is to ensure that the aerial shall be loosely coupled on the short waves, in order to allow ready oscillation) if the *medium*-wave coil in the dual-range tuner has a centre tap for the aerial connection. For short-wave reception, a short-wave coil is inserted in the socket and the switch SW closed, so that the long-wave coil is out of circuit. The aerial is now midway between the grid and earth ends of coil "I," and this will provide sufficient aerial coupling for short-wave reception as well as for medium and long-wave working. If, however, the aerial connection is brought farther up to the grid end of coil "I" the receiver will not oscillate on the short waves. This would be the effect actually if the switch SW were left open as the coil "II" would then also be in circuit, and, as both coils "I" and "II" are in series, the aerial would then, in effect, be connected very much nearer to the grid end of the circuit, making the damping too great for short-wave oscillation. With a long aerial, or when the aerial tapping is too near the grid end, a series condenser (.0001 mfd. maximum) may be necessary in the aerial lead to reduce the damping. Two short-wave chokes in series are used in conjunction with two by-passing condensers. Under certain conditions it may be necessary to dispense with the .0001 mfd. condenser, shown in the diagram, from the valve anode to earth, in order to maintain oscillation on the shortest wavelengths. If, however, satisfactory reaction effects are obtained on all bands, keep it in circuit as it will help to stabilize the receiver.

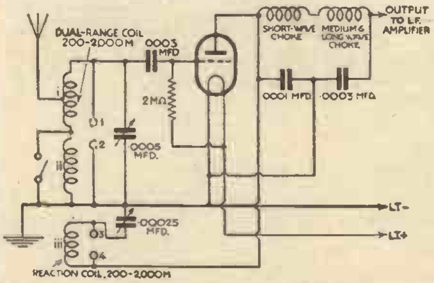


Fig. 1.—The detector circuit of a short-wave set showing the coil and sockets.

A FAULTY TEST

I WAS amused to watch a very young radio enthusiast testing a supposedly faulty variable condenser the other day. He suspected the fixed and variable plates of making contact somewhere, and he connected up a flash lamp bulb in series with a battery, and left two free ends with which to touch the two sets of plates. To his surprise and concern the lamp lit whichever way the dial was turned, which seemed to indicate that the condenser had completely broken down, and I am afraid a quite reputable make of condenser was forthwith condemned. Some time later I saw that the condenser was quite in order, for my young friend had forgotten to disconnect the tuning coil from the condenser terminals, so that there was a completely closed circuit through his testing system, of which the variable condenser virtually formed no part at all. Do not make the same mistake! R.R.

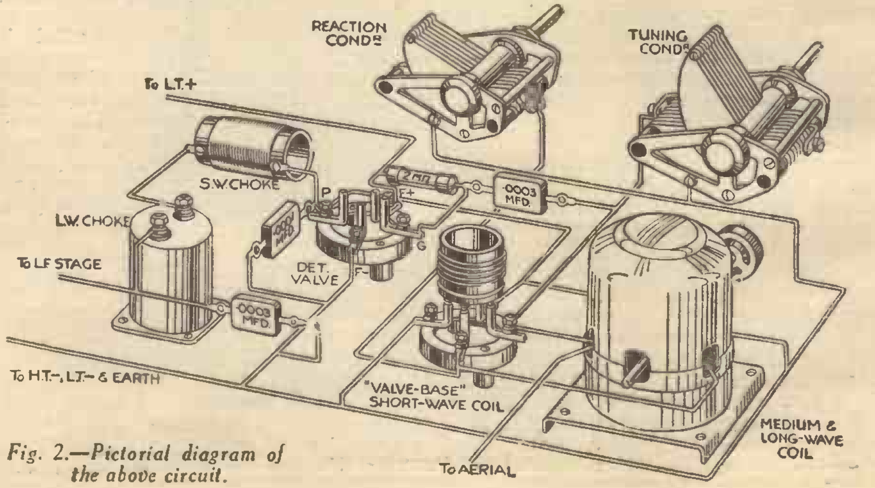


Fig. 2.—Pictorial diagram of the above circuit.

Our Views on Receivers

The Ferranti "Lancastria Parva" Superheterodyne

A SHORT time ago we gave our impressions of the Ferranti "Gloria" model seven-valve superhet, so we have found it particularly interesting to put the "small brother" of that excellent instrument through its paces. Strictly speaking, the "Lancastria Parva" is a four-valve receiver (plus full-wave rectifier), but such a description can scarcely be considered accurately to describe the instrument since it really has seven "stages." It is thus at least equal in efficiency to many of last season's receivers having almost twice as many valves. We mention this point just to emphasize the fact that at the present time the number of valves which a set contains is not by any means a measure of its capabilities.

Concentrated Efficiency

The performance of the "Lancastria Parva" is certainly not quite so good as that of the larger "Gloria," but it is nevertheless more than commendable. One feels on handling the set that it is extraordinarily efficient, for the complete and self-contained instrument measures only 10½ins. wide by 15½ins. high by 8¼ins. deep. In spite of this, however, the set gives an output sufficient for any domestic requirements, and the quality of reproduction approaches very close to perfection. There is no lack of bass due to the use of the necessarily small baffle, and if one could not see the set there would be nothing whatever to suggest that it was so small and compact.

Simple Controls

There are only three controls on the "Lancastria" and these are small and neatly arranged to harmonize with the general scheme. The centre knob operates the tuning condenser, which is driven through the medium of an illuminated dial marked off in wavelengths. On the left is a second knob which serves to operate both an on-off and wave-change switch. When it is turned clockwise through the first few degrees it completes the A.C. mains connections, and at the same time brings into circuit the medium-wave tuning windings; by giving it another slight turn the set is changed over to long waves.

The right-hand knob is a very effective volume control with which the volume can be changed from maximum down to little more than a whisper, without affecting the quality of reproduction to any extent that can be observed.

The set is made for use on A.C. voltages from 200 to 250 and is provided with a good length of flex and a lamp socket plug. When despatched from the works the set is ready for connecting to the most usual A.C. voltage of 230, but by removing a safety lock-plate and transferring a wander plug it can be altered to suit any other voltage within the range mentioned. It is interesting to mention in passing that the mains portion of the receiver is amply protected so that it is absolutely impossible for the user to touch any "live" portion, even if he should be so inquisitive to examine the interior without disconnecting the mains supply.

External Speaker and Pick-up

In addition to the speaker fitted into the consolette cabinet, provision is made for connecting an external one as well, and a type especially suitable for this purpose can be supplied by Messrs. Ferranti. There are also two pick-up terminals on the rear of the chassis, so that the set can easily be employed as a gramophone amplifier when required. Our only criticism in regard to this is that when a pick-up is being employed an external volume control is necessary.

The Ferranti "Lancastria" Superheterodyne.

We have mentioned the neat and compact appearance of the cabinet, but we should also say that it is extremely handsome, being made in veneered walnut with an inlaid strip running down each side. The speaker fret opening is of rather unusual design and takes the general shape of a shield; it is simple and effective.

Generous Volume—Long Range

The "Lancastria" receiver was first tested on a 20ft. indoor aerial situated some twelve miles from the Brookmans Park transmitters. At this range one was obliged to turn down the volume control to a setting about the centre of its movement to prevent the output stage being overloaded. The full significance of this statement can be realized when it is pointed out that the output valve is a Ferranti type LP4, which has a maximum undistorted output of no less than two and a half watts. Perhaps the first important point that claimed our attention was the excellent quality and absence of background noises. Combined with this, however, it is worth mentioning that the wavelength-calibrated tuning dial was found to be almost dead accurate, with a result that any required transmission could be located with the least possible delay. Not only could every worth-while transmission be located, but it could also be tuned in at excellent programme strength. We did not attempt to count the number of stations received during the preliminary test, which lasted for rather more than an hour, but we must have received at least fifty that could have been relied upon to provide real entertainment.

Ample Selectivity

It need hardly be mentioned that the selectivity problem definitely did not exist; every station could be completely eliminated within something like 8 kilocycles. As this is less than the frequency separation normally allowed between European transmitters it will be appreciated that any stations working on their allotted wavelengths could not possibly cause interference with others. On the medium-wave band the set tunes from 200 to 550 metres, and on long waves from 800 to 2,000 metres, from which it will be seen that practically every broadcasting station in Europe is within the tuning range. The long-wave band is somewhat wider than with most sets and the additional range from 900 to 800 is very useful for those who find interest in following the communications between airplanes and ground stations. Besides this, of course, the extra 100 metres increases the possible number of stations to be received by three or four.

It was found that sensitivity was equally good on both wavelength ranges. At the same time we would say that the somewhat greater background noise on the higher waveband gave the impression of signals being weaker. Incidentally, the rather noisy background on long waves is the only point in connection with the behaviour of the receiver upon which we could possibly comment adversely. We do not wish to imply by this that the "Lancastria" does not give a good account of itself on long waves, but merely that it is not possible to make full use of the available signal output if one is to have reception entirely free from extraneous noises.

Quality of Reproduction

We have previously remarked upon the excellent quality of reproduction afforded by this set, but we feel that this point is worthy of emphasis since the set is not provided with a tone control as is its "big brother" (or is it a sister ?), the "Gloria."

The tone and quality appeared to be entirely unaffected by changes in volume level or even by connecting a pick-up so that anything in the way of a tone control would be quite superfluous. Both bass and treble were found to be perfectly blended, so that any musical instrument from a drum to a piccolo sounded real. A good opportunity to study the reproduction was afforded by a Promenade Concert relayed from The Queen's Hall on one of the evenings during which the receiver was being thoroughly tried out. To the musical ear the reproduction afforded was in the nature of a real treat; every instrument in the symphony orchestra could be followed and thoroughly enjoyed.

The Circuit Arrangement

The more technical reader will find the circuit arrangement of the "Lancastria" particularly interesting, since it is eminently modern and employs the latest Ferranti variable-mu heptode valve (type V.H.T.4) as combined first detector and oscillator. This is followed by a Ferranti V.P.T.4 variable-mu pentode, acting as L.F. amplifier, an H.4 D. double-diode-triode second detector and an L.T.4 super-power output valve. A band-pass input filter precedes the first valve, whilst the other tuned circuits consist of the oscillator coil and two pre-tuned band-pass intermediate frequency transformers. Volume is controlled by varying the grid-bias voltage applied to the first two valves. Instead of using a resistance in the cathode leads for this purpose, however, a direct negative voltage is developed across a resistance connected (in series with a second one) in shunt with the field winding of the speaker. The double-diode-triode is actually used as a single diode detector and three-electrode amplifier, the two auxiliary anodes being wired in parallel. Coupling between the H.4 D. and the output valve is on the resistance-capacity system and this provides sufficient amplification to enable the power valve to be fully loaded even on weak signals.

A Ferranti R.4 full-wave rectifying valve is employed for power supply and the output from it is smoothed by the speaker field winding and by a generous network of resistances. As a result of the care expended in designing the smoothing circuits there is absolutely no trace of mains hum in the speaker.

At the moderate price of 13½ guineas, we can recommend the Ferranti "Lancastria" Superhet to the attention of any reader who requires a small, efficient, and really modern receiver.

TELE-TALKIE TOPICS

By H. J. BARTON CHAPPLE, Wh.Sch., B.Sc. (Hons.), A.C.G.I., D.I.C., A.M.I.E.E.

EVERY new development in television is being watched with the keenest interest by the potential "looker," not only for possible improvements at the receiving end, but also to see in what way the transmitting end is preparing to cater for programmes of wider scope. Not the least in this latter class was the intermediate film transmitter and receiver, featured by Fernseh A. G. at the recent German radio exhibition held in Berlin.

When First Shown

The first apparatus of this nature was shown last year, and Fig. 1 gives an idea of the model used. Any scene which had to be televised was first of all filmed, then developed, fixed and finally scanned in a manner somewhat similar to that shown in Fig. 2, which portrays the original Baird Tele-Talkie apparatus. An image of the film was projected on to the scanning disc, as illustrated in Fig. 3, and this was scanned. By having a photo electric cell mounted behind the disc the varying light pulses were changed to current pulses, these being transmitted to the receiving end for "reassembly" in the television apparatus.

Naturally, there is a certain time delay between the filming of the actual event and its portrayal in the television receiver, but as will be seen from the German notice featured in Fig. 1, this is only of the order of fifteen seconds. At the time the public saw this apparatus, a ninety line scan of the film was used, together with twenty-five pictures per second.

The New Transmitter

For a whole year the Fernseh A. G. carried out numerous experiments with this device, and the various improvements effected were made public recently. The transmitting side is shown pictorially in Fig. 4, the subject or scene to be televised being either floodlighted or exposed to ordinary daylight (that is to say, the scheme lends itself equally well to studio working or outdoor events). A movie camera of the normal intermittent type takes a film of this, and after leaving the camera the film is passed through a special double tank, where it is rapidly developed, fixed and washed. The film then passes across a scanning disc having sixty small holes arranged around the circumference of a circle, and two revolutions of the disc take place during the passage across the "frame" of one picture on the film. The picture is therefore broken up into a 120-line scan, and as there are twenty-five pictures per second transmitted, it

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Fig. 1.—The intermediate film television transmitter shown by Fernseh A. G. in Berlin in 1932.

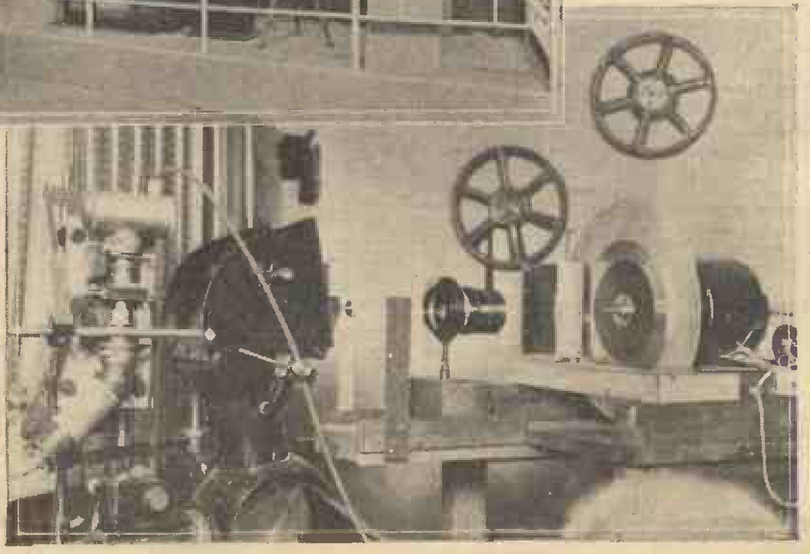


Fig. 2.—The first Baird tele-talkie transmitter.

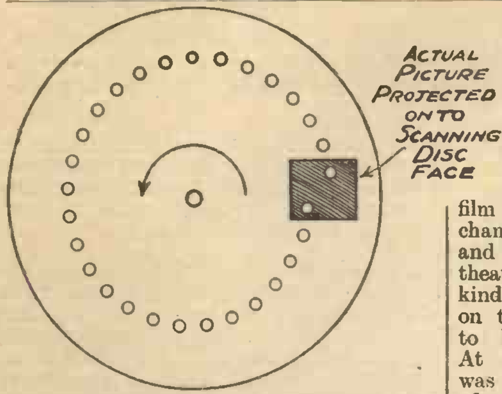


Fig. 3.—Showing how a picture of the film is projected on to the scanning disc face for exploring purposes.

TELE-TALKIE TOPICS

(Continued from previous page)

will be seen that the disc has to be kept running at 3,000 revolutions per minute.

Associated with this rapidly-moving exploring disc is the usual powerful light source, lenses, and single photo-electric cell, so that the detail in the picture is "broken up" in the normal tele-cinema fashion, and sent to the receiving end *via* special lines or a radio transmitter. The film passes on to a tank where the emulsion, and hence the picture, is washed off. From here the blank film enters an emulsion coating chamber, then passes along a drying chamber, finally emerging as a sensitive film ready to go through the process again. From the description, and diagram Fig. 4, it will be seen that a continuous loop of film is employed, as distinct from one or more reels, and in this way an enormous economy in costs is effected.

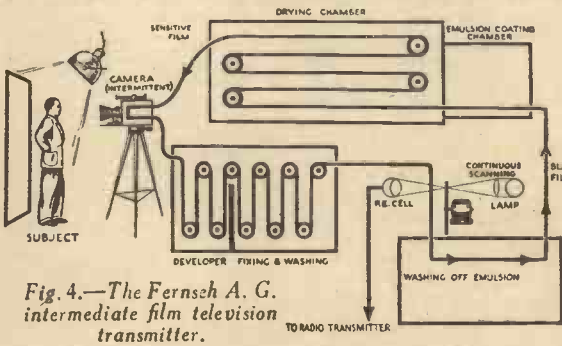


Fig. 4.—The Fernseh A. G. intermediate film television transmitter.

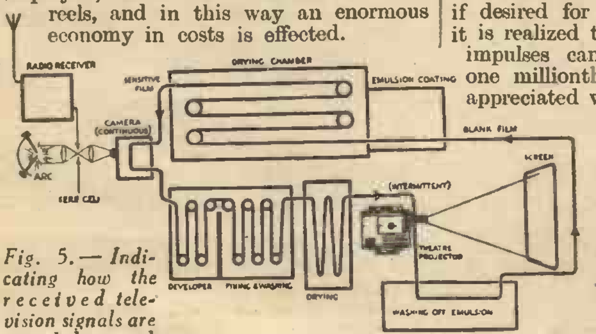


Fig. 5.—Indicating how the received television signals are recorded and finally projected on to a large screen.

At the Receiving End

Coming now to the receiving end, the signals are made to modulate a powerful beam of light with the aid of a Kerr cell (that is, a device similar to that which I described in my article, "Light Modulation for Television," PRACTICAL WIRELESS, dated September 2nd, 1933). In this way the picture is turned back or re-converted into its light values, and this is recorded on a film camera of the continuous and not intermittent variety—see Fig. 5. The film is then passed through separate chambers for developing, fixing, washing and drying. After this it is fed to a theatre projector of the intermittent kind, so that the film can be thrown on to a screen in the normal manner to be watched by a large audience. At the Berlin Exhibition this screen was very large, about 12ft. by 8ft., and after passing through the camera the film has the emulsion and picture washed away, is then re-emulsified and dried, emerging from the last tank as a sensitive film for the whole process to be repeated.

The invention is one which is likely to have far-reaching effects, and once the small imperfections have been removed, we can look forward to hearing more concerning this device. The apparatus at the transmitting end is not unduly complicated, being of such a size that it can be mounted on a normal motor-car chassis if desired for transport purposes. When it is realized that the incoming television impulses can only impress the film for one millionth of a second, it will be appreciated what enormous strides have been made in the perfection of television apparatus.

It is not too much to hope that the time is not so very far distant when apparatus will be devised which will permit of the recording of notable events so that they may be reproduced through the medium of the home television receiver on similar lines to the above apparatus, although, of course, it should be appreciated that there are several details which require careful consideration before we can hope to see the Derby, for instance, in our homes whilst it is being run, with the same degree of fidelity as we at present see the cinema picture.

TOPICAL PARAGRAPHS

Lisbon on the Air

HAS any reader heard the new *Radio Lisboa* station? French listeners state that this 20 kilowatter has been testing since October 5th on 291 metres, a channel which will be later adopted by a transmitter to be erected in the southern part of the country. In January, 1934, the Lisbon station will change its wavelength to 476.9 metres.

The Death of the Common Wave

GERMAN wireless papers comment freely on the impracticability of synchronizing broadcasting stations on common waves, inasmuch as experiments carried out tend to show that the useful range of such transmissions is limited to a radius of from five to twelve miles maximum. It is therefore considered that relays at present operating in Germany in this manner will have to be placed eventually on separate channels, a step which may cause much inconvenience owing to the number of transmitters involved.

Distinctive Cabinet Work

MESSRS. PETO-SCOTT CO., LTD., of 77, City Road, London, E.C.1, are so well known to all wireless amateurs as suppliers of components and kit sets to the home constructor that another side of their extensive business, that of making distinctive wireless cabinets, is apt to be overlooked. As a matter of fact, Messrs. Peto-Scott have made wireless cabinets of all types for the last twelve years, and they have a large and modern factory specially equipped for this work.

We are reminded of this by the receipt of a new 1934 catalogue, which gives very full details of a wide range of cabinets in every type and pattern that the home constructor is likely to require. This catalogue is a particularly useful one which should be in the hands of every reader of PRACTICAL WIRELESS, and it can be obtained post free from the above address if mention is made of this paper.

The Adaptagram

Among the many varieties of cabinets listed perhaps the "1934 Adaptagram" will prove of most interest. This is a radio-gramophone cabinet of beautiful design and construction, made in inlaid walnut, oak, or mahogany. It is intended especially for converting an ordinary wireless receiver, of either the mains or battery-operated type, into a complete radio-gram, and is thus provided with a new non-resonant motor board and handsome speaker grille with baffle-board. The "Adaptagram" can be obtained with either a plain or vignetted front to take a set having a panel up to 18in. by 8in.; this is style "Model A," and sells at the most attractive price of 63s. If fitted with baffle-board for the loud-speaker, an extra charge of 3s. 6d. is made. At the price named the "Adaptagram" is supplied drilled to any specification, and all ready to take any receiver.

Here is the Orbit in the handsome Peto-Scott cabinet.

Complete with Gramo Equipment

A "Model B" is also made, and this is like that described above but is also fitted with a double-spring gramophone motor, 12in. turntable, automatic stop, B.R.G. combined pick-up, tone arm, and volume control, and an automatic needle cup that delivers new needles one at a time. The price of this model is only 6 guineas.

There are also two other models, called "C" and "D" respectively, the first of which is fitted with a Collaro induction electric motor and all the other necessary gramophone components; it sells at 7 guineas. "Model D" has a Garrard automatic record changer, which enables one to play eight records continuously without any attention, as well as the complete gramophone equipment; the price of this is 14 guineas.

Readers will be particularly interested in the "Adaptagram" models in view of the fact that this excellent cabinet is specified for Mr. F. J. Camm's latest set, which is fully described in this issue. This is clear proof of the quality of the "Adaptagram."

New Ideas in Cabinet Work

Other interesting items in the Peto-Scott cabinet catalogue are the "Classic" model specified for the PRACTICAL WIRELESS "Premier Super." This is an eminently modern style of cabinet of the horizontal type having the speaker fret alongside the receiver controls. With a splendid hand-polished finish on walnut, the "Classic" is priced at 19s. 6d. Incidentally, this cabinet can be supplied with a veneered walnut stool 28in. high by 23in. wide by 14¾in. deep for an extra charge of 25s.; the combination of cabinet and stool forms a very handsome and modern piece of furniture.

Yet another new idea in cabinet work is represented by the "De-Luxe Twin Cabinet," which consists of a lovely loud-speaker section and a veneered walnut receiver cabinet. The two fit together, and so form a complete console, but the speaker may be removed if desired and moved to any other position in the room. The price of the pair of cabinets is 45s. in the standard size (set portion, 16in. by 10in. by 10in.; speaker portion, 15½in. by 10in. by 9¾in.) but any other sizes can be supplied to order, at correspondingly low prices.

Among the other cabinets listed in the new catalogue are the "Universal Consolette," which was recently specified for the PRACTICAL WIRELESS "A.C. Three," the "Fitzall Consolette," the "H.L.3 Oak Consolette," the "Fyntune Speaker Cabinet," and various American-type cabinets.

Full particulars and prices are also given in respect to a special Peto-Scott Baffle Baseboard Assembly and the "Metaplex" metallized wooden chassis, which are so well known to readers of PRACTICAL WIRELESS.

We recommend every reader to make application for the latest Peto-Scott cabinet catalogue—don't forget to mention PRACTICAL WIRELESS.

RADIO CLUBS AND SOCIETIES

Club Reports should not exceed 200 words in length and should be received First Post each Monday morning for publication in the following week's issue.

SLADE RADIO

The eleventh of the Society's "Junk Sales" took place at the meeting held last week. A large quantity of surplus apparatus was brought in and satisfactorily dealt with. As usual, the disposal of some of the items provided considerable amusement. The Society commenced a new year on the 1st of this month, and anyone living in the Birmingham district, who is interested in wireless, is invited to write for details of membership and an advance programme.—Hon. Sec., 110, Hillaries Road, Gravelly Hill, Birmingham.

THE CROYDON RADIO SOCIETY

This Society's annual general meeting took place at St. Peter's Hall, Ledbury Road, S. Croydon, on Tuesday, October 10th, with the Vice-President, Mr. G. S. Vellacott, presiding. The Chairman, Mr. F. Nightingale, was re-elected, as was the Hon. Treasurer and Hon. Secretary. The personnel of the programme committee was changed, as it was felt that however well last session's committee had worked, new blood was always desirable. An important post created was that of Hon. Librarian, Mr. R. P. Jonas securing it. His work would be to collect and file literature and data dealing with all components likely to be discussed at meetings. Finally Mr. J. W. Scholes presented the balance sheet for 1932–33. This was at length passed, but it was emphasised that more members were wanted to enable the Society's 1933–34 activities to be carried out on the desired big scale.

At a meeting of the above Society held on Tuesday, October 17th, at St. Peter's Hall, South Croydon, a dozen different cone loud-speakers were compared, and among them were two novel twin-cone units. One belonged to Mr. A. T. Betteridge, having a unit with home-made celluloid cone for the treble, while a specially-selected N. and K. Inductor dealt with bass notes. The other twin belonged to Mr. R. P. Jonas, and its chief interest was its Primustatic Electrostatic speaker. Its great advantage was the marvellous treble response, a range from 250 to 15,000 cycles being claimed.

As well as Inductors there were several speakers of the balanced armature types.

On test, all performed reasonably on speech, but Mr. Betteridge's twin had undoubtedly the best bass and widest range of frequency response. In conclusion, the Chairman reminded members that on Tuesday, November 7th, moving-coil speakers would be compared.—Hon. Secretary, E. L. Cumbers, Maycourt, Campden Road, S. Croydon.

THE BLACKPOOL AND FYLDE RADIO SOCIETY

A very enjoyable meeting of this Society was held on Tuesday evening, October 10th, at Booth's Café, this being the first meeting of the new winter session. Mr. Baker gave an interesting lecture on "The Problem of Interference," and he outlined the many causes of the different types that are met with in the construction and design of a commercial and, for that matter, in the home-constructed wireless set. He also gave a description of the different methods of A.V.C. and noise suppression which are at present being employed. After he had concluded, many questions were asked, which Mr. Baker gladly answered, and after a short discussion the meeting closed. This is the first of a series of lectures to be given before this Society by the leading manufacturers during the coming winter, and we invite anyone interested in radio, who lives in the Blackpool district, to attend one of their weekly meetings. New members are required, and full particulars of coming lectures can be obtained from Mr. Howard, Hon. Secretary, 43, Cumberland Avenue, Blackpool.

THORNTON HEATH RADIO SOCIETY

A meeting of this Society was held on Tuesday, October 17th, at St. Paul's Hall, Norfolk Road. Mr. S. J. Meares presided. Mr. Hoare gave a demonstration and talk on the Lissen Skyscraper All-Wave Four. This set covers all wavelengths from 12 to 2,000 metres and is stable over the whole range. The meeting closed with a vote of thanks to Mr. Hoare.

An attractive series of talks and demonstrations has been arranged for future meetings, full particulars of which can be obtained from the Hon. Secretary, Mr. J. T. Webber, 368, Brigstock Road, Thornton Heath.

CATFORD RADIO SOCIETY

The Catford Radio and Television Society held the first of the informal discussion evenings on Wednesday, October 18th, which were proposed at the Annual General Meeting. The meeting opened at 8 o'clock sharp, and various suggestions were forthcoming from members in the nature of the practical work which is to be undertaken in the near future. It is clear that radical changes are imminent in the Society's own receiver which, fortunately, is constructed in such a way that this is readily possible without much trouble. It was also strongly suggested that the Society should have a short-wave receiver, and the necessary apparatus for this will be obtained as soon as possible. In the discussion which followed, a wide range of topics was covered, and one of the members demonstrated a well-known make of portable receiver.—M. W. Jones, Publicity Secretary.

PRACTICAL LETTERS FROM READERS

The Editor does not necessarily agree with opinions expressed by his correspondents. All letters must be accompanied by the name and address of the sender (not necessarily for publication.)

The Supersonic Six

SIR,—I am writing to say that I have got the Supersonic Six to operate at last. I am very pleased to say now that the trouble has been due to a faulty Oscillator coil unit, the lead that should have been connected to tag of centre tap having come adrift. Of this I am sure, I have been shown the greatest of assistance, and I send my kind regards for the success of your valuable weekly.—G. GORE (S.W.8.).

The Microlode

SIR,—It gives me great pleasure to inform you of the safe arrival of my prize, the W. B. P.M.4A. "Microlode," which I won in your recent competition: many thanks, sir, for offering such splendid prizes. I have connected mine up to my set (a straight 3-valver) and it's hard to realize it's only battery operated, so real is the reproduction, due, of course, to the accurate matching ratio scheme.

This is the first time I've written to you, but I have been a regular reader of PRACTICAL WIRELESS since the first issue and I think it's the best paper of its kind. I have your Encyclopædia, and find it invaluable. I am also qualifying for the Tool Kit.—CHAS. F. C. NEWMAN (Nottingham).

Reports Wanted

SIR,—It has come to my notice that your readers are asking the address of my station, G5CU, and you have taken it from the last edition call book. My address is now as under.

I transmit every Sunday morning between 10 and 12.30, and I should like to have reports on the transmission. I shall acknowledge all reports sent me by QSL card. The wavelength used is 7,156 kc/s or 41 metres. Choke control telephony is used at this station. I am hon. secretary of the Scarborough and District Short-wave Society with headquarters at 41, Newborough, Scarborough. Meetings held bi-monthly.—J. A. CUTHBERTSON, G5CU, "Dunromyn," Cross Lane, Burmeston Road, Scarborough.

More Bouquets!

SIR,—I take this opportunity to congratulate you on PRACTICAL WIRELESS. I have read every one of its fifty-two copies, and have found them both helpful and instructive. Looking at the first and latest copies, and comparing them, one can readily credit the strides which you have contrived to make in only one year.

Your query service is nothing short of marvellous!

Please accept the best wishes of a regular reader. Good luck in the future, and—Many Happy Returns.—D. H. (Enfield).

"Better and Better"

SIR,—I have bought every copy of PRACTICAL WIRELESS since No. 1, and think every issue is better than the previous one, although even the first number was first class. It is, undoubtedly, the best paper of its kind. I have built several sets to the designs published in PRACTICAL WIRELESS, and have found each one to give optimum results. I have found some excellent information in your Short-wave Section which has been very useful to me.—K. BOWE (Chester-le-Street).

"Radiogram Motors"

SIR,—May I take this opportunity of expressing my appreciation of the article on "Radiogram Motors" in your issue of September 23rd. This article in my opinion, touched on a subject about which many people should know more; also ordinary gramophone motors as well.

The hints contained in the article were also helpful, as most users of motors seem to think that springs should be run "dry," and in any case that the makers would have put enough lubricant in to run for a long while, with disastrous results.

The article was, possibly, a bit brief, but quite a lot of information was squeezed into the space provided. I should like to see more articles on this subject by the same contributor.

Thanking you for PRACTICAL WIRELESS, which is a fine book.—F. FORD, jun. (Southampton).

CUT THIS OUT EACH WEEK

DO YOU KNOW?

—THAT many wavelengths will be exchanged at the beginning of next year in order to attempt to relieve some of the present chaos.

—THAT unless definite steps are taken "sideband splash" will still be in evidence in certain parts of the waveband.

—THAT an electro-static and an ordinary electro-dynamic loud-speaker in combination form a very good means of obtaining an even output response curve.

—THAT the field of a moving-coil loud-speaker may be used as a biasing resistance in many cases.

—THAT the value of the resistance used in this case may be modified by means of a further variable resistance.

—THAT ordinary house switches are often responsible for crackling noises on a mains operated receiver.

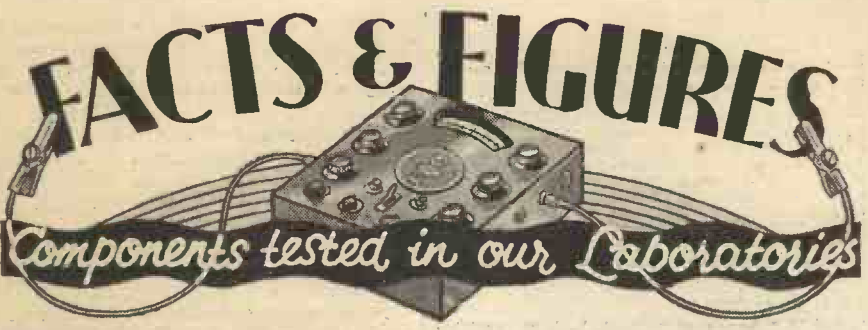
—THAT troubles from the above cause may be removed by cleaning the contacts of the switch and bending them so that they make better connection.

—THAT when L.F. choke coupling is employed hum may be introduced by interaction between the two chokes.

NOTICE.

The Editor will be pleased to consider articles of a practical nature suitable for publication in PRACTICAL WIRELESS. *Such articles should be written on one side of the paper only, and should contain the name and address of the sender. Whilst the Editor does not hold himself responsible for manuscripts, every effort will be made to return them if a stamped and addressed envelope is enclosed. All correspondence intended for the Editor should be addressed: The Editor,* PRACTICAL WIRELESS, *Geo. Newnes, Ltd., 8-11, Southampton Street, Strand, W.C.2.*

Owing to the rapid progress in the design of wireless apparatus and to our efforts to keep our readers in touch with the latest developments, we give no warranty that apparatus described in our columns is not the subject of letters patent.



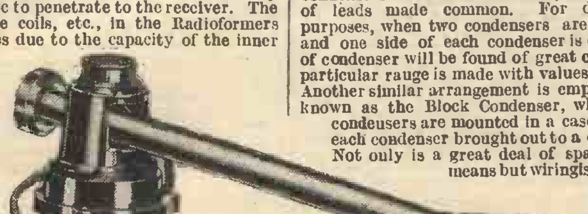
HIVAC D.210

THIS is a valve of the type designed especially for the detector stage of a receiver, and as such has an impedance of the order of 12,000 ohms. The amplification factor is 16, and the slope 1.25 ma/V. The filament is rated at .1 amps at 2 volts, and the maximum H.T. is given as 150 volts. The valve was tested and found to be very accurately rated, the slope actually working out at 1.3 on the specimen tested. The valve was inserted in the detector circuit of a standard H.F. detector and pentode circuit and found to give very even control of reaction with all normal values of H.T., and as an anode bend detector the results were quite up to the standard of more expensive valves. The valve can be thoroughly recommended for detector stages in ordinary battery circuits and its freedom from microphonics renders it a very good proposition for portable receivers. The makers are the High Vacuum Valve Co., Ltd., and the price is 5s. 6d.

Two Dubilier condensers.

THE RADIOFORMER

AMONGST the many static suppressors which have been received for test, probably the most elaborate in appearance is the Radioformer, which is marketed by Radioformer, Ltd. This comes packed in a box having three compartments. The central portion is occupied by 50 feet of screened lead, whilst in the two remaining sections are packed a pair of metal cases referred to as Radioformer Type A and Radioformer Type S. Type A is conical in shape and is provided at the apex with a clamp for attachment to the aerial, whilst the base of the device is sealed with a black composition to which two contacts are fitted. One of these is for attachment to the lead-in, whilst the other is intended to grip the metal covering of the screened lead. A winding inside the Radioformer provides coupling with the two sets of terminals. At the lower end of this aerial lead the other Radioformer is to be attached, and two terminals are employed in a similar manner, namely, one to grip the metal covering whilst the other grips the inner lead. Three coloured leads extend from this Radioformer, and one of these is attached to the aerial terminal of the receiver whilst another is attached to the earth terminal in place of the earth lead. This latter is connected to a special terminal on the Radioformer. The result of this complete combination is that the aerial is connected to the receiver through a network of connections which provide direct connection from the aerial but also connect the external screen to earth and thus render it almost impossible for ordinary "man-made" static to penetrate to the receiver. The arrangement of the coils, etc., in the Radioformers negatives any losses due to the capacity of the inner wire and the outer screening and so avoids loss of signal strength. The device works very efficiently and should prove a valuable accessory in districts where interference is experienced. The price is 17s. 6d. complete, and the two Radioformers are obtainable separately at 7s. 6d. each.



The Blue Spot pick-up which was referred to last week.

SOUND SALES CLASS B KIT

IN PRACTICAL WIRELESS dated April 8th last we described a simple but efficient Class B unit for addition to any existing battery receiver. Messrs. Sound Sales, whose Class B transformers were incorporated in this unit, have now produced a most attractive kit for this unit, boxed complete for 37s. 6d. The box contains a number of compartments in which are arranged a baseboard, valve-holder, switch, terminals, screws, plug, and valve. A sheet of instructions gives precise details for assembling the whole. As the originators of this neat little unit we can justly assert that it does all that is claimed for it, and as it is obtainable in such a neat and simple manner (without the necessity of, perhaps, paying visits to several shops in order to obtain the separate parts) we have no doubt that readers who desire to convert their receivers to this method of working will avail themselves of the opportunity of obtaining this kit.

A new speaker has also been received from Sound Sales, in which a novel principle has been introduced. Hitherto the difficulty of arranging the diaphragm surround so as to avoid resonances, damping, and other troubles has been one which has been attacked in many ways by the various manufacturers. Ingenious schemes have been proposed and even tried, but the new Sound Sales idea seems to be at once simple and effective. The cone is prepared in the ordinary way, and then a number of cuts are made radially from the periphery to a distance of about one inch towards the centre. At the point where all these cuts end the cone is creased and the cut portion turned back flat. The original periphery of the cone is then clamped in the edge of the chassis ring, resulting in a diaphragm that is all one and which relies for its rigidity on the small sections extending from the creased edge to the chassis edge. The cuts are of such a length that there is no possibility of the cut edges touching and thus causing chatter, and yet at the same time the small spaces which are produced by the turned-back edge do not permit any loss of bass. It appeared on test that the quality was improved by this small air leak, as a certain amount of boom was present when the section was covered in the usual way. The sensitivity certainly seems to have improved owing to the freedom of movement, and in addition a remarkable crispness is apparent on all forms of music and speech. For those who are looking for something really good in the way of reproduction we can confidently recommend this speaker, which costs 40s.

DUBILIER CONDENSERS

IT is often very convenient to avoid wires when making up a receiver, and readers will remember that in the Fury Four we used this principle to simplify the wiring of that circuit. The condenser illustrated above (right) is Type BE31L., manufactured by the Dubilier Condenser Company, and this consists of two condensers mounted in one case, with one pair of leads made common. For decoupling purposes, when two condensers are required and one side of each condenser is earthed, this type of condenser will be found of great convenience. This particular range is made with values of .1 plus .1 mfds. Another similar arrangement is employed in what is known as the Block Condenser, where a number of condensers are mounted in a case with one side of each condenser brought out to a common terminal. Not only is a great deal of space saved by this means but wiring is greatly simplified. These condensers are obtainable in ranges having totals of 2 mfds. to 20 mfds., the latter being made up of 6+6+4+2+2 mfds., and costing 34s. 6d. The other condenser in the illustration is Type B.B. a brown bakelite case condenser obtainable in ranges up to 4 mfds. at a cost from 1s. 9d. to 5s. 6d. These condensers are for 250-volt D.C. peak working and have a 500-volt D.C. test. There are many other new types of condenser in the new season's range of Dubilier products, especially in the non-inductive types of condenser, and we shall illustrate some of these in a future issue.

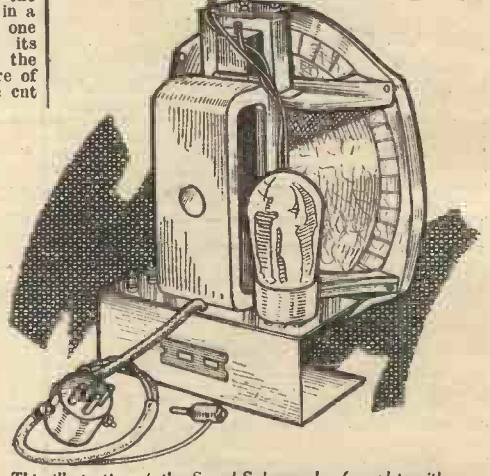
WARD AND GOLDSTONE P.H.F. HEAVY-DUTY CHOKE

AMONG the new chokes which have been produced for use with mains apparatus for the purpose of reducing interference from motors, etc., is the Ward and Goldstone type P.H.F. choke. This is a very substantially-built choke which fulfils practically all the normal requirements in the field for which it is intended. The current rating of .35 amps. allows the choke to be used with .1 and .25 amp. D.C. valves (in the filament leads, of course), while its extremely low D.C. resistance, namely, 17.5 ohms, enables it to be placed in the H.T. leads with a minimum voltage drop. The choke is sectionally wound with air spaces between each section, and the ventilation thus produced will ensure that the choke will be in no danger of overheating. Heavy wire is used for the choke, so that a high inductance is obtained (approximately 8,500 mics.) whilst keeping the D.C. resistance at the low figure mentioned. For D.C. sets, or mains battery eliminators, and also for interference suppressors, this choke will be found extremely useful, and the usual Ward and Goldstone ingenious mounting feature is included. This permits the choke to be mounted on a wooden baseboard, or on a metal chassis, and the terminals are reversible for above- or sub-baseboard connecting. The price is 7s. 6d.

NEW TUNGSRAM UNIVERSAL VALVES

DURING the course of their research work on mains receivers Messrs. Tungsram have found that a demand exists for H.F. pentode valves of lower efficiencies than those (HP 2018 and HP 2118) previously introduced, and accordingly they have released two such types in the HP 1018 and HP 1118, which have 10 V 0.18 A heaters. The first-mentioned valve has "straight" characteristics, while the second is of the variable-mu type with a working grid base of about 52 V. Both are suitable for use in receivers such as midgets, where space is limited, for they have greater stability than the original valves. Following American practice, the grid connection is taken to the top terminal in each case, and this is claimed still further to increase stability.

The HP 1018 is designed for a maximum anode voltage of 250, a screen voltage of 150, and with the correct G.B. of —3 V applied passes a normal anode current of 2.3. The amplification factor is above 1,500; the A.C. resistance is 1.5 Megohm, and the mutual conductance is 1.25 A/V. In the case of the



This illustration of the Sound Sales speaker (complete with Class B unit) shows the special cut-edge surround referred to in these notes.

variable-mu pentode, the maximum anode and screen voltages are 250 and 125 respectively, whilst the anode current at minimum bias is 10.5 MA. The maximum slope is given as 1.64 MA/V.

It is anticipated that deliveries will commence within three weeks.

The full range of Tungsram American valve equivalents will be continued during the present season, and such advanced high efficiency valves as H.F. pentodes, pentagrids, double diode triodes, double diode pentodes and I.H.C. rectifiers are in course of preparation. We understand that these will be released very shortly. All Tungsram equivalents have exact RCA characteristics and can be placed in any American receiver as substitutes for the original valves.

CATALOGUES RECEIVED

To save readers trouble, we undertake to send on catalogues of any of our advertisers. Merely state, on a postcard, the names of the firms from whom you require catalogues, and address it to "Catalogue," PRACTICAL WIRELESS, Geo. Newnes, Ltd., 8/11, Southampton St., Strand, London. W.C.2. Where advertisers make a charge, or require postage, this should be enclosed with applications for catalogues. No other correspondence whatsoever should be enclosed.

VARLEY RECEIVERS

A FINE range of new "Square Peak" receivers is shown in the latest list issued by Oliver Pell Control, Ltd. The superhet mains receiver is a 4-valve table model, incorporating a moving-coil speaker capable of handling an undistorted output of 1,600 milliwatts. Notable features are the use of reaction on the intermediate frequency, one-dial tuning, and wave-changing by sliding the escutcheon plate. This model, which has a cabinet of beautifully finished walnut, is priced at fifteen guineas. In the 5-valve table model, which embodies automatic volume control, the circuit combines great selectivity with excellent tone-quality and freedom from background noise, a true balance of bass and treble being maintained by a compensating L.F. amplifier. The price of this model is eighteen guineas. The 5-valve console model also has auto-volume control, the speaker handling an output of 2,250 milliwatts. Housed in a walnut cabinet of striking design, this instrument is listed at twenty-seven guineas. The superhet mains radio-gram has a similar circuit to the console model and is fitted with a Garrard synchronous motor with automatic stop, a Varley pick-up, independent volume control for gramophone, and provision for an external speaker. The cabinet is finished in beautifully matched and figured walnut, and the price is forty guineas. Included in the list full particulars are also given of a "Square Peak" 3-valve mains receiver with S.G., Det., and Pentode valves. The sensitivity of this receiver, which is priced at twelve guineas, is exceptionally good, and the band-pass tuning and moving-coil speaker combine to give reproduction of a very high order. Copies of the list can be obtained from the above mentioned firm at Kingsway House, 103, Kingsway, London, W.C.2.

KABI COMPONENTS

WE have been informed that F. W. Lechner and Co., of 61, Spencer Street, Clerkenwell, London, E.C.1, have been appointed sole distributors for the British Isles of Kabi radio components, including potentiometers, volume controls, variable resistances, and switches. In a booklet which we have received from Messrs. Lechner, a comprehensive range of these components is given, including the Kabi midget wire-wound resistances and volume controls, and single and double pole switches of the toggle and push-button type. Wave-change and multiple contact stud switches are also included in the list, copies of which can be obtained on application to the above address.

BELLING-LEE'S DISTURBANCE SUPPRESSOR

ONE of the troubles that beset many listeners is interference caused by "man-made static," consisting of high-frequency radiations produced by various types of electrical apparatus. Post Office engineers have been investigating the subject for some time and have come to the conclusion that in 80 to 90 per cent. of the cases dealt with, the disturbance is "mains carried," and can be cured by an efficient condenser unit fitted at the source.

The Belling-Lee Suppressor has therefore been designed in accordance with the Post Office specification, and includes safety fuses. The component costs 10s. 6d., and full particulars of how it should be fitted, with diagrams, are given in a booklet recently issued by Belling and Lee, Ltd., Cambridge Arterial Road, Enfield, Middlesex. Readers interested should write for a copy.

"IGRANIPAK" TUNING UNIT

WITH the introduction of many new powerful broadcasting stations, adequate separation of wavelengths is outside the scope of the usual straightforward receiver. To receive satisfactorily home and foreign programmes without mutual interference, it is necessary to use at least three efficient tuning circuits, and in order to make tuning simpler it is essential to gang condensers instead of the earlier method of using a separate condenser for each tuned circuit. If the condensers are ganged it follows that the associated inductances must be accurately matched, because an error of 1 or 2 per cent. would reduce over-all performance of the receiver to a considerably greater extent. The Igranic Electric Co., Ltd., have spent many months in evolving a tuning unit to meet the exacting requirements of broadcasting conditions, and are now in a position to offer the "Igranipak," which is a complete, compact H.F. amplifier, which, with the addition of a few components for the low-frequency circuit, may be built up into a first-class, easily manipulated modern receiver. The "Igranipak" makes provision for the use of two high-frequency stages of amplification, in which can be used any reliable make of indirectly heated A.C. valves. The price of this handy unit is 57s. 6d., and full particulars are given in an attractive folder, copies of which can be obtained from Igranic Electric Co., Ltd., 149, Queen Victoria Street, London, E.C.

C.A.C. APPOINTMENT

THE City Accumulator Co., Ltd., have appointed Mr. R. J. Durand to take charge of their West End Showrooms at 4, Surrey Street, Strand.

Mr. Durand is well-known to every exhibitor at the the various radio shows, and his voice is familiar to every visitor, as for some time past he has been in charge of the B.B.C. reproducing equipment used in connection with the R.M.A. Exhibitions at Olympia, Manchester and Glasgow.

PAMPHLETS ON B.B.C. AUTUMN TALKS

TWO interesting pamphlets have just been published in connection with the B.B.C.'s Autumn talks. The first, "Ourselves," by Mr. Henry W. Nevinson, is introductory to the National Character series, in which Mr. Arthur Bryant and others will take stock of this particular heritage of ours.

"The British Empire" pamphlet, by Professor R. Coupland, C.I.E., Beit Professor of Colonial History in the University of Oxford, is designed to cover a series of talks that will last through the winter, and will provide a valuable background to the more expansive treatment that must be expected from the various speakers in the series. The many illustrations to Mr. Nevinson's pamphlet make an attractive addition to an attractive piece of work. "The British Empire" pamphlet is also well illustrated, and contains in particular a number of statistical diagrams which enable the reader to see a great deal at a glance. The pamphlets are sixpence each, sevenpence post free, and can be obtained from the Publications Department, B.B.C., Broadcasting House, Portland Place, London, W.1, or from any local B.B.C. office.

Replies to Broadcast Queries.

CONSTANT READER (Barnet): We can trace the following transmitters on the amateur band comprised between 150 and 175 m.: G2WQ, A. Brown, 7, Stanley Road, Broughton Park, Manchester; G6IY, A. Pacey, 36, Beverley Road, Barnehurst, Bexley, Kent; G6FM, D. Milner, 64, Bury Street, Lower Edmonton, London, N.9; G6KA, Keith F. Hardie, 66, Ulverston Road, Walthamstow, E.17; G5CD, D. N. Corfield, 10, Golders Hill Gardens, Hendon, N.W.4. SEVEN-TWENTY-TWO (Ruislip): Regret, but cannot trace full address of G6JM; DOST (Co. Durham): DFE, Nauen (Germany); DDDE, Aquilla (German ship); cannot trace amateur transmitter without call sign

WHY NOT DIRECT COUPLING?

(*Continued from page 348*)

being wasted in heating up resistances. Then there are obvious objections to using such high voltages in a domestic receiver.

Again, in order to adjust the circuit properly, instead of the long-tapped potential divider shown in the diagram (Fig. 5), it is necessary to provide a number of separate resistances in series, some of which must be variable, and capable of providing a very accurate adjustment.

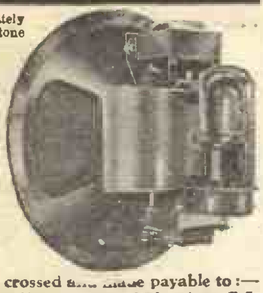
A Tedious Task

But the arrangement does work, and often works quite well in the hands of a skilled operator. I have made up several such amplifiers for special purposes, and one of these is shown illustrated in Fig. 6, it being designed for mains operation, a large rectifying valve providing the source of high tension for feeding the potential divider. The calculation of the various resistance values, however, though a simple combination of arithmetic and Ohm's law, is a tiresome job and, except for use in very special circumstances, or as an interesting experiment, it is doubtful whether the advantages anything like outweigh the disadvantages.

The idea is really an adaptation of the battery-coupled amplifiers used a good deal in the early days of radio practice. One of these is shown in circuit form in Fig. 7. Originally, these cascade amplifiers had separate filament, anode, and grid batteries for each valve, but this was later simplified to the arrangement shown in Fig. 7, separate grid balancing batteries being used for bringing about the differences of potential between anode, grid, and cathode. The amplifiers then needed the most careful adjustment, were bulky, and readily susceptible to the lack of reliability associated with the early forms of "dry" cell high-tension sources. When mains power became available the idea was resuscitated, but at present the scheme seems very unpopular.

MAINS VOLUME ASSURED WITH THE 362 CLASS "B" KIT OR SPEAKER UNIT

The 362 Class "B" Kit and Speaker-Unit, being accurately matched, will give enormously increased volume and rich tone from any battery set at extremely low H.T. drain.



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Newnes New Magazine

PRACTICAL MECHANICS

NUMBER TWO OUT TO-DAY

This most fascinating journal deals with every practical interest—television, wireless, microscopy, astronomy, money-making ideas, photography, cinematography, home broadcasting, engine-driven model aircraft, chemical and electrical experiments, lathe work, model locomotives, the stratosphere, new tools, gadgets and accessories, ray control of mechanism, etc. Lavishly illustrated, it covers every practical, mechanical and scientific interest. All Readers' queries are answered free. It is the journal without a rival.

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6D. MONTHLY

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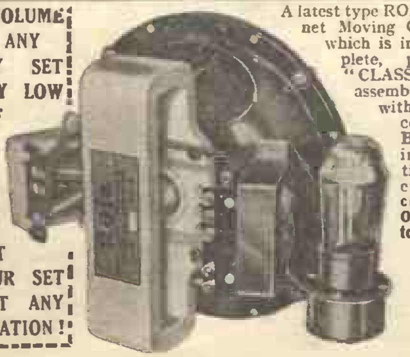
JUST CONNECT TO YOUR SET WITHOUT ANY ALTERATION!



A latest type ROLA Permanent Magnet Moving Coil Speaker with which is incorporated a complete, properly matched "CLASS B" amplifier. This assembly when connected with any Battery Set converts it to "Class B" output, increasing the overall sensitivity of the set several times, and **increasing the Power Output or Volume up to 5 times!**

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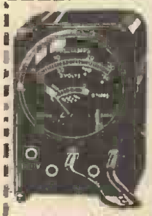

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P. W. Gift Stamp
"*Popular Mechanics*" No. 2

MORE ABOUT F. J. CAMM'S PHENOMENAL THREE-VALVER!

Practical Wireless

3D.

Published every Wednesday by
GEORGE NEWNES LTD.
Vol. 3.——No. 60.
NOVEMBER 11th, 1933.
Registered at the G.P.O. as a Newspaper.

EDITED BY F. J. CAMM.

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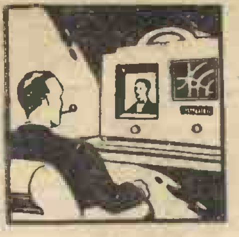
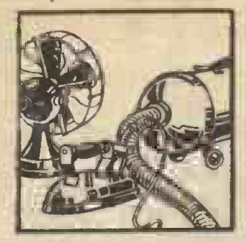

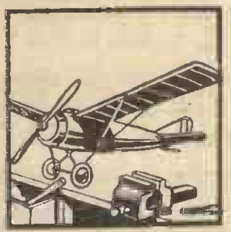


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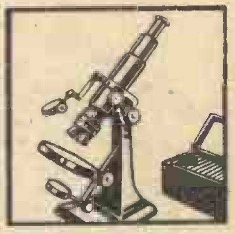
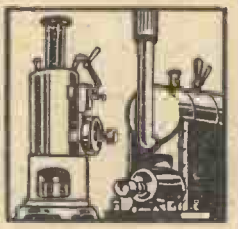


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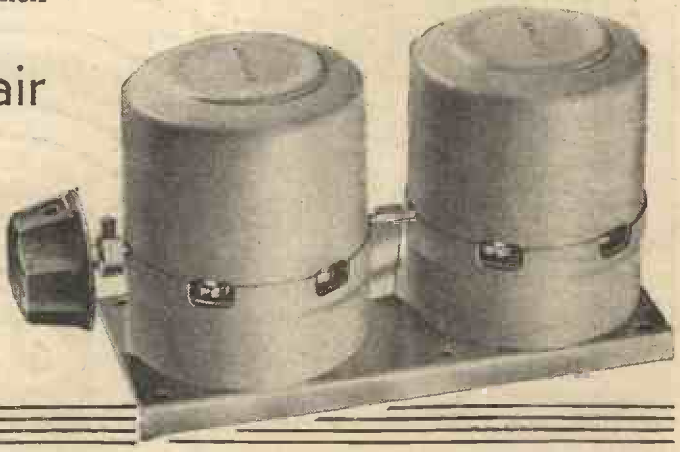

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INDEXES AND BINDING CASES FOR VOL. 2 NOW READY! SEE PAGE 445

Practical Wireless

EDITOR:
Vol. III. No. 60 || F. J. CAMM || Nov. 11th, 1933
Technical Staff:
W. J. Delaney,
H. J. Barton Chapple, Wh.Sch., B.Sc. (Hons.), A.M.I.E.E.,
Frank Preston, F.R.A., W. B. Richardson.

ROUND *the* WORLD *of* WIRELESS

Piatigorsky's First Broadcast Performance

AN artist who is arousing considerable interest in England and on the Continent is the thirty-year-old Russian 'cellist, Gregor Piatigorsky, who is giving Elgar's 'Cello Concerto in E minor in the B.B.C. Symphony Concert Series at the Queen's Hall on November 22nd. This will be Piatigorsky's first broadcast performance. Piatigorsky has had a distinguished career: at fifteen he was appointed principal 'cellist of the Imperial Opera at Moscow, and when the revolution broke out he went to Berlin, where he carried off in open competition the post of principal 'cellist of the Berlin Philharmonic Orchestra. Since Piatigorsky's association with this famous orchestra, he has become an international celebrity.

"America Calling Again"

JACK HYLTON and his band will take part in "America Calling Again," which is to be broadcast on November 16th and 17th. They will impersonate Paul Whiteman and his orchestra, Vincent Lopez and his orchestra, Duke Ellington and his band, Guy Lombardo and his Royal Canadians, all of which have distinctive features of their own. There will also be "a surprise item from Hollywood."

"Other People's Jobs"

THE first of a new series of talks with the title, "Other People's Jobs," is to be broadcast from Belfast on November 22nd. In this series various Ulstermen who hold interesting positions in the City and Province will tell listeners of their work. The first speaker will be a Belfast organizer, whose subject will be "Working for the Unemployed." Though the organizer will, for various reasons, remain anonymous, all those listeners who have assisted in various schemes which have been launched in Belfast to combat the evils of unemployment will find the speaker easily recognizable.

Police Band Concert

THE City of Bristol Police Band, directed by Captain F. W. Wood, will give a West Regional concert on November 17th. Ivy McGuigan (soprano) will be the soloist. She comes from a musical family, for her mother was a vocalist and her father a choral and orchestral conductor in London for many years.

Tea By Candlelight at 2 a.m.

NIGHT work means "light" work (of the electric variety), and when the current fails at two o'clock in the morning in a busy factory, compelled to work night shifts to keep pace with orders, it is not a "light" matter.

We hear that this was the unfortunate experience one night last week in the Graham Farish factory at Bromley. The failure could not be immediately remedied, and the staff had to wend its way home in the early hours—but not before enjoying a refreshing cup of tea by candlelight.

A big extra spurt was put on to make up lost time and catch up with the overflow of orders.

Musical Comedy from Belfast

A MUSICAL comedy with a local flavour, *Caravanella*, is to be broadcast from the Belfast Station on November 22nd. The authors, G. Rowantree Harvey and Kyle Hall have hit on a rather ingenious story for their show, which is set in a circus, and which bears some little resemblance to the tale of Cinderella. Like all good musical comedies, the story has the happiest ending possible, and the entertainment includes some very charming music.

Relays from Lincoln Cathedral

THESE relays are rare, and the last heard by Midland Regional listeners was in Lincolnshire Week in January. On November 21st the Minster Choir and the organist, Dr. Gordon Slater, give a William Byrd programme. This is one of Midland Regional's Midland Composers series, for Byrd was organist of Lincoln in the early years of Queen Elizabeth's reign, and it is generally accepted, although not definitely established, that he was a native of the county. The principal work to be given is the Magnificat and Nunc Dimittis (from the Second Service), which is probably the earliest example of an accompanied service with passages for solo voices and an independent organ part. The anthems include "O quam gloriosum," a fine example of five-part polyphonic writing.

Moscow's Radio Centre

AS the Russian capital possesses eight broadcasting stations of which the studios are scattered over the city, the Soviet authorities are planning the centralization of all radio activities under one single roof. This new broadcasting house should prove the largest in the world, inasmuch as it will contain forty separate studios, a gigantic public concert hall, a fully equipped theatre, and will also be called upon to provide accommodation for several hundred spectators for the display of films and television transmissions.

From 250 Watts to 10 Kilowatts

THE Germans have decided to replace the small relay station at Freiburg-im-Breisgau by a 10-kilowatt station which is to be added later to the Frankfurt-au-Main group; it will operate on the same channel as Trier and Cassel.

MAINS UNITS FOR F. J. CAMM'S PHENOMENALLY SUCCESSFUL RECEIVER—SEE PAGES 425—428

"Practical Wireless" Always Originates!

ROUND *the* WORLD *of* WIRELESS *(Continued)*

INTERESTING and TOPICAL PARAGRAPHS

Swiss Re-diffusion Network

NOTWITHSTANDING the fact that Switzerland possesses three high-power broadcasters and some smaller relay stations, many cities have established a "wired-wireless" service of radio programmes for telephone subscribers. At Geneva, the listener now has the choice of three separate entertainments; namely, those transmitted through Beromünster and Sottens and, in addition, a foreign broadcast at the option of the suppliers. These may be obtained at any time by the mere pushing of press buttons on a special panel fitted with a loud-speaker connected to the telephone system. It is stated that a substantial increase in the number of subscribers will permit additional programmes from abroad.

Odense's Radio Tower

IN order to secure a service of alternative programmes the Danish broadcasting authorities are erecting a Copenhagen "regional" transmitter at Odense. The aerial tower which will eventually reach a height of 177 metres (583 feet), in many ways will be modelled on that at present in use for Berlin-Witzleben. Similarly, it will possess a café and restaurant on the first and second platforms, and in addition will be used as an aerial system for a short-wave transmitter. With a view to the further development of the Danish broadcasting net six small stations are to be built in Greenland; they will relay the Copenhagen programme by wireless link.

New Single Side-band Broadcasts

THE Dutch high-power station at Kootwijk, near the Hague, has been carrying out experiments in broadcasts effected with a single side-band, with a view to demonstrations that transmissions made in this manner would permit a closer separation of stations. Although this would allow the inclusion of more transmitters in the longer waveband it would possess the disadvantage of entailing certain alterations to receiving sets. In these circumstances the method is of academic interest, but it is hardly likely that it will be adopted.

Radio-Paris on 120 Kilowatts

SO far Radio-Paris as a private concern has not broadcast with the greatest energy obtainable from the new plant at Remy St. Honoré. When the transmitter is taken over by the State the necessary alterations to obtain higher power will have been carried out. By the beginning of January, 1934, Radio-Paris will be rated as a 120 kilowatter and thus become one of the most effective stations in Europe.

The Amsterdam Wavelength Conference

ALTHOUGH no official statement has been issued to date by the U.I.R. (International Broadcasters' Union) according to a report from Holland, agreement was reached in regard to channels and their allotment to stations in the medium waveband. So far the countries which had refused to abide by the Lucerne Plan have not been induced to alter their decision. It is true that the Conference reaffirmed its findings in respect to a certain French station, but as it is unlikely that this station will be willing to reduce either its power or wavelength it will still cause considerable trouble in the upper waveband. In effect, it makes that portion of the Lucerne plan almost unworkable.

PRINCE GEORGE MAKES A RECORD

His Royal Highness Prince George pressing a record of his brother the Prince of Wales' voice, when he visited the "His Master's Voice" factories at Hayes recently. Standing next to him is John Higgins, who showed the Prince how to make gramophone records.

SOLVE THIS!

Problem No. 60.

Robinson built up the television apparatus described in the Wireless Constructor's Encyclopædia, and obtained very good results, although he found that it was a rather difficult task to hold the image steady. He therefore decided to make up a synchronising apparatus of the usual kind, and connected this in series with his Neon lamp. The receiver was connected in the correct manner to the television apparatus, but he found that the synchronising apparatus failed to function, although the toothed wheel and the mounting gear was purchased and above reproach. What was wrong? Three books will be awarded for the first three correct solutions opened. Address your attempts to The Editor, PRACTICAL WIRELESS, Geo. Newnes, Ltd., 8–11, Southampton Street, Strand, London, W.C.2, and post to reach here not later than Nov. 13th, 1933. Mark all envelopes Problem No. 60.

SOLUTION TO PROBLEM No. 59.

The insulators fitted to Blacksmith's aerial were very small and dirty. When a heavy dew was experienced the damp on these insulators formed a conducting path to the wire suspension holding the aerial to a metal mast. Thus signals leaked away through the metal mast. Fine dry mornings enabled loud signals to be obtained.

The following three readers succeeded in correctly solving Problem No. 58 and books have accordingly been forwarded to them:—

A. Cook, 4, Goolden Street, Chorlton-on-Medlock, Manchester 13; L. J. Sullivan, 56, St. James Road, Mitcham, Surrey; E. Chapman, 30, Abergele Road, Fallowfield, Manchester 14.

Naturalization of the Saxophone

ON discovering—after it had been vetoed—that the saxophone is an indispensable adjunct of dance bands, the Germans have decided that it may be used by them, as its inventor is of Aryan origin. Adophe Saxe, however, although bearing a Teutonic name, say the Belgians, was born at Dinant (Belgium) of Walloon parents. Whom are we to believe?

Do Ants Broadcast?

PROFESSOR LARSEN, a Scandinavian scientist, is said to have invented a new sound-recording instrument which permits "talkies" being made of insect life. By means of an ultra-sensitive microphone of exceptionally small dimensions it is reported that he has been able to amplify and record sounds produced by ants and actually inaudible to the human ear. He maintains that this constitutes a clear proof that these insects possess the sense of hearing and a language which allows them to communicate with each other.

Polish Broadcaster in a Fortress

THE 20-kilowatt transmitter now under construction in England and destined to replace the present Poznan station, will be installed in one of the old German forts which surrounded that city. The station may be ready to function early in the new Year; the wavelength should be 345.6 metres (868 kilocycles). There still exists a doubt, as Poland is one of the countries which has not agreed to the Lucerne Plan.

Italy's Musical Programmes

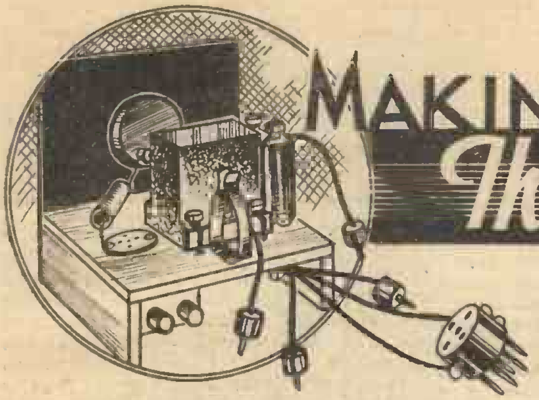
OF the European broadcasting studios, the Italian would appear to lead in the number of hours devoted to musical and dramatic entertainments. Of one hundred programme hours, seventy-two are devoted to concerts and plays; twenty-three to news and talks, and only five to recitals of gramophone records. Radio-Paris actually tops the list with seventy-eight hours of music, but of these, twenty-five consist of records, thus leaving comparatively a small percentage of the direct work of orchestras.

New York's Radio City

THE new "umpteenth" story building which has been erected in the heart of New York City, and which is to house the studios and staff of the National Broadcasting Company of America, will be officially opened on November 14th. Sir John Reith, Director General of the B.B.C., has been invited to attend the ceremony, and it is expected he may be induced to give an address to American listeners. The special programme compiled for this occasion will be relayed to all transmitters (both on medium and short waves) in the N.B.C. network and may also be transmitted to Europe. In all, the building comprises thirty-five studios, including the great Concert Hall; a large number of these will be used for the opening festivities.

A Simple Single-Valve Pentode Amplifier Fitted With Tone Control, and Which Can Be Used With Nearly Any Kind of Battery-Operated Receiver.

MAKING The ADD-PEN



THE "Unipen" all-wave receiver which I described recently in PRACTICAL WIRELESS has proved to be a very popular little set with a large number of readers. Many of those who have made it have told us of the excellent results which they have obtained, and a few of them have said that they would like to add an amplifier to it so that they could obtain more loud-speaker volume in order to operate a speaker of the moving-coil type.

The "Add-Pen" pentode amplifier, which I am going to describe now, has been designed especially for use with the "Unipen," but at the same time it can be used satisfactorily with any battery receiver which at present gives a comparatively small signal output. This amplifier uses a more or less standard circuit arrangement, but it has several constructional refinements which make it far more convenient than the ordinary type of low-frequency amplifier. In the first place, it is connected to the existing receiver by means of two spade terminals and a special plug adaptor only. No additional battery leads are required, and it is switched on and off by means of the single control of the receiver with which it is used.

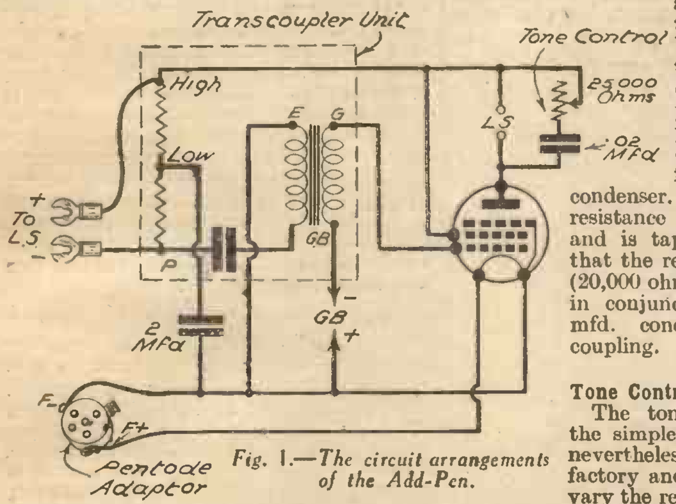


Fig. 1.—The circuit arrangements of the Add-Pen.

Simple Connections

The plug adaptor referred to has been specially made up for this amplifier by Messrs. Bulgin to my specification. It is, in effect, a combined valve-holder and plug, for it has five sockets in the top and corresponding split pins at the bottom. Two flexible leads from the filament terminals of the valve-holder on the amplifier are connected to terminals which are fitted and which make contact with the filament pins of the adaptor. Consequently, when the filament current is switched on to the set it is automatically fed to the amplifier as well. The only other two leads required to connect the amplifier are the "input" ones, and these are fitted with spades which are joined to the loud-speaker terminals on the set. These carry not only the signal voltages, but also the high-tension voltage to the amplifier.

Another useful feature is the provision of two small hooks, by means of which the amplifier and receiver can be clipped together.

The circuit of the amplifier is shown in Fig. 1, and from this it will be seen that resistance - fed intervalve transformer coupling is used; this is somewhat more efficient than ordinary transformer coupling and has the advantage of giving much better response to the lower notes. A complete unit is employed for coupling purposes, and this contains the necessary feed - resistance and condenser. Actually, the resistance is of 50,000 ohms and is tapped after 30,000 so that the remaining portion (20,000 ohms) may be used in conjunction with a 2 mfd. condenser for decoupling.

Tone Control

The tone control is of the simplest type, but is nevertheless perfectly satisfactory and enables one to vary the reproduction from the rather "screechy" tone generally associated with pentodes to a pleasant mellow one. Any desired tone between the two extremes can be obtained with perfect ease, merely by rotating the knob of the 25,000 ohm potentiometer.

Overall cost has been considered in making the "Add-Pen," but nothing has been stinted, since it was considered better to provide for really good quality rather than to sacrifice this for cheapness. Even so, all the parts (excluding the valve) can be bought for about 23s., so there is nothing to complain of in this direction.

A list of the few components required is given elsewhere, and you will find that all these can be obtained from any good dealer. You should take care to obtain the exact parts specified, since they have been chosen to work together and to produce good quality reproduction. The only item where variation is permissible is the ebonite panel; the size used in the original amplifier (6in. by 7in.) was chosen to match the panel of the "Unipen," but if you are to use the amplifier with some other receiver it might be better to make the panel higher or lower to match that of the set.

Ease of Construction and Wiring

The constructional work is particularly easy, and the first job is to assemble the three pieces of five-ply to form the chassis. After that you can make the 1in. diameter hole for the valve-holder and mount the components by means of ½in. round-head brass screws. Only a single hole is needed in the panel, and that is ⅜in. diameter to receive the bush of the potentiometer. Lastly, you can attach the panel to the chassis and proceed with the wiring. This is clearly shown in the wiring plan (Fig. 2). It will be noticed that some of the wires pass through the baseboard from one side to the other, so the holes through which they pass are numbered in the drawing to avoid any difficulty or confusion. Notice, especially, the connections of the two flexible leads to the plug adaptor; it is rather important that these should be wired the right way round, and this can easily be ensured if red and black flex is used for the purpose. The same thing applies to the two leads which have spade terminals

(Continued on page 408)

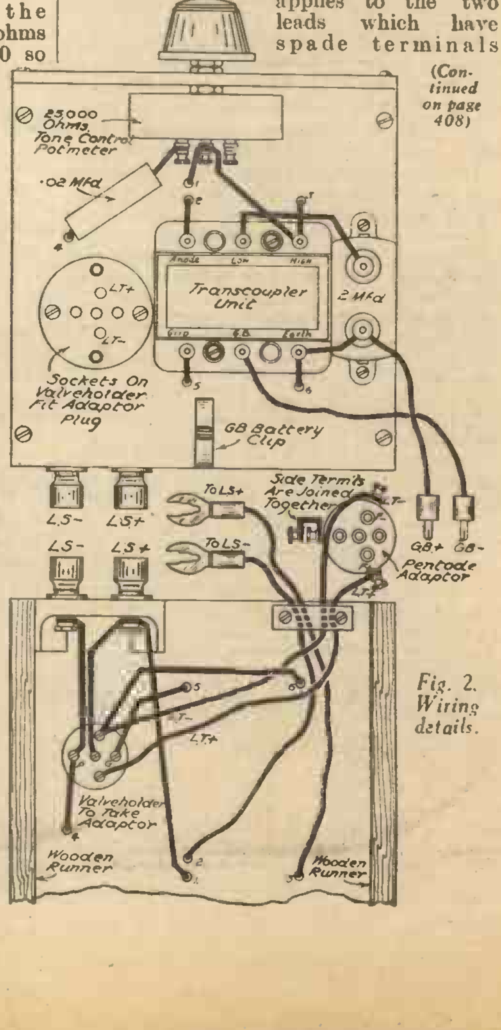


Fig. 2. Wiring details.

Neutralizing Circuits Explained

Improving Reception by Neutralizing Electrostatic and Electromagnetic Interference

By CYRIL SYLVESTER, A.M.I.E.E.

IN my wireless receiver of a few years ago I could raise the lid and look down upon valves, transformers, coils and condensers: the whole of them bare, unclothed. In my new receiver a view from the rear merely discloses a number of attractive cans: cans painted in silver

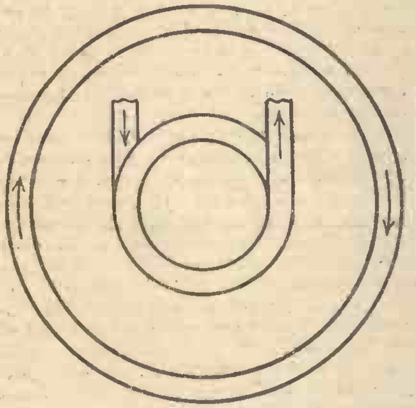


Fig. 1.—Current flowing through a wire induces a current in an opposite direction in an adjacent wire.

and gold, beautiful but without expression. The uninitiated look upon these cans as interlopers, a wrong impression since they are extremely useful.

The reason for these cans may be simply explained. It is that the components which go to make up a complete stage of amplification produce magnetic fluxes which, in the ordinary way, act and interact upon the fluxes produced by the components in another stage. In other words, unless suitable shields (cans) or filters are used to neutralize electrostatic or electromagnetic coupling between the essential parts of circuits which are at different radio frequency potentials, it is impossible to obtain high amplification because the receiver will be unstable and break into spurious oscillations.

How a can neutralizes interference is illustrated in Fig. 1, which shows the plan of a coil over which a screen has been placed. The arrangement is analogous to an air core transformer, the coil being the primary winding and the screen a completely closed secondary winding. The flux produced by the coil causes an e.m.f. to be induced in the walls of the screen; this causes current to flow in the screen which is nearly opposite in phase to the current in the coil. The induced current therefore produces a flux which substantially reduces that produced from the coil. The arrows in Fig. 1 show the direction of current in the coil and screen respectively.

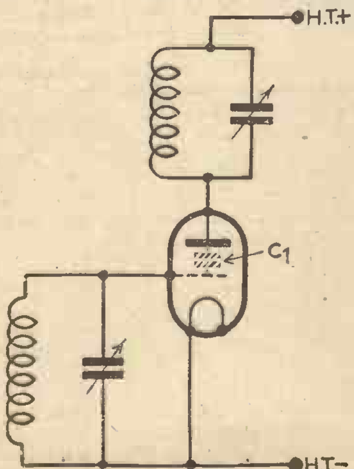


Fig. 3.—The self-capacity of the valve shown in diagrammatic form.

Induction and Capacity Reaction

But it is almost impossible to screen the whole of the components and circuits which go to make up the modern wireless receiver. A conductor of any circuit has, in conjunction with some other conductor in the receiver, a certain amount of capacity, and this same conductor, if in twisting between components produces a complete turn, has an impedance which at radio frequencies will be considerable. If this impedance is common to two or more circuits, the result will be that variations of radio-frequency current in one circuit will cause a difference of radio-frequency potential to exist across the impedance so that the second circuit will be affected.

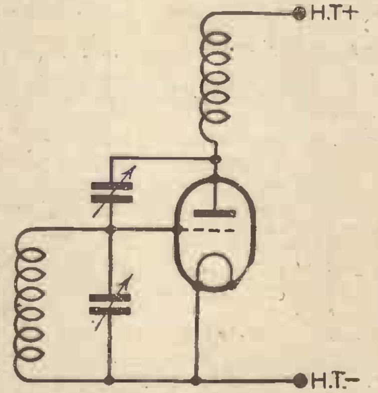


Fig. 2.—Intentional back-coupling introduced by means of a condenser.

It is well known that the effect of inductance is to neutralize that of capacity, and *vice versa*: to this end condensers are fitted in receiver circuits to neutralize the effects of excessive inductive reactance, and so on, from which it will be seen that in almost all radio-frequency amplifiers inductive or capacity reaction is present either intentionally or unintentionally.

An example of intentional capacity reactance is illustrated in Fig. 2. Here it will be seen that the radio-frequency anode current has an alternative path to the filament by way of the upper variable condenser and the grid-filament tuned circuit. This current is controllable, since the proportion which passes through the upper condenser depends upon the capacity of the latter. This case of intentionally applied reaction is illustrated because a similar method is adopted to neutralize the effect of unintentional reactance: that is, in both cases the damping on the input side of the amplifier is reduced so that the amplitude of the oscillations is increased to the necessary margin for stability.

Capacity Coupling in Valves

Although it is known that stray capacities occur between the leads of the circuits in any stage, it may be said that these are not all-important providing steps are taken to neutralize them. Far more important is the unintentional capacity coupling between circuits: a condition produced by the presence of capacity between the electrodes of valves used in the various stages.

Let us consider a simple case of a tuned circuit between grid and filament (illustrated in the bottom portion of Fig. 3) and a tuned anode output circuit (indicated in the upper portion of Fig. 3). Here it will be seen that both circuits are coupled together through the inherent capacity, C1, between grid and plate. This kind of coupling is most undesirable because energy can be fed from the tuned anode circuit back to the input circuit. This inter-electrode capacity varies in different types of valves, so that, where C1 has a high capacity, the co-efficient of coupling between circuits will be high, and a larger amount of energy will be fed back than would be the case with smaller values of C1.

Preventing Energy Feed-back

Overcoming the tendency of an amplifier to oscillate may take several forms, according to the amount of neutralizing required. Short leads spaced as far away from each other as possible, or screening the stages, may be sufficient. A reduction of filament current or H.T. voltage sometimes gives satisfactory results; here, however, although the energy feed-back will be diminished, the amplification factor of the valve will also be reduced.

(Continued on page 443)

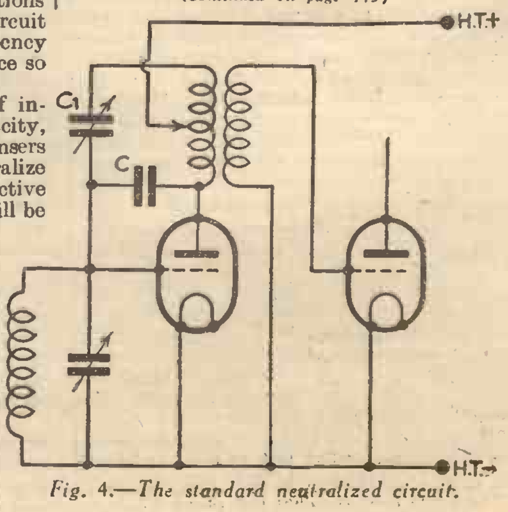
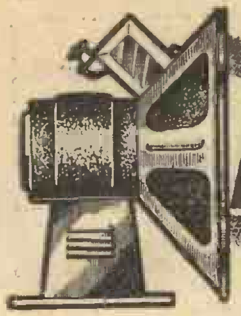


Fig. 4.—The standard neutralized circuit.



AUTO VOLUME CONTROL

A Practical Article Describing the Latest Developments and How They Operate

By H. J. BARTON CHAPPLE, Wh.Sch., B.Sc., A.M.I.E.E.

ONE result of the greatly increased power now radiated by the capital broadcasting stations of the world, and of the very efficient high-frequency amplification achieved by modern screened-grid valves, is that, to-day, it is quite an easy matter for listeners possessed of quite simple and inexpensive sets to pick up with certainty, and at good strength, a large number of foreign transmissions.

At the same time, however, the very facts which make possible such excellent results bring in their train certain difficulties, the chief among which is the overloading and distortion, combined with abnormal volume, which occurs when local stations are tuned in on highly sensitive sets. For example, if a receiver will bring in at good strength a number of distant stations, the volume on the local station will be far too loud, even with normal volume controls, such as reaction, turned down to the minimum setting. Moreover, the incoming signal due to the powerful station will be greater than the high-frequency valve or valves can handle without distortion.

Manual Control

It was to provide a solution to this difficulty that the variable-mu screened-grid valve was introduced—a high-frequency amplifier the effective gain of which can be decreased by the simple expedient of increasing the negative bias applied to its control grid. With such a valve, and a simple type of grid-bias control, maximum sensitivity can be obtained when it is desired to listen to distant or weak signals, while the effective gain of the valve can be reduced in order to avoid excessive volume and distortion on powerful signals. When first introduced, these valves were controlled manually by a potentiometer or variable resistance in the grid-bias network. First you found your station with the volume control in the "maximum" position, and, having found it, you adjusted the volume control until the output suited your taste as regards loudness and purity.

As, however, the prevailing fashion in set design favours the reduction of controls to a minimum, engineers began to turn their attention to developing a device whereby the variation of sensitivity in variable-mu valves should be performed automatically.

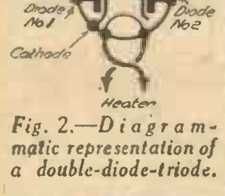


Fig. 2.—Diagrammatic representation of a double-diode-triode.

Definite Voltage Variation

Early attempts at automatic volume control—frequently termed "automatic gain control," A.V.C. or A.G.C.—were only partly successful, but, as will be shown later on in this article, automatic volume control has now reached the point when it can be applied with the certainty of success to any set employing one or more stages of high-frequency amplification.

It is obvious that for automatic volume control it is first of all necessary to select a point in the circuit at which exists a voltage that varies with the strength of the incoming radio frequency signal, and then to provide means whereby this varying voltage is fed back as a varying bias to the grid circuit of the variable-mu valve or valves.

There are many such points in a receiving circuit, but for several reasons the most suitable is the detector grid. In the circuit reproduced in Fig. 1 it is clear that a voltage drop exists across the grid leak R_1 depending in value upon the magnitude of the carrier voltage. This voltage is transferred to the grid of the high-frequency amplifying valve *via* the high-frequency choke (H.F.C.) and the decoupling resistance R_2.

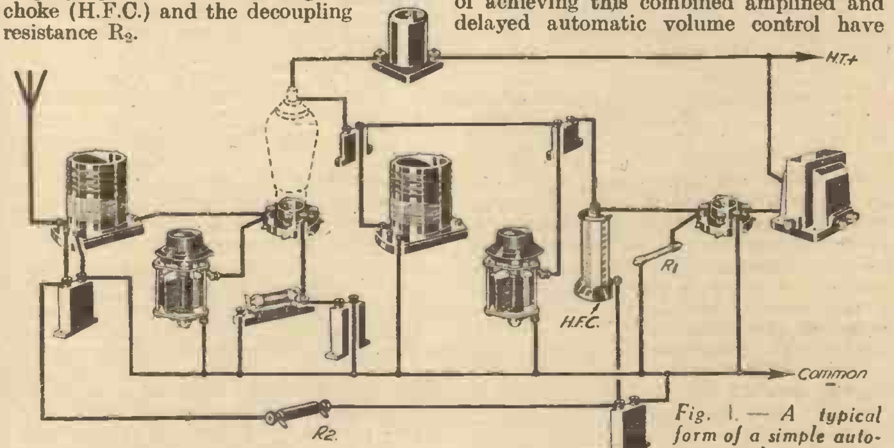


Fig. 1.—A typical form of a simple automatic volume control.

The disadvantages of this arrangement are two-fold. In the first place, a comparatively small voltage is available for control purposes, second, *every* signal, whatever its strength, is subject to a certain amount of control, with the result that although the stronger stations are toned down to the greatest extent, even weak stations are reduced somewhat in volume. The volume level, therefore, is very far from uniform.

Two Developments

Two developments were introduced which avoided both these faults—first a method of amplifying the controlling bias, and second a method of delaying the action of control until the incoming signal had reached a certain predetermined value. The results of these improvements were that controlling voltages of any desired value could be applied as negative bias, while at the same time weak signals were subjected to no control whatever if they were less than a certain initial strength, but were fully amplified to the limit of the capacity of the apparatus. If, however, a signal was of greater value than that selected, sufficient control was automatically applied to reduce the volume to the predetermined level.

As a consequence, the general level of volume with all stations normally receivable was substantially constant. It is true that with this arrangement powerful stations are heard slightly more loudly than average stations, but the difference is scarcely noticeable, while any station which, if the high-frequency amplifying stages are operating at maximum sensitivity, can be brought up to the selected level is heard at full strength. Of course, very weak stations which are too feeble to be amplified up to this volume are heard at reduced strength only.

Several Methods

During the past season several methods of achieving this combined amplified and delayed automatic volume control have been used. At first it was necessary to employ a separate automatic control valve in addition to the detector. Although this scheme has considerable technical interest, it will not be described here in detail because it has been superseded by a more modern circuit made possible by the introduction of that extremely interesting valve—the double-diode-triode.

This valve, which is shown in diagrammatic form in Fig. 2, comprises two small diodes, that is, a pair of two-electrode valves, and one three-electrode valve. When used for automatic volume control, the various sections of the valve are allocated as follows: one of the diodes acts as detector, that is, as a rectifier of the incoming radio frequency signal after it has been amplified by the variable-mu valves. In the case of a superhet receiver, this diode acts as second detector, that is to say, as the rectifier of the intermediate frequency signal. The rectified output of the first diode section is then passed to the control grid of the triode portion. This section of the valve performs two separate functions. In the first place, it amplifies the audio frequency component of the rectified signal, which is then passed on to the output valve in the usual way. Its second function is to amplify the direct current component of the rectified carrier voltage, for control bias purposes.

How It Is Done

This is done in the following manner: The rectified carrier is applied to the control grid of the triode portion, and thus acts as negative grid bias. With a weak signal, this negative bias is small, and the anode current of the triode will be fairly large. If the set is tuned in to a more powerful station, however, the carrier voltage, and thus the bias to the triode, is increased, and the anode current decreased, with the result that the voltage drop across a resistance in the cathode circuit of the triode will be similarly decreased. It can be arranged that the decrease in this voltage drop results in an increase in the difference of potential between the cathode and anode of the second diode portion of the double-diode-triode, and thus to increase the current through this diode. Increased current in this circuit results in an increased voltage drop across a resistance included in the circuit, and this voltage drop is applied as the controlling bias to the variable-mu stage or stages. The delayed action is achieved by a careful adjustment of the bias to the second diode.

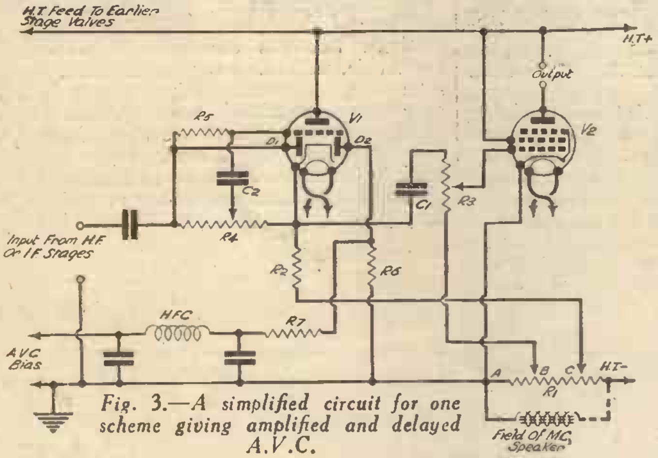


Fig. 3.—A simplified circuit for one scheme giving amplified and delayed A.V.C.

A Practical Circuit

All this may seem rather complicated, but a glance at the skeleton circuit shown in Fig. 3 should make matters very much plainer. In this circuit voltage dropping resistances and much of the decoupling has been omitted for the sake of clarity. The first thing to note in this diagram is that a resistance R_1 is introduced between the true H.T. negative terminal and the common earth lead, with the result that the earth lead at the point "A" is at a higher potential than H.T. negative by an amount equal to the voltage drop in the resistance R_1. It is the usual practice to make R_1 a potentiometer connected across the field of a moving-coil loudspeaker, but if this is not practicable, then R_1 must be of such a current carrying capacity that it will pass, without undue heating, the anode current taken by all the valves in the set.

A tapping off R_1 at point "B" gives grid bias to the output valve V_2, and a further tapping, which may be adjustable, at point "C" in conjunction with R_2, ensures that the cathode of the double-diode-triode, V_1, is biased with respect to the diode portion D_2 of the double-diode-triode, V_1. The resistance, R_2, in the cathode lead of V_1, serves also as the load resistance of the valve, the audio frequency drop across it being taken *via* the condenser C_1 to the grid of the output valve. Readers will recognize this as normal resistance capacity coupling, the only difference between this and the more conventional arrangement being that the load resistance is connected at the negative end of the circuit instead of between H.T. positive and the anode. The potentiometer, R_3, serves as a combined grid leak and volume control for the output stage.

We must now consider the circuit of the double-diode-triode. The input from the high-frequency stages is applied between the cathode and diode, D_1, of the double-diode-triode, and in this circuit there is a tapped resistance, R_4, from the tapping of which the audio frequency signal is transferred *via* the condenser, C_2, to the grid of the double-diode-triode. This signal modulates the anode current of the triode portion, and, as had been explained, the amplified audio frequency signal is passed *via* the condenser, C_1, to the grid of the output valve.

Automatic and Delayed

At the same time, the rectified carrier voltage is also transferred to the grid of V_1, *via* the resistance R_5. This voltage acts as negative bias to the triode, and it will be clear that this bias will be large when the input signal is strong, and small when the input signal is weak. The effect of this varying bias is to vary the strength of the mean anode current of the triode, the current being less for strong signals and greater for weak signals. The variation of the anode current in this way will vary the voltage drop across R_2 and consequently vary the bias of the cathode of V_1. The diode, D_2, is maintained at a constant positive potential, being fed from the common earth lead through the load resistance, R_6.

As soon as the strength of the incoming signal reaches a value at which the bias which it applies *via* R_5 causes the voltage drop in R_2 to render the cathode of V_1 negative with respect to D_2, current will flow in the diode, D_2, through the resistance R_6, and the voltage drop across R_6 will be passed as an A.V.C. bias voltage through the decoupling circuit comprising the resistance R_7, the high-frequency choke, and the associated by-pass condensers. By suitably arranging the values of bias voltages and resistances, matters can be so arranged that automatic volume control does not occur until the carrier voltage has reached a value giving the required output volume, while all the signals which would produce greater volume are toned down to the desired level.

The diagram herewith reproduced is sufficient to indicate clearly all the principles involved.

MAKING THE ADD-PEN

(*Continued from page 405*)

attached, since the amplifier will not work if these are reversed. For the sake of neatness, and in order to prevent the flexible leads being pulled away from their terminals when making subsequent connections, they are bunched together and secured under a small wooden "bridge."

Once the constructional work has been completed you can fit the bias battery into the clip provided and insert the "G.B.+" and "G.B.—" wander plugs into the positive and 7½ volt sockets respectively. Insert the 230 P.T. valve into its holder, connect the red and black spade terminals to the plus and minus loud-speaker terminals respectively on the receiver, replace the 220 H.P.T. valve by the adaptor and then fit the valve into the latter. The loud-speaker should, of course, be connected to the appropriate terminals on the amplifier.

Connecting to the Receiver

The connections just described apply particularly to the "Unipen," but the position will be just the same in the case of any other low-power battery receiver. There is only one other point which needs to be mentioned, and that is that the high-tension voltage must be increased from 60 to 120 to allow the amplifier to operate efficiently and to compensate for the voltage drop across the resistances in the coupling unit. If you have previously bought a 60-volt battery for the "Unipen" you can simply connect another one of similar size in series with it.

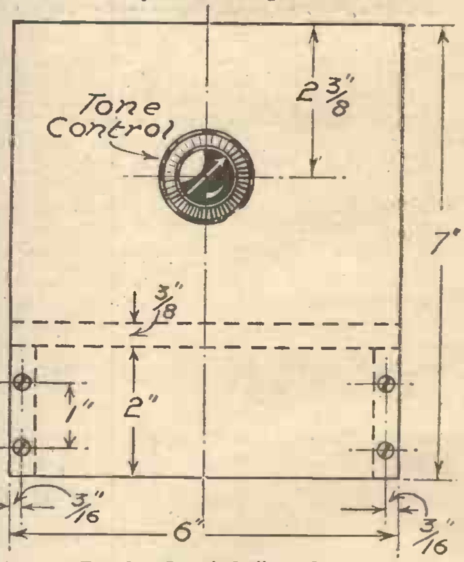


Fig. 3.—Panel drilling dimensions

When the amplifier is used in conjunction with a receiver that has previously received 120 volts high-tension it will not produce quite so great an increase in volume, since the last valve will receive less anode voltage than before.

LIST OF PARTS FOR THE "ADD-PEN" AMPLIFIER

One Becol Ebonite Panel, 7in. by 6in.
One Graham Farish 25,000 ohm "Megite" Potentiometer.
One Bulgin "Transcoupler."
One Bulgin Grid Bias Battery Clip, type No. 3.
One Dubilier 2 mfd. Fixed Condenser, type BB.
One Dubilier .02 mfd. Tubular Fixed Condenser, type 4,402.
One Clix 5-pin Chassis Mounting Valve Holder.
One Belling Lee Terminal Mount.
Two Belling Lee Terminals, type R, marked "L.S.+" and "L.S.—"
Two Clix Wander Plugs, marked "G.B.+" and "G.B.—" type No. 12.
Two Clix Spade Terminals, one red and one black, type No. 3.
One Bulgin Valve Plug Adaptor, with Filament Terminals.
One piece 5-ply 6in. by 6in.
Two pieces 5-ply 6in. by 2in.
Connecting Wire, Flex, Screws, etc.

DON'T BE NIGGARDLY WITH THE VOLTS

In this Article the Author Explains Why the Maximum Anode Voltages should be Used in Battery or Mains-operated Sets

I HAVE lately seen one or two glaring examples of inefficient radio receivers, due entirely to a wholly erroneous idea that battery power was being saved. In each instance a very small saving in consumption was occurring, but the loss of volume and quality which accompanied it was out of all proportion to the "economy."

An Unwise Policy

A large proportion of examples of abortive economy occur in a praiseworthy yet mistaken attempt to save power by cutting down the anode voltages to the various valves in a receiving set. It is perfectly true that by reducing the anode voltage you also reduce the anode current, and thus save power and prolong the life of your high-tension battery (or reduce the consumption of mains current if you employ a power unit). In a great many cases, however, this is a very unwise policy, for the performance of almost any valve, in almost any position—with the possible exception of the detector stage in certain circumstances—is definitely better at full anode voltage than at reduced pressure.

One reason why this is so common is that many listeners still think that the maximum anode voltage rating is based upon the output voltage of the high-tension battery or supply unit. This, however, is not so, the values being definitely the maximum voltage difference permissible between anode and cathode.

When a valve maker publishes a statement that a certain valve can be operated at anode voltages up to, say, 150 volts, he really means 150 volts on the anode—not 150 volts minus a drop of twenty volts or so in decoupling resistances, and minus a further drop of 80 volts in the resistance of an R.C.C. unit. Many a valve used as low-frequency amplifier with resistance capacity coupling is operated at very little more than 50 volts at the anode—the residue of a full 150 volts H.T. after various resistances in the circuit have taken their toll of the total voltage available.

A Typical Example

Even with mains receivers, in which, owing to the much cheaper cost of power, economy in consumption is not so vital as with battery-operated sets, a bare 200 volts is allowed for high tension, or 250 volts at the most, and this is whittled down at every turn. To begin with, anything from 10 to 30 volts is filched for grid bias to the output valve. Then decoupling resistances are provided in every anode circuit, and may account for another 20 to 30 volts, apart from the inevitable drop in the true anode load.

In order to gain some idea of the extent to which the capabilities of a valve are restricted by under volting it, you have only to glance at the characteristic curve of any valve suitable for R.C.C. coupling, such as the one reproduced in Fig. 1. This refers to a high magnification A.C. mains valve having an amplification factor of 75, and an impedance of 34,000 ohms. For a valve of this type a suitable anode resistance would be about 80,000 ohms.

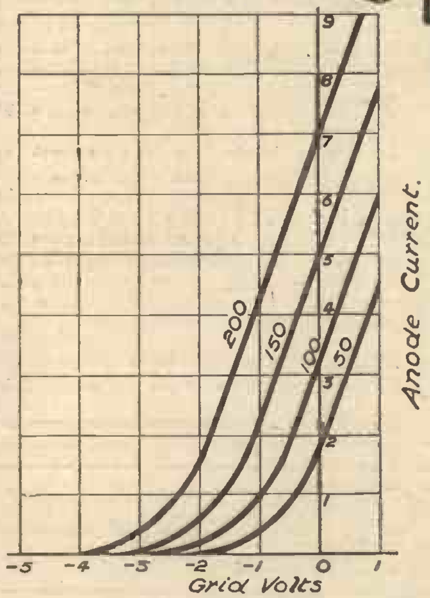


Fig. 1.—The characteristic curves of a valve suitable for R.C.C. coupling.

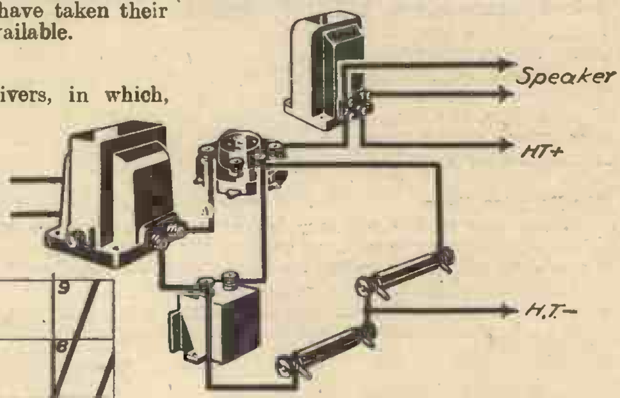


Fig. 2.—Connections for a mains output valve showing where the volts are lost.

With 200 volts actually applied to the anode, the valve should be biased to about 2.0 volts, and would be able to handle without serious distortion grid signals of about .75 volts (peak value). Under the load conditions specified above, the over-all stage gain would be of the order of 50.

Distortion

Now see what would happen if, owing to considering the nominal H.T. voltage as the anode voltage, the actual voltage at the anode were reduced, say, 100 volts. In the first place, if the bias were maintained at 2 volts, the valve would be hopelessly overbiased, and terrible distortion would be introduced. If, however, as the result of the distortion, the listener endeavoured to put matters right by reducing the bias to, say, 1.0 volt, the acceptance of the valve would still be seriously reduced, as you can see by comparing the curve at 200 volts with the curve marked 100 volts. There would, therefore, still be a good chance of the valve being overloaded and quality would still be much below par. Even if, recognizing the effect, though not the prime cause, the listener now rectifies matters by reducing the input, he has to put up with greatly reduced volume.

I have selected a resistance capacity coupled valve for an example because this particular application shows the effect of under-volting in its most aggravated form.

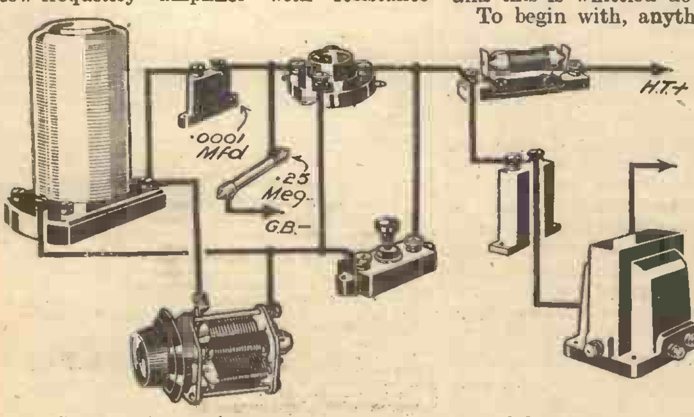


Fig. 3.—A suitable arrangement for a power-grid detector stage.

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but the principle can be applied to almost every stage of any receiver.

Take for example the output valve (see Fig. 2). There are quite a number of mains output valves requiring as much as 30 volts negative grid bias, and this is almost always stolen from the negative end of the high-tension supply, which means that the valve is under-volted by this amount. There is also the resistive drop in the loudspeaker to be taken into account, and this may well be another 50 volts or more.

Even the high-frequency stages suffer in this respect, for there is always the drop in decoupling resistances, high-frequency chokes and so forth to be considered and, in the case of variable-mu valves of the indirectly-heated type, the maximum bias, which may amount to as much as 40 volts.

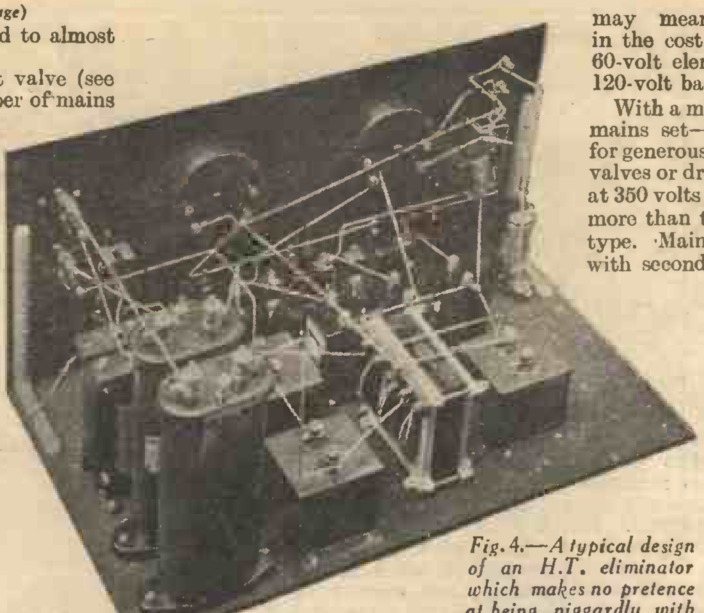


Fig. 4.—A typical design of an H.T. eliminator which makes no pretence at being niggardly with the volts and milliamps.

The Detector Stage

In the case of the ordinary leaky grid detector, matters are not so serious, for the guiding rule here is to use the minimum H.T. voltage which will give you adequate output and sufficient reaction, the lower limit being usually set by considerations of output, and the upper limit by reaction control.

But while on the subject of generous high-tension voltage, we might consider whether it is not wiser to use the valve under what is known as "power grid" conditions, that is to say, with the maximum anode voltage that the valve is rated to withstand, and with reduced values of grid condenser and leak (see Fig. 3). By so doing, we shall sacrifice nothing in sensitivity, and will gain in quality, because under power grid conditions the valve will handle and rectify still stronger signals without distortion. It is true that the anode current of a power grid detector is substantially greater than that of a leaky grid detector, thus necessitating, in many instances, resistance feed to the transformer following it. This slight increase of anode current, however, and the extra expenditure on the apparatus for resistance feeding—one resistance and a small fixed condenser—are well worth while in the interests of good performance.

Now, we must consider for a moment the means for ensuring that each valve shall be given its due anode voltage. To begin with, it is clear that the high-tension supply, whether a battery or a mains unit, must be capable of giving a total voltage equal to the desired anode voltage plus any odd volts required for bias, decoupling, drop in anode resistances, and so on.

Be Generous with H.T. Volts

In the case of a battery-operated set this may mean a 50 per cent. increase in the cost of the battery—say, one extra 60-volt element in series with the normal 120-volt battery.

With a mains set—or, at any rate, an A.C. mains set—it is quite possible to design for generous high-tension voltages. Rectifier valves or dry rectifiers, giving 120 milliamps at 350 volts are quite standard, cost but little more than the usual 60 milliamp, 250-volt type. Mains transformers, too, are made with secondaries wound for use with these larger rectifiers, and a typical mains eliminator of this generous type is shown in Fig. 4. A total high-tension voltage of 350 volts gives ample scope for full anode voltages to every valve in the set, and leaves a reasonable margin for the inevitable whittling down and for liberal decoupling where required.

Manufacturers of complete radio sets are already showing that they are fully alive to the wisdom of generosity with high-tension volts. This is indicated by the fact that, on examining the specifications of one hundred typical A.C. mains receivers of the three-valve and four-valve types, I discovered that rather more than one-half — actually fifty-three—of the sets are fitted with 350-volt rectifying units.

It is a rather more difficult matter to arrange liberal high-tension volts for D.C. mains sets, because the maximum high tension voltage is limited to the mains voltage, and there is always some drop in the smoothing choke. But most D.C. districts have at least 200 volts, and many as much as 240 volts. As the standard D.C. valves are rated for maximum anode voltages of 200 (including the output valves) something approximating to the maximum rated voltage can usually be made available for every stage.

AUTOMATIC REACTION

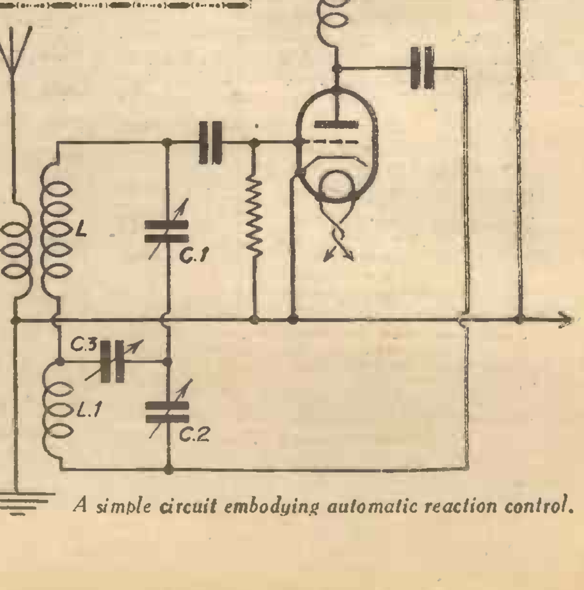
By LAMBDA

THE idea of producing one knob control, with regenerative receivers, at last appears to be an accomplished fact. Radio engineers are closely engaged upon this problem, and we hope to give further details shortly.

With automatic reaction, the present bugbear of constantly adjusting the reaction control over the tuning range will be dispensed with. The tuning and reaction condensers will be ganged, a decided advantage, particularly in short-wave receivers. The fundamental circuit is shown in the accompanying diagram: L being the grid coil and L1 the reaction coil. These are tuned by the ganged condensers C1, C2; C3 being the coupling condenser.

If we were to couple magnetically L and L1 without the capacity at C1, the feed back from the plate of the detector valve would be greater at the low capacity end of the tuning scale. By coupling the two coils together by means of the capacity C3 without magnetic coupling between them, regeneration would be greater at the high capacity end of the scale. If a combination of capacity and magnetic coupling be employed we can, by a careful arrangement of the capacity and magnetic coupling, obtain satisfactory reaction effects over the whole of the tuning scale. The values of C3 and degree of magnetic coupling is, however, entirely experimental.

This system should be particularly suitable for short-wave reception, sensitivity and selectivity being considerably increased.



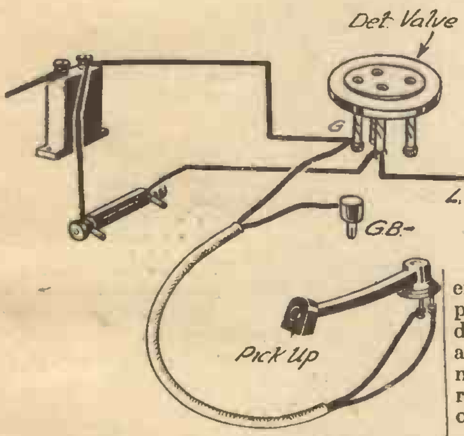
A simple circuit embodying automatic reaction control.

Here is the Fourth Complete Article in This Instructive Series, and in it the Author Describes How the "Progressor" Can Be Used with a Gramophone Pick-up. Some Simple Experiments in Regard to Decoupling are also Dealt With.

By FRANK PRESTON, F.R.A.

WE are now in possession of an excellent two-valve receiver of simple design. Before going on to explain how additional valves can be added in order to increase the range and volume, I propose to suggest a few refinements and additions to the circuit as it now stands.

Every modern set has pick-up terminals so that it can be used for the electrical reproduction of gramophone records. The terminals are included in the grid circuit of an amplifying valve, and usually a switch is provided to bring into circuit either the pick-up or the preceding "radio" portion of the set. In a set having two or more low-frequency amplifying valves it is best to connect the pick-up to the first L.F. amplifier, but where only a single L.F. stage is provided (as in the "Progressor") there is insufficient amplification from the one valve to enable sufficient volume of reproduction to be obtained. For that reason the pick-up can most satisfactorily be connected to the input circuit of the detector valve, suitable wiring modifications being made to enable that valve to function as an amplifier when the pick-up is in use.



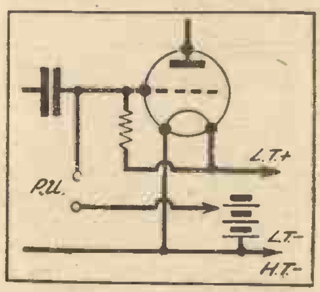


Fig. 1.—The simplest method of connecting a pick-up to the detector valve.

The Simplest Pick-up Connections

As a matter of fact, the only circuit alteration necessary is one which allows a suitable grid-bias voltage to be applied to the detector valve through the pick-up. This is provided by connecting one pick-up lead to the grid of the valve, and the other to a tapping on the G.B. battery, as shown in Fig. 1. There are two important objections to this system, however, one of which is that the detector grid leak is virtually in parallel with the pick-up. This has the effect, especially with certain types of pick-up, of affecting the quality of reproduction obtained, whilst the pick-up leads are liable to have a "damping" effect on normal radio reception and so to reduce the set's efficiency. A second objection to the method is that there is always a likelihood of "interference," by normal wireless signals, with gramophone music unless the aerial lead is disconnected.

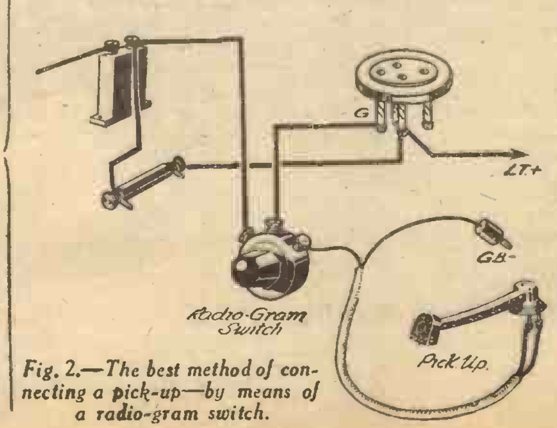
COMPONENTS REQUIRED FOR THIS WEEK'S EXPERIMENTS.

- One B.R.G. Rotary Radio-Gram Switch.
- One 25,000 ohm Graham Farish "Ohmite" Resistance.
- One 2 mfd. T.C.C. Fixed Condenser.
- One Belling Lee Wander Plug, marked "G.B.–2."
- One short length flex.

Fitting a Radio-gram Switch

Both these difficulties are easily and quickly removed by connecting the pick-up to the grid of the detector valve through the medium of a change-over switch. The necessary connections are shown pictorially and diagrammatically in Fig. 2, where it can be seen that the centre terminal (moving contact) of the switch is joined to the grid alone; one of the other (fixed contact) terminals is connected to the grid condenser and leak, whilst the third terminal is wired up to one side of the pick-up. A lead is taken from the second pick-up connection to a tapping on the grid-bias battery. It will quite easily be understood that as the moving contact is changed from one position to the other the receiver is at once adjusted for either "radio" or "gramo" reproduction.

Once you have seen the underlying idea of the pick-up connections you can turn to Fig. 3, where the actual wiring for the pick-up sockets on the "Progressor" is shown in full lines—for the sake of clarity all previous connections are shown as broken lines. The B.R.G. rotary radio-gram switch is mounted on the back of the chassis half-way between the two terminal socket strips, by fitting it into a 5/16in. hole. The wire which previously joined the grid terminal of the detector valve-holder to one terminal of the fixed grid condenser is removed. A lead is then taken from the former point to the centre terminal of the R.G. switch, and from the latter to the lower of the other two terminals. The third terminal on the switch is joined to the pick-up socket nearest to it. A short length of flex is attached to the second pick-up socket and a wander-plug marked "G.B.–2" is fixed to this. When using an H.T. voltage from 90 upwards for "H.T.+2," the wander-plug should be placed into the "1½ volt" socket on the bias battery, but when the voltage is lower



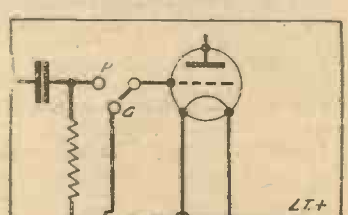


Fig. 2.—The best method of connecting a pick-up—by means of a radio-gram switch.

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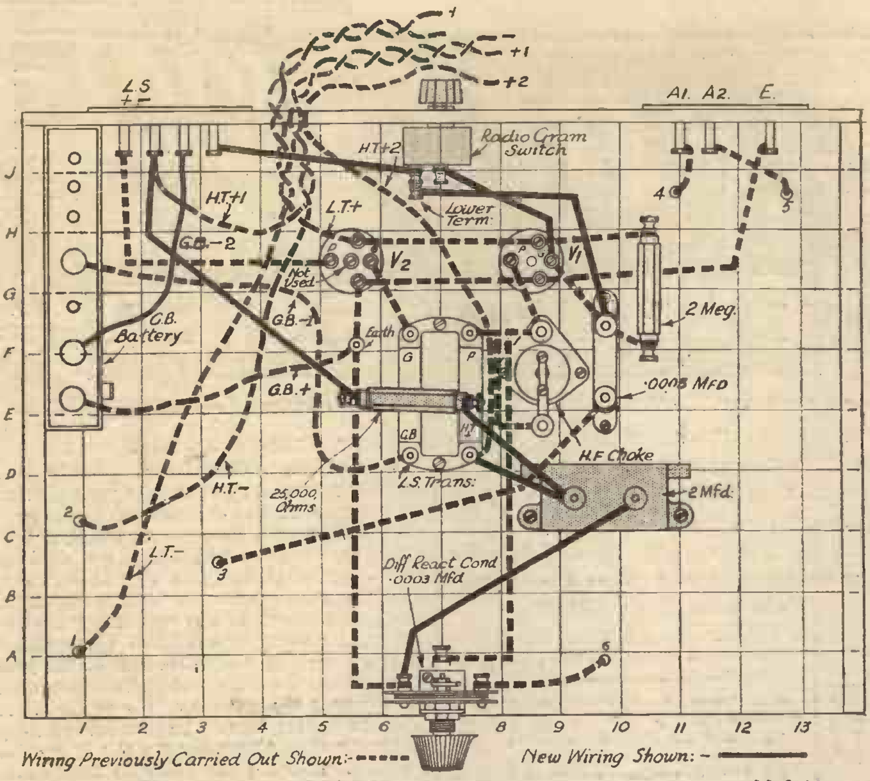

Fig. 3.—Wiring plan of underside of chassis, showing new components added for this week's experiments.

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than this it might be found better to connect the plug to the other one marked "G.B.+" by means of a short length of thin wire.

You can now connect the pick-up to the terminal sockets provided, and to change over from radio to gramophone it is only necessary to rotate the switch knob in a clockwise direction. There is no need to disconnect the pick-up when it is not in use, since it can be put entirely out of circuit by means of the switch.

Grid-bias Adjustments

The next step is to find the most suitable tapping point for "G.B.−2"; in all probability it will prove to be 1½ volts negative, but you should check this by trying the wander-plug in different positions. After you have done that it would be a good idea to try the effect of altering the position of the grid-bias tapping for the low-frequency valve. First try moving the plug to a higher voltage socket, and then to a lower one. One word of warning is necessary in regard to this experiment, since if the grid-bias plug is removed from the battery whilst the set is switched "on" there will be a danger of the power valve being damaged, due to its passing an excessive amount of anode current; because of this the set should be switched off between each adjustment to the bias voltage.

As the grid-bias voltage is increased it will be found that distortion occurs, particularly on loud passages. On the other hand, when the voltage is reduced below a certain point the reproduction becomes "muffled" and unpleasant. If you have a milliammeter reading up to about ten milliamps, you can also observe another effect by connecting the meter between the 120-volt socket on the high-tension battery and the corresponding wander-plug. As the G.B. voltage is increased the anode current taken by the power valve is reduced, and as the voltage is lowered the anode current rises. In view of this, it will be clear that the best and most economical position for the grid-bias wander-plug is in the highest tapping it is possible to use without distortion setting in. A good way to adjust the voltage is to tune in the station which can be received at greatest strength and then move the wander-plug "upwards" in 1½-volt steps until distortion is just noticeable; after that the plug should be moved back one step, when the setting will be the best possible, and H.T. current consumption will be at its minimum.

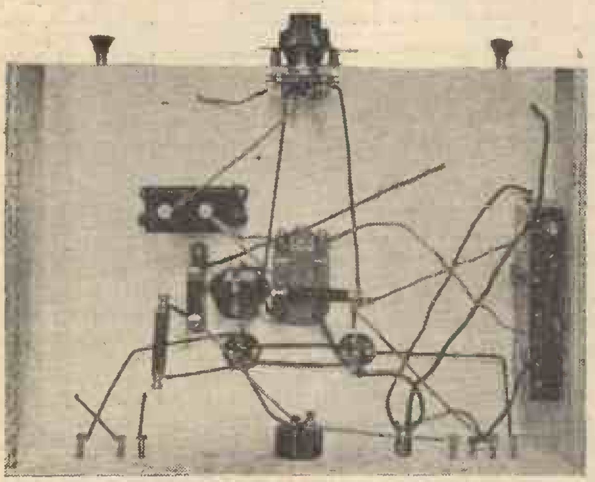

Fig. 5.—Underside of chassis after the decoupling components have been added.

Using a Pentode in the "Progressor"

It is quite likely that some constructors would like to increase the volume from the "Progressor" without the addition of any further valve stages. I originally made provision for this by providing a 5-pin holder for the power valve, so that a pentode could be used in its place. The only alteration in wiring which is necessary is that another H.T. positive lead should be taken from the centre terminal. This will consist of a length of flex fitted with a wander plug which can be plugged into the most suitable tapping on the H.T. battery. In most cases it will be found that best results are to be obtained by using the highest available voltage tapping, but it is best to try the effect of voltage variations. Besides altering the H.T. voltage it will also be best to experiment with different grid-bias voltages, as explained above in respect to the triode power valve.

Decoupling the Detector Valve

Our next experiments will be in respect to the prevention of low-frequency oscillation or feed-back, and which often gives rise to what is popularly known as motor-boating. The principal object in decoupling the detector valve is to prevent the effects caused by using a high-tension battery of high internal resistance—in other words, a battery that is past the prime of its life. For that reason the improved results brought about by decoupling cannot properly be observed unless a rather old H.T. battery is available. A battery which is in good condition can, however, be employed if a resistance of about 1,000 ohms

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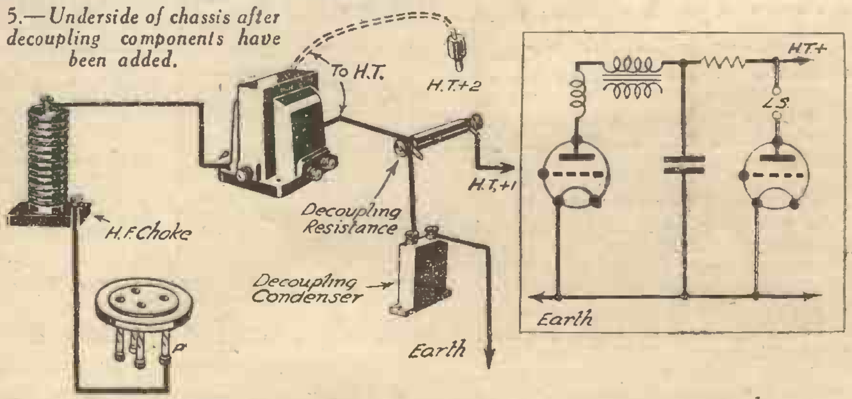

Fig. 4.—The connections for a resistance and condenser used to decouple the detector valve; the previous H.T. tapping is shown in broken lines.

Some causes & Cures for H.F. INSTABILITY

By BERNARD DUNN

Some Simple Methods of Obtaining Stable Operation of High-Frequency Amplifiers are Here Described.

IT might sound strange, but it is, nevertheless, quite true, that the task of designing a really stable, and at the same time efficient, high-frequency amplifier is more difficult to-day than it was a few years ago. The reason for this is simply that valves and tuning coils are now so very efficient that, if self-oscillation and similar troubles are to be avoided, the circuits in which both are used have to be worked out with extreme thoroughness.

I dare say that if a careful analysis were made of the amateur-designed receivers of the type employing one or more S.G. valves, it would be found that less than fifty per cent. were perfectly stable. Even when working to designs which have been evolved by competent engineers, it is extremely easy to make a slight mistake which makes all the difference between the set being "workable" or otherwise. Because of this I think that readers will appreciate a few notes in regard to possible causes of instability parasitic or uncontrollable oscillation, and similar forms of trouble to which high-frequency amplifiers are susceptible.

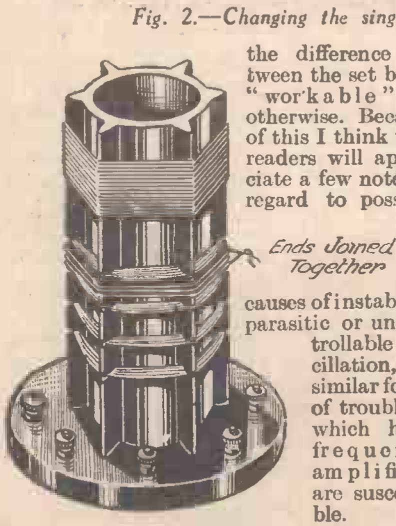

Fig. 3.—Sufficient damping to produce stability can often be introduced by putting a few short-circuited turns on the tuning coil.

The whole theory of stable working, stage gain, and the like is involved, and I doubt if readers would be interested in studying it, but some practical views and suggestions on the subject are sure to be welcome.

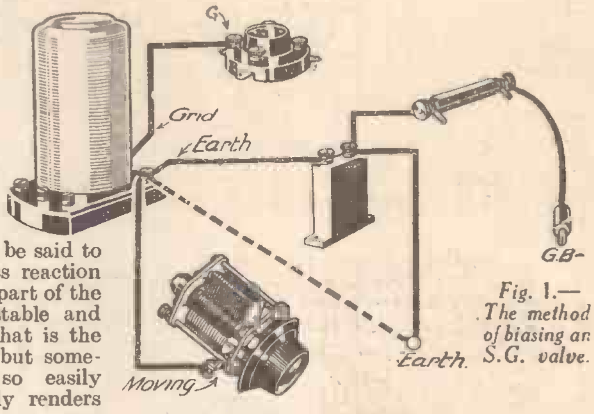

Fig. 1.—The method of biasing an S.G. valve.

Tests for Instability

In the first place, let us decide what are the indications of instability, and under what circumstances a set may be said to be stable or unstable. Unless reaction is under full control at every part of the tuning scale the set is unstable and should receive attention. That is the obvious form of instability, but sometimes the defect is not so easily recognizable because it merely renders the receiver inoperative at certain parts of the tuning range. In that case it can most easily be traced by touching the grid terminal of the first or second valves; if a "double-plop" is heard, or if signals can then be received, there is little doubt that self-oscillation (or instability) is present.

Sometimes instability is indicated by the fact that reproduction is poor and signals are accompanied by an annoying high-pitched whistle. The trouble can also make itself evident in other ways, but in nearly every case one of the symptoms referred to is present.

Unwanted Capacities

Just as with any other diagnosis, once the complaint has been found to be present, the cause and remedy have to be considered. In the majority of cases instability is caused by the existence of capacity between the anode and grid circuits of a valve. The capacity might be formed between two wires running close together or between components which are badly placed. In both these cases the obvious remedy would be to alter the positions of the wires or components concerned, but it might take quite a long time to find which were the parts causing trouble. The only thing is to try the effect of altering every wire and every component in turn, and even after going to all that trouble it might be found that to make a permanent change in the position of a component would spoil the whole layout of the set. An alternative to shifting the parts is to screen them, either by replacing such components as H.F. chokes and variable condensers with others which are provided with screens, or by erecting aluminium plates between the parts concerned. Remember, however, that no screening can be effective unless it is earth connected. In the case of wires which must of necessity run close together or near to some "important" component, it is best to employ screening braid of the kind which is now made by a number of manufacturers. Again, the screen must be earthed (or where the set is a portable, connected to L.T. negative), and care must be taken to see that the braiding cannot make contact with the bared end of the wire which it screens. The leads which generally require to be screened are those in the anode circuits of the S.G. valves and in the reaction circuit of the detector. In particularly bad cases it is also beneficial to screen the grid leads to the S.G. valves from the variable condensers and tuning coils. This remedy should only be applied when all others fail,

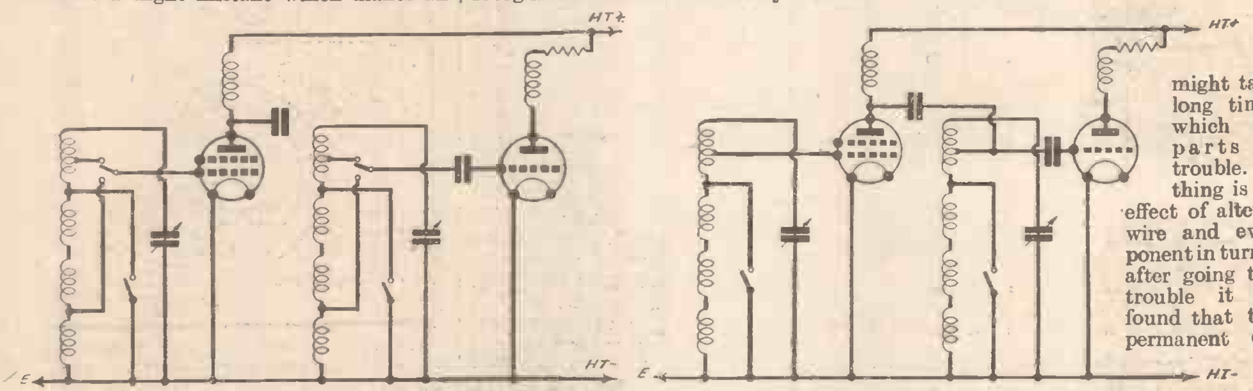

Fig. 2.—Changing the single tapped grid coils by others having transfer-tappings often cures instability.

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since it is liable to result in a loss of efficiency and to alter the tuning positions of the stations received.

The methods described are those which can be applied without altering the circuit arrangement and which can safely be tried with a receiver known to be of fundamentally sound design. There are others that are mainly applicable to a set which is being built up experimentally, and not to any particular arrangement. They are all intended principally to reduce the efficiency of either the tuning circuits or the valves. It might appear wrong to attempt to do anything which involves a sacrifice in efficiency, but it must be remembered that it is *theoretical* rather than *practical* efficiency that is being destroyed, because a stable set of low efficiency will permit of the reception of far more stations, and with greater ease, than will a highly efficient and unstable receiver.

Biasing the S.G. Valves

One of the simplest methods of reducing S.G. valve efficiency is by cutting down the screening-grid voltage, but this should only be employed when the desired effect is produced by making the voltage some twenty per cent. less than the optimum figure stated by the makers. Another often excellent way of producing stability without any

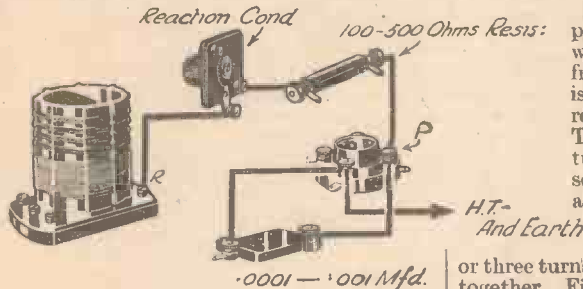


Fig. 4.—Parasitic oscillation and unstable reaction control can be generally cured by inserting a fixed resistance in the reaction circuit and connecting a fixed condenser between the detector anode and earth.

great loss in efficiency is by applying a small amount of negative bias to the grid of the S.G. valve(s). This voltage can be obtained from the normal bias battery by removing the wire which connects the " bottom " end of the grid coil to earth and tuning condenser, and replacing it by a .1 mfd. fixed condenser. A grid-bias tapping is then taken from the coil terminal; a 100,000 ohm resistance is included in the bias lead to prevent feed-back from the L.F. valves. The method just described is illustrated in Fig. 1, where the new components are shown in heavy lines, and the wire to be moved is indicated by broken lines.

" Unsymmetrical " Circuits

In a receiver which employs more than one S.G. or variable-mu valve, instability is often caused by interaction between the amplifying stages in various peculiar ways. We will not discuss these at length, but merely note that proper working can generally be obtained by making the circuits " unsymmetrical." By that I mean that the values of decoupling resistances and condensers used in connection with the valves, instead of being the same in each case, should be made slightly different. In the same way it is often helpful to use a different H.F. choke in each anode circuit. These simple expedients are always worth a trial, especially since they can be tried without going to very much trouble or expense.

" Transfer " Tappings

It is not uncommon, particularly with portable receivers, or with those having two S.G. stages, to find that reception on one waveband is quite satisfactory, whilst on the other instability spoils everything. In such instances it is generally safe to suspect the high-frequency chokes, and by replacing these with others of different type, the trouble can often entirely be overcome. On the other hand, when the instability occurs on long waves and medium-wave reception is normal, a cure can in the majority of cases be effected by changing the coils for others of the type having a transfer-tapping. The two corresponding circuit diagrams shown at Fig. 2 will make this suggested alteration clear. Instead of the anode of the preceding valve being connected to a tapping on the medium-wave winding of the tuned-grid coil it is connected to the centre point of a change-over switch so that it is joined to a tapping on either the medium or long-wave winding, according to the waveband in use. Most makers now supply coils already fitted with the change-over switch, and this works in conjunction with the normal wavechange switch.

Damping the Tuning Coil

There is yet another and particularly simple way by which long-wave instability can frequently be obviated when it is impossible or inconvenient to replace the coils already fitted. This is to wind a few " dead " turns round the long-wave section. All that is required is a short length of cotton-covered wire, and this is wound round the long-wave winding for two or three turns, and then the ends are twisted together. Fig. 3 will make this simple idea more easily understandable. The extra turns merely serve to " damp " the normal winding by slightly reducing its efficiency, but when a still more pronounced effect is required, the ends of the short-circuited turns can also be connected to the screening can or to earth. This latter method is not recommended excepting in very obstinate cases.

Parasitic oscillation, which is another form of instability, often originates in the detector circuit. Sometimes it can be overcome by altering the position of the grid tapping on the preceding tuning coil, or even by dispensing with the tapping entirely and joining the grid directly to the end of the winding. More often, however it is associated with the reaction circuit. When that is so, an improvement might be possible by screening the leads to the reaction condenser and reaction winding. Alternatively, it might be found better to insert a non-inductive (a spaghetti is not advised) resistance between the reaction condenser and the corresponding terminal on the coil. Another thing that often improves reaction control very considerably is a fixed condenser connected between the anode of the detector valve and earth. In mild cases a capacity of .001 or .0002 mfd. is ample, but it is sometimes found that a value as high as .0001 mfd. is desirable; still higher values *could* be used in some cases, but they would almost certainly cause a loss of the higher musical notes and are thus not recommended. Fig. 4 shows the anode and reaction circuits of a typical detector valve after the new components just suggested have been fitted.

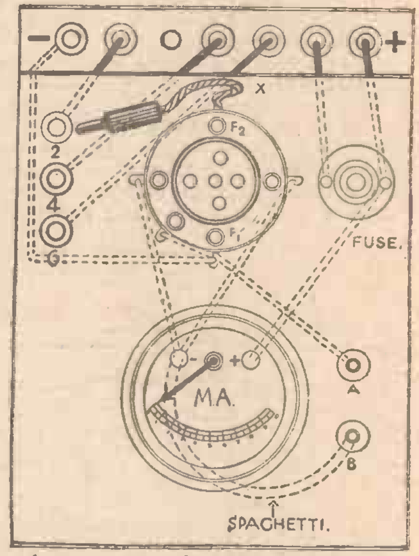
MAKING A VALVE TESTER

THE components required for constructing this tester are as follows:—

1 Small box	6 Wander plugs
1 Panel	1 Milliammeter 0-10
2 Terminals	1 1,000-ohm spaghetti
1 Plug	
3 Sockets	1 9-volt bias battery
1 Fuse holder	1 yard flex
1 5-pin valve-holder	

The diagram below shows clearly the position of the components and the wiring. Connect—

(1) Grid bias— to filament 1, cathode, and terminal A.
(2) Second socket to 2. (Third socket is blank.)
(3) Fourth socket to 4.
(4) Fifth socket to 6.
(5) Sixth socket to fuse-holder.
(6) Seventh socket (+) to fuse-holder and + terminal on milliammeter.



Arrangement and wiring of components for the tester described.

(7) Filament 2 to wander plug with wire X.
(8) Plate and grid to — terminal on milliammeter.
(9) Spaghetti between — terminal on milliammeter and terminal B.

The valve to be tested is plugged into the valve-holder, after the wander plug has been placed in the socket corresponding to its filament voltage.

S.G. valves ......read approx. 2 to 3 m/a.
Det., H.F. and L.F. read approx. 3 to 4 m/a.
Power ....read approx. 4 to 6 m/a.
Super power ......read approx. 6 to 8 m/a.

The filament can be tested by simply connecting the filament pins on terminals A and B. If the milliammeter shows current, the filament is O.K. The filament of a valve often sags and touches the grid, causing the valve to cease functioning. If such a valve is placed in the tester the needle bangs over to 10. To test transformers, resistances, etc., a pair of test prods on flex should be connected to A and B. Connect the prods to each end of the winding or resistance to be tested, when a reading will be obtained if O.K. Resistances above 100,000 ohms will not show any appreciable reading, therefore the test is not suitable for grid leaks.

Many other uses for this simple instrument will suggest themselves to readers.

To any and every listener there is only one thing which counts in his radio entertainment—that is, whether he is entertained. The quality of this entertainment is governed by the excellence of his valves. Now the Mullard P.M.1HL, the battery-operated non-microphonic detector valve, like all Mullard valves, is subject to continual tests and experiments in the Mullard laboratories. As a result, improvements are unceasing. This means that the P.M.1HL is pre-eminently the detector for improving quality and eliminating microphonic noise.

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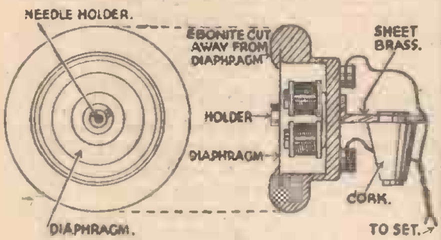
READERS' WRINKLES

THE HALF-GUINEA PAGE

An Improvised Pick-up

THE improvised pick-up shown in the accompanying sketch can be constructed from "junk." The parts required consist of a 'phone head-piece (2,000—



A simple improvised pick-up.

4,000 ohms), a cork, a piece of sheet brass, and a needle-holder.

The centre of the ebonite cover on the 'phone is cut out with a fret-saw, and the needle-holder is soldered to the centre of the diaphragm. The piece of sheet brass is also screwed to the 'phone and bent as shown in the sketch. Lastly, the cork is bolted to the brass bracket, and the pick-up is complete.

To use the pick-up, remove the sound-box of the gramophone, and plug in the cork. The pick-up may now be connected to the set in the usual way to the grid of the detector and to a 1 to 3 volts grid-bias tapping. The results are very good, and as the type of needle used affects the volume and quality, a little experimenting in this direction would be repaid by improved results.—L. G. MACLACHLAN (Glasgow).

Tone Improver for Loud-speakers

AS its name implies, this device is intended for improving the tone of speakers of the permanent magnet and balanced armature types.

When used with a cheap P.M. moving-coil unit the improver imparts the tone of the expensive mains energized M.C. units. When used with a balanced armature unit there is a great improvement in tone and volume. At the same time, one may adjust the speaker to the "tone" best suited to the surroundings. This is done by moving the speaker "in" or "out" of the "tone" tunnel. Few tools are required for the construction, but a fair amount of room is necessary in the cabinet of receiver, or loud-speaker. The details given herewith are for a speaker having an outside diameter of 8in.

The tunnel body is made from a piece of three-ply measuring 26in. by 8in. by ⅛in. and this must be curled to form a tube, as shown in Fig. 1. The ends are cut to form a half-lap joint, and glued. Two rings are cut out of five-ply wood (Fig. 2), and one is drilled to take screws for fixing to the baffle board.

The speaker supports are made from ⅝in. by ¼in. aluminium bar, the feet being slotted to take bolts, as indicated in Fig. 3. A thin piece of felt is glued round the outer rim of the cone suspension ring before inserting the speaker in the tunnel, within which the speaker must slide freely. Adjustment is made by drawing the speaker backward or forward in the tunnel, and then tightening up the wing nuts after the desired tone is obtained.—H. S. FRANCIS (Norwich).

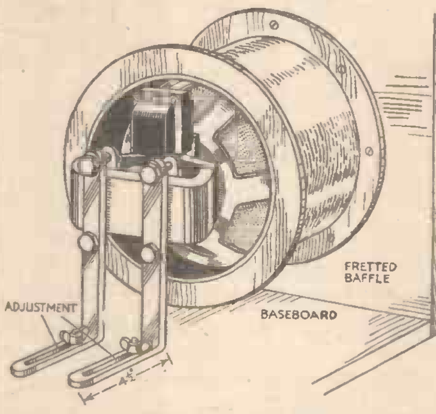


Fig. 3.—The finished tone improver device, showing supporting brackets.

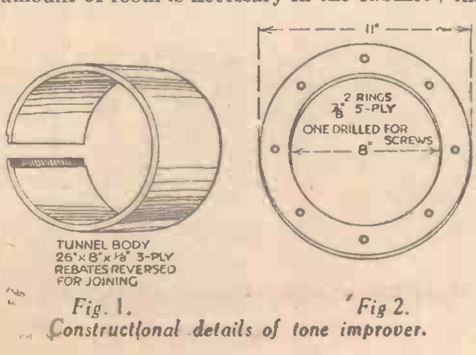


Fig. 1. Fig 2.
Constructional details of tone improver.

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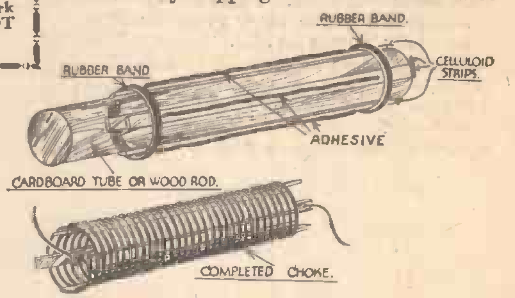
A 5-10 Metre H.F. Choke

WHEN working on the 5- or 10-metre short-wave bands a special H.F. choke is desirable, and the one described and shown in the accompanying sketches has given excellent results, and is easily made. The overall diameter of the choke should preferably not exceed half an inch, and a wooden rod or cardboard tube of about four-tenths of an inch diameter will be required for the former. Four strips of celluloid measuring 3ins. long by ⅛in. wide are cut and spaced round the former, being secured in position by rubber bands. Next, smear along each strip, for a distance of about 2½in., some strong, quick-drying adhesive. For the winding 24 or 26 D.S.C. gauge wire is required, and it is commenced by slipping one end of the wire under the rubber band, leaving about 2 or 3 in. projecting. Next wind on fifty turns, each turn being spaced by approximately the diameter of the wire, and finish by slipping the end of the wire under the other rubber band, leaving a similar length projecting as before. When the adhesive has dried it will be found that the celluloid strips are stuck securely to the wire, and the rubber bands may then be removed. The choke is slipped off the former, and the celluloid strips trimmed off (the actual winding occupying about 2½in.). No provision has been made for terminals, as it is preferable to connect the ends of the winding direct to the other components in the set.—F. N. PANTER (Ruislip).



A method of winding short-wave chokes.

A Novel Short-wave Coil Former

THE low-loss coil former shown in the accompanying illustration is made from two old wooden spools, a piece of dowel rod, and some scrap ebonite. The

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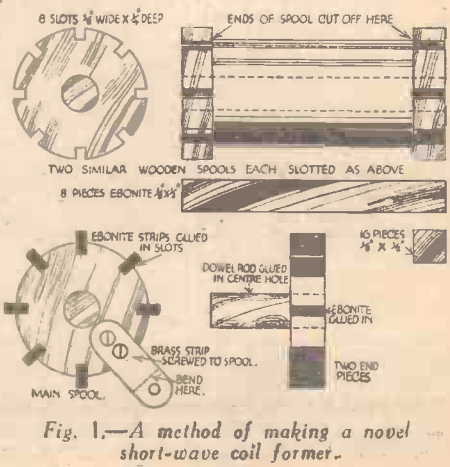

Fig. 1.—A method of making a novel short-wave coil former.

RADIO WRINKLES

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flanges of each spool are slotted, as indicated in Fig. 1, to take narrow strips of ebonite, which are glued in place. The flanged ends of one spool are cut off, and

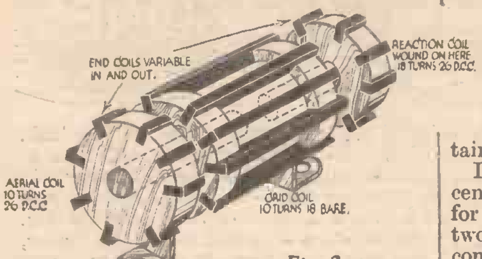


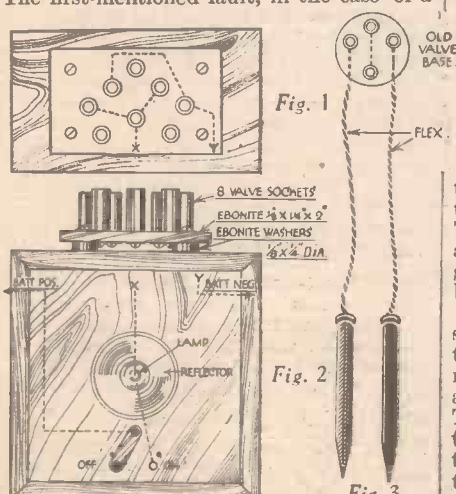
Fig. 2.

The finished coil former with adjustable ends for aerial and reaction coils.

a short piece of dowel rod is fitted into the centre hole of each. These rods fit into the central hole of the other spool, forming the assembly shown in Fig. 2, the whole being supported by two brackets made from thin sheet brass. The wire used, and number of turns for each coil, are given in Fig. 2. This arrangement gives excellent results, as the reaction and aerial coils can easily be adjusted to the best positions. —K. Bowe (Chester-le-Street).

Valve and Circuit Tester

A POINT often lost sight of by the amateur is that it is not sufficient to prove continuity of filament only before trying out his friend's valve in his own receiver. Other faults, that might lead to disastrous results, can be present; such as a broken grid lying on the filament, or a "short" between grid and anode, etc. The first-mentioned fault, in the case of a



A useful valve and circuit tester.

power valve taking, say, 12 volts bias, would cause 12 volts to be applied to all filaments (as they are in parallel), and blow all the remaining valves.

The little tester depicted in the drawings herewith is designed to provide a ready means for testing a valve for all the faults mentioned. It is built from a wooden flashlight as sold in the multiple stores for about 1s. 3d. complete with battery and lamp.

Eight valve-sockets, obtained from old six-pin coil-bases, are mounted on a piece of ebonite as shown in end view, Fig. 1. These form what might be termed a three-position valve-holder. The wiring is shown in broken lines. This arrangement is mounted on top of the box, as shown in Fig. 2. Place valve in left-hand position, if O.K. no light; if "short" between grid and/or anode and filament—lamp lights.

Valve in right-hand position, if O.K. —no light; if short between grid and anode or grid and filament—lamp lights. Valve in centre position, if O.K. (fil. good) —lamp lights; if fil. is broken—no light—unless a short exists between plate and filament, which fact will have been ascertained by first test.

In short, valve O.K. if lamp lights in centre position ONLY. To use the tester for continuity tests for coil windings, etc., two flex leads, as shown in Fig. 3, are connected to an old valve-base, the grid and plate pins of which are "shorted." When not in use, the valve base plug is placed in left-hand position, and all is safe. For continuity tests place the plug in centre when lamp will light if continuity is good. When lamp is required for lighting only, place the plug in right-hand position, the presence of the flex leads making no difference.—H. G. Jones (Buckley).

A Home-Made Microphone

THE microphone shown in the accompanying illustration was made with materials out of the junk box, so far as was possible, with the exception of a microphone inset which was purchased from a London firm for about two shillings.

First of all I made a wooden box that fitted a flash-lamp battery nicely, drilling a quarter-inch hole in the top, and one at the side for the flexible wire to pass through. The size of the box was approximately 4in. by 4in. by 1in. deep, with a loose bottom which can be fastened with two wood screws.

A piece of brass 2in. by 1in. by ⅛in. thick was drilled and counter-sunk to take two wood screws to screw it to the box. To this piece of brass is soldered a ring about 6½in. diameter made of No. 12 gauge copper wire, the joint in the ring being also soldered.

Four hooks of No. 16 gauge wire were soldered to the ring to suspend the microphone by the aid of rubber bands. The brass plate is then screwed down to the box so that the ring is in a vertical position.

Having obtained a tin which was a tight fit round the flange of the microphone inset, it was then cut down until it was 1½in. deep.

In the back of the tin were drilled two holes, one larger than the other to take an insulated bushing. A piece of springy brass was made (see Fig. 2) with a hole in one end to take a screw which was pushed through the insulating bushing, and tightened up with a nut, then a terminal head was screwed on. Another terminal was placed in the other hole and tightened up direct on to the metal casing of the microphone.

Four hooks of No. 16 gauge wire were soldered to the microphone casing corresponding to the four on the ring.

The microphone is suspended by four rubber bands, as shown in Fig. 1.

One of the connecting wires was cut inside the box, and the two ends soldered to the battery tags. The two ends of the flexible wire were connected to the primary winding of an old L.F. transformer, the secondary side of which was connected to the pick-up terminals on the set.—A. Donaldson (Preston).

A Radio-Gram. Switch

THIS switch was evolved when it became necessary to fix a radio-gram switch to a cabinet with a commercial make of set having no provision for same, and long leads would have been inevitable. The actuating rod in the switch may be any length, and the switch may be fixed right behind the detector valve. The control knob can be arranged at the side of the cabinet. The idea may be extended and a wave-change switch and on-off switch may be accommodated on the same rod, as shown in Fig. 1; the number of controls on the panel can thus be lessened. The set will remain switched on while the other controls are actuated by further turning the control knob, which can have the various positions marked on it as shown in Fig. 2.—E. Nicholson (Newcastle-on-Tyne).

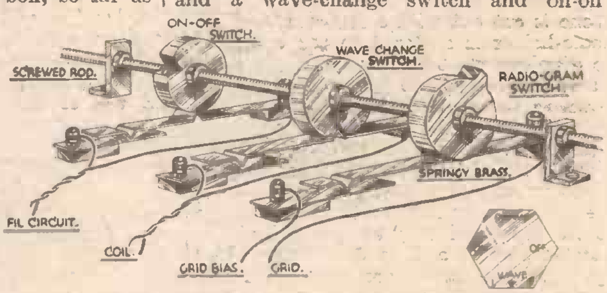


Fig. 1. *Fig. 2.*

A radio-gram switching arrangement.

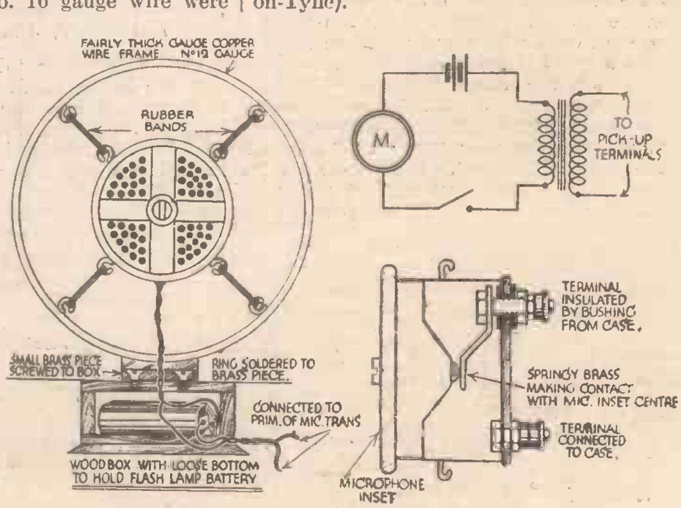
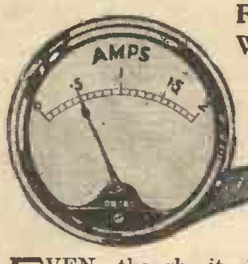


Fig. 1. *Fig. 2.*

Constructional details and circuit diagram of a home-made microphone.

More about F. J. CAMM'S Phenomenally Successful Receiver

Full constructional details were given, together with a Transfer Print Wiring Diagram, last week. By F. J. CAMM.



EVEN though it is only a few days since my latest and most successful receiver was described to readers, there is no doubt that many hundreds have already taken the opportunity of building it. This wonderful new set has appealed to the army of wireless constructors throughout the country as no receiver ever did before—its success is assured, and I know that it will be made up in thousands. Every home-constructor is bound to be intrigued by the many revolutionary features which it possesses; no enthusiastic amateur who is determined to keep abreast of latest developments can resist the fascination which it holds. This set is the first and only one of its type to combine the wonderful and modern refinement of automatic fading compensation with the real economy of a three-valve battery-operated receiver.

Why Only Three Valves

One or two critics have said that, for a "star" set, they would have preferred a four- or five-valve instrument. To these we would reply that in presenting an ultra efficient three-valver, we have appealed to the mass of home-constructors, and when it is realized that, with its three valves, this is one of the most satisfactory instruments available, one cannot do other than admit that a definite attempt has been made to save hard-earned money for the enthusiast. I claim, and I am sure that you will agree, that this set is one which cannot be judged by the number of valves—*performance* is the thing to consider, and on that score alone it stands supreme.

My 1934 receiver will mark a new era in home construction, not only because of its low cost or even extreme efficiency, but because it sets a new standard in receiver design. It has not been designed as a "stunt"; it has not been hurriedly prepared; it is not merely "another" set to amuse the enthusiast; but it is a set which cannot fail to interest every wireless experimenter, and every listener who wants "something better" at a price which he can afford.

The receiver in its final and well-nigh perfect form was evolved after a considerable amount of careful experiment and after making quite sure that it was the type of receiver that would be universally welcomed. It employs the combination of valves which statistics taken during recent months have proved to be most popular. Additionally, however, it includes many entirely new ideas and developments, which have only become available to the constructor during the last few weeks.

Theoretically, the set is *sound*; in practice and on extended test it is every bit as good as it looks. It is as selective as one could wish, despite its utter simplicity of construction and operation. During the tests which we have carried out on various aerial systems, we have definitely proved that even the most powerful local stations can be cut out in so little as a single degree of the tuning dial. When used on an average aerial, situated some twelve miles from Brookmans Park, we have found it a perfectly easy matter to bring in forty stations free from interference and at comfortable loud-speaker strength. Fading, which is one of the greatest evils of long-distance reception, is entirely removed by the ingenious automatic fading compensator—a really new device that has been available for only a very short time.

The handsome cabinet, with provision for balanced speakers.

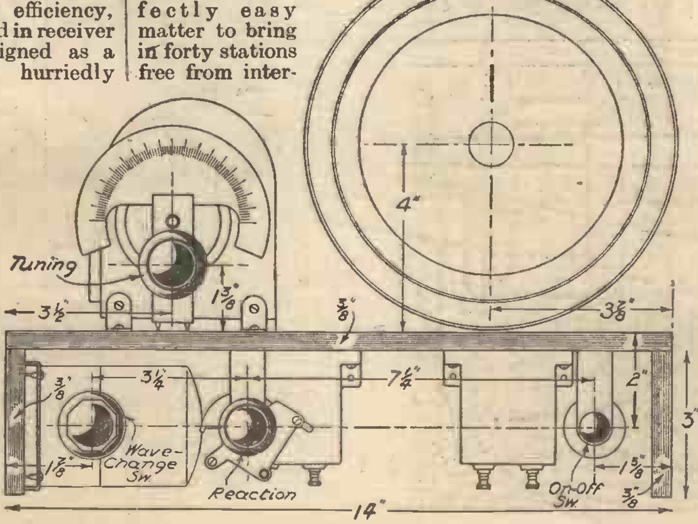
Additional Selectivity

It has been stated that ample selectivity is provided, but, if necessary, in any particular circumstances a still higher degree can be obtained in a very simple way. As a matter of fact, there is a "transfer-tapping" on the F.10 aerial coil, which provides a simple means of connecting the aerial lead to a tapping on either the medium- or long-wave section of the winding. The transfer is effected by means of a single-pole change-over switch fitted into the coil base, and the "contact arm" of this is connected to terminal 7. Thus, where a still higher degree of selectivity than that normally provided is called for, it can be obtained simply by removing the wire joining the aerial series condenser to terminal 1 on the F.10 "Ferrocart" coil and connecting the condenser to terminal 7 instead. The connections originally used, and which are shown on the transfer print, have been found best for most requirements, and are recommended in the majority of cases, but anyone who cares to carry out a little simple experimentation can do so in the manner just described.

An Interesting Experiment

There is another interesting experiment which some constructors might like to try, this time in respect to the automatic fading compensation system. A slightly different effect can be produced by applying a small initial bias to the grid of the variable-mu valve; to do this all that is needed is to remove the wire connecting terminal "E" on the A.V.C. unit, replacing it with a short length of flex with a grid-bias wander plug attached. The wander plug can then be tried in various sockets of the grid-bias battery; sometimes this has the effect of giving a "smoother" control of reaction, whilst it also tends still further to sharpen up the tuning. Again, this is not a suggested modification, but merely an interesting trial which some of our more experimentally-minded readers will be pleased to try.

It might be mentioned here that an apparent "flattening" of the tuning will be observed as the A.V.C. unit comes into action.

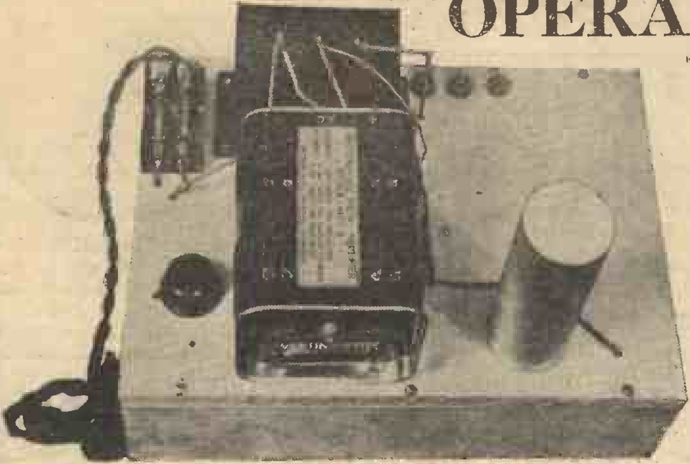


Dimensioned diagram, which should be used for the marking of the control spindle positions on the front of the cabinet.

OPERATING F. J. CAMM'S LA

Constructional Details of Mains Units

List of Components for the A.



The finished A.C. Unit.

IT was mentioned in last week's issue that the "Orbit" had been so designed that it could be used with either high-tension batteries or with an eliminator taking its supply from D.C. or A.C. mains. There are, no doubt, many readers who have electricity installed in their homes and who prefer the greater economy and reliability of mains operation to the use of dry batteries, and two special, simple and effective units have been designed for this receiver. The D.C. eliminator is fully described on another page, whilst this page will be devoted to the A.C. unit.

Fits into the Standard Cabinet

Before going on to describe the construction in detail it might be as well to say what were the principal requirements of the unit and to explain how they were obtained. In the first place it was essential that the eliminator must fit into the standard "Orbit" cabinet alongside the receiver itself. This meant that the chassis upon which it was built must not be greater than 7in. by 10in., and for preference it should be the same height as that used for the set. The next point was that the eliminator must give the same voltage as the high-tension battery specified, because the set was designed to operate most efficiently with that voltage. By choosing a suitable mains transformer (the Heayberd "W.20") giving an output of 80 volts at 70 milliamps, and using this in conjunction with a Westinghouse style "H.T.5" metal rectifier, the exact voltage was obtained. The rectifier is connected on the voltage doubler principle, under which conditions its rated output is 120 volts at 20 milliamps. As the receiver takes less current than this, the voltage would normally attain rather a higher figure than that required, but by suitably choosing the values of resistances for the potential dividing circuit (for S.G. supply), exactly the correct output under working conditions was secured.

Sub-chassis view of the A.C. Unit.

ORIGIN
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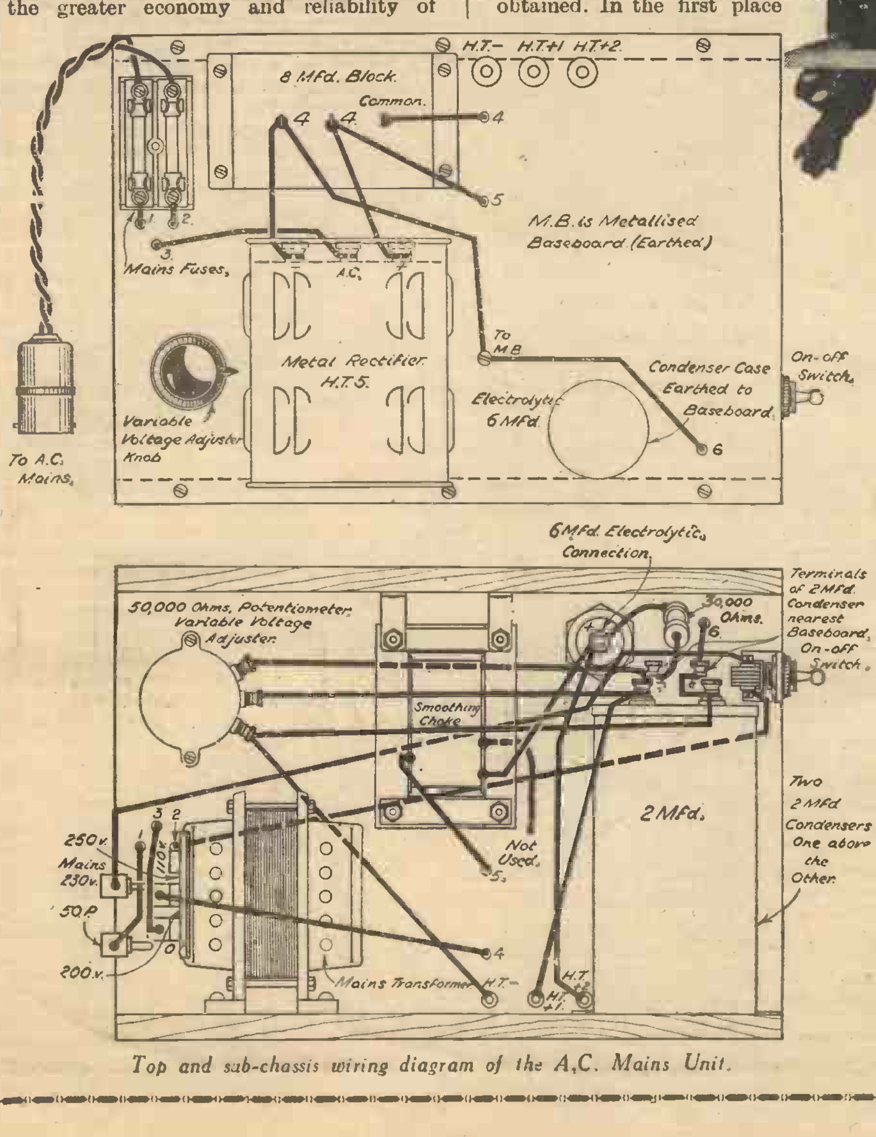


Top and sub-chassis wiring diagram of the A.C. Mains Unit.

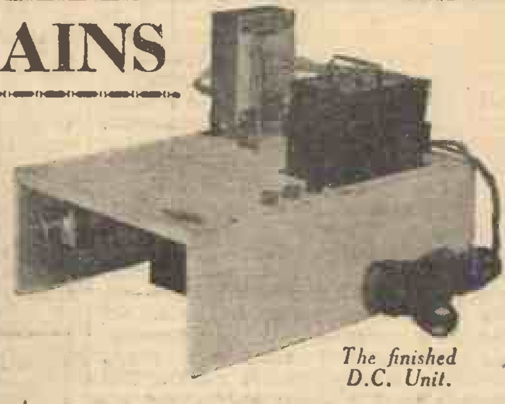
Perfectly Hum-free

In examining the wiring plan it will be seen that a centre-tapped double 4 mfd. condenser is used for voltage doubling, a 6 mfd. electrolytic condenser serves to smooth the output from the choke, and two other 2 mfd. condensers are employed in the potential divider circuit. It might appear at first glance that one of the two latter condensers could be dispensed with and that a single one between the slider of the potentiometer and H.T. negative would give all the decoupling necessary. As a matter of fact, however, it was found in experimenting that the second condenser did actually give a decided improvement and served to remove the very last traces of mains hum that could be detected when the set was operated from a rather "rough" supply. The eliminator in its final form gives perfectly hum-free results which are identical to those obtained when a brand new 120-volt high-tension battery is employed. By making use of a variable

TEST SET *from* A.C *or* D.C. MAINS

Specially Designed for this Remarkable Receiver

C. and D.C. Units appears on page 450



The finished D.C. Unit.

...otentiometer for deriving the screening ...d voltage it is possible easily to find the ...ost suitable value by trial, and to vary the voltage while the set is actually in use.

Absolute Safety

There was another point to consider in designing the eliminator, which was that of safety. This is ensured by including a fuse in each mains lead and also by employing a metallized chassis to which the negative high-tension lead is connected. In consequence there is no danger of the user receiving a shock, and in case of an accidental short-circuit, nothing worse than a burnt-out fuse could result.

...ALITY
...INED
MAXI-
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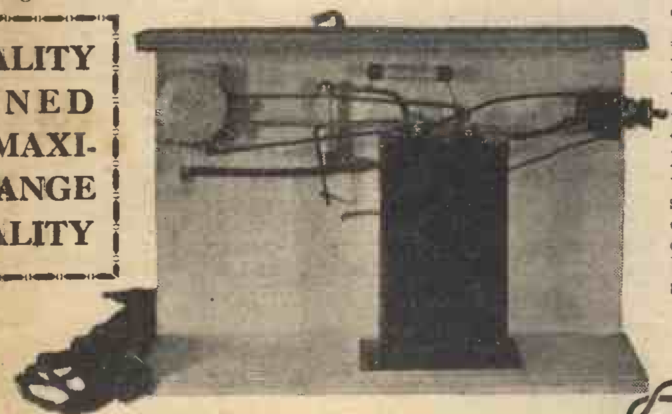
...ALITY



Sub-chassis view of the D.C. Unit.

It was mentioned in descriptive articles on the "Orbit" published last week that, if desired, a pair of dual-matched speakers could be fitted into the cabinet since two ...eaker frets are provided. In case any ...ader might wish to do this at a later date, ...fficient space has been left on top of the ...minator chassis for a speaker identical ...th that specified for the receiver to be ...ached without any alterations becoming ...cessary.

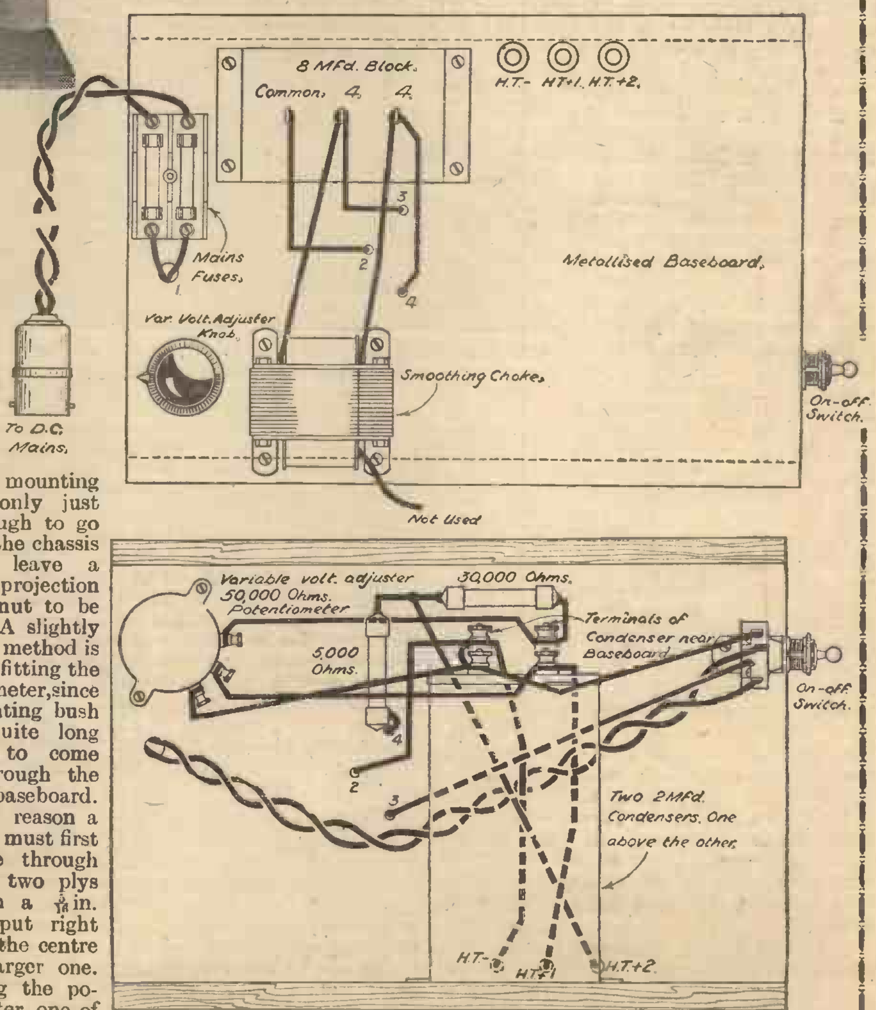
LOW OPERATING COST

With the interests of symmetry in mind the mains switch on the eliminator has been placed in such a position that it exactly "balances" up on the front of the cabinet with the push-pull on-off switch. Another convenient feature is the provision of insulated sockets on the chassis so that the eliminator can be connected up in exactly the same way as a high-tension battery by inserting the wander plugs.

Easy Construction

Having briefly described the mains features of the A.C. mains unit, I can now give all the necessary constructional details. Needless to say, the work of building the unit is particularly straightforward, and although I know that many readers fight shy of making mains equipment, no one need doubt his ability to make a perfect job of this simple piece of apparatus. The first requirement is the Peto-Scott "Metaplex" chassis, and before commencing to cut this it will be found very helpful to place all the components in the exact positions shown in the drawings and photographic illustrations. It was mentioned above that space had been left for a second speaker on the eliminator chassis, and you will therefore find it helpful in setting out the parts if you place the speaker from the receiver in position before finally mounting the components. Having decided upon all the positions, it will be found helpful to make thin pencil lines to show where the components are to go. You can then bore the holes for the electrolytic condenser, potentiometer and terminal sockets. That for the condenser is just ⅜in. in diameter, and care should be taken that there are no splintered edges, because the mounting bush is only just long enough to go through the chassis and to leave a sufficient projection for the nut to be fitted. A slightly different method is used for fitting the potentiometer, since the mounting bush is not quite long enough to come right through the wooden baseboard. For that reason a ⅜in. hole must first be made through the first two plys and then a $\frac{3}{16}$in. hole is put right through the centre of the larger one. In fitting the potentiometer, one of the insulating washers supplied with it should be placed on the bush before screwing on the mounting nut. There are two alternative ways of attaching the terminal sockets, the simplest of which is to drill ¼in. holes and screw the sockets into them. Another, which is somewhat better, is to drill $\frac{5}{16}$in. holes through two thicknesses of ply and then make $\frac{3}{16}$in. ones through the centres of these. In the latter case the sockets are sunk into the baseboard and the nuts can be fitted on the under side.

After making the necessary holes and mounting the components just referred to, the sides of the chassis should be removed



Top and sub-chassis wiring diagram of the D.C. Mains Unit.

and the mains transformer, smoothing choke, and 2 mfd. fixed condensers fastened to them in the exact positions shown in the drawings reproduced. Next, the component bracket with Q.M.B. switch attached should be fitted in place, and the rectifier and fuse-holder mounted on the baseboard.

The Wiring

The wiring will not present any difficulty, and is carried out entirely with B.R.G connecting wire. Most of the connections are made by looping the wire and fitting it over the ends of the terminals, but one or two connections—those to the terminal sockets and to the double condenser—are soldered. The smoothing choke is not fitted with terminals, but has connecting leads instead, and these are joined directly to the appropriate points. The terminals on the mains transformer are of the wander-plug type, and it will be found more convenient to remove the plugs whilst attaching the leads to them.

Lastly, the mains flex must be connected to the terminals on the twin fuse-holder. To prevent the possibility of the flex being accidentally pulled away it is also a good idea to secure it to the chassis by means of a "bridge" made from a short length of brass strip.

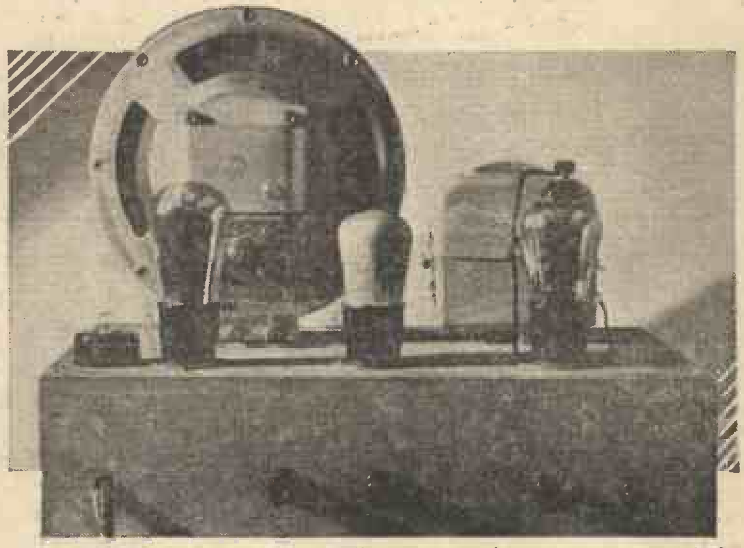
Little need be said of the method of fitting the mains unit into the receiver cabinet, since it is only necessary to make a ½in. hole to take the switch bush, pass the bush through this, and fit the "on-off" plate and ring nut on the front of the cabinet.

Connecting the Unit to the Set

As to connecting the unit to the receiver, all that is required is to fit the wander plugs into the appropriately marked sockets (they can easily be indicated with pencil on the metallized chassis as shown in the photographs). There is one slight alteration that is desirable to the receiver, however, and that is to replace the 100 m/a. fuse bulb by one of about 250 m/a. rating. This has been found desirable because the voltage "surge" when first switching on is sometimes sufficient to "blow" the smaller fuse.

When all connections have been made, the set should be switched on by means of the push-pull switch (which now acts on the L.T. supply only), and then the high tension should be switched on. It is important with this, as with any other mains unit, that the L.T. should be connected first and the H.T. afterwards; when switching off the sequence should be reversed, that is, H.T. first and L.T. second. The reason for this is that when not "on load" the eliminator voltage rises to nearly twice its normal value and the "peak" voltage might in some cases be sufficient to damage one or other of the fixed condensers. There is really an ample margin of safety in this receiver, but that is no reason why any, even slight, risks should be taken.

After the set has been switched on you should rotate the knob of the potentiometer until the optimum screening grid voltage is obtained. There is no need to make any further adjustment until the time when a new variable-mu valve is required, and, therefore, the back can be fitted on the cabinet in order to keep the set and unit free from dust.



Note from this photograph how all the principal components are tucked away out of sight on the Orbit.

For the Adaptagram

If you are making your "Orbit" into a complete radio-gram in the manner described last week you will find that the most satisfactory system is to remove the speaker from the set itself and attach it to the eliminator instead. The latter can then conveniently be mounted behind the speaker fret and you will have a very neat and well-arranged mains-operated radio-gramophone.

BUILDING THE ORBIT D.C. MAINS UNIT

THE Orbit has been designed to offer the least amount of difficulty to the constructor, and at the same time to provide the best results, and on the same manner the unit for operation from D.C. mains has been arranged on similar lines. That is to say, the construction is so simple that a child can build it, and it provides the best working voltages for the receiver itself. In fact, the unit may be joined to the Orbit in place of the usual battery, and you will be unable to detect any difference in operation. The receiver is just as stable, and is absolutely hum-free, whilst, of course, the results over a period will be much improved owing to the constant voltage which is obtained from the mains as distinct from the gradually falling voltage of the dry battery. The following details concern only the D.C. unit, so that if you are on A.C. mains you should turn to the centre pages where full details are given concerning the unit for that type of supply.

The Components

From the list of components required for this unit you will see that the total cost is no more than two guineas. The chassis upon which the components are assembled follows the same lines as the Orbit chassis, and is of such a size that it forms a continuation of the entire receiver and exactly fills the lower portion of the cabinet. The L.F. choke is of the skeleton type, providing a high inductance value with a low D.C. resistance, and in this particular instance is provided with a centre-tap which, however, we do not require. For smoothing purposes a condenser of the block type is used for connection to either side of the choke, whilst two separate condensers are provided for the tapping used for supplying the voltage to the screening grid of the H.F. valve. Ample safety is provided by the inclusion of a double fuse for each mains lead, and the on-off switch is of the two-pole type, thus breaking each mains lead and removing all possibility of shock due to a live wire being left in circuit. It will be seen from the list of parts that there is required one condenser more than is used in the unit, and the reason for this will be explained in a few moments.

The Circuit

Upon examining the circuit it will be seen that, apart from the conventional method of wiring a D.C. unit, there is a rather peculiar form of decoupling circuit connected between the maximum H.T. supply and the potentiometer, which is used for adjusting the screening potential. The receiver already possesses ample decoupling in each stage, and it would, at first sight, appear that the resistance and condenser inserted at the high voltage end of the potentiometer are unnecessary. In the course of our experiments, however, we found that this method of assembly definitely prevented hum difficulties on any type of mains, and if it is omitted there is a possibility of instability occurring on mains which are either not adequately smoothed, or which are supplied by certain apparatus. It should not, therefore, be omitted if you are anxious to obtain absolutely reliable operation.

The Construction

The construction of the unit is extremely simple and will occupy only a short time, but to enable all of the work to proceed in a straightforward fashion, it is essential to follow the order which is here given. First of all drill out the three holes for the sockets, using a 7/16 in. bit and drilling through two thicknesses of ply first of all, and then continuing with a 5/16in. bit for the remainder of the thickness of the chassis. This will allow the upper portion of the socket to sink in sufficiently far to permit the locking nut to be tightened up. An alternative method is to drill a hole ¼in. in diameter and to screw the sockets into this hole. The only disadvantage of this arrangement is that when the leads are soldered to the sockets there is a risk of their coming loose owing to the heat of the iron. The first method is much to be preferred. Having drilled the holes, mount the sockets according to which type of hole has been cut, and then cut the hole for the potentiometer. This hole also will have to be recessed, and a quick method of carrying out this one is to use a ⅜in. bit for the first thickness of ply and then a 5/16in. bit for the remainder. Alternatively a 5/16in. hole may be drilled right through the chassis and the top ply cut out with a pen-knife to a suitable size. To mount the potentiometer, remove the fixing nut and take away all the

(Continued on page 450)

THE EASY ROAD TO RADIO

THE BEGINNER'S SUPPLEMENT

An Article Explaining the Uses of Plugs and Jacks, and How They are Connected in Various Circuits. By W. B. RICHARDSON.

A PLUG is a device used in conjunction with a jack providing two insulated contacts, and hence enabling a circuit quickly to be completed or broken.

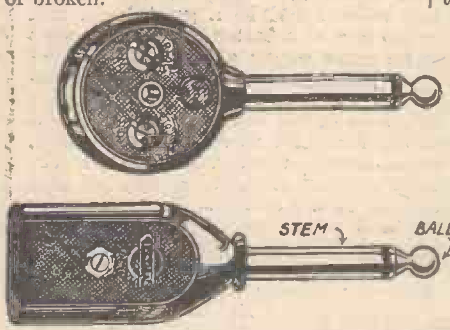


Fig. 1.—Two typical plugs.

Briefly, the uses of plugs and jacks are as follows:—

(1) They can be used as a convenient means of plugging-in the loud-speaker—either at the set itself or at extensions in other rooms of the house.

(2) The plugging-in of the speaker can be made to switch on the receiver.

(3) They can be used as a means of cutting out the last amplifier valve.

(4) As a means of making a quick change over from speaker to 'phones when ether searching.

(5) The gramophone pick-up can be easily plugged-in to either detector or L.F. stage, the grid-bias being automatically adjusted.

(6) They provide a quick method of connecting or disconnecting the batteries, and even the aerial and earth. For this latter duty, in order to reduce H.F. losses to a minimum, special low-capacity jacks should be used.

Construction of the Plug

For those who are not familiar with the elements of jack switching, an explanation of the construction of the plug and jack and how they work will not be out of place. Fig. 1 shows two popular plugs. The "business" parts are the ball and stem, and these are standard as regards size and shape. The only difference between one make and another is in the shape of the body or "shell" of the plug, and the method of connecting the leads. Fig. 2 is a sectioned drawing showing the construction of a plug. It will be seen that the stem is really a metal tube and that the ball is attached to the end of a rod which passes through the stem. Rod and stem are kept concentric and insulated from one another by means of an ebonite or fibre washer at each end. The rod is not surrounded with ebonite for its whole length, as this is unnecessary and would only add to the self-capacity of the plug. The rod and stem are each connected to a separate terminal or binding screw. In connecting the plug to the speaker or pick-up, the two wires forming the leads are joined to the two binding screws and are thus in direct electrical contact with the ball and stem. The body of the plug being of bakelite insulates the hand from any of the metal parts when plugging-in.

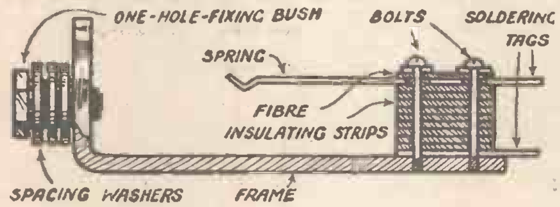


Fig. 3.—Details of single-circuit jack.

Jacks

These vary in detail according to the particular switching they have to perform, but all comprise a socket to receive the plug, and one or more insulated spring contacts. Figs. 3 and 4 illustrate a single open-circuit jack. The socket which receives the stem of the plug is in the form of a metal bush which screws in to the frame of the jack, and also serves as a means of fixing the jack to the panel of the set. The single spring is mounted on a pile of fibre strips which insulate it from the metal frame, and at the same time hold it at just the right height to make easy but firm contact with the ball of the plug. The spring is usually of nickel or German silver.

The lower sketch in Fig. 4 shows just what happens when the plug is inserted.

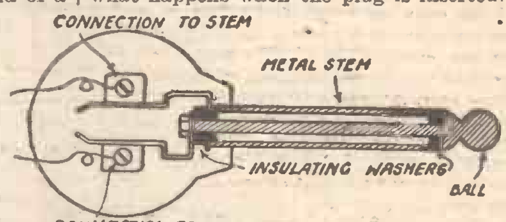


Fig. 2.—Section of plug showing construction.

The stem of the plug makes contact with the frame of the jack and the ball connects with the spring. This is the simplest switching operation possible with a plug and jack. However, by the multiplication of springs in the jack, other and more varied operations can be performed. For example, the jack shown in Figs. 8 and 9 will complete *two* circuits on insertion of the plug. Here three springs are used, and if you examine the illustrations you will see that normally all three are separated from one another. When the plug is pushed home it not only makes contact with the frame of the jack and with the lower spring, thus completing the speaker circuit, but also in raising the lower spring it connects the two upper ones together. There is a little fibre peg underneath the middle spring against which the lower spring presses when it is forced upwards by the ball; thus the middle spring is also bent upward. It does not actually make contact with the lower spring because the fibre peg is an insulator, but it does connect with the upper one which has a special silver contact for the purpose.

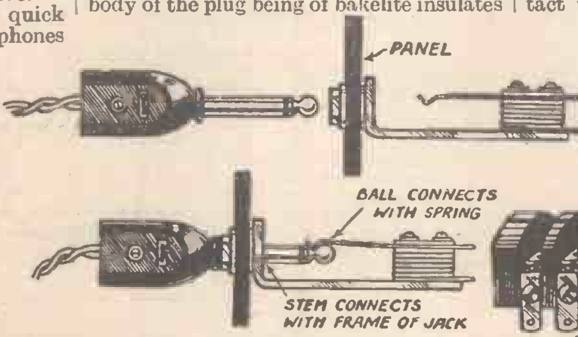


Fig. 4.—How the plug and jack connect.

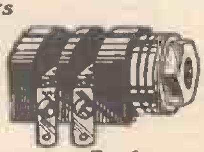


Fig. 5.

Fig. 5.—A midget jack for use in H.F. circuits.

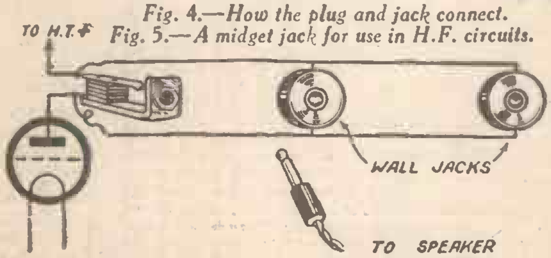


Fig. 6.—Speaker points can be arranged in different rooms by means of wall jacks.

Other Types

The type of jack previously described with its metal frame and parallel springs is the most common, but is not the only variety obtainable. Notable exceptions are the midget jack, shown in Fig. 5, and similar jacks of a small size. The former is specially designed for use in H.F. circuits, and one type is of

(Continued overleaf)

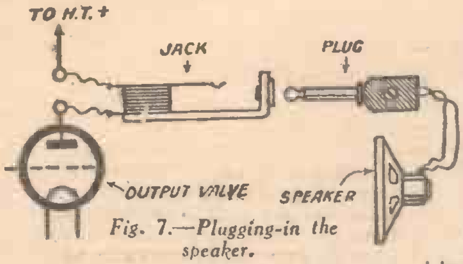


Fig. 7.—Plugging-in the speaker.

(Continued from previous page)

unusual design in that it has a bakelite frame and springs fitted with convenient terminals. Owing to the shape of the springs it does not project so far from the back of the panel, but, on the other hand, it takes up more room on the panel itself. Another type of jack is the wall jack, shown in Fig. 6.

Various Circuits

Now consider what jacks to use, and how to connect them up, to perform the various functions previously enumerated. The first use is the provision of a quickly-made speaker connection. Of course, the circuit is simplicity itself. It is illustrated in Fig. 7. Instead of having two terminals marked "L.S." on your receiver, you use a single open-circuit jack. The two wires, which would normally be joined to the "L.S." terminals are connected instead to the two tags of the jack. The plug is joined to the two leads from the speaker. A further elaboration of this arrangement is shown in Fig. 6. Here, several jacks are connected in

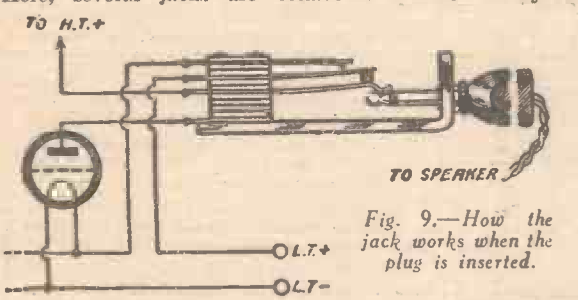


Fig. 9.—How the jack works when the plug is inserted.

parallel. An ordinary jack is fitted to the set, and wall jacks are fitted in any rooms where the speaker is likely to be used. Good quality, rubber-covered double wire or double flex should be run along the picture-rail or skirting to each point from the set, or from the set to the first point, and from there to the next one, and so on. Use whichever arrangement is most convenient, or that which requires least wire.

A very useful method of switching on a battery receiver is illustrated in Figs. 8 and 9. On plugging-in the speaker, the filaments are automatically switched on. This is sometimes a good scheme where there are children about, as no on-off switch is required on the panel of the set. If the speaker is placed on a shelf, with the lead and plug well out of the way of inquisitive little fingers, there is no chance of the set being switched on while the grown-ups are out of the room. The working of the particular three-spring jack which is used has previously been described, and a further study of the illustrations should make the connections quite clear. The two upper springs are connected to the wires which normally go to the filament switch, and the lower spring and the body of the jack are joined to the wires which would otherwise connect to the terminals marked "L.S.+" and "L.S.—" on the receiver. The plug is naturally connected to the speaker.

Cutting Out the Last Valve

Some years ago it was quite common to have several low-frequency stages of amplification, but nowadays, with the general improvement in H.F. amplifiers and the introduction of the pentode, one stage is often sufficient. However, there is undoubtedly a

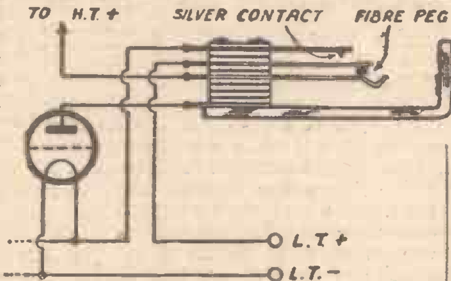


Fig. 8.—How to connect a three-spring jack so as to switch on the set when the speaker plug is inserted.

large number of listeners who prefer the extra punch provided by two or three L.F. valves, especially when receiving dance music. Naturally, the full volume is not always required, although it is nice to know it is there if needed. This means that there are many occasions when drastic use has to be made of the volume control. At such times, the ability to cut out the last valve would be a great boon, and in the case of a battery set, would result in no small saving of "juice." Fig. 11 shows how this can be done in a transformer-coupled set. The jack on the left, that is, the one in the plate circuit of the first L.F. valve, is of the single, closed-circuit type. The one in the output circuit is the same type as that used in Figs. 9 and 10. When the plug, which is connected to the speaker, is inserted in the right-hand jack, the receiver works in the normal way, both L.F. stages being used. On

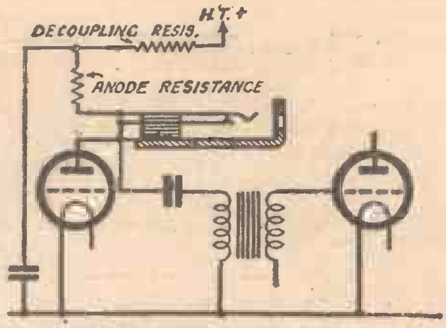


Fig. 10.—One or two L.F. stages can be used at will in this circuit.

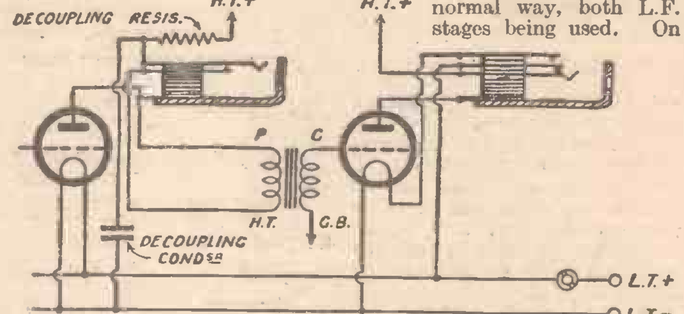


Fig. 11.—The modification necessary to the circuit in Fig. 7.

taking the plug out, the plate circuit of the output valve is broken and so is its filament circuit. If the plug is now inserted in the other jack, it connects the speaker in the plate circuit of the previous valve, the upper spring connecting with the ball and the frame with the stem of the plug. The raising of the upper spring causes it to break contact with the lower one, which is connected to the primary of the L.F. transformer, and thus the transformer is cut out while the speaker is in circuit.

It will be noticed that the decoupling resistance is not shown as being disconnected as well as the transformer, although this could easily be arranged by altering the connections. The reason for this is that the cutting out of the decoupling resistance would produce a rise in the plate voltage applied to the valve, with the probable necessity for an increase in the grid-bias voltage. Rather than complicate the circuit by arranging for automatic readjustment of the bias, the resistance is left out of circuit. The same remarks apply to any resistance of a high value in the plate circuit, whether

(Continued on page 434)

TOPICAL TECHNICALITIES

REACTANCE (INDUCTIVE)

In wireless practice, especially where design is concerned, the calculation of reactance is of the greatest importance. When a steady voltage is applied to a single wire a certain current will flow, and this has already been explained, and the value may be computed from Ohm's Law. When, however, we take a circuit consisting of an inductance and apply a steady voltage to it, the current flowing induces in each adjacent turn a similar current, but in the opposite direction. Therefore, if we apply an alternating current to an inductance there will be a retarding force at work in each direction of current and this will act in the same way as a resistance, namely, it will tend to retard or resist the flow of current. This retarding force is known as "reactance," and is measured, like resistance, in ohms. The formula for ascertaining the value of the reactance is 6.28fL, where L is the inductance measured in henries, and f is the frequency of the applied alternating current. One example of the use of this formula is in calculating the reactance of the primary of an L.F. transformer. Suppose we have a transformer with a primary inductance of 10 henries. At 500 cycles the reactance of the primary would be $6.28 \times 500 \times 10 = 31,400$ ohms.

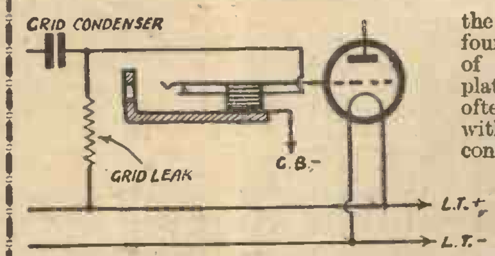


Fig. 12.—An easy way to plug-in the pick-up to the detector valve of a battery set.

(Continued from page 432)

it be for voltage controlling purposes, decoupling, or anode coupling. It is better to leave them in than endeavour to work the valve at a higher rate of voltage, and so get distortion owing to insufficient bias. However, automatic adjustment of bias *can* be arranged by using a five-spring jack with its attendant complication of the circuit.

'Phones or Speaker

Now as regards the method of coupling the L.F. transformer. Fig. 11 is the circuit to use when ordinary series coupling is employed, but in the case of a parallel feed it will have to be modified to that of Fig. 10. Here again, the resistances in the anode circuit are left connected, so as not to disturb the working conditions of the valve. One advantage of the jack method of cutting out the last valve is that by fitting another plug to a pair of headphones, these can be used in place of the speaker. They will very often be found useful for D.X. work. If necessary, of course, a jack can be fitted in the plate circuit of the *detector* valve, and often, ample strength will be provided with the 'phones plugged-in here. The connections would be substantially the same as those in Figs. 8 and 9.

Plugging-in the Pick-up

One of the chief "snags" in connecting a gramophone pick-up in the detector circuit of a receiver is that the detector valve has to be biased while the pick-up is in use. Nevertheless, this drawback can easily be overcome by the use of jack switching. A single closed circuit jack is used, as in Figs. 12 and 13. These show the connections in the case of a battery and mains receiver respectively. Grid-bias is automatically applied as soon as the pick-up is plugged in. The decoupling resistance, shown in Fig. 13, is optional, and is not included in all sets. If it is not used, the connections from the frame of the jack and from the left side of the decoupling condenser are joined direct to H.T.

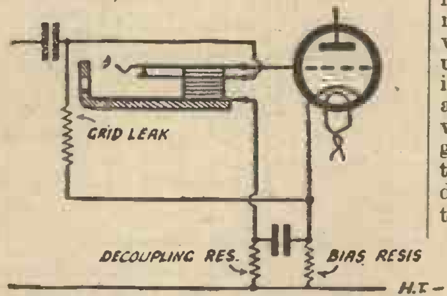


Fig. 13.—The mains version of Fig. 12. Note grid bias when radio is in use.

Where a mains receiver employing resistances for various voltage dropping purposes is in use, there are one or two points which must receive attention. We refer particularly to the use of a detector valve as the valve to which the pick-up is joined. If this employs a decoupling resistance in the anode circuit, the voltage drop through this will depend upon the anode current when the valve is in use as a detector. When used with a different bias there will be a different voltage drop in the anode circuit, and, generally speaking, this will be greater than when the valve is employed as a detector. It will therefore be necessary to arrange that the value of the decoupling resistance is also altered when the pick-up is plugged into circuit. The multi-contact jack may be used for this purpose, as has already been shown.

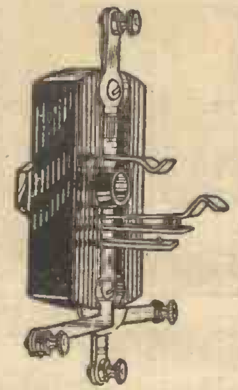


Fig. 14.—A midget two-circuit jack.

THE PROGRESSIVE EXPERIMENTER

(*Continued from page 414*)

is inserted between the negative wander plug and the corresponding socket in the battery.

If you try an old battery or connect the resistance mentioned in series with the old one you will be able to notice several effects. The first of these is that when the reaction condenser is adjusted towards the position at which oscillation commences you will in all probability hear the peculiar "motor-boating" noise in the speaker. The sound might, instead of being composed of a rapid series of "plop-plops," be more in the nature of a "groan" or even a high-pitched whistle. In any case the reaction control will become more difficult to operate satisfactorily and a certain amount of distortion will in most instances be in evidence. The whole trouble is due to the fact that low-frequency currents appearing in the anode circuit of the power valve are unable to find an easy path to earth by way of the high-tension supply, and they are therefore fed back to the anode circuit of the detector valve, so producing L.F. oscillation or feed-back.

There is a fairly obvious solution to this difficulty, which is to provide a difficult leakage path between the anodes of the two valves. The simplest way of doing this is to insert a resistance greater than that of the battery between the anode of the detector valve and the H.T. positive supply to it. At the same time an easy leakage path to earth must be provided and this is done by connecting a large-capacity fixed condenser between the "anode" end of the resistance and the earth lead. A pictorial circuit of the connections to the new components mentioned is given in Fig. 4, whilst the corresponding connections in the "Progressor" itself are shown in the wiring plan (Fig. 3).

Finding the Value of the Decoupling Resistance

In both of these illustrations it will be seen that only one H.T. positive lead is employed, and that this supplies both valves. Despite this, the detector valve only receives the same anode voltage as before, since there is a certain voltage drop across the resistance. If you measured the anode current of the detector valve before the addition of decoupling (by inserting a 0-5 m.a. meter in series with the "H.T.+2" lead) you would find that a reading of approximately 1½ milliamps was obtained. And you would also find by experiment that the optimum voltage for the detector valve H.T. tapping was about 80; from these figures it is an easy matter to find the correct value for the decoupling resistance to ensure that the detector valve is operated under precisely the conditions which proved to be best. The method of calculating the value depends upon Ohm's Law, which (in its simplified form) states that the value of resistance required (in thousands of ohms) is equal to the voltage to be "dropped" divided by the current passing through the resistance (in milliamperes). As the H.T. battery has a voltage of 120 and the valve requires 80 volts, it is clear that the voltage to be dropped is 40. And since the current under working conditions is 1½ m.a. the resistance value needed is 40 divided by 1½ multiplied by 1,000, or in other words, approximately 25,000 ohms. Actually, the exact figure is by no means critical and the resistance is to a great extent self-compensating due to the fact that the voltage drop becomes greater as the current is increased, and the current is reduced if the voltage drop becomes greater. The value given is, however, perfectly satisfactory and that is why a 25,000 ohm resistance is specified. For the large-capacity by-pass condenser anything from 1 to 4 mfds. can be used, but 2 mfds. is a good average value.

The new components can very easily be recognized in the wiring plan since they are shaded; the new wiring is shown in heavy lines for easy reference, all previous wires being indicated by broken lines.

A Dynatron Frequency Meter

In This Article the Author Deals with the Construction of an Efficient Instrument for Use on Broadcast Wavelengths

MANY instruments which are described as wavemeters, or frequency meters, are primarily intended merely for the identification of stations by the rough measurement of the wavelength. There appears to be no aim towards the accurate measurement of frequency, the object being apparently to find the wavelength within about ten metres or so. The most accurate type of meter is the ordinary heterodyne type, and it is this type which is the subject of the present article.

The Dynatron Oscillator

Many of the difficulties associated with other types of meter are eliminated by the use of an oscillator of the dynatron type. The circuit is such that the frequency of the oscillation depends almost entirely upon the frequency of a single tuned circuit of a coil and condenser. There is no reaction winding to get out of place, and cause alteration in the capacity of the circuit, and it is found that so long as the coil and condenser are of absolutely rigid construction, the calibration will remain much more constant than a similar oscillator of the two-coil type. In addition, there are available methods of correcting for changes in the high-tension voltages of the valve; over a range of some thirty volts variation it was found to be impossible to measure any difference in the dial setting for a constant frequency when reading on a carefully mounted 0 to 100 dial.

The Circuit

The oscillator circuit is shown in Fig. 1. It will be seen that it consists of a screen-grid valve with a tuned circuit in the plate lead. This circuit will only operate under the conditions when the valve is said to have negative resistance. To explain this more fully we must examine the characteristic curve of a screen-grid valve. Fig. 2 shows how the anode current of a screen-grid valve varies with the anode voltage applied when the control grid and the screen-grid are kept at constant potential. It does not look like an ordinary valve curve because of the strange kinks at A and B. It can be easily seen that the part between A and B slopes downward, that is, if we slightly increase the anode voltage at this part of the curve, we shall get a decrease in current. This is the reason why the valve is said to have negative resistance at the points between A and B. For this to occur the anode voltage is always less than the screen voltage. Also the control grid voltage must be of a suitable value for the valve to oscillate. Under these conditions a remarkably steady oscillation is obtained.

It has been stated that a relatively large variation of the HT voltage can be compensated without altering the calibration of the meter. This is done by variation of the potentiometer R, which controls the grid bias. This control is used in conjunction with the milliammeter M, and the reading of this meter must be kept the same no matter how the HT is varied. If the current indicated by this meter is always kept the same, say at 3 milliamps, then the calibration will remain constant even when the HT is altered by 10 or 20 volts. Very few triode oscillators exhibit this property. So much for the theoretical side of the question.

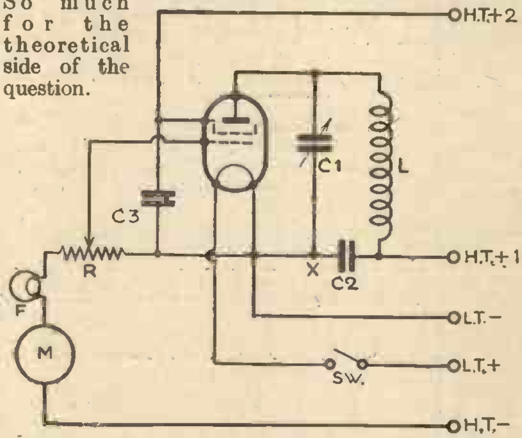


Fig. 1.—The circuit of the meter. The values of the principal components are :—
C1.—Tuning condenser (see text). M.—0—10 milliammeter.
C2.—.01 mica condenser. F.—Fuse,—60 m/A.
C3.—1 mfd. fixed condenser. HT+ 1.—50-70 volts.
R.— 2,000 ohm potentiometer. HT+ 2.—90-120 volts.

Constructional Details

The actual construction should present no more difficulty than an ordinary receiver so long as it is remembered that everything must be as rigid as possible. The condenser should be of heavy construction, and should not be larger than 0.0003 or the wave-range covered will be too great for accurate measurement. It does not matter how the coil is wound so long as it is done tightly, and is firmly mounted. On no account should plug-in coils be used; a dual-wave coil

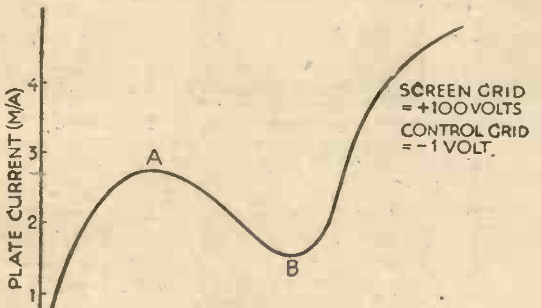


Fig. 2.—The kink in the characteristic curve of a Tetrode.

could be used, but it is much better to use a coil on the long waveband, and make use of the harmonics for medium-wave measurements. A condenser of .0003 mfd. capacity with a .0001 mfd. in parallel

Fig. 3.—A view of the complete meter.

should just spread the wavebanp from 1,000 to 2,000 metres right round the dial. It is a good idea to mount the coil, condenser and valve on top of a metal panel with the fixed condensers, control switch, and all the battery leads underneath. In this way the tuning circuit is shielded from the flex leads, which might move and cause frequency variation. The screen is connected to the point X, so that one side of the condenser C1 is at low potential, and the other side is at high potential. The condenser C2 (0.01 mfd., mica) isolates the coil L from negative, and also forms part of the tuned circuit. As the condenser C1 is also of stout construction there should be no danger of a short circuit, but as there is a meter in circuit, it is advisable to insert a fuse of as low a rating as is obtainable.

Calibrating the Meter

The calibration of a medium-wave oscillator is quite straightforward, but when we come to the harmonic type of instrument there is some complication. The calibration must be carried out on stations whose frequency is known to remain absolutely constant and as stated in the published lists. The British stations are quite beyond reproach in the matter of frequency wobble, but some of the Continental stations are not so well behaved in this respect. Rome, and most of the German stations can also be relied upon. With the long wavemeter the first job is to get the range correct, and there is no alternative to taking turns off the coil till it tunes from 1,000 to 2,000 metres; I wound my coil on an old transformer bobbin giving a mean diameter of about 1in., and I found that 300 turns were required with a 0.0003 condenser. A rough calibration can be obtained from a few long-wave stations like Daventry, and the long-wave Parisiens, which are easily identified. Now on the medium waveband harmonics of the oscillator are heard; that is to say, if the oscillator is operating on 1,200 metres the harmonics will be heard on 600, 400, 300, 240 metres and so on, these figures being obtained by dividing the 1,200 by 2, 3, 4, and 5, and so on. If we make the oscillator heterodyne the London Regional transmission on 355.9 metres, and take a reading on the silent point of this heterodyne, we have a calibration point, and it remains to find the wavelength of the wavemeter oscillation. Now, instead of dividing by 2, 3, 4, etc., we must multiply. This gives figures of 711.8, 1,067.7, 1,423.6, 1,779.5, and 2,135.4 metres. Of these there are probably three in the range of the meter, but a glance at the rough graph will show where the oscillation actually is. Another point will here be apparent. There are three points on the oscillator range at which there is a harmonic on the London Regional. As the dial is turned three separate heterodynes will be heard at different points on the dial, and the three readings correspond to three calibration points. Nearly all the other medium-wave stations give two or three calibration readings, and by making use of the fact the calibration becomes quite straightforward. Three stations are quite enough to completely calibrate the meter.

Plot the points in the usual way on a graph, making the wavelength scale as

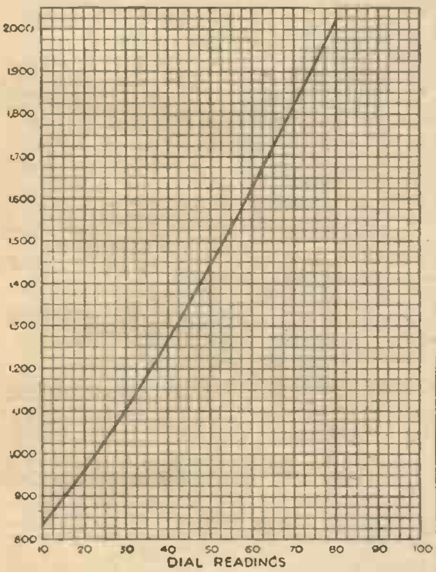


Fig. 4.—A calibration chart for use with the meter.

large as possible, and make the dial reading scale such a size that the reading on the graph is as accurate as the dial reading. If you can read to a quarter of a division on the dial, make your graph so that it can be read to this accuracy.

Using the Meter

So much for the calibration of the meter. In order to use the meter to measure a wavelength of a station switch it on, wait for about a minute for the filament of the valve to reach a steady state and then adjust the current to the same value to that at which the meter was calibrated. If the wavelength is in the long waveband it can be read off directly from the chart. If in the medium waveband a multiple of the actual wavelength will be found. If the approximate wavelength is known it will be easy to find which harmonic is being used by trial and error. If the wavelength is absolutely unknown, however, the following method must be used to find it. Find a setting at the lower end of the oscillator dial which gives a harmonic reading. Suppose this is on a wavelength of 1,025 metres. Now increase the dial reading till the next higher wavelength giving a reading is reached. Look this up

(Continued on page 449)

OUR VIEWS ON RECEIVERS

The G.E.C. Superhet Five

NO matter what views one may have on the controversy of straight sets versus superhets, it is an undisputed fact that as far as this season is concerned the superhet has come very much into favour. Many manufacturers have developed models to give the highest possible standards of reception, and as a result of the tests we have just made, the G.E.C. Superhet 5 must be included in this class.

It possesses a far greater degree of selectivity, power, and flexibility of control than would seem possible in a model priced at 14 guineas, and when this is coupled with a first-class appearance, together with good quality of reproduction, it will be appreciated that the set is quite outstanding.

Modern Lines

Five valves are included and their respective designations and functions are as follows:—

M.S. 4B. Screen-grid Second Detector.
VMS4. Screen-grid intermediate frequency amplifier.
M.S.4B. Screen-grid first detector and oscillator.
M.P.T.4. Super-power pentode output valve.
U 12. Double phase rectifier.

The first three valves are housed in screening cans, and, of course, the set is built on modern lines with an all-metal chassis construction, the screening being very thorough throughout. A polished figured walnut cabinet accommodates the set, the top and front being made from one piece of wood to preserve a continuous flow of graining.

At the back is a mains terminal board with a movable pronged link which can be inserted beneath the appropriate screw for the set to be matched up to the house mains rated voltage 190/210, 210/230 and 230/250. As the consumption of the set is about 70 watts, approximately fourteen hours running is obtained for the cost of one unit of electricity.

Internal Aerial

The receiver is designed to cover the two usual wavebands, namely, 200 to 550 metres and 1,000 to 2,000 metres, the right-hand knob effecting the wave change, and also bringing the set into the proper condition for gramophone pick-up working when desired. The centre knob operates the ganged condensers, a pointer moving over an illuminated scale having the principal broadcasting stations indicated in their correct tuning positions, British stations being shown in red.

When tuning it is necessary to exercise care and to see that the desired station is tuned in to the loudest point, the volume being adjusted through the medium of the combined on-off switch and volume control knob situated on the left. On test it was found necessary not to increase the volume beyond adequate room strength, otherwise the receiver became overloaded, with consequent distortion.

For the reception of strong "local" stations, an internal aerial, consisting of a short length of vertical wire anchored to the top of the cabinet back, is included. Naturally this internal aerial gives only a fraction of the efficiency of an ordinary aerial and earth system. During the course of some very stringent tests made on the set, however, a length of wire (about 15ft.) tucked behind the picture rail and using no earth, proved sufficient to bring in about forty stations at full loud-speaker strength.

Refinements

Coming now to the refinements, we have first of all the variable tone control. This is effected by adjusting a knob in the centre of the loud-speaker fret. Anti-clockwise rotation renders the reproduction "brighter," while turning the knob in the opposite direction gives the reproduction a deeper tone and tends to reduce the background noise which is sometimes experienced when receiving distant stations. Naturally, this control can be set to suit the tastes of each individual listener, but as a general rule it was found that the knob turned anti-clockwise for speech, and clockwise for music, was preferred.

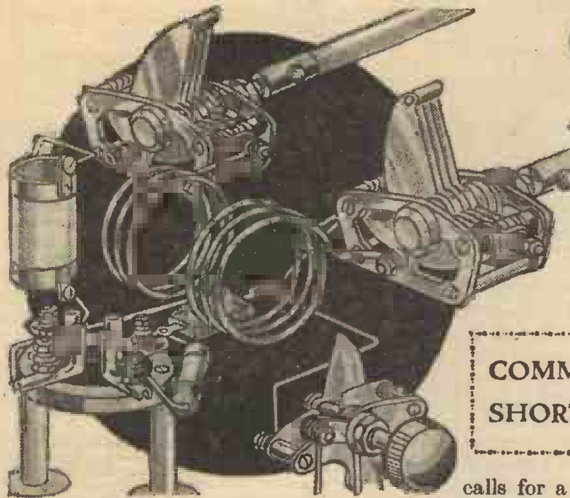
The G.E.C. Superhet Five.

Provision is made whereby a speaker of 7,000/10,000 ohms impedance may be connected to the set for use at a point remote from the instrument. Both speakers function together, but when desired the silencing key is brought into commission, and this disconnects the internal loud-speaker.

Extreme Simplicity

Anyone who handles this set cannot fail to be impressed with the extreme simplicity of control, and this is a feature which is sure to commend the instrument for general household use. The selectivity is particularly fine, so that the tuning operation has to be carried out very slowly to ensure that no station is missed.

Reproduction is well up to a high standard.



Short Wave Section

COMMON TROUBLES IN SHORT-WAVE RECEIVERS

SHORT-WAVE reception is often described as a very specialized branch of radio. The sooner this illusion is dispelled the better, for there is absolutely no reason why the ordinary non-technical listener should not obtain results in every way comparable with the performance of his normal broadcast set. Nevertheless, it is true that various snags present themselves to the novice which, at the outset, are liable to damp his enthusiasm rather severely. There are three difficulties which we all come up against, novice and expert alike; I refer to "hand-capacity," "blind spots," and "threshold howl." None of these is by any means an insuperable difficulty, and with a little patience can be easily cured.

Hand Capacity

To take these troubles in order, we come to "hand-capacity." At some time or other we have all tuned in a station very nicely, only to find on withdrawing our hand from the dial that the tuning is completely upset; this is due to the unintentional capacity of our body which is applied across the tuning condenser. An expert skilled in the art of tuning will allow for this by tuning just slightly above the correct tuning point on the dial, thus balancing the hand-capacity effect. Needless to say, although this is not a difficult matter on medium-waves, when we go lower down the scale we find that tuning in this way calls for a great deal of patience, bearing in mind that on short waves a small increase in tuning capacity can make an almost incredible change in frequency. A very great improvement can be made in this direction by fitting extension handles to the tuning and reaction condensers, thus removing as far as possible the influence of the hand. It used to be the practice to construct all short-wave sets with metal panels, the moving vanes of the condensers being connected to this, and thence to earth; thus there was a complete electrostatic shield between the operator and the set; theoretically, this should result in complete tuning stability. Sometimes it was an unqualified success, but equally often it was a failure. On these very high frequencies there is no guarantee that because you earth one end of a metal panel, the other end is at the same potential. It is very certain that a long earth lead will make a metal panel worse than useless. A solution to the whole problem can usually be found in fitting condensers of the type which utilizes its own metal end-plates as a screen, the moving vanes being connected to this, and so to earth.

Hand-capacity troubles are often due to H.F. currents finding their way into the L.F. part of the set. If this is suspected, try the effect of fitting "grid-stoppers," and connect H.F. chokes in each 'phone lead as shown in Fig. 1. H.F. energy in the 'phone leads is a fruitful source of trouble, and may be detected by tuning in a carrier wave, and touching one of the output terminals; any change in the heterodyne note is a sure indication that an H.F. filter is necessary.

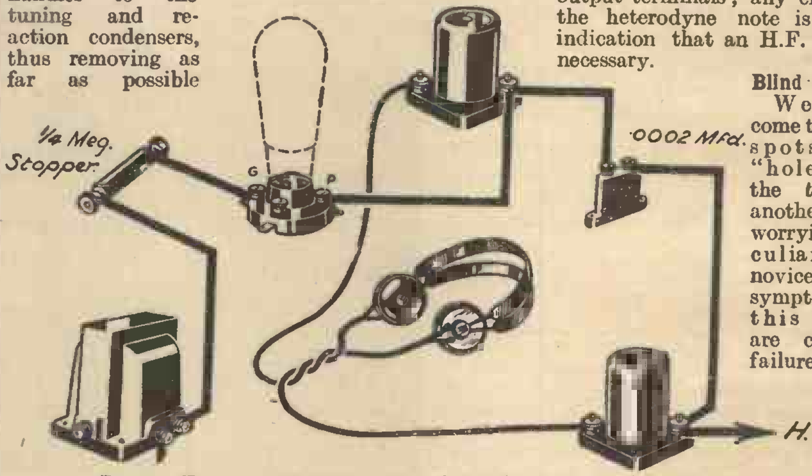


Fig. 1.—To prevent hand-capacity effects a 'grid-stopper' may be employed.

Blind Spots

We now come to "blind spots," or "holes" in the tuning, another very worrying peculiarity to novices. The symptoms of this trouble are complete failure of the set to oscillate at certain spots on the dial, or, at the best, an abnormally high feed-back is required to obtain adequate reaction. To explain this, we must digress for a moment. Any aerial, whatever its length, has a certain natural period of vibration (electrically speaking), which is dependent on its physical dimensions, if in free space, and, in addition, its capacity to earth under normal conditions. Should

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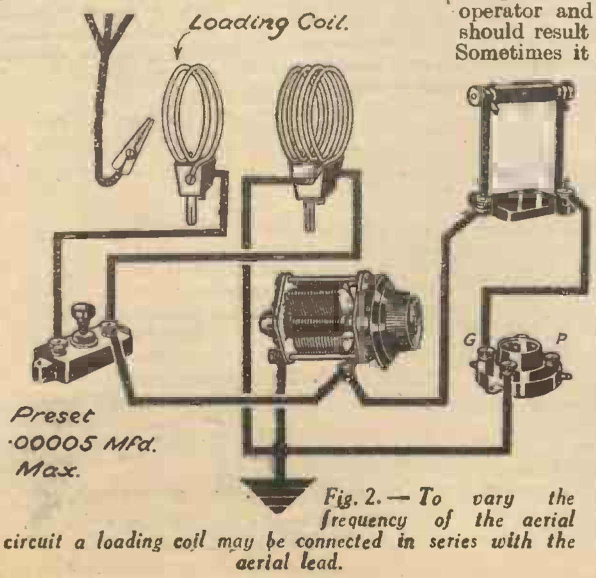


Fig. 2.—To vary the frequency of the aerial circuit a loading coil may be connected in series with the aerial lead.

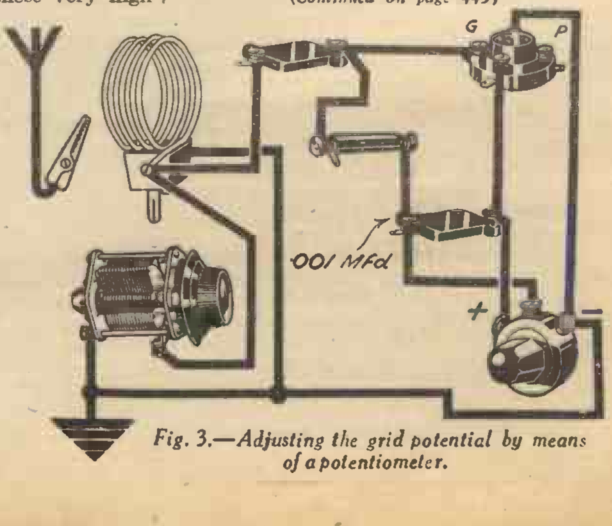


Fig. 3.—Adjusting the grid potential by means of a potentiometer.

SHORT WAVE SECTION

(Continued from page 440)

the receiver be tuned to this critical frequency, the aerial will absorb energy from the oscillating detector; the latter will, therefore, have to overcome the losses in the aerial in addition to the losses in the tuned circuit; furthermore, the same thing will occur in a lesser degree on the harmonic frequencies of the aerial which are exact sub-multiples of the fundamental frequency. To cure this trouble, we must either very much reduce aerial coupling, or shift the frequency of the aerial. The means of reducing aerial coupling will be obvious, but an alternative method of altering the fundamental aerial frequency by the simple expedient of connecting a loading coil in the lead-in may be tried. (See Fig. 2.) It is worth while preceding the detector by a screened-grid stage even if the actual gain is negligible, for by this means the aerial loading is entirely removed from the detector, and the blind spots will disappear; furthermore, an H.F. stage on the short waves is by no means a passenger nowadays.

"Threshold howl" is so called because it occurs on the threshold of oscillation, and as the efficiency of a short-waver is dependent entirely on the adjustment of the detector to this point, the whole performance of the set is ruined if this trouble is not removed. An unsuitable detector valve is often the cause, and substitution of various types should be tried. More often than not, however, it will be found that the valve is working under wrong conditions; although rectification is at its best with a high positive grid potential, it will be found that threshold howl often entirely disappears if the bias be reduced. This is conveniently arranged by adjusting the grid potential with a potentiometer, as shown in Fig. 3. The by-pass condenser is important and should not be omitted. If the set does not yield to this treatment, try experimenting with different values of grid-leak and condenser, and, more important still, use no higher H.T. than is absolutely necessary for good oscillation. The egress of H.F. energy into the L.F. department can be a prolific source of trouble in this direction as well as from the hand-capacity point of view. As explained above, a well-designed filtering system will work wonders. A more elaborate system is shown in Fig. 4.

NEUTRALIZING CIRCUITS

(Continued from page 406)

Increasing the resistance of the input circuit acts as a deterrent to oscillation from the fact that the amount of energy fed back is less capable of overcoming the damping losses. Applying positive bias to the grid may also be tried; this may be effected by connecting the filament terminal from the input circuit to the sliding contact of a potentiometer connected across the filament battery. It should be pointed out, however, that in the whole of the suggestions put forward there must be a reduction of amplification.

The Neutralizing Condenser

The neutralizing condenser can be used in some form of neutralizing circuit so that the amplification is not reduced. The object of the condenser, or more than one condenser may be used, is to produce an equal but opposite reaction effect to that which exists in the valve by reason of the inter-electrode capacity reactance between the anode and grid. A typical circuit is illustrated in Fig. 4.

It will be seen that the inductance of the anode circuit is tapped at mid-point, the tapping being led to the positive side of the H.T. The neutralizing condenser, C_1, is connected to the upper end of the anode inductance. The inductance may be in the form of the primary coil of a transformer (as shown), a choke coupling, or the inductance arm of a tuned anode coupling. The fixed condenser, C, represents the inherent reactance of the valve the effects of which have to be neutralized.

It will be seen that the energy conveyed through the respective paths of C_1 and C passes to the grid circuit from opposite ends of the output coil. The potentials across the respective halves of this coil are about 180 degrees out of phase, so that the energy through C_1 and C are approximately opposite in phase so that they tend to neutralize each other. If, then, the capacity of C_1 is adjusted until it is equal to that of C, the effect of the latter is completely neutralized.

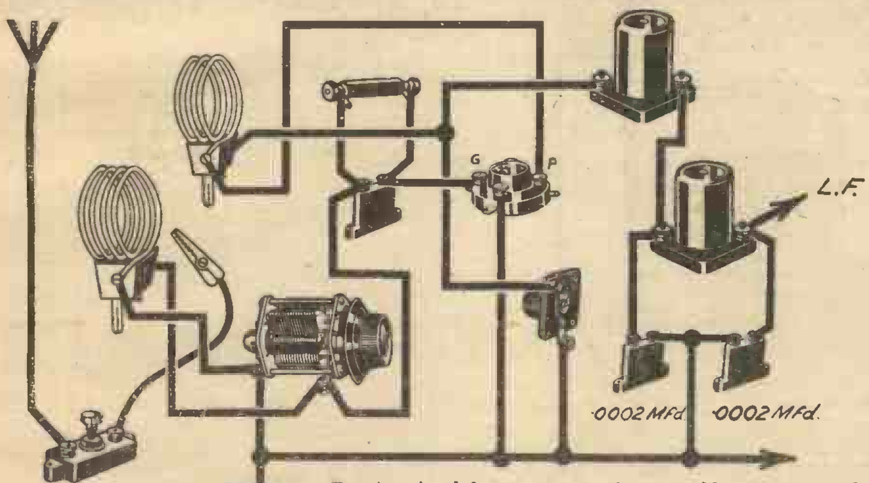


Fig. 4.—An elaborate circuit which should prove extremely efficient and stable.

50 Tested Wireless Circuits 2/6, or 2/9 by post, from Geo. Newnes, Ltd., 8-11, Southampton Street, Strand, W.C.2.

RANDOM REMARKS

RADIO FREQUENCIES

An Interesting Account of the Development of the Various Wavebands, and their Characteristics.

By E. G. ROWE, B.Sc. (Hons.), A.C.G.I.

THE credit for the development of the short waves must go first to the amateurs. In the early days of wireless fading was not understood, and the reflected "sky-wave" unknown, distance working being only thought obtainable by increasing the strength of the "ground-wave" to overcome the absorption of the earth. These longer waves were of too great a commercial value to be allotted to amateurs, and the latter were given frequency bands in the supposedly useless part of the spectrum. Then "hams," using very simple apparatus, began to obtain communication over thousands of miles with only a few watts in the aerial. This led to the development of what is known as the "Short Waveband." Then, as these frequencies were taken over commercially, so the everlasting urge to be doing something new has led the amateurs to study higher and still higher frequencies. At present a considerable amount of work is being done on five metres.

It is possible to produce electromagnetic waves in the whole range down to visible light. Straight oscillatory circuits can be used down to 1½ metres, but with these very short waves, the radiated energy is small because it is difficult to build tuned circuits having sufficiently high impedances. Also the time of flight of the electron from cathode to anode approaches the time of oscillation of the circuit. To get shorter wavelengths still the latter property is made use of in the electronic oscillators of Barkhausen and Kurz, in which the generated wavelength is determined by the dimensions and disposition of the valve electrodes and the voltage applied, frequency increasing with increasing voltage. Waves of five centimetres have been obtained in this manner. Spark oscillators will reach higher frequencies again, and can get to the heat waveband.

Details of the Spectrum

The long waves extend from 30,000 metres to about 800 metres, and are distinguished by the fact that they experience little or no fading. They are, however, more troubled by atmospheric disturbances which are generally of very long wavelength. Reliable ranges of from 6,000 to 1,000 miles are obtained, the distance decreasing with decreasing wavelength.

The medium waveband goes from 800 to about 150 metres. The fading effects become worse as the frequency increases. The maximum ranges vary from 1,000 miles at 800 metres to 200 miles at 160 metres.

When the short waveband of 100 metres to 10 metres is used, the phenomenon known as "skip distance" shows itself prominently. At 100 metres the ground wave exists for eighty miles, while communication can be held up to 1,200 miles, owing to the reflected wave from the Heaviside Layer. At 40 metres, signals are heard from 0 to 40 miles and from 400 to 4,000 miles, there being this skip distance between where the ground wave is completely absorbed and where the reflected wave arrives back to the earth.

Ultra-Short Region

Below eight metres is the ultra-short region in which the upward rays are not reflected by the upper layers, but pass right through, and are completely lost. Reception can only be had from the ground wave, the waves also travelling in straight lines to the horizon, and more or less obeying optical laws—being obstructed by large buildings, etc. The big attraction of these ultra-short waves is, peculiarly enough, their limitation. Different stations do not interfere with each other even at very nearby frequencies owing to their limited radiation, and the solution of the radio problem may lie in the reception of programmes from a certain fixed number of big stations on the longer waves, and the relaying of them by every town's seven-metre transmitter, each having about a ten mile range. These ultra-short waves may be directed in any desired direction, and focused to any degree of sharpness by simple reflectors and mirrors, giving almost perfect secrecy if required. Another useful asset is that they are not affected by fog, rain, or fading.

The present extreme limit of frequencies, that is, waves below a metre in length, are sometimes known as "microwaves" from obvious reasons. Successful communication has taken place on 18 centimetres between Dover and Calais, while the Pope has a regular telephone service between the Vatican City and Castel Gandolfo, a distance of twelve miles, operated on a wavelength of 60 centimetres. These very short waves offer tremendous possibilities for future development. The table appended gives a general summary of the radio spectrum and its characteristics.

WAVERANGE TABLE

Waveband	Wavelength in Metres	Frequency in Kilohertz	Reliable Range in Miles	Characteristics
LONG	30,000	10	6,000	No skywave and hence no fading. Static prevalent.
	3,000	100		
	800	375	1,000	
MEDIUM				Fading effects commence.
	200	1,500	300	
SHORT	100	2,500	0—80 200—1,000	Skip distance gradually becomes more important
	20	14,000	0—40 600—6,000	No use for night working.
	10	30,000		
ULTRA-SHORT	8	37,500		Skywave is lost. Optical range only. Easily reflected. Low powers only.
	5	60,000	5—20	
MICROWAVE	70 cms.	450,000		No static nor noises.
	30 cms.	1,000,000		Rain and fog have no effect.
	7.5 cms			Present useful limit.

Paraphase Amplification

A Novel System of Push-Pull Working. By A. L. CARY

EVEN in these days of Class B and Q.P.P. output circuits, to the owner of a large mains unit the old form of push-pull amplification has much to recommend it. In a properly-designed circuit harmonic distortion is reduced to a minimum, and very good quality and volume can be obtained. Here is rather an unusual system of push-pull working which provides exceedingly good quality, and which should appeal to all readers who are interested in obtaining realistic reproduction.

The underlying principle of all push-pull working consists in dividing between two valves the grid swing which would normally be taken by one. This means that the grids of the last two valves must be out of phase, and is usually accomplished by employing an input transformer having a centre-tapped secondary. There is, however, another method of putting the two grids out of phase, which does not involve the use of an input transformer, and which is here described.

Principle of Working

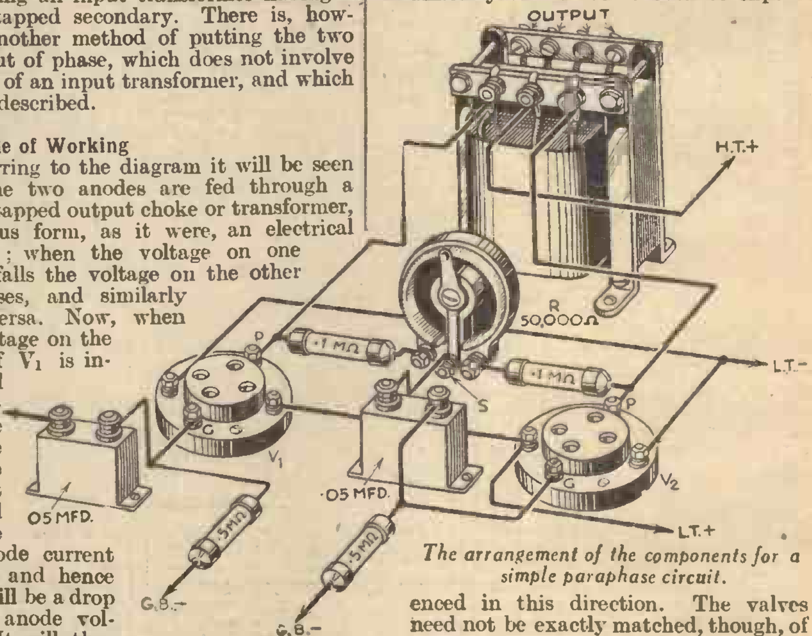
Referring to the diagram it will be seen that the two anodes are fed through a centre-tapped output choke or transformer, and thus form, as it were, an electrical balance; when the voltage on one anode falls the voltage on the other one rises, and similarly vice versa. Now, when the voltage on the grid of V_1 is increased the impedance in the anode circuit will cause the anode current to rise, and hence there will be a drop in the anode voltage. It will thus be seen that the anode of V_1 is out of phase with its grid, and that the changes in anode voltage of the two valves will be reproduced in the resistance R which connects them, which must be made fairly high to avoid short-circuiting the two anodes. The centre of the resistance, which represents the pivot of our suppositious balance, will remain at a constant level, and by attaching a slider S, any A.C. voltage between zero and the maximum developed on the anode can be tapped off and applied to the grid of V_2, and this voltage will be of opposite phase to the grid of V_1, as we have already seen. It only remains to find the point on the resistance at which the voltage developed will be exactly equal to the signal voltage applied to the grid of the first valve.

Operating Notes

This, roughly, is the principle on which this form of amplifier works, but the article would not be complete without some operating notes. This circuit is best suited to resistance-capacity coupling, and this form of coupling has therefore been illustrated. Suitable values for the coupling condensers and grid-leaks are .05 mfd. and ½ megohm respectively. The output choke, or (as illustrated), the transformer, should be one of the ordinary push-pull type, if possible with a tapped secondary for matching to the characteristics of the speaker used.

The resistance R is the only component which presents any difficulty at all, and even here the difficulty is practically negligible. The adjustment of the slider is somewhat critical and yet the resistance must total in all its length about 250,000 ohms. Probably the best way out of the difficulty is to use a potentiometer of 50,000 ohms, and use two resistances of 100,000 ohms each one on either side of it.

Construction is exceedingly simple, and no difficulty whatsoever should be experienced in this direction. The valves need not be exactly matched, though, of course, they should both be the same make and type.



The arrangement of the components for a simple paraphase circuit.

The first step in the actual operation is to alter the grid bias on the two valves until their quiescent anode currents are equal. If a pair of matched valves has been obtained this step is, of course, unnecessary. Then the set should be switched on, a strong signal tuned in, and the slider of the potentiometer adjusted to give the best results. An aural test is perfectly satisfactory, but a more accurate way is to join two high resistances in series, connect the two ends to the two anodes of the valves, and the mid-point to one tag of a pair of phones, the other tag being joined to earth. The slider is then adjusted until the minimum of sound is heard in the 'phones. Once the position of the slider has been found it need not be altered.

I have had this circuit in use for some time, and it has given no trouble at all. It is very simple indeed to build and operate, and I can thoroughly recommend it to anyone who is interested in obtaining real quality reproduction from his set with a modest expenditure.

A DYNATRON FREQUENCY METER

(Continued from page 437)

on your graph, and let us suppose that it is 1,370 metres. Now the difference of these two readings will give an approximate idea of the wavelength being measured. In our example the difference is 345 metres, so that we can say that we are round this wavelength. A better estimate is then obtained by dividing 1,025 metres by three, giving the accurate measurement as 341.6 metres, or 342 correct to the nearest metre. This method of measurement is of use down to wavelengths as far as two consecutive harmonics can be heard, which was found to be in the neighbourhood of 70 metres. Accurate measurements can thus be made from 70 to 600, and from 1,000 to 2,000 metres without the necessity of changing any coils.

There is no reason why the same HT or LT should not be used for receiver and wavemeter, but do not use them both together as the meter in the HT lead of the wavemeter will be shorted. About 100 volts of HT should be put on the screen-grid, and 60 on the plate. Any battery SG valve may be used, but a mains valve is not recommended, owing to the long time taken by the filament to warm up.

BAND PASS TUNING

YOU have no doubt noticed that band-pass tuning is not used nearly so much at the present time as it was a year ago. Perhaps you have also wondered why; I think the answer can be supplied in the form of two names, iron-core coils and variable-mu valves. With ordinary S.G. valves band-pass tuning was a practical essential if the form of interference known as cross-modulation was to be avoided. If a single tuned circuit was used prior to the high-frequency amplifier the modulation of even the weakest station working on a close wavelength to the local was liable to be impressed upon the carrier of the latter station, and as a result interference was experienced no matter how selective the tuner happened to be.

The variable-mu valve, however, is practically immune from cross-modulation troubles (for reasons which have previously been explained in these pages) and, therefore, a band-pass tuner preceding the H.F. amplifier is not nearly so important. In addition to this the present-day iron-core tuner is appreciably more selective than the previous air-core one of similar type, and so the required degree of selectivity can almost invariably be obtained by means of a single circuit. A variation occurs in respect to a superheterodyne receiver though, because in that case a band-pass input circuit is practically essential to prevent the difficulty of second-channel interference.

A system which is being adopted rather widely in a number of selective receivers having only a single V.M. stage is that of using a single-circuit aerial tuner followed by a band-pass circuit between the amplifier and detector. This is an excellent arrangement and has a good deal to recommend it, especially in a set of the medium power type, and is one I would advise you to try if you are interested in the selectivity problem. The single iron-core coil in the aerial circuit provides an ample degree of selectivity in conjunction with the V.M. valve, whilst the band-pass intermediate circuit prevents flat tuning which might otherwise occur on powerful signals due to detector overloading.—(B.D.)

F. J. CAMM'S LATEST RECEIVER

(Continued from page 428)

insulating washers which are fitted. Now mount the fuse-holder, choke, and block condenser, and before going any farther take off the side runner to which the two large fixed condensers are attached. Fit the other parts, and the wiring may then be commenced.

Do not replace the side runner at this stage of affairs. Carry out as much wiring as possible, starting with the leads from the three sockets. Leave the connections to the two 2 mfd. condensers until last, and then measure off the required lengths of wire with the side runner held in position. Attach the wires, and then screw the side runner into its original position, when the unit will be completed.

Installation, and a Warning

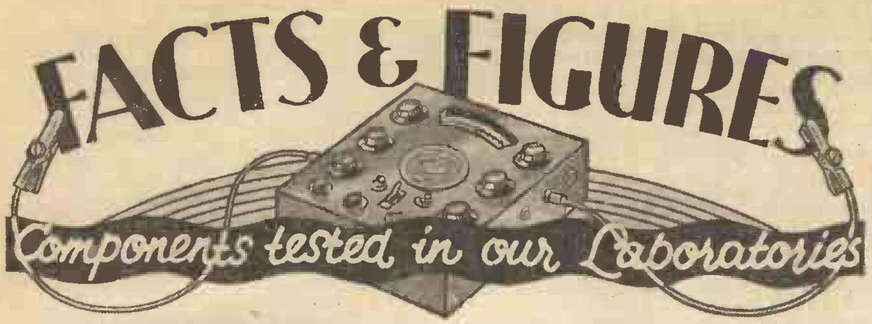
The unit is now ready to be fitted to the receiver, but before doing so the user must realize the fact that with D.C. mains one of the actual wires is earthed. When the unit is joined to the receiver, therefore, one of the mains leads will be also joined to earth, and if this is the negative lead, all well and good. There is, however, a risk of the positive being earthed, or some other scheme being in force. Therefore, before fitting the unit, the spare 2 mfd. condenser which is specified should be attached to the rear of the chassis of the Orbit receiver, and the wire which at present is joined to the earth terminal should be passed to one terminal on this 2 mfd. condenser. The other terminal on the condenser is then joined to the earth terminal. Thus, when the earth lead is joined to the Orbit it will be connected *via* the fixed condenser and a risk of shorting the house mains will be removed. The mains flex should now be attached to the two vacant terminals on the fuse-holder and inserted in a convenient mains socket. It will be realized, of course, that to enable signals to be received, both switches on the cabinet, the one on the right and the one on the left, will have to be operated, and this procedure will have to be carried out when switching off, or the accumulator will be left on and will rapidly discharge. If no signals are heard, the Mains Plug should be reversed in its socket.

LIST OF PARTS FOR THE ORBIT D.C. MAINS UNIT

One Peto-Scott "Metaplex" Chassis, 10in. by 7in. with 3in. runners.
One Bulgin Skeleton Smoothing Choke, Type L.F.17S.
One Dubilier Type BE316 Block Condenser.
Three Dubilier Type BS 2 mfd. Fixed Condensers.
One Bulgin 50,000 ohm 5 watt Potentiometer, Type V.C.11.
One Dubilier 30,000 ohm metallized Resistance (1 watt type).
One Dubilier 5,000 ohm metallized Resistance (1 watt type).
One Bulgin Twin Fuse Holder, Type F.11.
One Heayberd Mains Flex and Adaptor.
One Bulgin Toggle Switch, Type S.104.
One B.R.G. Component Bracket, Type 22.
Three Clix Insulated Sockets, Type 11 (b) (Two red and one black). Wire, Screws.

LIST OF PARTS FOR THE ORBIT A.C. MAINS UNIT

One Peto-Scott "Metaplex" Chassis, 10in. by 7in. with 3in. runners.
One Bulgin Skeleton Smoothing Choke, Type L.F.17S
One Dubilier Type BE316 Block Condenser.
One Bulgin 50,000 ohm 5 watt Potentiometer, Type V.C.11.
One Dubilier 30,000 ohm metallized resistance (1 watt).
One Dubilier 6 mfd. electrolytic high voltage Condenser.
Two Dubilier Type BS 2 mfd. fixed Condensers.
One Bulgin Twin Fuse-holder, Type F.11.
One Heayberd Type W.20 Mains Transformer.
One Westinghouse Metal Rectifier, Style H.T.5.
One Heayberd Mains Flex and Adaptor.
One Bulgin Toggle Switch, Type S.80.
One B.R.G. Component Bracket, Type 22.
Three Clix Insulated Sockets, Type 11.(b) (Two red and one black). Wire, Screws.

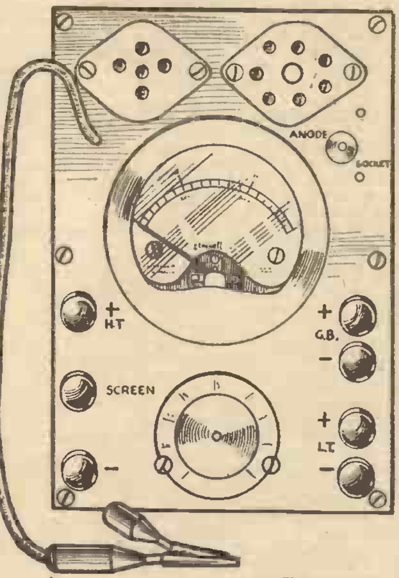


HAMBLING AUTOCELECTA UNIT

THERE is already a number of selectivity devices obtainable by the home-constructor, the majority of which are simply series-aerial condenser arrangements, or absorption tuned circuits arranged in a similar manner. The principal disadvantage of these arrangements, although they do carry out the purpose for which they are intended, is that a reduction of signal strength is obtained in practically all cases. A new idea has, however, been developed by A. W. Hambling and is incorporated in a neat unit which he has called the Autocelecta Unit. This consists of a cylindrical metal can about three inches in diameter and just over four inches tall. Fitted to one side of the can are three insulated terminals, and on the opposite side is a push-pull switch. At the top of the can is a small control knob. Arranged inside the can is an ingenious low-loss coil, wound on four ebonite rods. One portion of the winding is of the solenoid type, whilst a second portion is pile-wound into three slots, thus following the arrangements normally adopted in standard dual-range broadcast coils. Tappings are brought out to the three terminals, and the push-pull switch short-circuits the long-wave portion when the unit is employed for the medium wave-band. A small solid-dielectric condenser is connected across the winding and tunes the coil on the band to which it is adjusted. To use the Unit the aerial is disconnected from the receiver and joined to Terminal 1 on the unit, whilst Terminal 2 is taken to the aerial terminal on the receiver. Terminal 3 is then connected to earth. The receiver is then tuned to the desired station, ignoring any interference, and when the maximum setting has been obtained, the control knob on the Autocelecta Unit is adjusted until the interference is removed. Whilst this is being done there is no necessity to retune the receiver, and this removes one of the principal difficulties of the older type of selectivity unit. In addition, there is a remarkably smooth action and slight building-up effect which results in a clear signal, with no reduction due to the losses in the selectivity arrangement. The device works equally effectively on battery or mains receivers and will be found of great value to the users of old-type receivers where selectivity is poor. The price is 9s. 6d.

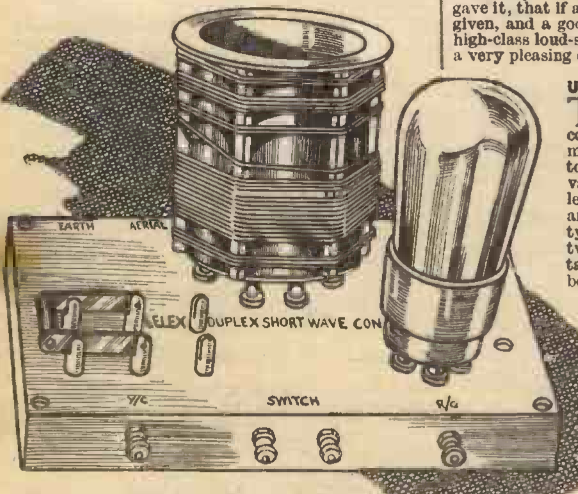
CONTRA RESONANT DUAL SPEAKER CONES

WHILST the simple type of moving-iron loud-speaker gives splendid results when properly adjusted, there are certain inherent faults which render its use undesirable to the keen musician. Resonance is, of course, one of the principal difficulties, and there has been a number of interesting suggestions for overcoming this fault. From the Grantona people we have received a novelty bearing the above name, and this would appear to be a splendid idea. It consists actually of two special loud-speaker cones, supplied in a neat box together with a dual brass fitment. This consists of a small nipple for attachment to the armature of a simple cone unit, and to the end of the nipple two short brass rods are fitted at right angles. The extremities of these rods are provided with ordinary cone attachments. The lid of the box carries instructions for using



The Ferranti Universal Valve Tester.

the cones, and the user is recommended to make a triangular section cabinet of certain dimensions, and to mount the speaker unit at the rear with the two cones attached to the duplex driving spindle, so that there are eventually two loud-speakers facing into the room at right-angles. One cone is of black material resembling buckram, whilst the other is of material similar to bakelized paper. A rough wooden structure resembling the recommended cabinet was built and the two cones were mounted according to the instructions. There was definitely an advantage gained in using this method of reproduction over that obtained with the same unit and a single cone mounted in the usual way. It would appear, from the tests which we gave it, that if a sound cabinet is made up on the lines given, and a good unit is fitted to the cones, a really high-class loud-speaker should result, capable of giving a very pleasing overall response. The price is 3s. 6d.



A unique Duplex Short-Wave Converter suitable for use with an existing receiver. This Eelex converter was fully described in a recent issue.

UNIVERSAL VALVE TESTER

THE illustration shows a unique valve tester made by Ferranti. It incorporates one of their well-known meters of the combined reading type, together with a five-pin and a seven-pin valve-holder. Terminals and the wander-lead enable the required H.T., L.T. and G.B. voltages to be applied to any type of valve inserted in either of the two valve-holders, and the various details concerning its characteristics may be ascertained on the meter by suitably adjusting the lower control knob according to the type of reading desired. Mains as well as battery valves may be tested, and the instrument is not restricted to the simpler types of valves, but may be used for testing Class B valves as well as the newer mains Heptode and double-diode-triode valves. The instrument is, of course, principally of use to dealers or Service engineers, to whom it will prove of great value. The price is £7 7s. 0d.

RADIO CLUBS AND SOCIETIES

Club Reports should not exceed 200 words in length and should be received First Post each Monday morning for publication in the following week's issue.

THE SOUTHALL RADIO SOCIETY

In a lecture at a recent meeting of the Southall Radio Society, Mr. Tyler (vice-chairman) dealt with the problem of choosing a loud-speaker to suit individual requirements. A large number of speakers were available for test, from the early models to the latest modern equipment, and were subjected to a frequency test by means of a specially constructed L.F. oscillator.—Hon. Sec., Mr. A. J. Stephens, 98, Pole Hill Road, Hillingdon.

INTERNATIONAL SHORT-WAVE CLUB (LONDON)

At the meeting of the London Chapter, held on Friday, October 20th, at the R.A.C.S. Hall, Wandsworth Road, S.W.8, a lecture on the cathode ray oscillograph was given by Mr. T. D. Humphreys. He described the construction of the tube and its varied applications. With the aid of the blackboard, he was able to illustrate many interesting points. The various applications of the cathode ray oscillograph was afterwards demonstrated. We shall be pleased to send future dates of meetings to any reader of PRACTICAL WIRELESS.—A. E. Bear, Sec., 10, St. Mary's Place, Rotherhithe, London, S.E.16.

THE LEICESTER RADIO CLUB

The above club has recently been formed in Leicester, and it is the object of the club to deal with most branches of radio work, but chiefly to stimulate interest in short-wave work. Meetings are held weekly, on Thursday evenings. Anyone interested should write for particulars to C. Cramp, Hon. Sec., The Leicester Radio Club, 9, Cecilia Road, Leicester.

WEST HARTLEPOOL RADIO CLUB

Will any readers in West Hartlepool and district who are interested in radio, television, or home talkies, etc., and are desirous of helping the existing small band of enthusiasts in this locality to make a success of the above club, please communicate with Robert W. Stewart, 9, Kilwick Street, West Hartlepool.

SLADE RADIO

A lecture entitled "Sets of To-day" was given by Mr. W. L. Hartshorne at the meeting held last week. After explaining that modern sets depended on new types of valves, he went on to describe the H.F. pentode variable-mu and straight H.F. pentode, giving particulars of the many advantages which these valves offer. The double-diode-triode and double-diode-pentode were dealt with next, and a circuit was given for the latter type, which included delayed A.V.C. Details were also given of the neon stabilizer, and samples showing the construction of several types of valves were handed round for inspection.—Hon. Sec., 110, Hillaries Road, Gravelly Hill, Birmingham.

ILFORD AND DISTRICT RADIO SOCIETY

At last Thursday's meeting a popular feature was again held, consisting of a demonstration of moving-coil loud-speakers, brought along by members for the purpose of comparison. The society's receiver was used, together with their standard loud-speaker, and the other speakers were compared for sensitivity and response, with surprising differences in results.

Nov. 16—Demonstrations of Photophone method of Transmission of Music by Light Beam, by Mr. R. V. McWeston. Inter-meeting with members of the Southend and District Radio Society.

Nov. 23—Questions.

Nov. 30—Lecture on "Modern Valve Developments," by Mr. W. G. J. Nixon.

Visitors are invited to the meetings. Details of the society can be had from the Hon. Secretary, Mr. C. E. Largen, 44, Trelawney Road, Barkingside, Ilford.

FULHAM AND DISTRICT RADIO AND TELEVISION SOCIETY

The above society is now in formation, and in order to promote interest in it the organizers are endeavouring to hire a local hall for lecture and demonstration purposes. Television and ultra-short-wave reception will be the main subjects. Will those interested in the society please write to Mr. A. L. Nagels, 267G, Fulham Court, London, S.W.6.

CHESTER-LE-STREET AND DISTRICT RADIO SOCIETY

A demonstration was given by Mr. D. Wilson of his home-constructed battery set on October 24th, at which meeting the secretary produced a home-built granulated-core transformer. This was an output transformer, and aroused considerable discussion, as the society's technical representative, Mr. Wm. Murray, was of the opinion that an efficient intervalve transformer could not be made on this plan, since the self-capacity of the windings and eddy current losses in the core would be present.

Lectures and demonstrations are being arranged for the session, and radio societies and manufacturers are invited to communicate with the secretary, Mr. K. Bowe, 60, Lancaster Terrace, Chester-le-Street, if they have any interesting lectures, slides, or photographs to loan to the society.

PRACTICAL LETTERS FROM READERS

The Editor does not necessarily agree with opinions expressed by his correspondents. All letters must be accompanied by the name and address of the sender (not necessarily for publication.)

An Indian Reader and Our Short-wave Section

SIR,—I was very interested in the notes on "Mains Short-wave Receivers" in the September 16th issue of PRACTICAL WIRELESS.

Could you give us some more notes on these receivers, and some practical details of an all-mains short-wave superhet?

Your short-wave section is very interesting, but I am afraid one- and two-valve sets are not of much use to people abroad, who must have good quality loud-speaker reception of the short-wave stations, especially the Empire station.

At present I am running a four-valve (H.F., Det., 2 L.F.) all-mains set (converted from an American battery set). Results are very good when conditions are favourable, but selectivity is poor, and I would like to construct a short-wave superhet, with A.V.C. if possible. If you published details of such a set I am sure your readers abroad would be very grateful.

Many thanks for making PRACTICAL WIRELESS so *practical*.—L. H. MCLAGGAN (Manikuppam, S. India).

A Criticism

SIR,—Herewith some praise and a little criticism. I have sampled a few wireless publications during the past sixteen years, both here and abroad, but for *consistent* good quality of contents PRACTICAL WIRELESS stands alone. I am an old sea-going operator, and I have read most wireless publications, but I have got more "meat" from PRACTICAL WIRELESS than any of them. I have taken advantage of *all* your gift offers since No. 1, and they have all been splendid value. I have also obtained several new readers, knowing that you won't let my judgment down.

Now for a little criticism. First of all take set construction. Now, Sir, I join issue with you here. I think that these articles should be called "Set Assembly." After all, you only say, "buy so-and-so, and wire it to "this or that." The sets are *assembled* only—not constructed. Why not give us details of, say, the construction of the coils for instance, listing a standard coil if you wish, in addition, but let real builders make their own. Many of us have a small workshop with a small lathe (a treadle in my case), and we *do* make our own coils, transformers, etc., and give time and trouble and work carefully with first-class materials, and turn out first-class jobs, even to variable condensers. In fact, I maintain that to a *real* fan, the only thing necessary to buy is the loud-speaker, and even then some of us have attempted the construction of these. I could enlarge on this point, but will refrain.

Next, as a wireless paper, why "Impressions on the Wax." In sufficient records are reviewed to be of any practical use, the reviewer has a "classical complex," suggests reading poetry, and runs down popular music.

Thirdly, why not periodically (say monthly or quarterly) publish the wavelengths, power, *distance from London*, etc., of as many *European* and *American* broadcasting stations (all waves) as possible.—JAS. N. CLARK (Southampton).

(Very few of our readers, we think, have lathes. Many articles have already appeared in PRACTICAL WIRELESS explaining the construction of coils, transformers, etc., and many others are in hand for early publication. Most readers prefer to buy their components, as they lack factory testing equipment. Record reviews are included to cater for the radiogram enthusiast. Every article in the paper cannot be made to appeal to every reader. Many thanks for your helpful letter.—ED.)

An Efficient Aerial System

SIR,—As a reader of your paper from the first issue, I should like you to publish my letter in your paper in the hope that it may help T. G. Blackheath *re* his aerial and experimenting.

My own set is a three-valve battery operated one consisting of a screened-grid H.F., screened-grid Det., small power pentode; my earth is three feet long, my aerial is twelve feet long, one end being joined to one spiral coil of the bed-spring, the set and bed both being situated in the basement of the house, which is ten feet below the pavement. I am able to get any station, long or medium wave, on moving coil loud-speaker, including Russian, and on two occasions have received America direct.

Wishing your paper the best of luck.—F. G. P. (London, N.W.).

CUT THIS OUT EACH WEEK

DO YOU KNOW?

—THAT the separate "sections" of an Heptode (or Pentagrid) valve may be tested in the same manner as single valves.

—THAT all by-pass condensers should be chosen with care, bearing in mind their function and also the fact of high-note loss.

—THAT no alterations should be made, for the above reason, to by-pass condenser values in published designs.

—THAT electrolytic condensers are to be preferred for by-passing grid-bias resistors in mains receivers.

—THAT special condensers having values up to 50 mfds. are available for the above purpose.

—THAT iron is necessary for screening L.F. oscillations and aluminium and copper are useless for that purpose.

—THAT the loud-speaker leads should not be permitted to approach the aerial or earth leads of a receiver.

—THAT an H.F. Choke should be included in the output circuit of a short-wave or an all-wave set.

NOTICE.

The Editor will be pleased to consider articles of a practical nature suitable for publication in PRACTICAL WIRELESS. Such articles should be written on one side of the paper only, and should contain the name and address of the sender. Whilst the Editor does not hold himself responsible for manuscripts, every effort will be made to return them if a stamped and addressed envelope is enclosed. All correspondence intended for the Editor should be addressed: The Editor, PRACTICAL WIRELESS, Geo. Newnes, Ltd., 8-11, Southampton Street, Strand, W.C.2.

Owing to the rapid progress in the design of wireless apparatus and to our efforts to keep our readers in touch with the latest developments, we give no warranty that apparatus described in our columns is not the subject of letters patent.

CATALOGUES RECEIVED

To save readers trouble, we undertake to send on catalogues of any of our advertisers. Merely state, on a postcard, the names of the firms from whom you require catalogues, and address it to "Catalogue," PRACTICAL WIRELESS, *Geo. Newnes, Ltd., 8/11, Southampton St., Strand, London. W.C.2. Where advertisers make a charge, or require postage, this should be enclosed with applications for catalogues. No other correspondence whatsoever should be enclosed.*

WEARITE RADIO COMPONENTS

OF particular interest to constructors is the range of "Nucleon" iron-core coils, full particulars of which are given in an attractive booklet recently issued by Wright and Weaire, Ltd. These coils, which are the outcome of many months of intensive research work, are made to suit all requirements, and all terminals are arranged in standard positions. Several diagrams in the booklet clearly show the connections for these coils in different circuits.

The new "Wearite" ganged coils are also of special interest, and consist of aerial, band-pass, and H.F. coils. These are obtainable in 2, 3, or 4-ganged units. Another noteworthy "Wearite" component is a very compact superhet coil built on a new principle. The screening is effected by small cans, which are assembled in such a manner that the coil is automatically held central. The single coil units can easily be ganged, when necessary, into any combination. Other components listed are class "B" driver transformers, matching chokes, power transformers, H.F. chokes, potentiometers, automatic volume-control unit, and a useful range of switches for all purposes. Copies of this handy booklet are obtainable for threepence, post free. Separate leaflets, giving full particulars and prices of either the Nucleon iron core coils, automatic volume-control unit, or adding Class "B" to your set, can be obtained from the address given below. Another leaflet, of special interest to constructors, describes the new Wearite Teamster, a fine four-valve receiver embodying S.G. detection, band-pass tuning, automatic volume control, and matched Class "B" output. A blue print, giving a full-size wiring diagram, is priced at 1s. The address is 740, High Road, Tottenham, N.17.

NEW EXTENSION SPEAKER

RADIO entertainment is made more enjoyable when it is possible to listen in any room in the house without moving the set. In the kitchen, or for invalids confined to bed, an extension speaker is a great boon. The new Wharfedale extension speaker incorporates a combined on-off switch and volume-control built into the cabinet, so that the volume can be adjusted to suit the room in which the extension speaker is situated without disturbing the setting of the receiver. The control consists of a small, unobtrusive knob on the side of the cabinet. Full particulars and prices are given in a leaflet, copies of which can be had on application to Wharfedale Wireless Works, 62, Leeds Road, Bradford.

NEW BLUE SPOT CLASS "B" OUTPUT STAGE

AN interesting leaflet just to hand from the Blue Spot people gives full particulars of a new unit which should appeal to all home constructors, particularly users of Blue Spot moving-coil speakers. The design of the unit has been carefully considered, so that an existing speaker can be fixed in a few seconds, the whole bolting together and forming a complete and rigid unit. Tone control is fitted, providing means for completely matching the speaker to the set, and also to minimize high-frequency disturbances and background noises. Provision is made for grid bias for the Class "B" valve, where required. The complete unit is of high-class manufacture throughout, and will enable a set to be converted to Class "B" output in a few seconds. The price of the unit, without valve, is 29s. 6d., or with an Osram B21 valve, 43s. 6d. Copies of the leaflet can be obtained from The Blue Spot Company, Ltd., Blue Spot House, 94-96, Rosoman Street, Rosebery Avenue, London, E.C.1.

WARD AND GOLDSTONE

READERS may be interested to know that Ward and Goldstone, Ltd., of Frederick Road (Pendleton), Salford, Lancs., have received contracts from the British and Dominion Governments for their air-spaced metal-screened down lead. In addition to the use of these leads for the suppression of man-made statics, they are also being successfully fitted for short-wave transmitting and receiving apparatus.

THE ADEY SELF-COUPLING VALVE

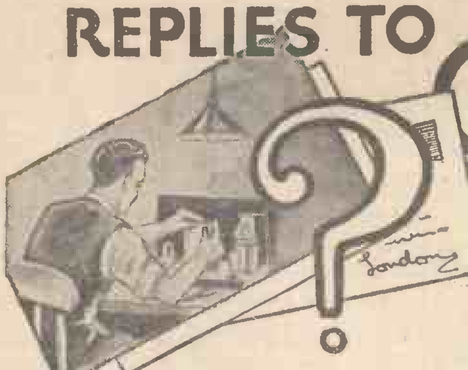
WITH reference to our note on page 330 of October 28th issue, this valve is now supplied as a separate component at a cost of 6s. 6d., and interested readers should get into touch with Messrs. Adey Portable Radio, 99, Mortimer Street, Regent Street, London, W.1.

Replies to Broadcast Queries.

RADIOHM (Nottingham): G6GU, E. Gauwrodger, 4, Montrose Villas, Chewton Road, Keynsham, Bristol, Glos.; G5HB, H. Biltcliffe, "Wheat Sheaf," Kirkgate, Wakefield, Yorks; G5SK, W. H. Maycock, 33, Camden Street, Stoke, Coventry, Warwickshire; G2JS, Radio Investigation Committee, Desford Colliery, Desford, Leicester; ON4LU (P ?) Douffet, 11, rue des Jardins, Verviers (Belgium); ON4NA (D ?) R. Vaerewijck, 9, avenue Troyentenhof, Berchem, Antwerp (Belgium); PAOIDW, D. H. Wijkman, Kanaalstraat 13, 11, Amsterdam (Holland); F8AJ, Claudet, rue George Sand, Vierzon, Cher (France). F. GEE (E.C.1): (1) PAOIM, M. B. Gorter, Pieter de Hooghstraat 30, Amsterdam (Z), Holland; G6SR, S. W. Rowden, "Rosebank," Pilrig Street, Edinburgh, Scotland; (2) EAQ, Madrid (Spain) on 30 m.; (3) 2nd harmonic of Moscow, RNE, on 50 m. BRS 958 (Exmouth): Harmonic (62nd) of FYL, Croix d'Hins (near Bordeaux), France, on 19,150 kc/s. (15.66 m.) E. BIDDLESTONE (Birmingham); SEARCHER (Southall): This was G2BN, Marconi Company, Ltd., Chelmsford, Essex. S. BARBER (Eastbourne): W2XP (U ?), R.C.A. Comm., Inc., Riverhead, New York, U.S.A. DENNE, *Graf Zeppelin* (35.129 m.); PPQ, Sepetiba (Brazil), 25.706 m. RECEIVER (Stockton-on-Tees): G2HS, G. W. Hale, 1, Bijou Villas, Grand Drive, Raynes Park, London, S.W.20; G2RC, A. C. Reid, 171, Reads Avenue, Blackpool (Lancs.); G5XT, F. Robinson, 4, Cranford Gardens, Acklam, Middlesbrough (Yorks); G6CK, T. S. Garrard, 50, Lambeth Road, Linthorpe, Middlesbrough (Yorks). MAC (N.10): We can trace the following call signs: G2YI, R. C. Horsnell, "St. Neots," Wick Drive, Wickford (Essex); G2KB, H. K. Bourne, 62, Shenstone Avenue, Hillmorton Paddox, Rugby (Warwickshire); G5RV, R. L. Varney, 19, Springfield Park Avenue, Chelmsford (Essex); G5MM, R. F. J. Maidment, "Red House," Hoo (Kent); G5AW, A. E. Wood, 247, Leigham Court Road, Streatham, S.W.16; G5GU, J. O. J. Hudson, 107, Chedington Road, Upper Edmonton, N.18; G6CD, F. W. Foster, 562, Woodborough Road, Mapperley, Nottingham; G6NS, N. T. Shuttlewood, 40, The Avenue, Gravesend (Kent); G6AC, A. N. Le Cheminant, Training Squadron, School of Army Co-operation, R.A.F. Old Sarum, Salisbury (Wilts); G6BA, J. R. Baker, 133, Trafalgar Street, Gillingham (Kent); H6GH, D. S. Heightman, 59, Burrs Road, Clacton-on-Sea, Essex; G6FA, G. E. Wardle, "Kingsdown," College Road North, Blundellsands, Liverpool; ON4NC, C. J. Nolf, Château de Rameignies, par Thumaide (Hainaut), Belgium; ON4BL (A ?), H. de Thier, 115, Avenue du Chêne, Heusy-Verviers (Belgium); ON4LV, L. Vervareke, 17, avenue de la Reine, Knocke (Belgium); ON4RC, A. Rombauts, 30, Place de Jamblinnes de Meux, Brussels (Belgium); ON4RP, Josz. Lerno, Groote Markt 6, Lokeren (Belgium); PAOIDW, D. H. Wijkman, Kanaalstraat 13, 11, Amsterdam (Holland); PAOBL, O. A. J. van Lin, Herungerweg 120, Venlo (Holland); PAOPDA, D. Dekker, Eiklaan 71, Rijswijk (Z-H), (Holland); PAOAV, G. C. Das, Anjelierstraat 13, The Hague (Holland); F8VA, Lehmann, 5, Ave. de Vaucresson, Vaucresson (Seine-et-Oise), France; F3BE, Grolleau, rue Jean-Mace, Parthenay (Deux-Sevres), France; G6UK, T. W. Gentleman, 36, Ashcroft Drive, Cathcart, Glasgow; G6UY, L. H. Gordon, 82, Lenton Blvd., Nottingham; G6RH, R. Holmes, 26, Crane Avenue, Worple Estate, Isleworth (Middlesex); G5GG, Capt. L. G. Young, Petit Cottage, Havant, Hants; G2WG, W. C. Goult, Holly Mount, Rayleigh (Essex); ELJAIESSE (Bristol): We can trace only the following call signs and advise you to write to the Radio Society of Great Britain, 53, Victoria Street, London, S.W.1, for further information. G5FV, W. A. Clark, 19, Grove Road, Surbiton (Surrey); G6RB, R. A. Bartlett, 9, King's Drive, Bishop Road, Bishopston, Bristol (Glos); G6UJ, A. Watson, 52, Middle Street, South Driffield (Yorks). E. A. A. HARDWICK (Somerset): Thank you for information; we very much regret we are unable to trace many of the call signs you give and advise you to write to the Radio Society of Great Britain, 53, Victoria Street, London, S.W.1. G6UI, W. T. Bassage, "East Lynn," Joynson Street, King's Hill, Wednesbury (Staffs); G6UK, T. W. Gentleman, 36, Ashcroft Drive, Cathcart, Glasgow; G6OS, J. W. Gill, 37, Parkfield Drive, Hull (Yorks). J. H. FITZGIBBONS (Islington): Apparently new Belgium amateur transmitter; cannot trace in list. Write to: Reseau Belge, 33, Rue Alphonse-Renard, Brussels (X1), Belgium. G6RL, R. F. Loomes, 14, Nursery Close, Wickham Road, Shirley, Croydon (Surrey). TWISTER (Newburgh): We can trace the following calls: G2GW, G. S. White, "Moonrakers," Hardenhuish, Chippenham (Wilts), G2MI, Arthur O. Milne, "Southcot," Larkfield, Maidstone (Kent); G2BJ, B. Jackson, Bryn Alan, Colwyn Bay; G5CA, N. L. Yates-Fish, 19, Mansfield Road, Reading (Bucks); G5CI, A. Hargreaves, 1, Ridge Street, Barnoldswick, Colne (Lancs); G6RD, J. E. Hooper, 26, Hale Street, Poplar, London, E.14; G6RW, E. T. Salmon, 15, Delamain Road, West Derby, Liverpool.

LET OUR TECHNICAL STAFF SOLVE YOUR PROBLEMS

REPLIES TO QUERIES and ENQUIRIES by Our Technical Staff



The coupon on this page must be attached to every query.

If a postal reply is desired, a stamped addressed envelope must be enclosed. Every query and drawing which is sent must bear the name and address of the sender. Send your queries to the Editor, PRACTICAL WIRELESS, Geo. Newnes, Ltd., 8-11, Southampton St., Strand, London, W.C.2.

SPECIAL NOTE.

We wish to draw the reader's attention to the fact that the Queries Service is intended only for the solution of problems or difficulties arising from the construction of receivers described in our pages, from articles appearing in our pages, or on general wireless matters. We regret that we cannot, for obvious reasons—

(1) Supply circuit diagrams of complete multi-valve receivers.

(2) Suggest alterations or modifications of receivers described in our contemporaries.

(3) Suggest alterations or modifications to commercial receivers.

(4) Answer queries over the telephone.

Please note also, that all sketches and drawings which are sent to us should bear the name and address of the sender.

H.F. OSCILLATION

"I have built a receiver, not to any of your designs, but from details which I have taken from various sources, and am rather puzzled by the mo ement of the milliammeter needle which I have used to ascertain that each valve is correctly adjuste!. I find, for instance, that when I put the meter in the anode circuit of the H.F. valve the needle moves over a few degrees when I pass a station, although it does not seem to affect the signal strength. I cannot get very good results from the set, and although all other adjustments see n correct, this is the only point where I find any poss bility of error. Can you explain the needle movements?"—T. G. (Balham.)

Without more complete details it is rather difficult to state exactly what is wrong. You do not, for instance, state whether A.V.C. is employed, nor whether the H.F. valve is of the variable-mu type or a simple triode. Certain circuit arrangements could produce a needle deflection when tuned to resonance, but as you state that results are not good we would think that most probably the H.F. stage is unstable, and the needle movement denotes oscillation. Check up the voltages, and pay particular attention to the wiring to prevent any interaction at that point. We presume, of course, that the coils and variable condensers are effectively screened.

HISSING NOISES

"I have bought a well-known make of set, and am rather upset by a fault which it appears to possess. I have reported it to the makers, but they say that that is a natural function of the set, and does not denote any form of fault whatsoever, but I should like you to confirm this and to explain why it happens. This is the fault: When I tune to London quality is quite good and power ample for normal purpose. When I turn to either side of London to reduce the volume there is a sort of hissing noise, something like fat burning. I find this happens at quite a lot of points over the tuning dial, and it is an objectional sound to me. Is it a fault?"—A. L. P. (Southend, Essex.)

There are two forms of hissing which may be heard in a modern receiver. One is due to side-band cutting due to sharply-tuned circuits, and another is due to actual heterodyning of two stations working on closely adjacent wavelengths. As you hear the trouble on the London Regional, we think the latter is the cause, as there are often signs that one of the foreign stations working near London's wavelength wanders slightly and produces this side-band splash. On the other hand, it is possible that you are hearing some local ship work which is giving a similar heterodyne effect, and you could verify this by turning up the reaction control and endeavouring to resolve the signal into a morse call of some sort. However, why de-tune to reduce signal strength? Is there not a volume control fitted to the receiver for this purpose? You should tune to resonance and use the control to reduce the strength, and never de-tune, as you will spoil quality by so doing.

INCORRECT TYPE OF FUSE

"I have made up the Fury Four, and have had a lot of trouble with the fuse bulb in the set. Practically e ery time I switch the set on the fuse blows, and I have already bought seven of these. The set works beautifully on all stations, and I have no fault to find with it, except the expense which it is costing me for fuse bulbs. Can you help me to cure this little trouble so that I may have a receiver of which I am justly proud?"—T. C. W. (Swansea.)

It is quite obvious that you are using a fuse with too low a rating. Obviously, from your results, the set is wired correctly, and you could, therefore, fit a much heavier fuse provided it offers sufficient protection to the filaments in the event of a wire becoming loose and producing a short-circuit. When next you buy a fuse obtain one with a much higher rating in order to allow for the preliminary surge which you obtain on your set.

DATA SHEET No. 60

Cut this out each week and paste it in a notebook

TUNED CIRCUIT DATA

This table is arranged on the same lines as the two last sheets, and gives details for the long-wave band.

Wavelength	Frequency	Inductance	Capacity
1,000 metres	300 kc/s	2,000 μH	140 $\mu\mu$F
1,250 ,,	240 ,,	2,010 ,,	206 ,,
1.500 ,,	200 ,,	2,050 ,,	252 ,,
1,750 ,,	171.4 ,,	3,000 ,,	290 ,,
2,000 ,,	150 ,,	3,040 ,,	330 ,,
2,250 ,,	133.8 ,,	4,000 ,,	360 ,,
2,500 ,,	120 ,,	4,020 ,,	420 ,,
3,000 ,,	100 ,,	5,000 ,,	500 ,,
3,250 ,,	92.3 ,,	5,050 ,,	550 ,,
3,500 ,,	85.6 ,,	6,000 ,,	580 ,,
4,000 ,,	75 ,,	7,000 ,,	650 ,,

The table is used in the same manner as the two previous tables, and gives the total inductance and capacity to tune to the wavelengths given. The total capacity of a variable condenser to cover a definite range may easily be selected from these tables.

RECEIVER FOR THE TROPICS

"I am shortly going to the tropics, as a steward on a boat. I am greatly struck with your superhet and should like to know whether this is suitable for tropical use, together with the modifications which would have to be made to the components for use in the higher temperatures which I shall experience."—T. H. S. (c/o G.P.O.)

We regret that we cannot advise any alteration from the specified components of the receivers which we describe. With regard to the use of a receiver in the tropics, we presume that you fully appreciate the difficulties of keeping ordinary simple wooden structures in shape in such high temperature, and we can only advise you, therefore, if you build up one of these receivers, to purchase a special teak or metal cabinet in order that sufficient protection may be given to the apparatus. Alternatively, we would recommend, especially as you will find best reception on the shorter wavelengths, that you communicate with one of the well-known firms who specialize in receivers for use in the tropics. There are one or two good super-heterodyne receivers obtainable which have been designed for use abroad.

H. F. CIRCUIT ARRANGEMENT

"I enclose a diagram of the H.F. side of my receiver which I cannot stabilize. The coils are home-made and the details are given on the sketch, together with details of the rest of the circuit values, etc. Can you offer any suggestion? On the back I have shown the exact layout with the actual distances between valves, etc."—Y. A. W. L. (Blackheath.)

The coil arrangements are very efficient, and it is no doubt this high efficiency which is causing your trouble. You will undoubtedly get better results if you tap the coils about one-third of the way down from the high potential end, and you could then experiment with various connections to this point. For instance, you could connect the tuning condenser across the entire coil, with the grid connection for the detector valve taken from the H.P. end. The lead from the H.F. anode could be taken to the tapping point. Alternatively, you could connect the anode to the H.P. end and take the grid connection from the tap. Yet another arrangement would be to take both anode and grid leads from the tap. The layout should not give rise to any trouble, and the values of resistances, etc., appear quite in order. We think the tapping of the coil will produce the desired stability.

ANTI-BREAK-THROUGH CHOKE

"I suffer with the following difficulty on my set. When I switch over to long waves, from 0 up to about 40 to 50 degrees, I can hear the North Regional quite loudly. I find it almost impossible to listen to the lower long-wave stations, and I have had the coils tested by the makers and passed O.K. Is there any way I can prevent this trouble? The aerial is about 50ft. long, and I am on high ground. The earth is one of the mineral proprietary type."—A. T. (Dewsbury.)

One method of curing the trouble would be to vary the direction of your aerial. This may be directional so far as the North Regional is concerned, and therefore is aggravating the trouble known as "break-through." If you connect what is known as an anti-break-through choke in series with the aerial lead you will find that you will have no further trouble. Such chokes may be obtained from advertisers in PRACTICAL WIRELESS, or you could experiment by making up the one described on the Radio Wrinkles page last week.

FREE ADVICE BUREAU
COUPON
This coupon is available until Nov. 18th, 1933, and must be attached to all letters containing queries.
PRACTICAL WIRELESS, 11/11/33.

PRACTICAL WIRELESS
Miscellaneous Advertisements

Advertisements are accepted for these columns at the rate of 3d. per word. Minimum charge 3/-. All advertisements must be prepaid.

PREMIER SUPPLY STORES Offer the following Set Manufacturers' Surplus New Goods at a fraction of the Original Cost, all goods guaranteed perfect, carriage paid over 5/-, under 5/- postage 6d. extra (Ireland, carriage forward).

ELIMINATOR Kits, including transformer, choke, Westinghouse metal rectifier, T.C.C. condensers resistances and diagram, 120v. 20 m.a., 20/-; trickle charger 8/- extra; 150v. 30 milliamps, with 4v. 2-4 amps. C.T., L.T. 25/-; trickle charger, 6/6 extra; 250v. 60 milliamps. with 4v. 3-5 amps. C.T., L.T., 30/-; 200v. 100 milliamps. with 4v. 3-5 amps. C.T., L.T., 40/6; 300v. 60 milliamps with 4v. 3-5 amps. C.T., L.T., 37/6.

T.C.C. Condensers, 750v. working, 2 mf. 3/6, 4 mf. 6/-, 4 mf. 450v. working 4/-, 250v. working 1 mf. 1/-, 2 mf. 1/9, 4 mf. 2/6; aqueous electrolytic 440v. working, 4 mf. 3/-, 8 mf. 3/6.

ALL the Following Lines 6d. each or 5/- per dozen: 4- and 5-pin chassis mounting valve holders; shielded screen grid or pentode leads 1-watt wire end resistances, any value; 0.1 condensers; on-off switches push-pull; 0.02 condensers, 0.5 condensers.

AMSCO Triple-gang 0.0005 Condensers, with trimmers, 4/11.

T.C.C. Electrolytic Condensers, 100 volts working 15 mfd.; 1/3.

PREMIER Chokes, 40 m.a., 25 hys., 4/-; 65 m.a., 30 hys., 6/-; 150 m.a., 30 hys., 10/6.

PYE Chokes 20 or 32 hys., 4/-; Premier multi-ratio output transformers, giving 15 different ratios, 7/6.

HARLEY Pick-up, complete with arm and volume control; 12/6.

BRITISH RADIOPHONE Wire Wound Potentiometers, with mains switch incorporated, 5,000 ohms, 10,000 ohms, 50,000 ohms, 100,000 ohms, 250,000 ohms, any value; 3/6.

KOLSTER BRANDES Gramophone Motors, dual type, can be worked by clockwork or mains, induction type 100-250 volts, 27/6; complete with all fittings and turntable.

SPECIAL Offer.—Microphones by prominent manufacturer, high sensitivity, uniform response, complete with stand, transformer and battery; listed £3/15, our price 18/6.

PREMIER British Made Meters, moving iron, flush mounting, accurate; 0-15, 0-50, 0-100, 0-250 milliamps., 1-1, 0-5 amps., all at 6/-.

ORMOND Condensers, 2-gang, semi shielded; 2/6.

SPECIAL Offer of Mains Transformers, manufactured by Philips, input 100-115v. or 200-250v., output 180-0-180 volts, 40 m.a., 4v. 1a., and 4v. 3a., 4/6; 200-0-200v., 4v. 1a., 4v. 3a., 4/6.

ALL Premier Guaranteed Mains Transformers have engraved terminal strips with terminal connections, input 20-250 volts, 40-100 cycles, all windings paper interleaved.

PREMIER H.T.8 Transformers, 250v. 60 m.a., rectified, with 4v. 3-5a. C.T., L.T., and screened primary, 15/-; with Westinghouse rectifier, 25/-.

PREMIER H.T.9 Transformer, 300v. 60 m.a., rectified, with 4v. 3-5a. C.T., L.T., and screened primary, 15/-; with Westinghouse rectifier, 26/-.

PREMIER H.T.10 Transformer, 200v. 100 m.a., rectified, with 4v. 3-5a. C.T., L.T., and screened primary, 15/-; with Westinghouse rectifier, 26/-.

CENTRALAB POTENTIOMETERS, 200 ohms and 400 ohms 1/- 250,000 ohms, 50,000 ohms and 500,000 ohms 2/6.

ROLA F7 MOVING COILS, 10002 FIELD 20/-; MAGNAVOX 142. 1000 2 FIELD 22/-. PLEASE STATE WHETHER POWER OR PENTODE TRANSFORMER REQUIRED. A.C. CONVERSION KIT.

FOLLOWING VALVES USED FOR TEST ONLY. CALLERS ONLY. MS4B, MS4, DSB, DS, PTA. S4VB.

MAGNAVOX, D.C.144, 2,500 ohms field, with hum-bucking coil, Pentode transformer, 17/6; complete with A.C. conversion kit, 27/6.

DOUBLE Spring Motors, made by Garrard, play five sides of 10in. record, complete with turntable and all fittings; 17/6.

McMICHAEL 2-screen Grid Pentode Transportable 4, complete; gets many stations, £6/15.

SPECIAL Offer.—Accumulator chargers, input 200-250v. A.C., to charge 2- and 4-volt accumulators at ½ amp.; owing to the high efficiency of the silver oxide rectifier employed charger may be used during broadcast; 9/6 each.

RELIABLE Canned Coils with circuit; 3/-, accurately matched; dual range.

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CONSTRUCTORS' Kits.—Ready Radio "303" battery 3-valve kits, less valves, 18/- each; complete with 3 Mullard valves (P.M.1L.F., P.M.2, 2D.X.), 33/- each (list 70/-); Ready Radio Meteor screen grid 3-valve kit, less valves, 26/-; with 3 Mullard valves (P.M.12a, P.M.2D.X., P.M.2a), 49/- (list £5/7/6); Universal Radio 3-valve kits, ready assembled on chassis, 12/6 (listed 45/-).

READY Radio "303" A Kits, complete with cabinet, M.C. speaker, less valves, £2/5; with 3 Mullard valves (P.M.1L.F., P.M.2D.X., P.M.2). £3/5 (list £6/17/6).

READY Radio Meteor "A" 3-valve Screen Grid Kit complete with cabinet, M.C. speaker, less valves, £3/7/6; with 3 Mullard valves (P.M.12A., P.M.2D.X., P.M.2.A.), £4/10 (list £8/7/6).

READY RADIO ST.400 Kits, as specified by Scott Taggart, £2/19/6 each (list £4/17/6); Mullard Radio for Million 3-valve A.C. kit, complete with 3 Mullard A.C. valves (Pen.4V, 354V, S4V), £3/10 (list £6/10); Mullard Radio for Million 3-valve battery kits, complete with 3 Mullard valves, £3/3 (list £6/2/6), all kit brand new in original sealed cartons.

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"Popular Mechanics" **No. 3**

AMAZING SUCCESS OF THE ORBIT!

Practical Wireless

3D.

Published every Wednesday by
GEORGE NEWNES LTD.
Vol. 3.—No. 61.
NOVEMBER 18th, 1933.
Registered at the G.P.O. as a Newspaper.

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ROUND *the* WORLD *of* WIRELESS

Binding Case and Index for Volume Two

BINDING cases and indexes for Volume II of PRACTICAL WIRELESS, which encompasses the issues dated March 25th, 1933, to September 16th, 1933 (Nos. 27–52), are now ready, and we urge readers anxious to preserve their issues in a readily consultable form to take advantage of the generous binding offer given on page 445 of our last week's issue. As there explained, all you have to do is to send your twenty-six copies, clearly marked with your name and address, to A. W. Bain and Co., Ltd., 17–19, Bishop's Road, Cambridge Heath, London, E.2, together with a postal order or cheque for 5s. 6d. This includes return carriage. Your issues will then come back to you correctly bound in blue cloth on strong boards, neatly lettered in silver. *Readers should note that this is not an untidy loose binder*, but a correctly bound volume with the issues neatly trimmed. It is the cheapest way of making your own wireless encyclopædia.

Radio Lisbon

PORTUGUESE "fans" are bitterly complaining over the delay in opening the new Lisbon broadcasting station, for which the transmitter was duly delivered some months ago. Apparently the postponement is due to the fact that the construction of the buildings to house the plant was in the hands of the Ministry of National Monuments, which it appears has not been working in close collaboration with the Administration of Posts and Telegraphs responsible for the organization of broadcasting in that country. The broadcasting law decreed the bringing into operation of Portugal's key station within six months of the passing of the Act, but, according to a report from Lisbon, no date can now be fixed for the long-awaited official ceremony.

Development of German Television Transmissions

STEPS are being taken by the *Reichs Rundfunk* (Berlin) to make television transmissions a daily feature of the broadcasting programmes, and experiments are being carried out in the manufacture of receivers at a cost which will allow of their almost general use by the listening public. So far it is expected that the first regular service will be made within the next two or three months, when the German radio industry has had time to get together a series of moderately priced instruments. In the meantime the authorities will carry out transmissions of "talkie" films on ultra-short wavelengths, and later the broadcast of open-air performances. A second short-wave transmitter is under construction to permit broadcasts of both vision and sound on channels in the seven-metre band.

Pity the Poor Announcer!

AT Radio Tananarive (Madagascar) the greater part of the programme is supplied by local talent, and many entertainments are provided by native Hovas and Malagasy. Where, in such instances, names are broadcast, the announcer must have a hard time. Madam *Ambatotsiribilanzana* may prove to be a good soprano and Monsieur *Fianarantvohibemeranandravatomoudri* may shine as a violinist, but they do not lighten the task of the announcer!

Radio in the Polar Regions

AS in previous years, the Schenectady (New York) short-wave stations will again broadcast special programmes destined to dwellers in the Arctic Circle. In addition, during the coming winter, the studios will endeavour to get into touch with Rear Admiral Byrd's Antarctic Expedition so soon as it passes the Panama Canal on its way to the South Pole. Special transmissions will be made every Saturday night at 11 p.m. Eastern Standard Time (4 a.m. G.M.T.) on a wavelength of 31.48 metres with a power of 20 kilowatts. Later, in January, 1934, an attempt will be made to broadcast through the entire Columbia network a description of his aeroplane flight over the South Pole; this will be relayed from his ship the s.s. *Jacob Ruppert*, which is equipped with a powerful transmitting plant. Short-wave experimenters who may wish to pick up signals direct from Byrd's ship should listen for the call sign KJJY, the frequencies to be used are 6,650, 6,660, 6,670, 8,820, 8,840, 13,185, 13,200, 13,230, 13,245, 13,260, 17,600, 17,620, 21,515, 21,600, and 21,625 kc/s.

Interference with Broadcasts

THE Post Office Authorities have instituted a new campaign for the elimination of electrical interference with the reception of the broadcast programmes. All post offices throughout the country have been equipped with forms which enable listeners to detail their complaints. On receipt, by the local engineers of the P.O. Engineering Department, the causes of the trouble are investigated and remedies suggested. Already some ten thousand cases a year have been dealt with, and in most instances devices have been found for mitigating the interference.

The Droitwich Long-Wave Station

ALTHOUGH, originally, the new "Daventry" station to be installed at Droitwich was planned to radiate 100 kilowatts, it has now been decided to use at least 150 kilowatts in the aerial, and the transmitter will be so constructed that, if necessary, an output of 200 kilowatts can be attained. Such a power would put us on a par with some of the newer super stations in Europe.

ROUND *the* WORLD *of* WIRELESS *(Continued)*

INTERESTING and TOPICAL PARAGRAPHS

Berlin Jams Moscow

ON various occasions broadcasts from the Moscow-Noghinsk high-power station have been jammed by morse transmissions. It is stated that this interference, far from being accidental, has been caused by a special transmitter erected at Zeesen, near Berlin. German papers announce that in future steps will be taken regularly to prevent the reception of anti-German propaganda emanating from U.S.S.R. studios.

Belgium's Two Stations

THE authorities have decided to increase the power of the two transmitters at Velthem (near Louvain) which assure the broadcast of the Brussels programmes. In 1934 the stations will be reconstructed to obtain a radiation of some 100 kilowatts and, if necessary, a third transmitter (30 kilowatts) will be erected in the southern part of the country. This decision has been taken in view of the fact that when the Lucerne Plan comes into operation the Belgian wavelengths of respectively 483.9 and 321.8 metres will be surrounded by channels on which neighbouring countries are using super-power transmitters.

The Advantage of Single-aerial Towers

ON a recent foggy night one of the aeroplanes working the London-Berlin night mail service crashed into the aerial of the Witzleben station. The latter is supported at one end by the famous tower which has become one of the principal attractions of the German capital. Radio newspapers commenting on the subject take this incident as definite proof of the advantage derived by the use of single vertical aerial pylons with warning lights at their summit.

Catalonia versus Spain

THE reorganization of the Spanish broadcasting system is being complicated by the fact that Madrid and Barcelona cannot agree regarding either the power of stations to be installed or the wavelengths to be allocated. Barcelona claims the right to a 60-kilowatt broadcaster, and protests against a Governmental decision to install a 120-kilowatt transmitter in the Madrid region. Moreover, the Lucerne Plan allocating to a station situated at Barcelona the 274-metre channel, it is contended that if the Spanish authorities take it for one of the official stations there will only remain for Catalonia an *onde commune*, namely 207.3 metres, which is not only unfavourable for the broadcasts in the northern part of the country, but carries with it a stringent limitation in respect to power. More breakers ahead!

Radio Thessaloniki

THE small experimental station at Salonica (Greece), which had been closed down for several months, has now resumed its transmissions on 268.9 m. (1,115 kilocycles). The call is: *Empros etho Thessaloniki* (Hallo! Here is Salonica). It is a private concern, and programmes are not broadcast daily. Efforts are being made to secure financial assistance in order to erect a more powerful station in that city pending the organization of a regular State broadcasting system.

THE NEW H.M.V. SUPERHET PORTABLE GRAND

This receiver, which is provided with automatic volume control, is pictured here with the back open, showing the neat lay-out of the chassis and batteries, and frame aerial.

Interesting B.B.C. Innovation

THE second news bulletin broadcast on Saturday evenings now comes to us in the form of an "illustrated" news reel with direct relays or records of topical events which have taken place during the week. An appropriate background of noises in every instance creates a true atmosphere for the subject being dealt with. On November 18th we are promised the start of a new feature entitled *In Town To-night*. Its aim is to give listeners up-to-the minute items of what is happening in London. Interviews with notable personages who have just arrived in town, or a short address by them, excerpts of stage performances, new songs and "surprises" outside the published programmes will be included in future in these transmissions.

New Stations for Poland

TWO more transmitters are to be added to the Polish broadcasting network, thus bringing the number of stations in that country up to nine. Poznan is to be endowed with a 20-kilowatt transmitter, and the plant at present in use will be dismantled and re-erected at Torun (Thorn), at no great distance from Danzic. At Pinsk, in the eastern part of the country, on the Russian border, a new station will be erected to act as a relay of the Warsaw programmes. It will work on 219.6 metres in 1934, thus sharing a wavelength with Cracow.

Triumph for the Micro-wave

AT the Lympne (Kent) aerodrome the Air Ministry has installed a new micro-wave telephony station for communication with the airport at St. Inglevere (France). The wavelength used is only 0.175 metre (17½ *centimetres*), but tests have demonstrated that this channel is perfectly satisfactory for beam transmissions at comparatively short distances. The main advantage reaped from the adoption of micro-waves is found in the simplicity of the apparatus needed for the purpose.

Mühlacker Closes Down

LISTENERS, no doubt, will have noticed the weakness of signals emanating from Mühlacker on 361 metres. This is due to the fact that the high-power station has closed down, and that the broadcasts are carried out by the old Stuttgart 1½ kilowatt transmitter, pending entire reconstruction. Mühlacker as a 100 kilowatter will reopen on December 1st and will then work on the Munich wavelength (532.9 m.).

Reconstruction of Radio Strasbourg

AS alterations are being carried out to the plant of this French station, from time to time during the next few weeks it may be compelled to curtail or even suspend its broadcasts. Although it has been rumoured that a more powerful transmitter may be erected eventually on the present site in order to counteract broadcasts from Mühlacker (Stuttgart), the recent political crisis in France may prevent, at least temporarily, the fulfilment of this plan. In the meantime, however, the plant is being overhauled and so far as possible every measure will be taken to secure greater radiation from the equipment. Radio Strasbourg, it is stated, will become one of the most powerful stations in the French network.

SOLVE THIS!

Problem No. 61.

Rawlinson purchased all the components for a three-valve receiver, including two screened coils of modern make and design. The circuit was wired from Fifty Tested Wireless Circuits, and every component was tested as it was fitted into position. When finished the most peculiar results were obtained. Tuning was most erratic, no stations appearing at anything like the correct position on the dial, and morse interference being experienced on the medium wave-band. In addition, it was found absolutely impossible to obtain adequate station separation, jamming being experienced on every station heard. The circuit was the conventional H.F. (screen grid), detector and pentode. What was wrong? Three Books will be awarded for the first three correct solutions opened. Address your envelopes to The Editor, PRACTICAL WIRELESS, Geo. Newnes, Ltd., 8-11, Southampton Street, Strand, London, W.C.2, and post to reach here not later than Nov. 20th. Mark your envelopes Problem No. 61.

SOLUTION TO PROBLEM No. 60.

Robinson had connected the two coils of his synchronizing apparatus and the neon in parallel instead of series. The device was thus prevented from functioning in the correct manner.

The following three readers accurately solved Problem No. 59, and books have, therefore, been forwarded to them:—

W. Gilchrist, 46, Main Street, Tweedmouth, Berwick-on-Tweed.

H. Stevenson, 10, New Brotton, Brotton, Yorks.

H. Gilkerson, 45, Prince of Wales Crescent, Kentish Town, N.W.5.

Converting Your Set to a 1934 Model

There are Many Readers Who Wish to Add Some of the Latest Components to Their Receivers, and This Article Explains the Best Ways of Doing This. By BERNARD DUNN

IT has been said that fitting new components into an old receiver is like putting old wine into new bottles. The simile may be true if the additions are made without paying due regard to the circuit modifications which they entail, but if the matter is given a reasonable amount of consideration the result is almost bound to be satisfactory. I would say, therefore, that practically any set, if of fairly sound design, can be improved by the addition of some of the latest types of components and accessories.

New Valves

One of the very simplest ways of improving the performance of a receiver which is upwards of two years old is by replacing the valves by new ones. Perhaps the original ones still function in what is considered to be a satisfactory manner, but in nearly every case it will be found that the newest types are considerably more efficient. That does not mean that the mere substitution of another set of valves will necessarily improve reception; in fact, the very reverse might be the case simply because the new ones afford a greater degree of amplification and are thus more likely to make the set unstable. But if slight alterations are made to the circuit, so as to bring it as up-to-date as the valves are, considerably better results are almost certain to accrue.

What circuit alterations are required? Naturally, the answer depends upon the type of set in use. If it is of the Det.-L.F. kind it will probably only be necessary to fit the usual decoupling resistance and condenser in the anode circuit of the detector. The method of doing this is indicated in Fig. 1; the wire joining the H.F. choke to the L.F. transformer is removed and a fixed resistance (a value of 25,000 ohms is nearly always as suitable as any) is fitted in its place, a 2 mfd. condenser being joined between the "transformer" end of the resistance and earth.

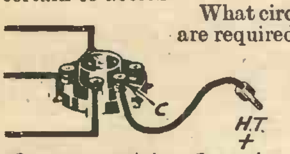

Fig. 2.—To use a pentode in place of a small power valve, it is only necessary to replace the 4-pin holder by a 5-pin one and fit an additional H.T.+ tapping to the fifth terminal (marked C).

In some cases this might not be sufficient, due to the fact that the new L.F. valve has a much higher amplification factor than the previous one, and thus tends to overload the output valve and so to introduce distortion. The obvious remedy would appear to lie in the direction of replacing the L.F. transformer by one of lower ratio, but in many cases it is sufficient merely to reduce its efficiency by connecting a .25 megohm resistance between its secondary terminals.

A Pentode for More Volume

When more volume is required from a receiver having a single L.F. stage consisting of a small power valve, it is an excellent idea to use a pentode instead. To do this the last valve-holder must be changed for one of the five-pin type, and an additional high-tension positive lead taken to the centre socket—this is connected to the terminal marked "C." The new H.T. lead can be fitted with a wander plug, as shown in Fig. 2, so that the optimum screening-grid voltage can be found by trial, or it may be joined directly to the main H.T. positive lead.

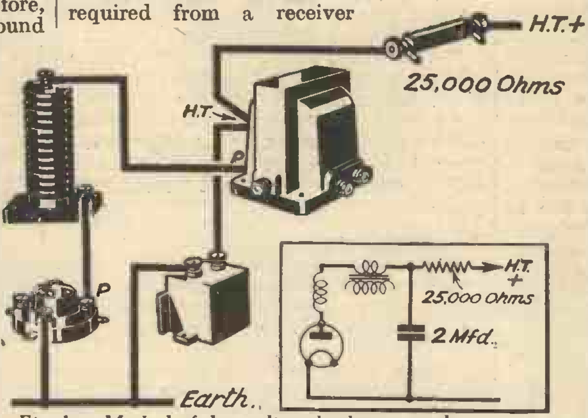

Fig. 1.—Method of decoupling the detector valve to prevent instability when fitting new valves into an old set.

Variable-Mu Modifications

Most users of S.G. receivers are now changing over to the variable-mu type of valve. The method of doing this has been described in PRACTICAL WIRELESS so often that it seems almost superfluous to mention it again, but for the benefit of new readers it is illustrated in Fig. 3. It will be seen that the wire previously joining the earth terminal of the aerial tuning coil (as well as the moving vanes of the variable condenser) to earth is removed and a .1 mfd. fixed condenser put in its place. A lead is then taken from the coil to the centre terminal of a 50,000 ohm potentiometer connected across the existing grid-bias battery. In some cases, where more than one V.M. valve is to be used, or where the set is rather unusually sensitive, it is better to include a 100,000 ohm decoupling resistance in the position indicated by broken lines. There is another point to watch, because if the ordinary two-point battery switch is employed the grid-bias battery will quickly run down, due to the potentiometer being constantly in parallel with it. That difficulty is easily overcome by using a three-point switch connected as shown in Fig. 3.

The H.F. Pentode

Hundreds of mains-set users have written

(Continued overleaf)

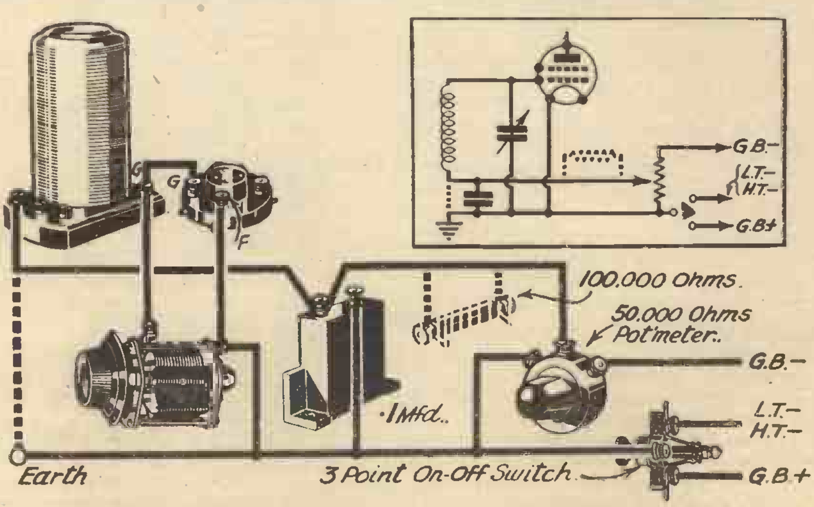

Fig. 3.—The connections required when changing over from an S.G. to a V.-M. valve. Note that a 3-point on-off switch is required.

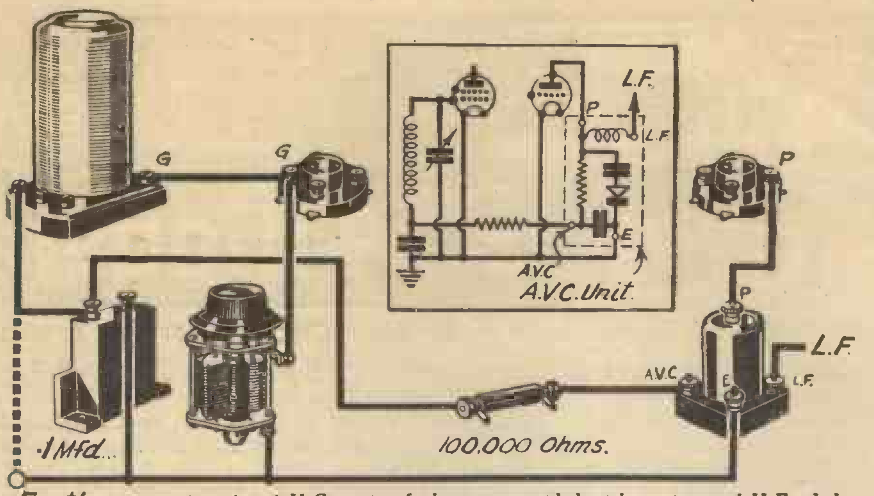

Fig. 5.—An A.V.C. unit of the type provided with an integral H.F. choke is connected as shown above. The illustration does not refer to any particular make of unit.

(*Continued from previous page*)

to us asking if it is possible to substitute one of the new H.F. pentodes for the S.G. valve at present in use. In nearly every case this can be done with entire satisfaction and results thereby improved. At the same time, it is well to point out that the maximum efficiency will not be obtained from the pentode unless the impedance in its anode circuit is very high. In other words, the H.F. choke used for coupling the valve to the following coil must be a really good one; if you are in any doubt in regard to this it will pay to buy a new choke of the high-inductance type. Sometimes the H.F. pentode requires different values of feed resistances, so this point should not be overlooked in making the modification. It would be impossible for me to give any suggestions regarding resistance values, since they depend upon the exact type and make of valve used. The makers' instructions should, therefore, be followed implicitly.

Ganging the Condensers

Another query which often crops up is in respect to the substitution of a gang condenser for two separate components, the object being to simplify tuning and reduce the number of knobs. This is a question that the individual can best decide for himself. If the settings of the two condensers are practically the same—say, within 10 degrees or so—for any station, a gang condenser can most certainly be used. To ensure that there shall be no loss in selectivity or sensitivity, however, the new condenser should be of the type provided with an external-trimmer adjustment. Nearly every maker now supplies such a component, having two concentric knobs, one smaller than the other; the larger knob operates the moving vanes of both sections of the condenser and the smaller one either "rocks" one set of "fixed" vanes or drives a separate low-capacity variable condenser connected in parallel with one section.

Iron-Core Coils

The advantages of iron-core tuning coils in providing increased selectivity—and often greater efficiency—are by now well known, and there are many who contemplate improving their receivers by changing over to them. Are there any objections to doing so? No! but the alteration might make the set so efficient that it becomes unstable. The usual cures for instability were dealt with in a recent article and they should be applied in a case such as that just referred to. In nearly every case it will be found sufficient to screen a few of the anode and grid leads, whilst in others slight re-adjustments to H.T. voltages will do the trick. When the iron-core coils are fitted at the same time as the variable-mu valve it will be found that perfect stability can be secured by keeping the potentiometer setting somewhat below its "maximum" position.

Automatic Volume Control

There is no doubt whatever that automatic volume control is now appealing very strongly to every wireless enthusiast, and it is only right that it should, for it is sure to become a standard fitting of all high-class receivers in the future. Complete automatic volume control, by which I mean a system with which the volume from all stations is maintained at a perfectly uniform level, is quite impossible of attainment in a simple receiver. At least two H.F. amplifying stages are essential in order to obtain real A.V.C., but the principal advantage of the scheme—absence of fading when receiving distant stations—can be secured in quite a simple type of receiver having only a single H.F. amplifier.

All that is needed is one of the excellent little so-called A.V.C. units that have lately been placed on the market by at least two reliable firms, a fixed resistance and a condenser. As a matter of fact, if the set is already fitted with a V.M. valve the latter two components are not needed, and so the expense is very slight. These A.V.C. units are of two general types, one of which consists of a "Westector" high-frequency metal rectifier, two fixed condensers, and a resistance, whilst the other is provided with an H.F. choke in addition. Both types of unit have practically the same circuit arrangement and are similarly connected in circuit. The pictorial circuit Fig. 4 shows the connections for an A.V.C. unit of the type not provided with a choke, and which functions in conjunction with the normal H.F. choke wired in the anode circuit of the detector valve. Fig. 5 shows the slightly different wiring which is necessary when using a unit which includes the choke.

In examining the circuits given it will be seen that the arrangement is very similar to that shown in Fig. 1 in respect to the inclusion of a variable-mu valve, and that the A.V.C. unit takes the place of the volume control potentiometer and grid bias battery.

When using one of these units with a single H.F. receiver it is possible to employ an ordinary S.G. valve in the high-frequency stage, but a valve of the short-base variable-mu type is more satisfactory. The reason for recommending a short-base V.M. is that this kind of valve produces a greater change in volume for any given variation in applied bias voltage.

More complete automatic volume control is possible in a receiver having two V.M. stages and the connections for the unit are the same as those shown in Figs. 4 and 5 except that two leads have to be taken from the "A.V.C." terminal, through 100,000-ohm decoupling resistances, to the "bottom" ends of the grid coils of the two H.F. valves.

"1934" Appearances

All the modification suggested above refer to circuit arrangements and do not affect the appearance of the receiver in the least. There may be many readers who possess sets which are perfectly satisfactory in the way of performance, but which *look* rather obsolete due to the style of cabinet and controls which are employed. In such cases much can be done to bring the set into line by modernizing cabinet and controls.

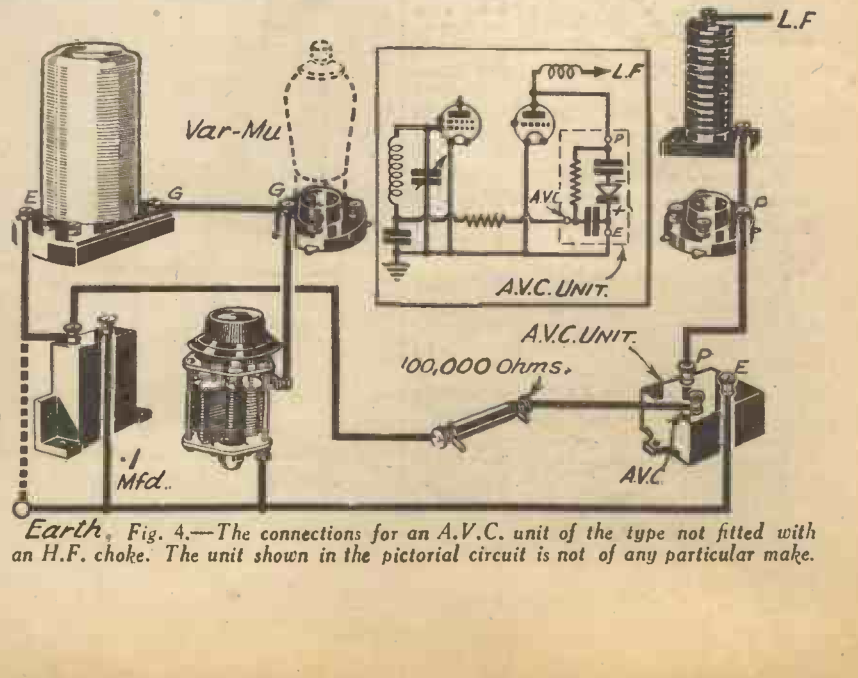

Fig. 4.—The connections for an A.V.C. unit of the type not fitted with an H.F. choke. The unit shown in the pictorial circuit is not of any particular make.

MORE ABOUT MY ORBIT

Many Hundreds of Readers Have Already Built this Revolutionary Receiver. This Article Gives Further Notes on Adjustment and Operation

By F. J. CAMM

Here is the radiogram version of the Orbit, which may be battery- or mains-operated —D.C. or A.C.

American Medium-Wave Reception

FULL constructional details for my latest and best receiver were published in PRACTICAL WIRELESS No. 59, and this issue was on sale on the morning of Wednesday, November 1st. On Thursday morning, November 2nd, I received a post card from a very enthusiastic reader who had immediately bought a kit of parts after reading about the set. He commenced work on the receiver on Wednesday evening, finished at 2.15 a.m., tuned in three stations on the medium-wave band before 3 a.m., the third of which was identified as being an American. I will not repeat here what this reader said in his card, but you will find that on the "Practical Letters From Readers" page.

Mr. Pedlar must have created quite a few records by his feat. First, I should imagine he was the first person outside our own laboratory to make the receiver; secondly, he was the very first to advise me of his excellent results; and thirdly, he is probably one of very few constructors who have received American medium-wave stations during a week when reception conditions over the Atlantic were far from good. My hearty congratulations on an excellent performance, Mr. Pedlar!

If any other of my readers have attempted American reception lately, especially with a receiver having only three valves, I am perfectly sure that they will agree with me that anything like good reception is a feat to be proud of. I would go further than this by saying that reception with any kind of receiver (multi-valve and expensive superheterodynes not excluded) during the last few weeks is sufficient to entitle even the most modest to boast a little.

Congratulations—My Transfer Print

At the time of writing these notes just four days have elapsed since complete details of this revolutionary receiver were first available to the public, and I have already received innumerable letters of congratulation upon producing the very set that the public wants. I have also had scores of letters from readers who have built the receiver and declare it to be the most efficient, selective, and easily-tuned instrument they have ever made. Numerous other letters have come in from readers who are making this their first home-constructed set; in every case they report the ease with which they are being enabled to carry out the work entirely without assistance, thanks to the wonderfully novel and epoch-making Transfer Print Scheme. This is something quite new to wireless construction and is an idea that no amateur can fail to appreciate. The beginner finds that it makes all the difference between his being able or unable to trust himself with the task of making his first receiver; even the most advanced experimenter finds the idea particularly useful, for though he has previously scorned blue-prints, working only to theoretical diagrams, he finds the Transfer Print a wonderful time saver. There is no doubt whatever that the Transfer Print method of receiver construction is the system which must inevitably become standardized in the future.

Claims—And Range

You will remember that I did not make any particular claims for this receiver in the way of long range. I did not say that it would bring in a hundred stations at full loud-speaker strength when using a spring mattress for an aerial and window-sill flower box for an earth. I preferred to say that this was the best set I had ever designed; to regular readers of PRACTICAL WIRELESS, and particularly to those who built my "Fury Four" and other receivers, this meant far more than mere words could say. It is ridiculous in these days to speak of the capabilities of a set in terms of range of reception or the number of stations which it will receive. That some designers make claims along these lines I know perfectly well, but any thinking reader knows as well as I do that the number of stations which can be tuned in on any particular receiver depends so much upon local conditions, aerial, earth, screening, etc., that any figures can be nothing short of misleading. To tell you that this newest set of mine had brought in sixty stations at good loud-speaker strength (as it certainly has, of course) would mean nothing to you. Even if it was added that the stations were received between 7 and 9 p.m. on a thirty-foot aerial 20 feet high situated twelve miles from Brookmans Park it would not be very much help in enabling you to determine just how good the set was. For that reason I prefer to say that, in comparison with any other receiver having less than five valves which I have used and tested under identical conditions, this newest three-valver is by far the best.

The unit responsible for automatic-fading compensation in the Orbit.

Real Selectivity

Not only is it sufficiently sensitive to bring in a terrific number of programmes (by which I mean stations that can comfortably be listened to and enjoyed), but it has a degree of selectivity which is more than ample to permit of easy rejection of the local stations. The use of iron-core coils in the carefully matched and balanced circuit results in a degree of selectivity equal to that of many superheterodynes. In saying this I do not wish to imply that the set is "nearly as good" as a superhet—*I claim that from many points of view it is better.* For instance, it is entirely free from second channel interference, which no one has yet been able entirely to overcome with the superhet; it gives ample selectivity without "cutting" the higher notes and so making artificial compensation a practical essential; it gives maximum efficiency without the need for delicate trimming adjustments or complicated tuning controls; it is cheaper to build and run; and it is simpler and easier to construct.

Real Quality of Reproduction

I rather have a feeling that in previous articles I have not stressed sufficiently strongly the fact that this receiver gives quality of reproduction which is unsurpassed by that of any battery set I know. There are no fancy tone-correction systems, tone-balancing circuits—call them what you will—but instead the whole circuit has been so designed that anything in the nature of camouflage would be superfluous. At the same time I have provided one control which can be used slightly to vary the actual tone of reproduction if desired. I refer to the variable-ratio tappings on the "Microlode" loud-speaker. By rotating the two arms a large number of different output transformer ratios can easily and quickly be provided. In the majority of cases it will

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be found that most pleasing reception is obtained when the levers are on contacts C and H, but by moving first one and then the other a slight and even variation in tone from "bass" to "treble" can be obtained. Some listeners prefer to have reproduction rather high-pitched, whilst others would rather hear the thump of the bass; either kind of reproduction can be chosen to suit the taste of the listener and the room in which the set is installed.

Building the Radio-Gramophone

Those readers who build the set as a radio-gramophone in the "Adaptagram" cabinet will find that the control knobs do not come quite in the centre of the front panel, due to the width of the "Adaptagram" being somewhat less than that of the Peto-Scott console cabinet. In order to retain the symmetry it is therefore advisable slightly to move the tuning condenser and reaction condenser. The ganged tuning condenser is moved 1¼in. to the right and the reaction condenser is moved 1¾in. in the same direction. This slight alteration has been thoroughly tried out and has been proved to have no adverse effect upon results, and therefore you can adopt it without any fear of spoiling anything.

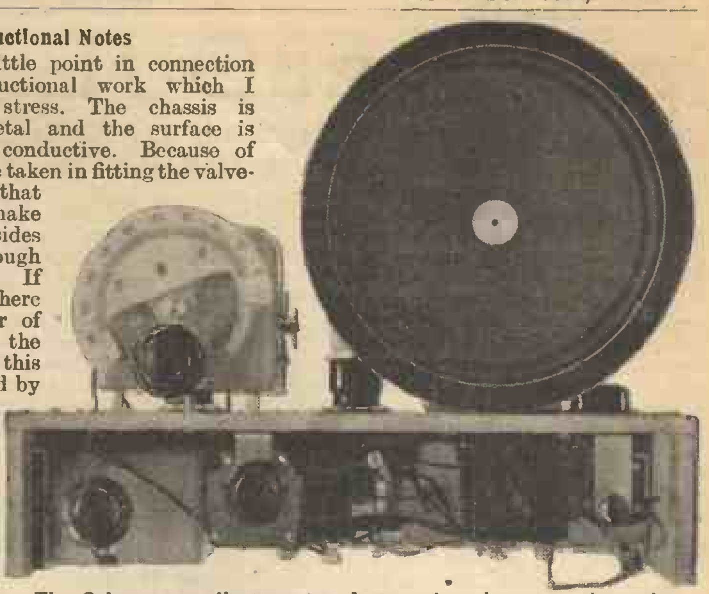
There is another point of interest in connection with the radio-gramophone version of the set. Some listeners prefer to have a rather considerable volume of sound from records, and in consequence they might find that the output from the pentode valve—although ample for most purposes—is not quite so great as they would like. This minor difficulty can easily be overcome, since I have made arrangements with Messrs. Peto-Scott to supply the "Adaptagram" cabinet already fitted with a Class B Adaptor where necessary, at a modest extra charge. The amplifier can be brought into circuit whenever it is specially desired to have an extremely large output or it can quickly be disconnected at other times, so considerably reducing the current consumption to the low figures of 11 milliamps and .5 amp. respectively for high and low tension, which are taken by the standard receiver.

An External Loud-speaker

Some constructors of the console model might wish to fit an additional speaker which can be moved right away from the set itself and perhaps used in another room. This can easily be done by attaching the connecting leads from the second speaker to the terminals on that fitted to the chassis, but it will be found rather more convenient to screw a double terminal block to the chassis of the set and connect the two lengths of flex normally going to the speaker terminals to it. Two leads can then be taken from the block to the built-in speaker and other leads can be taken to external speakers in the same way. A very convenient and suitable terminal block for this purpose is made by Messrs. Lissen. There is, of course, no need whatever to disconnect the second speaker when it is not required to be used away from the set, for it can simply be placed into the cabinet behind the second speaker fret. It will then function in conjunction with the built-in speaker, and by trying various tappings on both speakers it will be possible to use them as a balanced pair, one dealing principally with the higher frequencies and the other with the low. Excellent quality can be obtained in this way and I can strongly recommend any constructor to try the idea.

Additional Constructional Notes

There is one little point in connection with the constructional work which I would like to stress. The chassis is covered with metal and the surface is therefore highly conductive. Because of this care should be taken in fitting the valve-holders to ensure that the legs do not make contact with the sides of the hole through which they pass. If they do touch there will be a danger of short-circuiting the H.T. supply; this would be indicated by a "blown" fuse, and the set would be absolutely "dead." One other point—do not forget to attach the connecting wires to terminals 5, 6, 7 and 8 on the F.3 coil, and to terminal 5 on the F.10 coil before re-fixing the chassis side runner on to the baseboard. These terminals are rather difficult to get at later on, and much trouble and delay can be avoided by using a little forethought in this matter.



The Orbit is a really ingenious design—clean layout, with speaker accommodated on the chassis.

One or two readers have not been quite clear in regard to the connection made from a terminal of the on-off switch to a screw through the chassis marked on the Transfer Print "To Earth." The screw is simply a 4 B.A. bolt about ¾in. long which passes through the baseboard and so makes contact with the upper (metallized) surface. Another similar bolt, for the same purpose, is situated near to the third valve-holder, and the L.T. connection between the two bolts is completed by the metallized surface of the chassis.

MY UNIQUE GUARANTEE

Regular readers of PRACTICAL WIRELESS *are well aware that we specify only the actual parts used in our receivers*—no alternatives! *I want here to reaffirm, for the special benefit of new readers, the object of that policy—a policy carefully laid down and rigorously followed.*

When I planned PRACTICAL WIRELESS (*many months before it actually appeared) I determined to reawaken the flagging interest in home-constructed receivers by doing my utmost to ensure that every receiver made by readers from instructions appearing in our pages should give results equal to those obtained from the original receiver. I came to the obvious conclusion that this desirable end could only be obtained if readers used exactly the same parts as were employed in the original design; for the variation in results when alternatives are used is practically illimitable. I felt that some standard of performance could only be achieved by adopting a standard in materials used, so that any failure to achieve our claimed results must be directly attributable to one of three things—local conditions, a fault in the wiring, or a faulty component. Hence our specification of only those parts actually used by me and my personal guarantee of free advice until the receiver functions in the manner claimed. You can make a* PRACTICAL WIRELESS *Receiver with the same confidence as you would purchase a commercial receiver.*

Easy Tuning

In previous articles I have dealt rather fully with the method of tuning the set, and as this is really so simple there is not much need to enlarge upon my previous statements. I would just add, however, that although tuning can be carried out entirely by means of the larger condenser knob, a certain increase in signal strength can in some instances be obtained by making a final tuning adjustment on the smaller concentric trimmer knob. By this means both tuning circuits can be matched with perfect accuracy at any part of either wavelength range so that the same efficiency is obtained with a single tuning control as with the more usual double one which many designers have found it necessary to use in order to obtain satisfactory results.

Guaranteed Efficiency

I would conclude by reminding you once again that this set is covered by my PERSONAL GUARANTEE. That means that if you encounter any difficulty—however great or small—in building it, my FREE ADVICE is at your disposal. This is a unique service which PRACTICAL WIRELESS alone of all wireless journals offers to its readers. It is a service that has been widely used, highly praised, and keenly appreciated by readers. Its purpose is to help YOU. The only stipulation I make is that you rigidly adhere to my list of specified components. In doing this you will be considerably helping yourself to avoid trouble, *for no receiver can work equally well when any odd collection of components is used.* After all there is a considerable amount of team work in a wireless set and whilst some components may work extremely well in a particular circuit arrangement they may not do so in another. *My solus specification does not impugn unspecified makes*, but it does ensure a reasonable standard of performance and also a uniformity of result. Furthermore, it enables me rapidly to diagnose readers' troubles and to be of service to them.

USING AN ELIMINATOR *With* CLASS "B" OR Q.P.-P. OUTPUT

With Particular Reference to the Neon Stabilizer. By PERCY RAY

IN the past it has not always been practicable to use either an A.C. or D.C. eliminator with Class B or Q.P.-P., but owing to radio's latest development, the Cossor Neon Tube voltage stabilizer, running either system from an eliminator has been simplified.

The Neon stabilizer will be more readily understood if the reason for its existence is made perfectly clear. Readers will recollect that Class B valves take an H.T. current that varies within wide limits. For example, the 240B valve arranged to give an undistorted output of 2 watts will consume about 4 milliamps during an announcement, and will rise on a very loud orchestral passage to a figure approaching 45 milliamps, even though the average taken over a week would only be, say, 8 milliamps.

Assuming that a screened grid stage and detector stage take 4 milliamps, this means that the current required from the eliminator will vary between 8 and 49 milliamps according to the volume of sound at any particular instant.

It will be seen that an eliminator capable of delivering the largest current would be necessary, but unfortunately, an extraordinary noise would result, because the voltage of an eliminator varies in proportion to the current drawn from it. An A.C. eliminator designed to give 50 milliamps at 120 volts would rise to 200 or more volts with the current dropped to 8 milliamps. With a D.C. eliminator it might even be worse; assuming that the D.C. voltage is 250 volts, a drop in current demand from 49 to 8 would send the voltage from 120 up to well over 200 volts. The result of this would be extraordinary, because the increase in voltage on the detector valve is equivalent to turning up reaction, consequently the volume of sound on weak passages would be raised to the

Fig. 1.—Cossor Neon stabilizer S130.

volume of the loud, and all light and shade would be taken from the music. Alternatively, the rise in voltage would be sufficient to cause the detector to oscillate, except when an orchestra was playing loudly. Added to this there would be distortion caused by the voltage variation on the Class B valve, and the possibility of the valves breaking down under the strain.

It is therefore apparent that some device is required whereby the voltage of an eliminator will remain reasonably constant, irrespective of the current drawn, and it is the object of this article to give a full description of the working of this device, the Neon stabilizer, together with full practical information for both D.C. and A.C. working.

The Cossor Neon stabilizer is shown at Fig. 1, where it will be seen that the tube is mounted in a valve-holder for convenience. The interior of the tube consists of an anode and a cathode, surrounded by a mixture of special gases, the pressure of which is so adjusted that a current flows through from one electrode to the other when a certain H.T. voltage is applied. Incidentally, when this current flows the tube lights up; when the H.T. voltage is reduced to the point where the tube just remains alight a small current will be flowing, but a slight increase in voltage brings about an enormous increase in current. This action is the exact opposite of the eliminator driving a Class B valve. A decrease in Class B anode current brings about an increase in voltage; whereas an increase in voltage on the Neon stabilizer brings about an increase in current.

When a Class B valve and Neon stabilizer are both driven by an eliminator the current drawn by valve and tube tends to be always the same, irrespective of the proportion drawn by either; thus voltage regulation is achieved.

Fig. 2 shows an A.C. eliminator equipped with Neon stabilizer. The eliminator portion will have a minimum output of 60 milliamps, so that there is no danger of the current drawn by the tube robbing the Class B valve, as the tube itself draws between 5 and 10 milliamps, when idle.

Fig. 3 shows a voltage regulation curve, where it will be seen that when the current drawn by the receiver varies between 10 and 50 milliamps, the voltage rises only 6 volts, and with a larger set, when two screened grids of the variable-mu type are used, the rise in voltage is even smaller, the characteristics of the tube being amazingly good from 15 milliamps upwards.

A D.C. eliminator equipped with Neon stabilizer is shown at Fig. 4. In both this illus-

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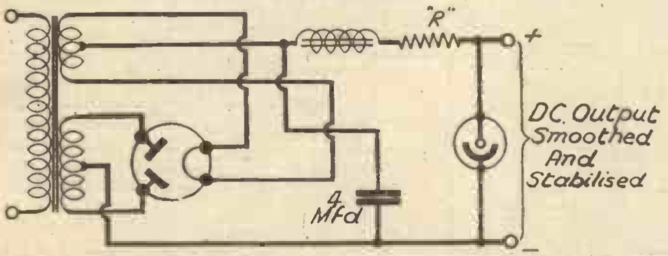

Fig. 2.—Basic circuit of an A.C. eliminator with Neon stabilizer.

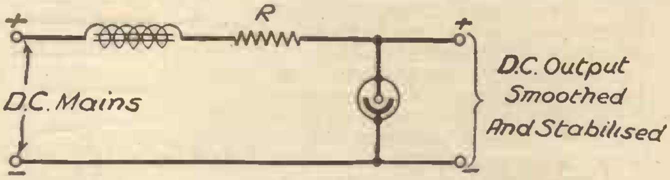

Fig. 4.—Basic circuit of D.C. eliminator with Neon stabilizer.

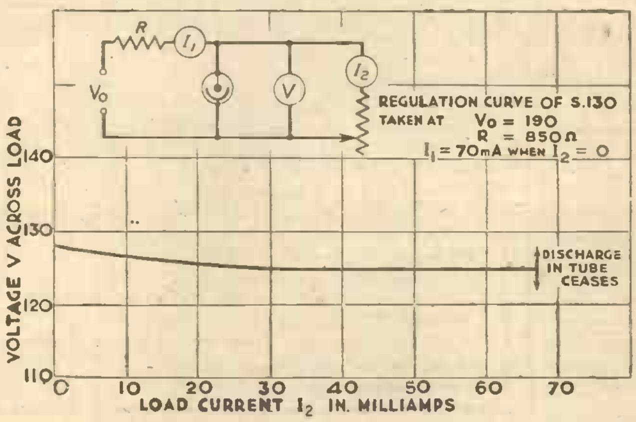

Fig. 3.—Voltage regulation curve of Neon stabilizer.

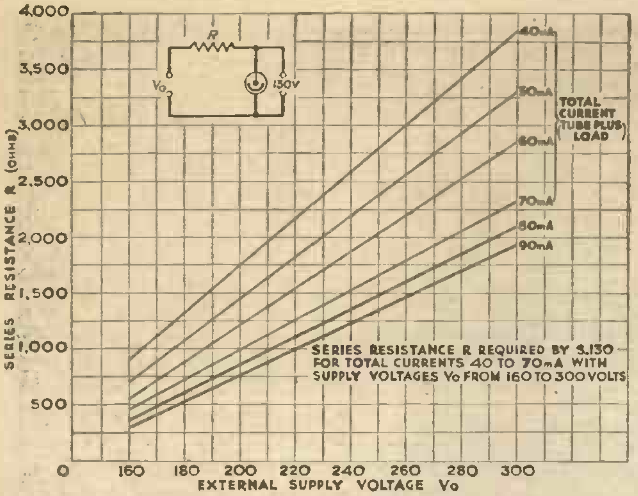

Fig. 5.—Graph showing value of resistance " R." Note that Vo is the voltage of eliminator when delivering the required current.

(Continued from previous page)

tration and Fig. 3 it will be seen that a resistance, R., is inserted in order to save the tube from destruction when the eliminator is switched on and the set is switched off, a precaution that is, of course, absolutely necessary.

The value of this resistance can very easily be ascertained from the graph at Fig. 5, each angular line representing the total smoothed output of the eliminator plotted against eliminator output volts and the required resistance. For the convenience of those who are not entirely familiar with a graph, a table is given, showing the correct resistance for various eliminator outputs, the accuracy of resistance value being such that intermediate values can be estimated.

Reference to Figs. 3 and 4 will show that the customary smoothing condenser following the smoothing choke has been omitted as a Neon stabilizer has a large smoothing action; for example, at 100 cycles which as the ripple to be smoothed when using a full-wave rectifier of 50 cycles, the Neon stabilizer is equal to more than 6 mfd.

The circuit diagrams at Figs. 3 and 4 show the resistance in the positive side, but this can be placed in the negative lead as shown at Figs. 6 and 7, so that free grid bias may be obtained.

It is interesting to notice that this grid bias really is free, as the voltage across resistance R. would normally be wasted, the presence of this resistance being necessary for safety, as described above.

TOTAL VOLTAGE OF ELIMINATOR UNDER LOAD

Total Current. Tube & Load	160	180	200	220	240	260	280	300
40	1000	1250	1750	2250	2500	3000	3500	3750
50	750	1000	1500	1750	2250	2500	3000	3250
60	500	900	1250	1500	1850	2250	2500	2750
70	450	750	1000	1250	1500	1750	2000	2250
80	400	600	850	1100	1350	1600	1850	2100
90	300	500	750	1000	1250	1500	1750	2000

Table showing resistance value for "R." It is essential that the D.C. resistance of the smoothing choke or chokes is deducted from the figure derived from above. The above figures are not exactly in agreement with Fig. 5, as they have been reduced to the nearest round figure.

The eliminator shown at Figs. 4 or 7 would hardly be adequate for rough mains, so a really efficient eliminator is shown at Fig. 8, using one condenser, two chokes or a centre tapped choke, and the Neon stabilizer. It will be noticed that no condenser is placed on the mains side of the choke, though such an arrangements is often seen. The writer contends, however, that this is a waste of a good condenser, because the capacity of the mains itself would be so enormous that an ordinary smoothing condenser would not make the slightest difference. The eliminator at Fig. 8 gives one grid-bias tapping, although any number could be used by suitably dividing the resistance R. by fixed or variable tappings.

It will be observed that two small condensers are connected across the mains, not for the purpose of smoothing but to minimize the possibility of modulation hum, which so often ruins an otherwise excellent D.C. receiver.

The resistance R. 1 and condenser C. 1 act as grid-bias decoupling which is shown in case its use becomes necessary, although it can usually be dispensed with when a single grid-bias tapping is used.

A complete and highly efficient A.C. eliminator is shown at Fig. 9, where two grid-bias tappings are shown, one fixed and one variable, both of which are decoupled, while a potentiometer is shown right across the bias resistance, for controlling the bias applied to a variable-mu valve, the lead to which is also decoupled. For sets not using a variable-mu valve, the potentiometer and the associated resistance R. 1 and condenser C. 1 will be omitted.

Either of the eliminators shown at Figs. 8 or 9 represent thoroughly efficient units with regulated stabilized outputs suitable for use with either Class B or Q.P.-P. outputs. The values given are for an output of 65 milliamps, which will be ample for most requirements. It should be noted that the 65 milliamps is available for the set and does not include the current drawn by the stabilizer.

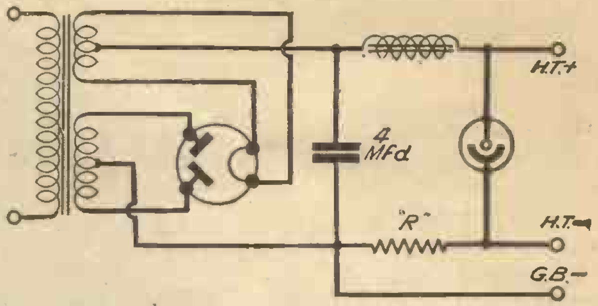

Fig. 6.—A modification of Fig. 2 showing how free grid-bias may be obtained; this is a skeleton circuit as the value of G.B. is not controllable.

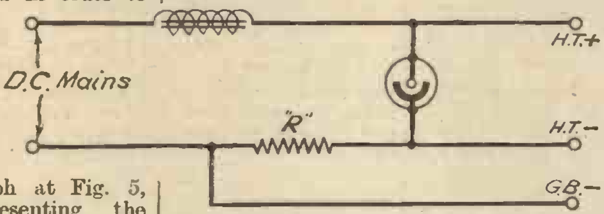

Fig. 7.—A modification of Fig. 4, showing the basic principle of free grid bias across the resistance " R."

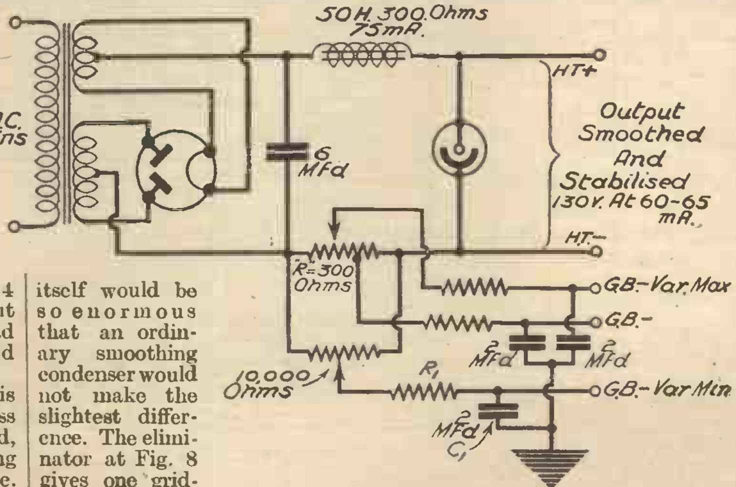

Fig. 9. — Complete A. C. eliminator. The total resistance " R." must be 300 megohms as the choke is 200 megohms. This makes the correct total of 500 megohms.

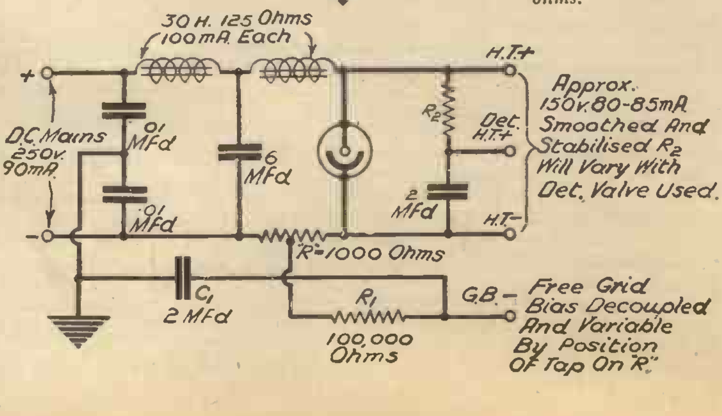

Fig. 8.—A complete and efficient D.C. eliminator.

The PROGRESSIVE EXPERIMENTER

The Fifth Complete Article of this Interesting Series is Given This Week, and in it FRANK PRESTON, F.R.A., Explains How you can Add a Screened-Grid High-Frequency Amplifying Stage to the "Progressor"

LAST week we carried out a number of experiments in relation to the low-frequency amplifying side of the "Progressor," so this week I want to show how another valve can be added in order to make the set into a three-valver. I was in some doubt as to whether you would prefer to add another L.F. stage (such as a Class B valve) first, or if you would prefer to fit an H.F. amplifier. As, however, the high-frequency stage gives both longer range and a greater degree of selectivity I decided that this would be most popular.

To add the third valve a fair number of new components will be required, and a complete list of these is given elsewhere for easy reference. You will see that the cost works out at something like ten shillings, plus the price of the valve, but as our experiments for the last fortnight have not involved a great expenditure I do not think you will complain of the expense. On reading through the list of parts it will be noticed that a second tuner is specified. This is precisely the same as that we made a fortnight ago; in winding it great care should be taken to ensure that the numbers of turns and the positions of the slots are identical with those of the original tuner. If any mistake is made in this direction it will be found that the two coils will not "match" and, as a result, the two-gang condenser will not tune correctly. One item in the list will no doubt occur to you as being rather peculiar; I refer to the valve, which is of the variable-mu type. In our experiments this week we shall not make use of the "variable-mu" properties, but will employ the valve as an ordinary screened-grid one. As a matter of fact, any V.M. valve can successfully be used in an S.G. circuit without making any sacrifice in the way of efficiency, and as we shall later modify the H.F. stage for variable-mu working we might as well get the most suitable valve in the first place, to save unnecessary expense later on.

Mounting the New Components

Having obtained the required parts, they can be assembled on the chassis in the positions shown in the wiring plans marked Fig. 1. A 1in. diameter hole is required for the four-pin valve-holder and the exact position for this can be determined by

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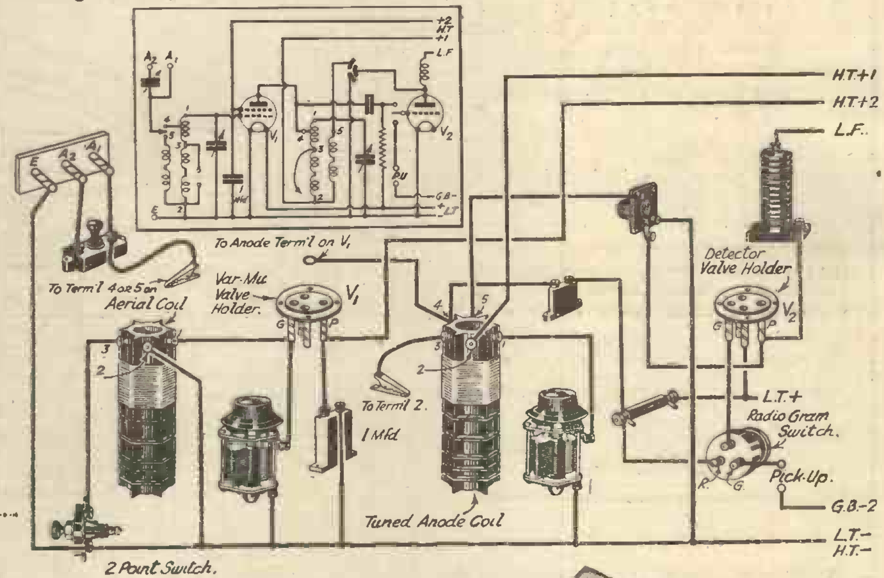
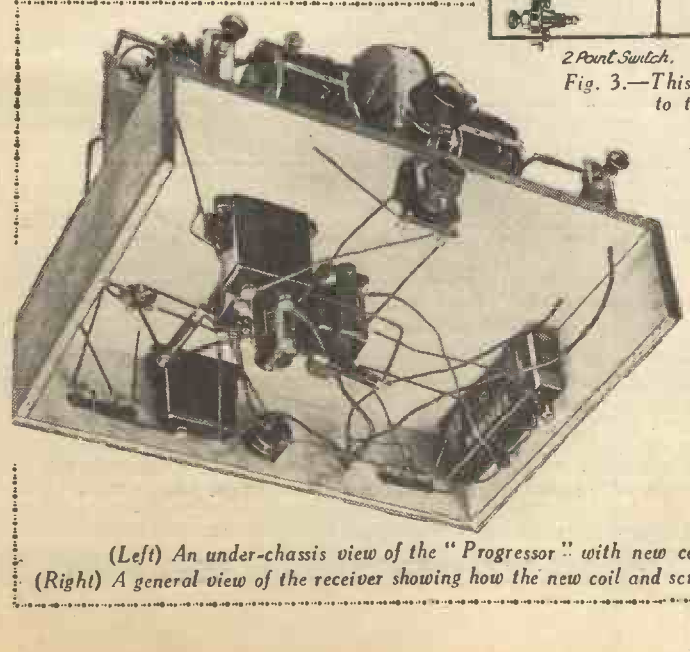
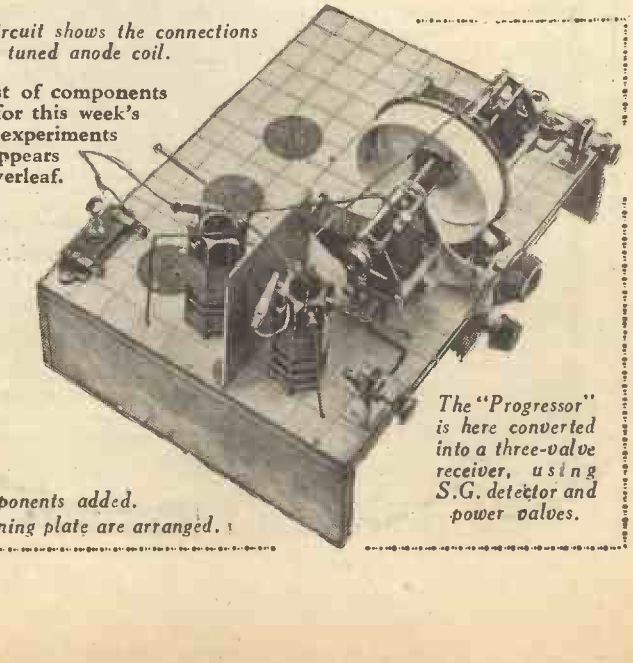


Fig. 3.—This circuit shows the connections to the tuned anode coil.

List of components for this week's experiments appears overleaf.





The "Progressor" is here converted into a three-valve receiver, using S.G. detector and power valves.

(Left) An under-chassis view of the "Progressor" with new components added.
(Right) A general view of the receiver showing how the new coil and screening plate are arranged.

(Continued from previous page)

referring to the 1in. squares marked out in pencil on the chassis. It will also be noticed that the position of the tuner has been slightly altered and a second one fitted by the same means as was previously used for the other. In order to reduce the degree of coupling between the two tuners an aluminium screening plate is fitted, after cutting out and bending it to the shape shown in Fig. 2. A second .0005 mfd. tuning condenser is also required to be fitted to the drum dial on the opposite side to the previous one. In fitting this, it is best to "close" the vanes of both condensers and set the dial to its maximum reading before tightening the spindle locking nut for the second condenser.

The position of the .1 mfd. fixed condenser can easily be determined from the underneath wiring plan, whilst many of the connections are also shown in that view. It will be seen that a high-tension positive lead, with wander plug, is required for the screening-grid lead of the V.M. valve; the lead previously employed for the detector valve will be used for this purpose.

I need not explain all the new wiring, nor the few slightly altered connections, since these are clearly to be seen in Fig. 1 where the new components are shown shaded. There is only one connection which might not be perfectly clear, and that is the one made by means of the crocodile clip attached to a flex lead from the aerial pre-set condenser. It will be explained later that the clip can be attached to either terminal 4 or terminal 5 on the new (aerial tuning) coil.

The Circuit Arrangement

By this time you are no doubt taking an interest in circuit arrangements. If that is the case you will find the wiring plan

THE COMPONENTS REQUIRED FOR THIS WEEK'S EXPERIMENTS.

- One Dual-Range Tuner (made exactly as before)
- One .1 mfd. T.C.C. Fixed Condenser, type 50.
- One Clix 4-pin Chassis-Mounting Valve-holder.
- One J.B. .0005 mfd. "Universal Log" Condenser (or Telsen Right-hand Logarithmic Condenser. See previous note).
- One Sheet 20 gauge Aluminium.
- One Bulgin Crocodile Clip.
- Connecting Wire, Flex, Screws.
- One Cossor 220 V.S. Variable-Mu Valve.

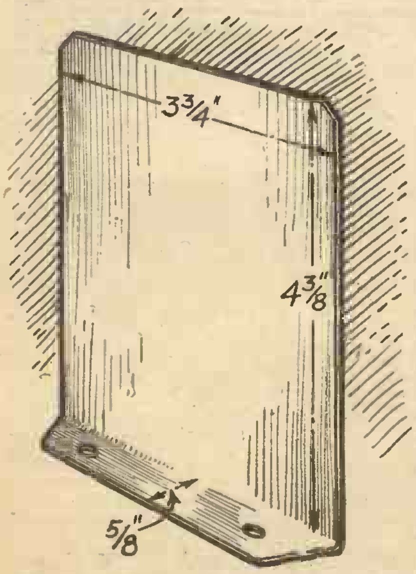


Fig. 2.—Details of the aluminium screen.

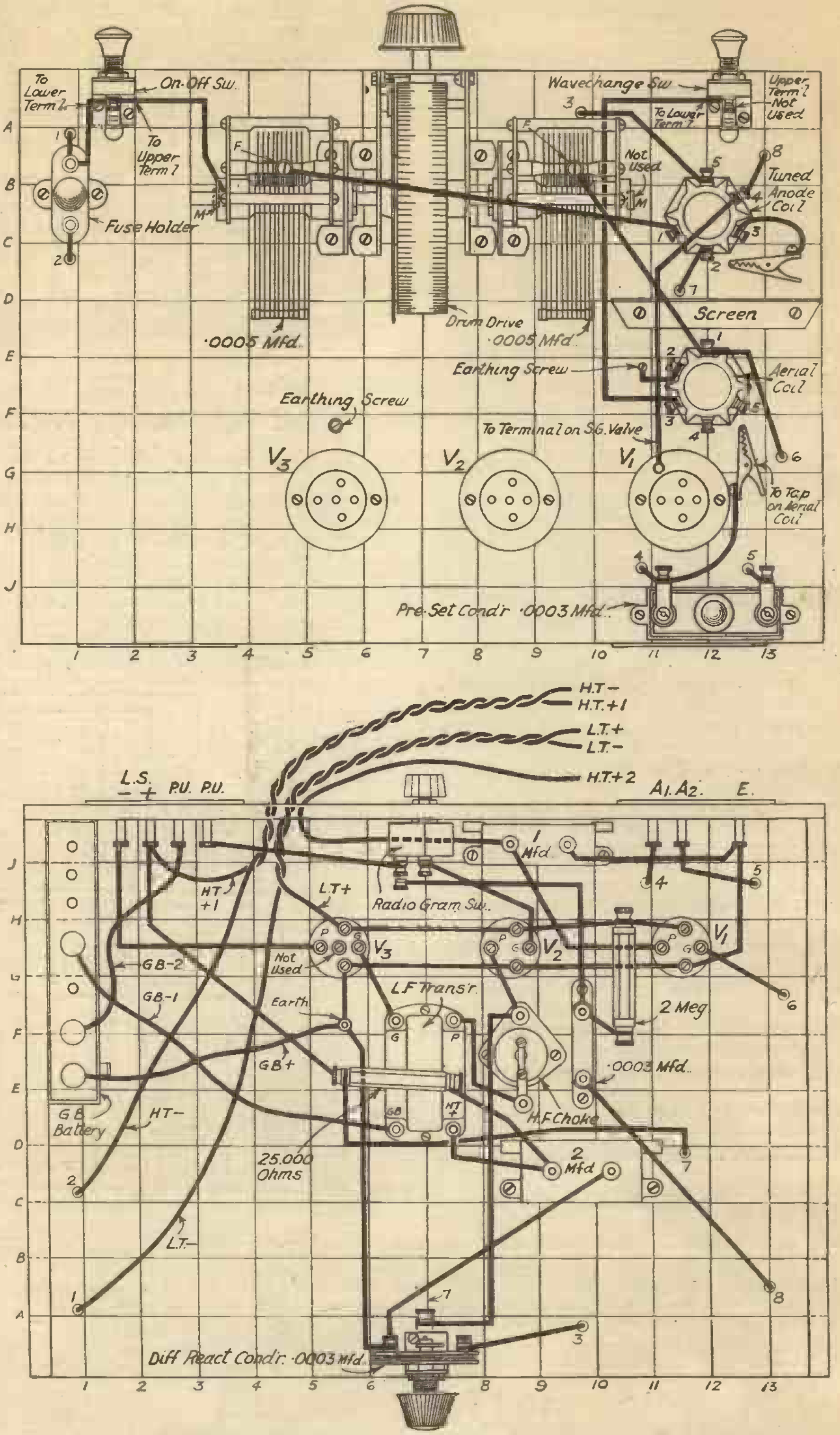


Fig. 1.—Complete wiring plans of the "Progressor," including all the new components and wiring.

rather uninteresting and useful only as a means of following the exact connections. Fig. 3 will be found of far more value in studying the circuit, and in it the wiring is shown in both pictorial and theoretical form. Only the first two valve stages are shown, since these are the only ones which are affected by our present experiments. The circuit illustrated is that of a screened-grid amplifying valve coupled to a grid leak detector on the tuned-anode principle. The coupling arrangement is given the name "tuned-anode" because the intervalve coil (with its tuning condenser) is connected directly in the anode lead of the S.G. valve. The coil carries the anode current to the first valve and acts as a further selectivity device. In later experiments we shall change over to tuned-grid coupling in order that we may compare the relative efficiency of the two best-known systems.

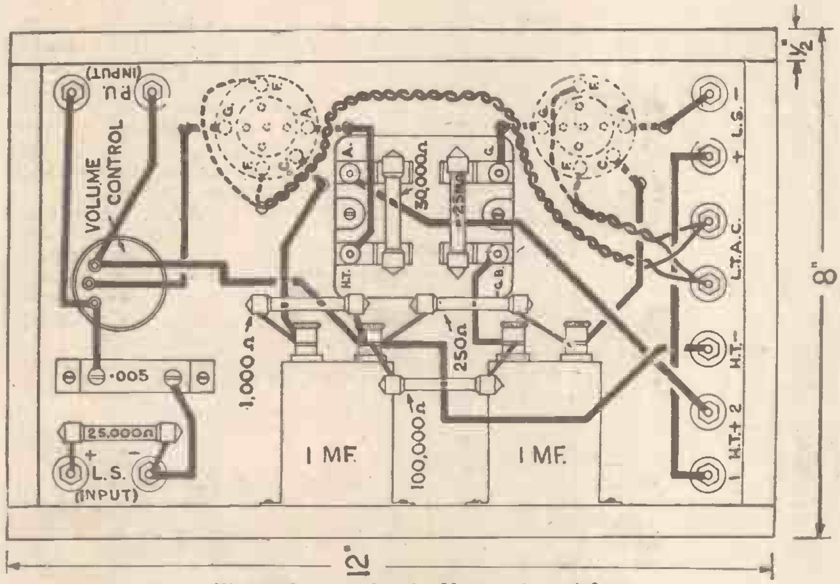
In the circuit there is one connection which might not be quite understandable,

(Continued on page 491)

MAKING A Universal Amplifier

A Powerful Unit for Use in Connection with Either Radio or Gramophone.

RESEARCH workers in the field of sound reproduction are constantly endeavouring to impress upon we humble radio experimenters that it is



Wiring diagram for the Universal amplifier.

quite impossible to hope for true reproduction of musical sounds unless we are prepared to make our loud-speakers emit such a volume that when it reaches our ears it is of the same intensity as if we were listening to the original music. In other words, they say that when we listen to, say, an orchestral concert whilst sitting in our favourite arm-chair in the drawing-room, the volume of sound which we hear should be the same as if we were in the broadcasting studio.

This does not mean, of course, that the speaker should give out the same amount of sound as does the orchestra, but that the proportion of sound should be the same as the proportion of the size of our drawing-room to the size of the studio.

We will not consider the reason for this necessity, but will rather take it as being true and see what we can do to achieve that ideal.

For most average-sized drawing-rooms the power supplied to the speaker to fulfil the conditions laid down must be at least one watt, or 1,000 milliwatts. Now very few receivers of the older types are capable of delivering that amount of power, so some kind of amplifier is necessary. A powerful "quality" amplifier is usually associated with high initial and running expense, but the writer will endeavour to show that such an instrument need not be a costly affair at all.

The amplifier illustrated on this page can be built for very slightly more than thirty shillings. It will give an output of at least 1,000 milliwatts,* and can be used either with a low-power wireless receiver, a gramophone pick-up, or a microphone. Designed in the first place to take its high and low-tension supplies, as well as grid-bias, from the All Power A.C. Eliminator described in PRACTICAL WIRELESS, No. 5, it can be fed from almost any good A.C. eliminator or, at a pinch, from batteries.

The Circuit

First of all let us look over the circuit diagram. Starting at the left-hand side it will be seen that there are four input terminals; two of these are marked "L.S." and the other two "Pick-Up." When the amplifier is to be used with a wireless receiver, terminals "L.S." will be connected to the loud-speaker or phone terminals. By making those connections the last valve of the receiver will be coupled to the amplifier by the 25,000 ohm resistance and .005 mfd. condenser (on the Resistance-Capacity-Coupling principle). The 500,000 ohm potentiometer will then act both as a grid-leak and as a volume control.

If the amplifier is to be used for gramophone reproduction or public address purposes terminals "L.S." will be left entirely free, whilst the pick-up or microphone will be joined to the "Pick-Up" terminals, the potentiometer again acting as volume control. Whatever form of

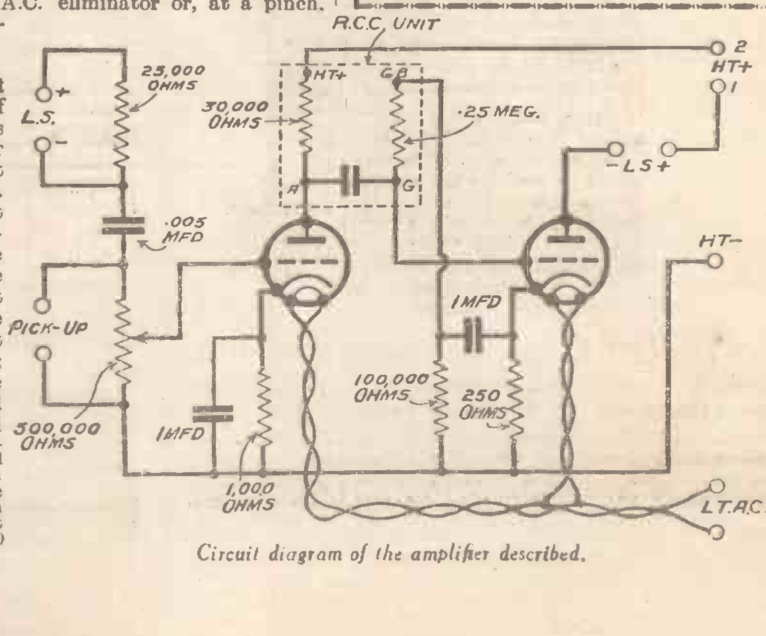
(Continued overleaf)

* The actual output with a H.T. voltage of 210 and an input of 1 volt R.M.S. is 1,250 milliwatts.

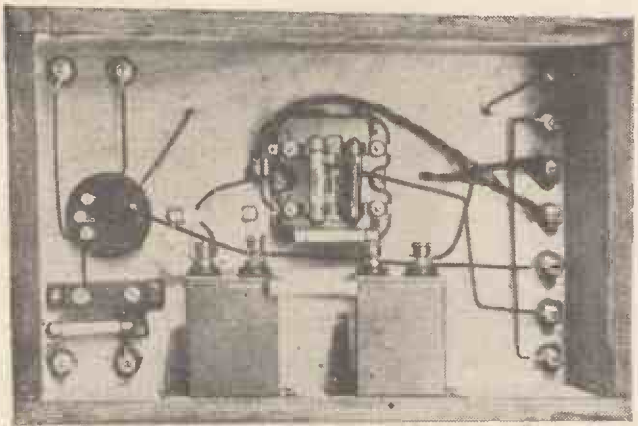
THE COMPONENTS REQUIRED

One Plywood Panel, 12in. by 8in.
One Piece, 3in. by ½in. Wood 38in. long (for "chassis").
Two 5-pin Valve Holders (Graham Farish).
One Resistance Capacity Unit, with 30,000 ohm anode resistance and ¼ megohm grid leak (Dubilier).
One .5 megohm Volume Control Potentiometer (Graham Farish).
One .005 mfd. Mica Condenser (Dubilier type 620).
Two 1 mfd. Condensers, 400 volts D.C. working (Dubilier type LSB).
Four Metallized Resistances: 1, 100,000 ohms, 1, 25,000 ohms; 1,000 ohms, and 1, 250 ohms (Dubilier, 1 watt).
Eleven Insulated Terminals: Two marked "L.S.+"; Two "L.S.—"; Two "L.T. A.C."; Two, Pick-Up"; One, "H.T.+1"; One "H.T.+2"; and One "H.T.—" (Belling Lee type "B").
Eleven Terminal Insulating Washers (Belling Lee).
Coil Glazite, flex and screws.

Two A.C. Valves; One 41 MHL (metallized); and One 41 MP (Cossor).



Circuit diagram of the amplifier described.



A good impression of the wiring and component disposition can be gained from this illustration.

MAKING A UNIVERSAL AMPLIFIER
(Continued from previous page)

input employed is applied to the grid of the first valve, a Cossor type 41 M.H.L. This valve is coupled to a 41 MP. power-valve through a resistance capacity unit. The values of anode resistance and grid-leak (30,000 ohms and 250,000 ohms respectively) are chosen to match the characteristics of the M.H.L. valve.

Correct grid-bias for both valves is obtained by inserting suitable voltage dropping resistances in series with the leads from the cathodes to H.T. —. To prevent instability or feed-back the grid of the second valve is decoupled by means of a 100,000 ohm non-inductive resistance. Both grid-bias resistances are by-passed by 1 mfd. condensers. The anode circuit of the first valve is decoupled by the resistance and condenser contained in the eliminator feed circuit.

The loud-speaker terminals are shown as being directly in the anode circuit of the power valve. Actually it would not be wise to connect any of the smaller-balanced armature speakers to these terminals because the anode current would be too much for their windings. But an amplifier of this kind can only give of its best when connected to a moving coil speaker, and such speakers almost invariably contain a built-in transformer of correct ratio. In cases where the speaker is not fitted with a transformer it will be necessary to obtain one of suitable ratio; the latter cannot be stated here, since it will depend entirely on the impedance of the speaker.

To enable constructors to calculate the transformer ratio it might be pointed out that the optimum load of the Cossor 41 MP. valve is 2,600 ohms.

Making the Amplifier

The constructional work is remarkably simple, as can be judged from the photographs and wiring plan.

The first step is to make the chassis and panel. The former merely consists of four lengths (two 12in. long and two 7in.) of 3in. by ½in. wood, screwed together to form the sides of a box. The plywood panel fits on top and is held in place with eight screws. Drill the panel, as shown in the wiring plan, to take the terminals and volume control potentiometer. The terminal holes are ¼in. diameter and have a small "V" cut filed in them to take a projection on the terminal bush; the potentiometer hole is ⅜in. diameter. In fitting the terminals an insulating washer must be put on before each nut so as to insulate the terminals from the panel.

After attaching the terminals and potentiometer, screw the two valve-holders down and make 5/32in. holes through the panel near each of four terminals—there is no hole near one "F" terminal. The remainder of the components can then be attached, making sure that the R.C.C. Unit does not foul any of the panel holes.

Wiring is straightforward enough and no soldering is required. Glazite is used for all except L.T. connections which are made in twin flex. Twisted flex is always preferable for this purpose since it introduces a certain amount of capacity which reduces the possibility of mains hum. The metallized resistances are joined direct to the various terminals by means of their connecting wires.

Using the Amplifier

The method of connecting the amplifier to a pick-up or receiver has already been dealt with, so we need now only consider how the power supply should be applied.

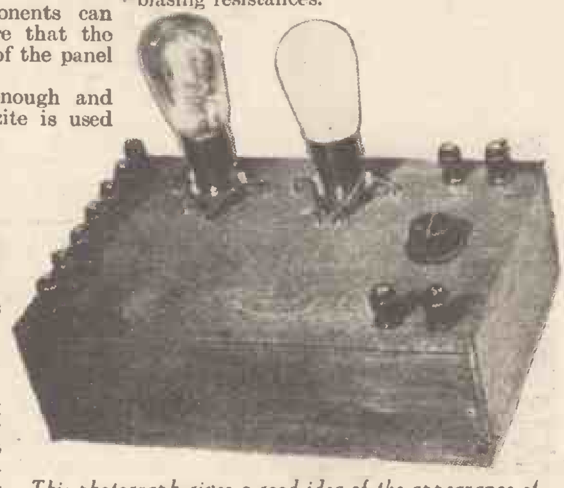
If the eliminator previously mentioned is used, terminal "H.T.+1" should be joined to that of similar name on the eliminator, whilst terminal "H.T.+2" may be taken to either of the terminals "H.T.+2" or "H.T.+3"; the latter will generally be the better since a higher voltage can be obtained from it by turning the potentiometer near to its maximum setting. The other three terminals will be connected to corresponding ones on the eliminator.

When using any other eliminator, terminal "H.T.+1" must be taken to a tapping which gives up to 200 volts at 25 milliamps and terminal "H.T.+2" to some slightly lower voltage tapping.

As stated above, the amplifier could be fed from batteries, but the H.T. should consist of accumulators or super-capacity dry batteries. A voltage of between 150 and 200 should be applied to "H.T.+1" and from 100 to 180 to "H.T.+2." A 4-volt accumulator will feed the filaments and should be connected to terminals "L.T.A.C." The negative accumulator terminal must be joined to the negative terminal of the high-tension battery. If batteries are to be used for high tension supply they should preferably be of the accumulator type, although super-capacity dry batteries can be employed.

It will be obvious that any eliminator supplying H.T. only could be used in conjunction with a 4-volt accumulator.

Whatever form of voltage of high tension is employed the grid bias will automatically be regulated to the correct amount by the biasing resistances.



This photograph gives a good idea of the appearance of the complete unit.

FROM HERE AND THERE.

Sweden's Thirty-Three Stations

SWEDEN, one of the first European countries to build a high-power station, has decided to increase the energy of the Motala transmitter to 120 kilowatts. The broadcasting net is an extensive one, and in the number of stations ranks only second to that established by Russia. As most of the country is sparsely populated, to secure an efficient service thirty-three broadcasting stations are needed.

Distance no Object!

THE fact that Odessa is distant from Paris by roughly 1,350 miles does not appear to prevent the former's 10-kilowatt station from interfering with the broadcasts from the French capital. Their transmissions are only separated by two or three kilocycles. In view of the fact that the Lucerne Plan makes considerable use of shared channels, it is feared that in actual practice the results may not prove too favourable.

Compulsory Listening

IN Germany, listeners who do not renew their broadcasting licences are forced to supply the reason for not doing so; any adverse criticism of the programme is prohibited, and brands the culprit as an enemy to the present régime! To avoid unpleasantness, the licensing tax is paid, and thus the statistical figures published do not show any reduction.

Radio Strasbourg 60 Kilowatts

TO counteract German propaganda broadcast by Stuttgart and Munich, the French P.T.T. has reconstructed the Strasbourg station to obtain better radiation. From 11 kilowatts the power is being increased to 38 kilowatts, and with the addition of a further stage of amplification, it is hoped to reach 60 kilowatts. If this is not considered sufficient to secure a perfect service over the two provinces of Alsace and Lorraine, a new 100 kilowatt transmitter will be installed.

Reorganization of B.B.C. Network

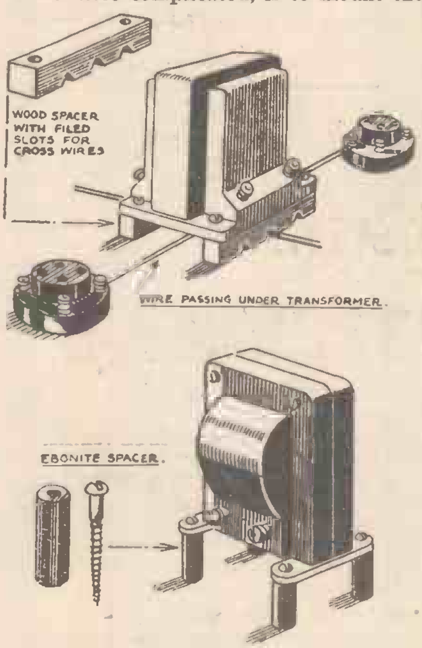
FOLLOWING the launching of the new 150-kilowatt Droitwich transmitter, which is destined to broadcast the London National programme, the London, North, and West National stations will be closed down. By so doing, two exclusive channels will be made free, and will be utilized for two other modern high-power transmitters. One of these, North-East Regional, will be situated near Newcastle-on-Tyne, the other in the vicinity of Belfast (Northern Ireland).

READERS' WRINKLES

THE HALF-GUINEA PAGE

A Baseboard Mounting Hint

I HAVE often found it a good idea to mount all large components, such as transformers, chokes, and large fixed condensers, on strips of wood, thus raising the component a short height above the baseboard. Connecting wires (particularly filament leads to valve-holders) can then be passed straight through without bends, thus simplifying wiring. Another method, a little more complicated, is to mount the



A useful baseboard-mounting hint.

components on ebonite legs (cut from old lead-in tube). This allows room for small condensers underneath if required. The accompanying sketch shows the arrangement quite clearly. Of course, grid wires should not be passed under L.F. transformers.—R. GRAPER (St. Albans).

An Efficient Earth Tube

DIFFICULTY having been experienced in obtaining a good earth which had to pass through a concrete paving, the following cheap and efficient tube was designed and found very satisfactory.

A length of ½in. iron gas pipe is used; five or six feet will probably be sufficient for most situations. This size of piping will be found to be approximately 13/16in. diameter. In each end is driven a short length of brass or copper tube, and in the lower one is fixed a steel point. This should have four flats on the tapered portion as shown in the sketch. The distance across the corners must be a little greater than the diameter of the pipe, and the shank end is filed to a driving fit in the brass tube. A few holes are drilled in the pipe to allow the access of moisture, and a ¼in. tapped hole is drilled at each end through the brass and iron.

> **THAT DODGE OF YOURS!**
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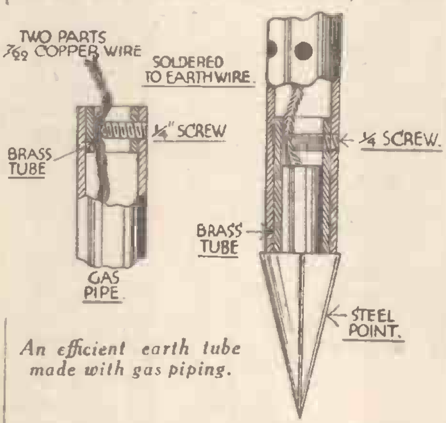
Two or more lengths of bare copper aerial wire are passed down the tube and fixed at each end by means of screws, which are then cut off and filed flush. To fix this tube in position a corner of one of the concrete paving slabs was cut away. The tube was then inserted in the hole, and, whilst maintaining a steady downward pressure, was turned by means of a footprint wrench.

It will be found that comparatively little effort is required to force it right down into the ground. The ends of the wires were then well cleaned, twisted

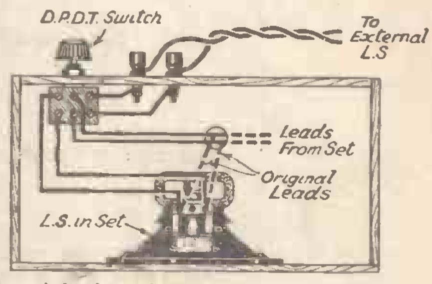


An efficient earth tube made with gas piping.

together, and soldered to the earth wire leading to the set; the joint being well covered with rubber and adhesive tape.—D. TANGUY (Portsmouth).

Loud-speaker Extensions

MY set has a self-contained loud-speaker, and when I am in any other room I cannot hear the programme satisfactorily. To overcome this I obtained another loud-speaker, which I placed in the distant room and ran leads from it to the set. On the back panel of the set I fixed a D.P.D.T. switch of the rotary type, together with two terminals. Then the leads were removed from the loud-speaker in the set and connected to the centre terminals of the switch. One side of the switch was connected to the loud-speaker terminals and the other side to the terminals on the back panel. The extension leads are also connected to these terminals. In this way I was able to tune the required station on the loud-speaker in the set, and then, by throwing the switch into the other position, I was able to hear the programme in the distant room. When this programme became unsatisfactory, I



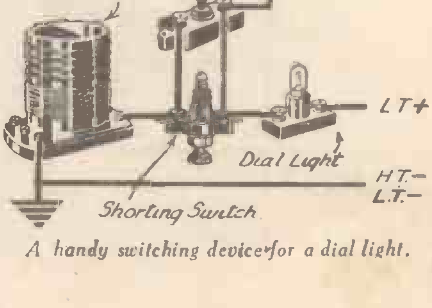
A loud-speaker extension arrangement.

was able to obtain another station, by returning to the set and reversing the switch, thus energising the loud-speaker in the set. This programme could then be heard in the usual way on the other loud-speaker.—L. AITCHISON (Durham).

Switching a Dial Light

AS battery users appreciate every economy which can be effected, it is the custom for constructors to include some means of switching off the dial light when not in use, and though there are less obtrusive ways of doing this, a separate switch is often incorporated. A much neater way is represented in the accompanying illustration. Instead of returning the lead to negative L.T., either direct to the chassis or through a switch of normal design, the lead is taken to the aerial lead of the set, which must include in its length an aerial series condenser with a shorting switch. When the switch is closed—*i.e.*, when the condenser is short-circuited for maximum volume—the dial light is switched on to assist in the "searching" which, probably, is then taking place. Once the station wanted is located, and accurately tuned, the volume will be *slightly* reduced by the turning of the knob to bring the aerial series condenser into circuit, and the dial light will be switched off. Alternatively, if the set is to be left at its maximum sensitivity, it is reasonable to infer that it will be only for a short period, in order,

(Continued overleaf)



A handy switching device for a dial light.

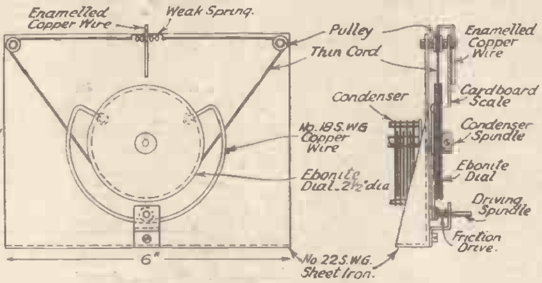
RADIO WRINKLES

(Continued from previous page)

perhaps, to hear some important item from a weak or distant station.—N. ROLLASON (Canterbury).

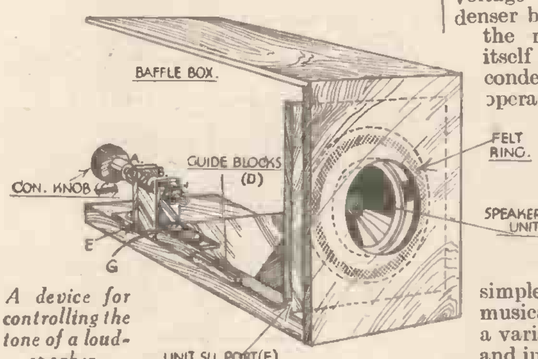
Making a Straight-line Tuning Scale

HAVING made the "All-Wave Two" recently described in PRACTICAL WIRELESS, and being very pleased with the results obtained, I decided thoroughly to



A simple method of making a straight-line tuning scale.

modernize my set and fit a straight-line tuning scale. The sketch herewith shows how I made this action with material taken from the "junk box." The back plate was made from 22-gauge sheet-iron, afterwards painted with aluminium, and the condenser was fixed to the back of this by the usual one-hole fixing. An old ebonite 3½-in. dial was grooved for a driving drum and fixed to the spindle by a 4 B.A. set-screw tapped obliquely into the centre hole. A thin cord was taken once around the drum and over the pulleys, being joined by a weak spring ½in. long to which is soldered a short length of enamelled copper-wire, which is afterwards bent to shape over the scale to act as a pointer. The pulleys are small terminal nuts drilled with a clearance hole. The slow-motion drive consists of 18-gauge copper-wire formed round a jar and screwed to the back of the drum. The drive is by friction in the usual way. The scale, of thick cardboard, which is omitted from the drawing in front elevation, is fixed by nuts on to the same spindles that carry the pulleys.



A device for controlling the tone of a loud-speaker.

Station names, cut from the programmes, were stuck in position after calibration, and the whole, when behind a neat window, gives a very effective appearance to the set.—J. E. DUMERTON (Enfield).

Speaker Tone-control Device

THE accompanying sketch shows a device, made up from scrap, to control the excessive bass response often experienced when reaction is used to bring in a distant station. The parts required are three nuts, a short length of screwed rod, an old condenser knob to fit, and two rectangular brackets made from stout brass. The speaker unit is attached to a wooden support F, and the latter is not attached to the cabinet, but is placed between two guides D, so that its distance from the front of the cabinet can be varied, the greater the distance, the less the bass, and *vice versa*. In order to obtain a fine adjustment, the knob G is fitted. This is locked to the rod by nut A, which is passed through a hole in bracket E, after which nut B is screwed on and soldered in position, or it may be held by a lock-nut. A hole is bored in bracket G and a nut C is soldered in position, after which the rod is inserted and the brackets fixed as shown. By rotating the knob carefully a very fine control results, which brightens up the reproduction surprisingly.—H. ADAMS (Leeds).

Uses for a Neon Lamp

FOR the practical radio amateur a neon lamp is a very handy gadget. Its use, however, is in a great many cases confined to testing continuity in various circuits or components.

There are other uses to which it may be put, and they include checking the capacity of large condensers, checking high resistances, and producing electrical oscillations within the audio-frequency range for testing, etc. It is well known that these lamps do not conduct until a certain electrical pressure (breakdown voltage) has been reached between the electrodes, and that when once a discharge has commenced the voltage must be brought to a considerably lower value (extinguishing voltage) before the current flow ceases. If we consider the circuit in Fig. 1 we shall see how this property may be utilized—N being the neon lamp or tube, C is a large condenser, and R a high resistance. As soon as the switch S is closed, current trickles through R and charges the condenser until the breakdown voltage of the lamp is reached. The condenser then discharges through the lamp until its extinguishing voltage is reached, and then the condenser becomes charged up again through the resistance, the process repeating itself indefinitely. The smaller the condenser the higher the frequency of operations, as it takes less time to charge and discharge. Consequently, the larger the condenser, the lower the frequency, and the lower the resistance the higher the frequency as more current is passed and the condenser is charged more quickly.

Thus we can arrange a very simple circuit to produce a variable musical note, with a variable resistance or a variable condenser, or both, as in Fig. 2, and in this case an ordinary tuning condenser is employed in conjunction with a grid leak. Alternatively, we can arrange for the frequency to be so low that each flash of the lamp may be counted. The latter arrangement will be of great value in checking large resistances or condensers by substitution.

For example, in one particular case I obtained a frequency of 1 p.p.s. by using a 250,000 ohm resistance with a 1 mfd. condenser. Changing this condenser for a .5 mfd. would double the frequency, whilst a 2 mfd. condenser would halve the frequency, and, of course, another 1 mfd. condenser would keep the frequency the same. Similarly, a ½ meg. resistance would halve the frequency, whilst a resistance of 125,000 ohms would double it. During these tests the same lamp should be used and the voltage kept steady. In the case of producing a musical note, the upper limit of frequency is governed by persistence of ionization of the gas, which, in turn, depends upon the amount of current flowing. For example, a certain combination of resistance and condenser, as in Fig. 2, might reach, say, 500 p.p.s., after which one continuous discharge would take place, due to the above reason. The remedy is to use a higher value resistance, and a lower value condenser, so as to reduce the mean value of the current

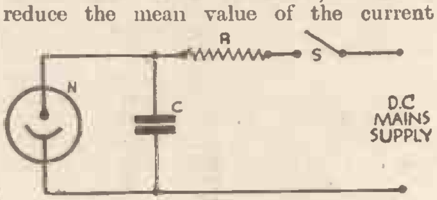


Fig. 1.

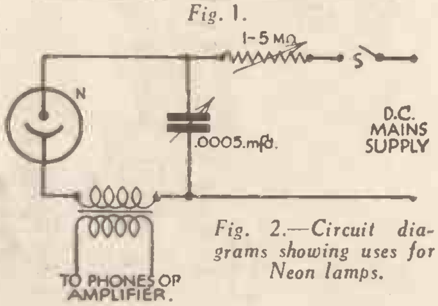
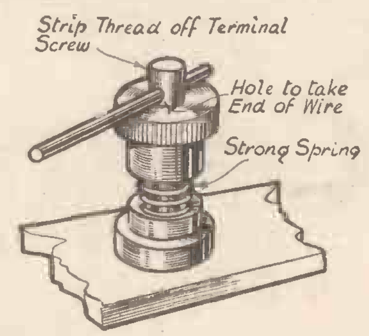


Fig. 2.—Circuit diagrams showing uses for Neon lamps.

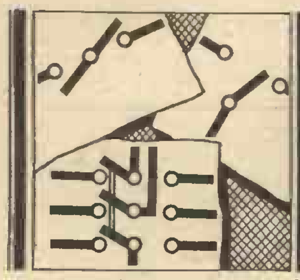
flowing through the lamp. With care, it is possible to produce a very wide range of audio frequencies by the above method. Only a D.C. supply may be used, and the voltage of supply must be a little higher than the breakdown voltage of the lamp. An ordinary 5-watt neon lamp may be employed, but it is preferable, first of all, to remove the resistance in the cap of the lamp, and in that case the lamp should never be directly connected across a supply.—J. R. PERRY (Norwich).

An Improved Terminal

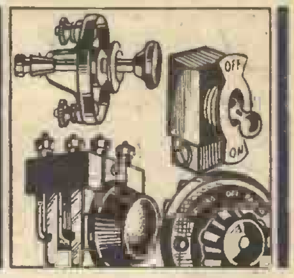
THE accompanying sketch shows a simple dodge for converting a terminal so that the end of a connecting wire can be instantly gripped or released. The thread of the terminal screw is stripped so that the nut slides easily up and down, and between the bottom of the nut and the base of the terminal a fairly strong coil spring is placed. A hole is drilled through the top part of the stem, as indicated, to take the end of the connectng wire, and it will be seen that to insert or release the wire it is only necessary to depress the terminal nut.



Converting a terminal to provide for quick release of connecting wire.



Which switch—and why!



Practical Points to be Considered When Arranging Switches for Receivers or Radiograms.

By H. BEAT HEAVYCHURCH

BY the exercise of a little ingenuity it is possible to arrange for a number of interesting and useful switching operations by means of which the circuit and performance of a receiver can be varied at will. While a very large number of combinations or modifications is possible, however, the indiscriminate

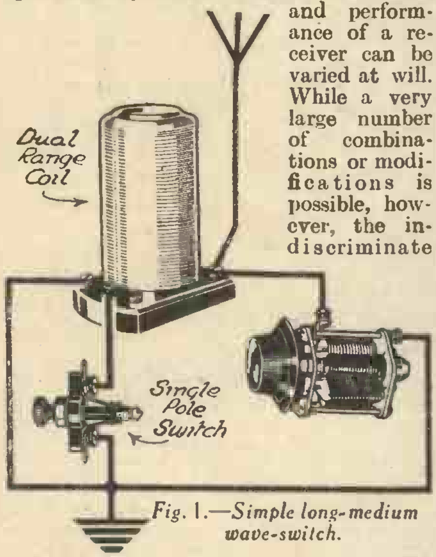


Fig. 1.—Simple long-medium wave-switch.

use of switching in radio receiving circuits is not recommended—indeed, in certain portions of the apparatus, switching is to be avoided as far as possible if the maximum efficiency is to be obtained.

Time was when the number of stages of high- and low-frequency amplification was normally controlled by switching. To-day modern practice is to provide sufficient amplification for all normal purposes, and to control it by varying the gain—as in the case of variable-mu valves—or by using a part only of the available input to a stage or of the output of a stage, as in the case of a volume control potentiometer in a low-frequency amplifier.

Ganged Switching

So far as switching in radio-frequency circuits is concerned, the guiding rule is—don't. The sole exception is in the case of the wave-change switch. Changing from one waveband to a lower waveband is usually accomplished by short-circuiting a portion of the tuning coil, as illustrated in the first diagram, Fig. 1.

In most modern receivers, however, there is more than one tuned circuit, and it is desirable to operate the wave-changing switches of all these circuits simultaneously. Usually this is arranged for by connecting the operating mechanism of all these switches to a common operating spindle, as indicated by the two-gang set of coils illustrated in Fig. 2, while a three-gang is represented graphically in Fig. 3.

Referring to this diagram, it will be observed that not only is a portion of each main tuned circuit shorted out when operating on the medium-wave band, but that corresponding alterations are also made to the aperiodic aerial coil and to the reaction coil.

The chief difficulty in high-frequency switching is the losses caused by the leads connecting the components to be switched to the switch terminals, and also the losses in the switches themselves.

These leads act as small condensers, as do also the various metal parts of the switches, and permit high-frequency energy to leak away. For this reason, it is desirable to make the connecting leads as short as possible, and it is generally arranged that the wave-change switches are enclosed in the coil screening can, thus forming part of the complete coil assembly, and only the operating rods protruding outside.

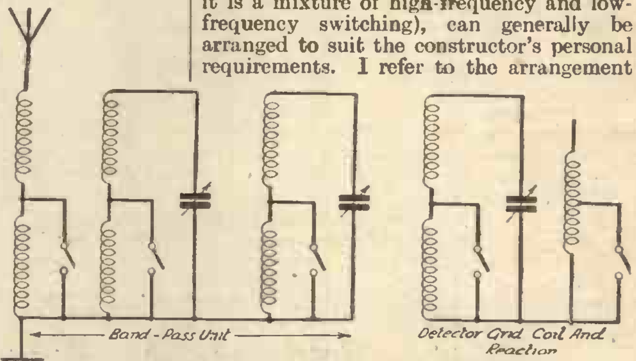


Fig. 3.—As many as five switches may be ganged in a 3-coil assembly.

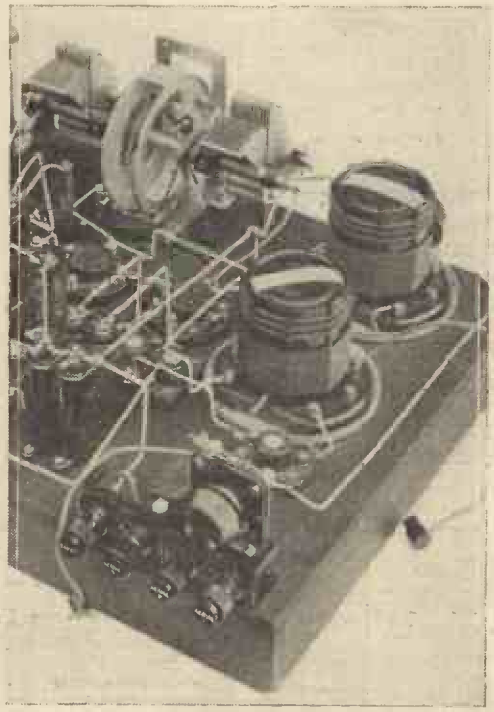


Fig. 2.—A section of a radio receiver, showing the ganged coil switching arrangement which is now common practice.

Radio Or Gram

Since the wave-change switch is so frequently screened in this way, its design and position is largely outside the amateur's control, but the next type of high-frequency switching to be discussed (strictly speaking it is a mixture of high-frequency and low-frequency switching), can generally be arranged to suit the constructor's personal requirements. I refer to the arrangement whereby the set is changed over from radio to gramophone reproduction.

In most sets, this occurs at the detector grid, the detector valve serving also as the first low-frequency amplifier for gramophone reproduction. It will be clear that two operations are involved here—first, the pick-up voltage must be applied to the grid of the valve in place of the radio signal; and second, the operating conditions of the valve must be altered from the unbiased condition necessary for detection to the negatively biased condition which is essential for distortionless Class "A" amplification.

A very popular and incidentally very simple method of doing this is by a complete change over as illustrated in Fig. 4, from which it will be seen that the grid of the detector valve is joined to the moving switch arm of a single pole change-over switch. In one position of this arm the grid is connected to the grid condenser and grid leak, so that the radio signals can reach the valve, while in the other position the condenser and grid leak are disconnected, and the grid of the valve is joined to the pick-up circuit in which is included the necessary grid bias.

Alternatives

The version of this circuit for a mains set is given in Fig. 5. Here the grid bias is achieved by means of a resistance in the cathode lead, in the usual way, but this bias is inoperative while the switch is in the radio position because the grid leak is returned direct to the cathode.

There are various alternative arrangements for radio-gram switching. For example, in Fig. 6 the pick-up and grid bias are connected across the tuned circuit by the action of a single pole switch, and no arrangements are made for disconnecting

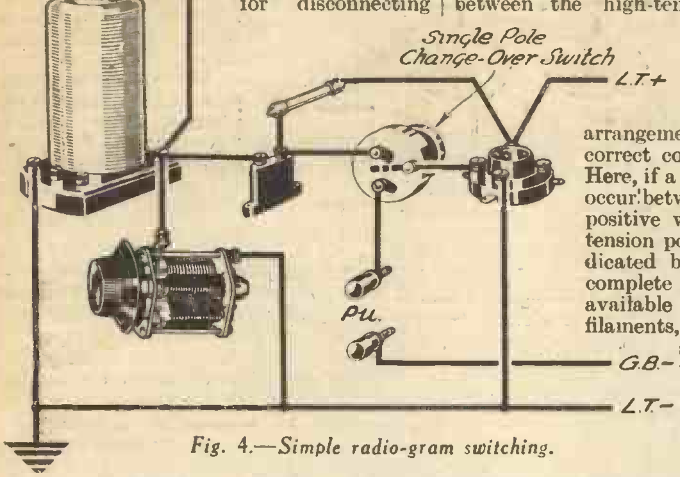


Fig. 4.—Simple radio-gram switching.

the radio-frequency portion of the circuit. The advantages of this arrangement are simplicity and cheapness, and the disadvantage lies in the fact that while the pick-up is in use the radio-frequency signal is still applied to the detector grid. Usually the radio is swamped by the gramophone because the pick-up is, to all intents and purposes, a short circuit across the tuned circuit, but the radio-frequency impulse is there all the same, and is likely to make some difference to the quality of reproduction.

Correct Filament Switching

It is not necessary to discuss the question of switching in or out low-frequency stages, because in modern sets this is not done—principally because most sets have but one low-frequency stage. The next problem to receive attention, therefore, is that of the main on and off switching of a receiver. Dealing first with the battery set, all that is required in the normal way is a single-pole switch in the low-tension battery lead, as indicated in Fig. 7.

Note carefully the position of this switch—in the low-tension negative lead. In this, arrangement both high-tension negative and low-tension negative leads are broken when the switch is "off," so that, even should an accidental contact be made between the high-tension and filament wiring, say, while making adjustments, no damage can occur.

Compare this arrangement with the incorrect connections in Fig. 8. Here, if a short circuit should occur between the high-tension positive wiring and the low-tension positive wiring as indicated by the dotted line, a complete circuit to H.T.— is available through the valve filaments, and the complete set of valves is sure to be ruined.

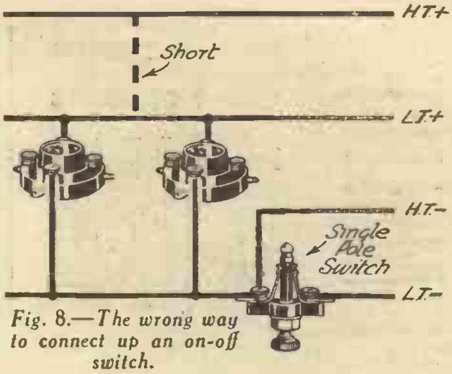


Fig. 8.—The wrong way to connect up an on-off switch.

Avoiding Waste

Another very important point in connection with the on/off switch is where the screen voltage to a screen grid valve is obtained through a potentiometer, as is often done for purposes of volume control. It is vital that this potentiometer be disconnected when the set is not in use, so as to avoid waste of high-tension current. This can be arranged as in Fig. 9, where a three-point switch is employed.

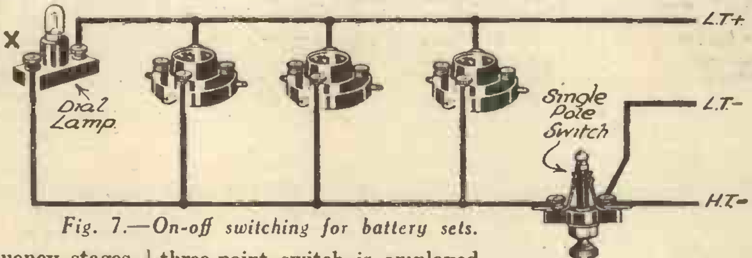


Fig. 7.—On-off switching for battery sets.

In the case of variable-mu screened-grid valves in battery sets, it is usual to obtain varying bias by means of a potentiometer connected across the grid-bias battery. The on/off switch in this case must be arranged to break the potentiometer circuit in order to prevent the grid-bias battery from being prematurely run down. Fig. 10 shows how this can be done by means of an ordinary single-pole switch.

In arranging the low-tension switching it is important to see that the connections to the dial lamp of the variable condenser (if such a lamp is incorporated) are on the "off" side of the battery switch as indicated at "X" in Fig. 7. It is also advisable that all the wiring between the terminals of the set and the actual switch is well insulated, as should this be bare accidental contacts during repair or adjustments will very likely result in serious damage to valve filaments.

Mains Switching

It is not usually considered worth while to incorporate a switch to disconnect the filament of the high-frequency valve during the period when the gramophone pick-up is being used, but if this is desired it can be arranged by using a double-pole switch for the radio-gram change-over as illustrated in Fig. 11. Here one arm and set of contacts is connected exactly as in Fig. 4, while the filament switching is performed by the second pole of the switch.

Switching for a mains receiver is simplicity itself. All that is required is a single-pole or double-pole switch in the mains circuit as indicated in Fig. 12. The best place for this switch, from a purely technical point of view, is as close to the house mains leads as possible. Some listeners, however, prefer this switch to be mounted on the main panel. If this is considered essential, place it on the low-frequency side of the set and *not* on the high-frequency side. Take care also that the leads both to and from the switch are of the metal screened type, in order to avoid the risk of introducing mains hum.

In a mains radio-gram with an

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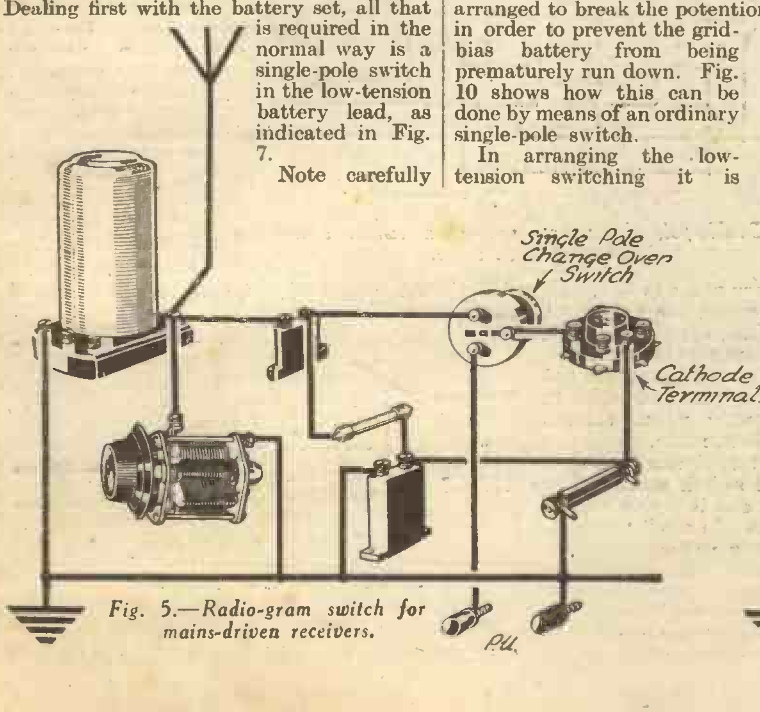

Fig. 5.—Radio-gram switch for mains-driven receivers.

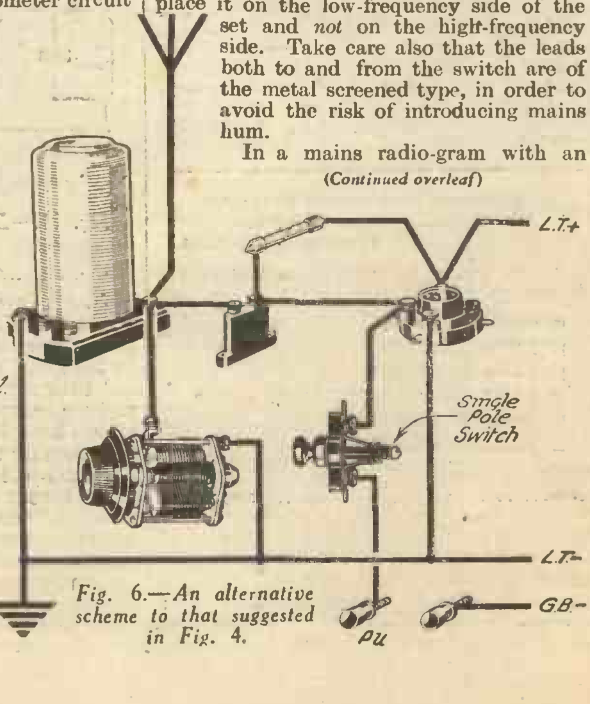

Fig. 6.—An alternative scheme to that suggested in Fig. 4.

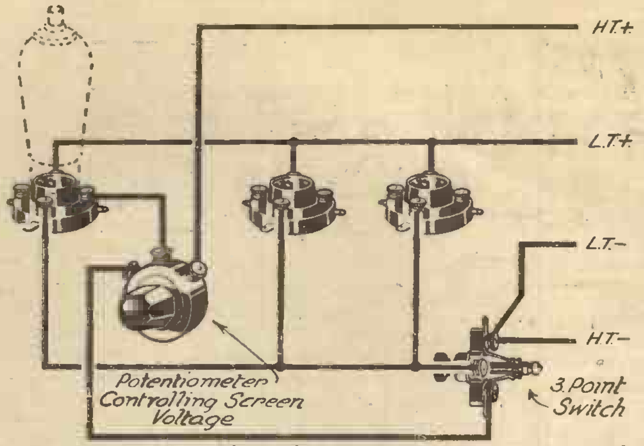

Fig. 9.—On/off switching where a screen potentiometer is used.

(Continued from previous page)

electric turntable it is necessary to provide a switch for the electric motor, unless an automatic switch is incorporated in the pick-up arm. This switch, again, may be an ordinary single-pole electric light type switch, or one of the snap-toggle switches specially designed for radio use.

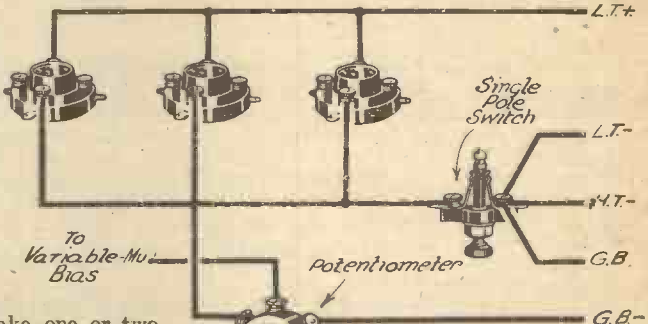

Fig. 10.—On/off switching which also breaks the G.B. potentiometer circuit.

General Observations

Having dealt at fair length with several switch applications, it is necessary now to make one or two observations about switches generally. In the early days of radio both commercial and home-constructed receivers suffered a good deal from faulty switches. Unless the contact is a good one, both electrically and mechanically, very unpleasant crackling noises are sure to arise. The ordinary push-pull switch was very prone to this. Frequently the bush in which the switch rod moved was a faulty fit, or, alternatively, the spring contacts that were shorted by the metal end of the switch rod lost their springiness and failed to register correctly when contact should have been made.

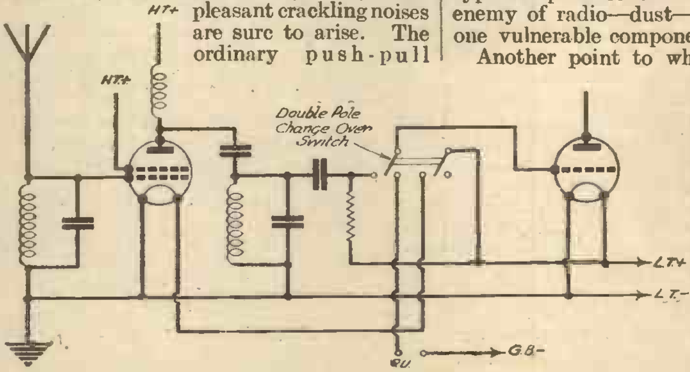

Fig. 11.—Double-pole change-over radiogram switch controlling filament of H.F. valve.

Except for very simple operations the push-pull switch seems to be losing favour and is giving way to those of the "snap" variety. There are many patterns of these on the market, but, speaking generally, they have a spring-controlled action, and this ensures a much better electrical contact. It is impossible to find a "half-way" position, that is, the switch knob on being pressed, or turned, "snaps" into position very definitely so that psychologically the user is given the impression of the job being well done.

Where contact is established through a metal blade being "sprung into" spring side faces there is the added advantage of a self-cleaning action, and naturally this is of material advantage in ensuring that the contacts do not become clogged with dirt, and in this way either introduce a high resistance into the circuit or in many cases prevent electrical continuity altogether. The mere fact that so many switch manufacturers are now totally enclosing their products in moulded or other type dustproof covers ensures that the arch enemy of radio—dust—is being kept from one vulnerable component at least.

Another point to which the user must give serious consideration is the nature of the circuit which is to be made and broken by the switch. One of suitable rating must be chosen to handle the voltage and current to be employed. In every case it is advisable to choose and use a switch which has the casing and operating knob (or "dolly" in the case of a toggle switch) insulated from the contacts.

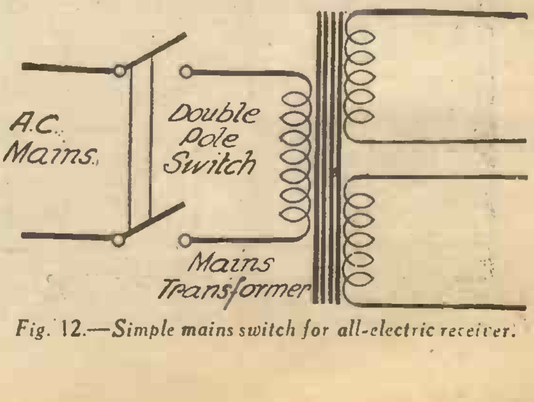

Fig. 12.—Simple mains switch for all-electric receiver.

THE EASY ROAD TO RADIO

THE BEGINNER'S SUPPLEMENT

DESIGNING YOUR OWN RADIO CABINET

Some Practical Suggestions for a Number of Up-to-date Designs.

By W. B. RICHARDSON.

MANY of the designs for sets offered to the public by the radio press are not accompanied by any suggestions on how to house the completed receiver. This is not necessarily an oversight on the part of the designers, for they well know that many readers already have cabinets they wish to make use of, or they may prefer to design their own.

It is for those readers who like to design and construct as much of the receiver as they possibly can themselves that this article is intended.

Elements of Design

For the purposes of this article we will confine ourselves to a study of the "all in" type of cabinet—that is to say the popular type which houses the complete receiver.

In the design of such cabinets there are several points to bear in mind. The chief of these are: acoustical properties, appearance, and mechanical strength.

In designing a cabinet, the scope which we can allow our artistic imagination is limited by the fact that we have two, and sometimes three, irregularly-shaped masses to be accommodated in the one cabinet. I mean, of course, that we have the speaker, the set itself, and sometimes batteries or a separate power pack. Moreover, the set is adorned with a certain number of controls which will have to protrude through the cabinet, and will therefore form some part of the outward design.

Generally speaking, there are three ways of arranging the contents, and on these will depend the shape of the cabinet. The speaker may be placed above the set, the set above the speaker, or the two units may be situated side by side. These alternatives are illustrated in Fig. 1. The dotted lines represent the position of the third unit—namely, the batteries, when such are employed. In each case they occupy the space behind and around the speaker.

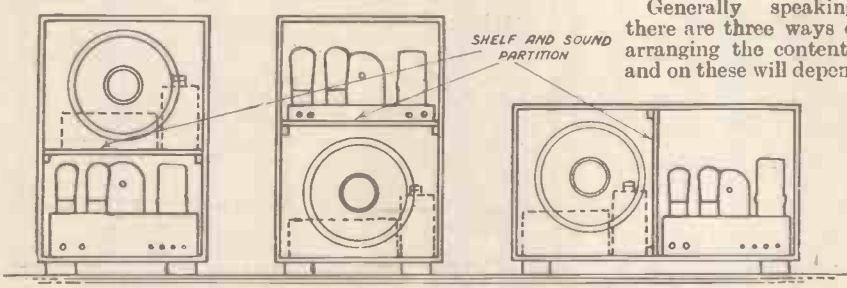

Fig. 1.—Three possible alternatives for the arrangement of set and speaker in a self-contained receiver.

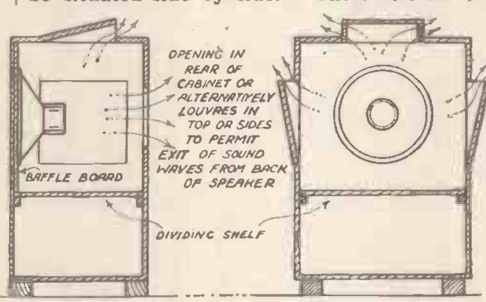

Fig. 2.—How to obtain a baffle effect with a cabinet. Arrows indicate the path of sound waves.

Preventing Drumming

Before proceeding with details we must not forget that the design must conform to the acoustical requirements previously mentioned. These are quite simple and need not in any way restrict the scope of the design in the matter of outward appearance. In the first place, the wall of the cabinet on which the speaker is mounted must be rigid and of a non-resonant nature. This presupposes the use of some such material as a thick plywood board, as in Fig. 2. Obviously its use is to prevent any resonating or drumming effect.

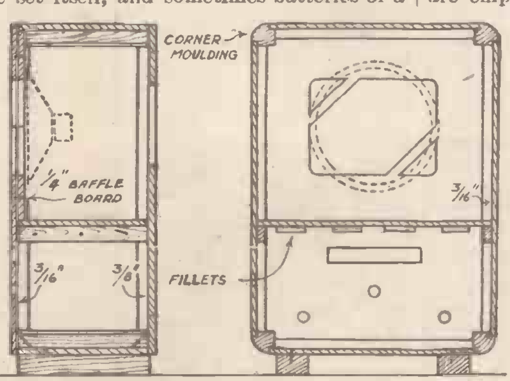

Fig. 4.—Constructional details of the cabinet shown by Fig. 3

The next consideration is the provision of an outlet for the sound waves from the *back* of the speaker. This is essential for life-like reproduction, quite apart from the question of preventing a "boxed-in" effect. The longer the path of the sound waves from the back to the front of the unit, within reason, the better will be the stereoscopic—or should we say "stereophonic"?—effect which is so essential to realism of reproduction. Fig. 2 shows two ways of providing a "back door" for the sound waves. The most usual is to cut a hole about the same size as the speaker fret in the back of the cabinet opposite the speaker. The other way shown is to provide openings or louvres in the sides, top, or bottom of the cabinet. Although both methods are shown, they would not, of course, both be employed in the one receiver.

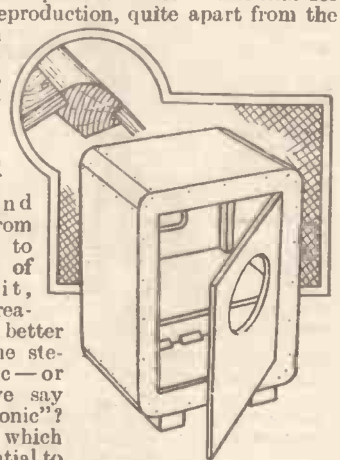

Fig. 5.—View of rear of cabinet with (inset) details of corner joints.

A further refinement from an acoustical point of view is the provision of a shelf or division between the speaker compartment and the receiver portion of the cabinet. In some designs this will be included in any case in the form of a shelf for batteries, etc., but if there is no need for a battery shelf, the dividing wall should nevertheless still be included. Its object is to insulate the receiver itself from any direct impingement of sound waves from the speaker on to the valves and vanes of the variable condensers, thus minimizing the risk of microphonic feed-back.

A Matter of Finish

Having decided on the acoustical essentials we are in a position to elaborate our design. From the point of view of appearance there are, broadly speaking, two methods of obtaining a pleasing result. One is to use a very simple design, and to rely on the markings of the wood and a

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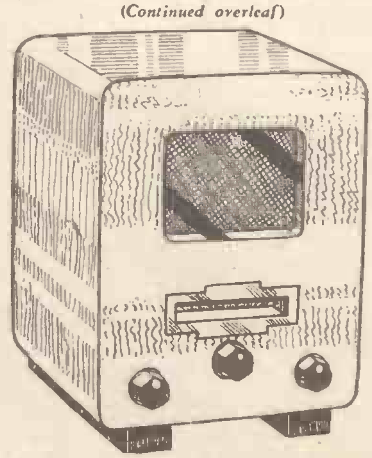


Fig. 3.—A simple but effective design carried out in satinwood and ebony.

THE BEGINNER'S SUPPLEMENT—*(Continued from previous page)*

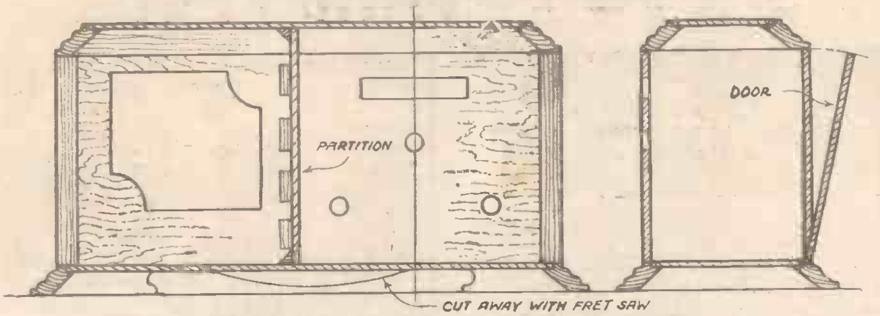


Fig. 8.—Sectional views of the cabinet shown in Fig. 7.

highly polished surface in order to obtain the desired effect, while the other is to introduce some elaboration of form such as is usual with period furniture, making the cabinet conform to some well-known style, such as Sheraton, Chippendale, etc.

The modern tendency is towards the first method, and this will therefore claim most of our attention. Incidentally it has the one great advantage for the amateur in that the construction is usually very easy.

Of course, one must use a certain amount of imagination in the choice of a design, bearing in mind the decoration and furnishings of the room in which the receiver is to be used.

Sycamore and Ebony

A good example of simple but effective design is shown in Fig. 3. It is carried out in light sycamore or satinwood set off by ebony coloured feet, control knobs, and the diagonals of the speaker fret. Actual measurements, except of one or two details, are not shown on the drawings because they will naturally vary according to the size of the receiver to be accommodated. The first part to construct is the framework. This, as shown in Fig. 4, is made of ¾in. by ¾in. stuff with the exception of the side rails at the top and bottom. As these form part of the rounded top and bottom edges they are made of rebated moulding specially made for this purpose and obtainable at any good handicrafts store. Fig. 5 (inset) gives a close up showing how the moulding is joined to the top and side panels of the cabinet. The whole framework is glued and bradded together and then the sycamore panels are cut out and glued and bradded in position. These should preferably be made of veneered plywood. Great care should be exercised in fitting them as failure to make a good joint along the edges will completely spoil the finished appearance. When the panels are in position the brads should be driven right in with a punch, and the holes filled in with wood filler of a suitable colour to match the wood. Incidentally, the colour of the moulding forming the rounded edges of the cabinets may not quite match that of the panels. A little wood stain applied sparingly will rectify this

Of course the front panel of the cabinet will have to be cut for the speaker fret and to accommodate the controls before being fixed in position. The black diagonal pieces across the fret are not genuine ebony but simply part of the panel itself, and are stained black with Indian ink or some such medium to resemble ebony. The same applies to the feet of the cabinet. They are made of mahogany or satin walnut and stained black in a similar manner.

To add rigidity to the front the thickness of the upper portion is increased by screwing an additional board to the back of the fret. This baffle-board has an opening in it coinciding exactly with the fretted opening in the front. When in position the speaker gauze is added. This latter is of old gold tinsel.

The back of the cabinet is fitted with a door for access to the contents as illustrated in Fig. 5. Before securing the back in position the dividing shelf is placed inside and glued to its bearers. The whole thing is finished off by carefully rubbing down, filling all holes and crevices with wood filler, and french polishing.

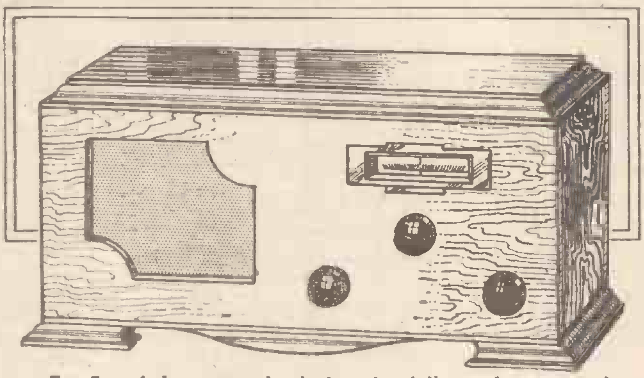


Fig. 7.—A design in oak which makes full use of ornamental mouldings.

TOPICAL TECHNICALITIES.
REACTANCE (CAPACITATIVE)

As mentioned last week, the passage of a current (either H.F. or L.F.) through a coil or condenser is effected by utilising a force to drive it through. The ratio of the voltage (force) to current is the reactance, and is measured in ohms. The formula for calculating this in the case of inductances was given last week, and the formula for a capacity reactance is $\frac{1}{6.28fC}$, *where f is the frequency of the applied current, whilst C is the capacity in farads. As, however, for normal wireless practice capacity is usually given in microfarads, the formula becomes* $\frac{1,000,000}{6.28fC}$. *One application of this formula may be cited in the case of a condenser across the H.T. battery. The usual value of such a condenser is 2 mfds. and, therefore, at 1,000 cycles (speech frequency) the reactance would be* $\frac{1,000,000}{6.28 \times 1,000 \times 2} = 80$ *ohms (approximately). Thus, in a decoupling circuit where a 10,000 ohms resistance is used in conjunction with a 2 mfd. fixed condenser, it is possible to see from this how the condenser offers a lower path (80 ohms) compared with the resistance.*

For H.F. work, where wavelengths are employed in place of frequency, the formula becomes $\frac{\lambda}{1,885C}$, *where λ is in metres and C is in microfarads. Thus a .001 mfd. fixed condenser would offer, at a wavelength of 350 metres, a reactance of* $\frac{350}{1,885 \times .001} = 190$ *ohms (approximately).*

A Simple Mahogany Cabinet

Another design for an upright receiver is illustrated in Fig. 6. This again is of somewhat austere outline, and relies for its effectiveness largely on the finish of the wood. It looks rather nice made in highly polished mahogany. Either plain mahogany or mahogany-faced plywood may be used. The latter is less likely to warp. In this design you will notice that a rectangular opening to harmonize with the speaker opening is cut in the front for the controls. In this case the cabinet is intended for use with a set which has its own ebonite panel on which are arranged the various "knobs." The set simply slides in from the back so that the panel comes flush up against the opening.

The cabinet shown in Figs. 7 and 8 is a good example of the "single decker" type. Fancy moulding plays a large part in the design, but nevertheless the construction is quite simple. The moulding employed is such as is used for making the lids of small cabinets and similar articles. It is rebated along the top edge to take a panel 3/16in. or ¼in. thick. The same pattern is used both for the top of the cabinet and for the base. For the latter a complete strip is used for each side but the middle portion of the front and back strips is removed with a fretsaw to give the pattern shown. The four strips are then glued and screwed together (the corners are mitred, of course) to form a rectangular frame. The middle of the frame is filled in with a plywood panel which fits snugly in the rebates along the top edge of the moulding. In this way a stand is formed which is something like an inverted tea tray. On this the sides of the cabinet are erected. The top of the cabinet is similar to the stand but without the cut-away in the edge of the moulding. You will notice that the end walls of the cabinet are of comparatively thick wood. This is because there is no frame to the cabinet as with the other models. The thick end walls, in conjunction with the moulding top and bottom, serve to give the necessary mechanical strength. However, in order to pass the controls through the front it is necessary that this should be of thin material. It is advisable to glue an additional baffle-board to the back of the panel behind the speaker fret.

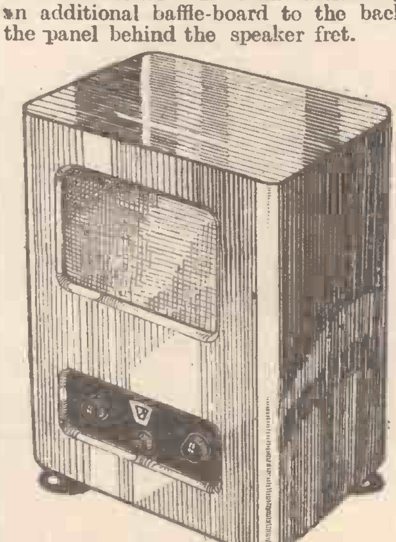


Fig. 6.—Another easily constructed upright cabinet.

(Continued from previous page)

be used. This means that the grid potential must not be made more negative than the point A where the bottom bend of the characteristic begins. The straight line portion of the curve may extend far into the region where the grid has positive potential, but if this part of the curve is used, the output will be distorted owing to the presence of grid current. If the part of the curve to the right of B is used, grid current commences, and, due to the resistance of the transformer secondary or, in the case of resistance capacity coupling, the resistance of the bias resistance, the grid will acquire an extra negative bias, which will cause the flattening of the peaks in the output wave, and consequently distortion will occur. Thus, in a Class A amplifier, the proper biasing point is midway between the zero bias point and the point where the bottom bend of the valve curve appears. The permissible grid swing under these conditions is equal to twice the bias value, and distortion will undoubtably occur if these limits are exceeded.

Q.P.-P. and Class B

In the case of Q.P.-P. it is only necessary to change the value of the grid bias in a common push-pull stage, whilst in the case of Class B it is necessary to have special transformers and valves. Q.P.-P. is only really an introduction to Class B, a stepping stone between the Class A and the Class B systems. In true Class B grid current is present, and the components must be so designed that this does not cause appreciable distortion.

There is no need whatever for the two valves in a Class B amplifier to be in the same bulb; it is merely a matter of convenience to make the valve thus. The only property which the valves must have is that they must be capable of passing grid current, that is to say, that the grids must be of such a construction that they can stand the grid current; many valves which would otherwise be quite suitable for Class B working are unsuitable as they cannot be driven into grid current without harm to the valve. Another property which is desirable in the case of valves for Class B is that the straight part of the characteristic curve should approach near to the zero current line; that is to say, the bottom bend should be short. It is assumed that most readers know the elementary principles of Class B working, and how the valves are biased to nearly zero current. If, as in Fig. 3, the valves in use had a straight line characteristic and no bottom bend, and were to be biased to zero current for Class B working, then distortionless amplification would be possible, since the wave form shown on the right is the exact replica of half of the input wave form. The other half is put in by the other side of the circuit, as usual. But in practice it is not possible to make a valve with a straight characteristic, and the curve must be as in Fig. 4. The biasing point is then at P, and a small quiescent current flows when there is no drive on the valve. The curve in the characteristic must cause some distortion in the output wave, so that a valve with a very small bottom bend in its characteristic must be used. The most important distortion is, however, likely to occur due to grid current being allowed to flow without the grid circuit being properly designed to carry it.

The distortion due to grid current is similar to that which occurs in a Class A amplifier, viz., the flattening of the peaks in the output wave-form. For no distortion to occur when grid current flows, the resistance of the grid circuit, the R of Fig. 1, must be made very small. R may be the resistance of a bias resistance, a transformer, or a choke, according to the coupling system, but whatever it is, the resistance must be small. The transformer is used for the input coupler in a Class B stage in nearly all cases. The fact that the secondary resistance must be small leads to a small number of secondary turns and thus a low ratio. The number of primary turns cannot be reduced because its impedance would then be too low.

Since current flows through the transformer secondary and there is, of course, voltage present, the transformer must not only transform voltage, but also power. This power may be quite considerable and the previous stage must be capable of supplying it without distortion. Thus the driver stage must use a power valve. In a Class A amplifier there is no grid current and the transformer is only required to give a voltage input to the grid of the amplifier valve. The previous stage need then be so designed as to give a high gain of voltage only, and the power output may be extremely small. When a power valve is used as a driving amplifier the amplification factor of the valve is low and there is only a small voltage gain. It is obvious then, that a driver and Class B amplifier cannot give the gain of two Class A stages, but they are capable of giving a far greater output under the same voltage conditions. It should also be remembered that the Class B system cannot possibly give the same quality as a suitably designed Class A amplifier. Where there is ample power available it is better to stick to Class A if faultless reproduction is required.

THE PROGRESSIVE EXPERIMENTER

(Continued from page 470)

and you might even think that it is wrong. The tuning condenser for the tuned-anode coil is not connected directly across the coil as might be expected, but is joined between the "anode" and earth. As a matter of fact, this arrangement gives precisely the same effect as if the condenser were in the more usual position. The reason for this is that the moving vanes of the condenser are joined to the end of the coil "through" the high-tension battery, which has a negligible resistance. There is a distinct advantage to be gained from the method of connection employed, because it is possible to use a gang condenser of normal type, whereas if the tuned-anode section were joined between the two ends of the tuner a special component, in which the moving vanes of both sections of the condenser were insulated from each other and from the drum drive, would be required. The only disadvantage is that if the moving and fixed vanes of the condenser were to touch each other the high-tension battery would be short-circuited. This trouble will not occur with well-made condensers of the types specified.

Operating the Three-Valve "Progressor"

And now for the practical details. After completing the wiring as shown in Fig. 1, insert the new valve in its holder and connect the flexible lead from terminal 4 on the second coil to the anode terminal mounted on top of the glass bulb. First of all fit the crocodile clip connected to the pre-set condenser to terminal 4 on the first coil. Next insert wander plug "H.T.2" into the 60-volt socket on the H.T. battery and then switch on.

Set reaction to zero and then rotate the tuning condenser knob until the dial reading is that previously found for the local station. This station will probably be heard at about the same strength as before, but it might be even weaker until the necessary trimming adjustments have been carried out. In any case, once you have convinced yourself that the set *is* working, find a station that can only just be heard. This will be used as a basis for accurately ganging the tuned circuits.

If you are using the Telsen tuning condensers specified in the first article of this series you can most probably obtain correct matching merely by rotating the smaller concentric knob of the drum drive. Should it be found impossible to obtain the proper setting by this means, you should try altering the trimmer on the new condenser; this is adjusted by screwing a wing nut which is situated between the two terminals on the end plate.

"Trimming" the Condensers

Supposing the J.B. tuning condensers and drive are being used, the method of trimming will be quite different. There is no trimmer provided, but instead the position of the moving vanes on the spindle of the left-hand condenser will be varied. To do this you simply slacken the grub screw going through the large brass boss at the end of the spindle and move the vanes very slightly, first in one direction and then in the other, with the fingers. In doing this trimming it might be found necessary occasionally to alter the dial reading in order to bring in the transmission at maximum strength. If by any chance it is found that correct ganging cannot be obtained with any setting of the condensers, it will clearly be indicated that some mistake has been made in winding the second tuner, and the turns should carefully be checked.

Once you have got the H.F. amplifier into "working order," some further experiments in regard to selectivity can be taken in hand. The first thing is to alter the pre-set condenser and then to try connecting the crocodile clip first to terminal 1 and then to terminal 5. Maximum selectivity will be obtained with the clip on terminal 5 and with the knob of the pre-set screwed up as far as it will go. Under those conditions the set will not be very sensitive, however, and distant stations will probably be received rather poorly. The best long-distance reception will be obtained when the crocodile clip is on terminal 1 and the pre-set adjusted to its optimum position, but the degree of selectivity will not then be very high. It should be mentioned that a slight alteration to the condenser trimming adjustment will probably be necessary after each change in the selectivity settings.

When changing from long to medium waves with the set in its present form it will be necessary not only to pull out the knob of the (left-hand) wave-change switch, but also to bridge terminals 3 and 2 on the tuned-anode coil. This is done by attaching the crocodile clip joined to terminal 3 on to terminal 2. When we change over to tuned-grid coupling the wavechange switch will be made to act upon both coils, but at present that is impossible due to the fact that one is in the high-tension and the other in the low-tension circuit. For long-wave reception the clip is simply left on terminal 3.

OUR VIEWS ON RECEIVERS

The Cossor A.C. Superheterodyne Model 635

THE Cossor A.C. receiver, model 635, is an outstanding example of modern superhet design, and, although built on well-tried principles, its creators have not hesitated to enter into new fields where worth-while innovations were possible.

The initial detector valve is not preceded by a high-frequency stage, the possibility of a second channel interference being prevented by a pre-selector tuner. It would probably be more correct if this tuner were referred to as two tuned circuits rather than band-pass, as both the appearance of the circuit, and the set when handled, give the impression that these circuits do not constitute a band-pass arrangement in the accepted sense, tuning being extremely sharp.

Three-quarter view of the Cossor A.C. Superhet Model 635.

The first valve is a Cossor variable-mu high-frequency pentode (MVS/Pen), having its suppressor grid brought out to a separate connection and not joined internally to the cathode in the customary manner. The reason for this is that the output from the separate oscillator valve may be injected into the detector circuit by way of this extra grid, instead of the more normal arrangement of coupling the oscillator to anode or cathode.

The reason for connecting the oscillator valve (which, incidentally, is a Cossor 41 M.P. power valve) in this manner is to prevent the oscillator tuning condenser from "dragging" the preceding tuned circuit off its proper wave-length.

It will be remembered that the suppressor grid is nearest the anode, consequently the screening grid acts as an almost perfect shield between the anode and control grid of this valve, thus preventing the oscillator circuit from having any appreciable influence over the aerial and grid circuit tuning. This is an extremely ingenious means of overcoming the troublesome problem of stopping the oscillator circuit in a superheterodyne from pulling the grid circuit out of tune.

There is only a single intermediate frequency valve, which is another variable-mu high-frequency pentode, the stage being designed to give the very greatest gain, which can be an alarming figure with a valve of this type.

The second detector is an MSG/HA screened-grid valve, working at anode bend, resistance-capacity coupled to an indirectly-heated pentode output valve, Cossor MP/Pen. The power-pack is of conventional design, but the smoothing is rather more heavy than customary.

There is only one I.F. valve, and the detector is R.C. coupled, and after considering the circuit details it might be assumed that the over-all amplification of the set is low. On the contrary, the overall amplification is extraordinarily high, and forms indisputable testimony that five valves properly used can be capable of far better results than a similar number of valves used in a manner not conducive to producing their maximum efficiency; the measured amplification of this set (input to output) is over 1,000,000 times.

As will be seen from the illustration, the cabinet is of very pleasing and modern design, fitted with three variable controls, or, more strictly speaking, two variable controls, as the tone-control is not required for station selection. The upper knob controls the illuminated dial, which is calibrated in metres from 200 to 570 on medium waves, and 1,000 to 2,000 on the long waves, both wavebands being adequately covered when tested with a heterodyne wave-meter.

The knob immediately below the tone-control acts as combined volume-control and mains on-off switch. The remaining one (on the left), as already intimated, is a tone control.

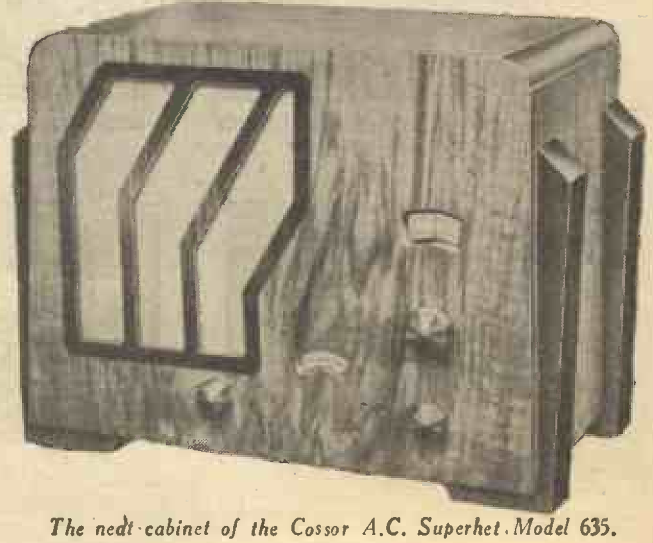
The receiver was first tested on an aerial rather more than sixty feet long at approximately twenty miles from Brookmans Park, and it was instantly apparent that the selectivity was well above the average even for a superhet; so sharp, in fact, that a few moments were necessary in order to master it. The volume control was extremely smooth in action, and gave a complete range from dead silence to maximum volume. The tone control was also very nicely balanced, as the range of tone available was such that any person would be satisfied, and it did not range from a shrieking treble to a depth where all pretence of music is lost.

As the high overall amplification of this receiver would lead one to expect, the number of stations received on this set in a single hour were more than enough to satisfy the most critical user. A mains aerial is also provided, suitable for use when local stations only are required, although it was found that quite a number of stations were received at excellent volume, rendering the mains aerial extremely useful when it is desired to use the set in a room where an aerial is not connected.

The quality of this receiver leaves nothing whatever to be desired; at full volume the Cossor MP/Pen. can deliver its full output without the least sign of distress. Similarly, the mains-energized loud-speaker gave us the impression that it could handle far more than was ever likely to be demanded from it. The balance of the musical register was excellently preserved, while the bass was there in correct proportion without any tendency towards booming. There is a striking absence of mains hum, and the background is silent though the overall amplification is very high as already mentioned.

Many otherwise excellent receivers do not do justice to themselves when a gramophone pickup is connected, but this criticism cannot possibly be levelled at the Cossor 635, as its reproduction of gramophone records is equal in every way to the quality on radio. The tone control covers a sufficiently wide range to completely kill needle scratch, always providing, of course, that the listener is willing to sacrifice a certain amount of high notes; but those who prefer to retain this brilliance and who are willing to tolerate the needle scratch, are perfectly catered for, as the tone control will permit reproduction well above the natural cut-off of the gramophone record itself.

The Cossor Model 635 is available for 200 to 250 volts, 40 to 100 cycles only, at fourteen guineas, which is very moderate for such an excellent receiver.



The neat cabinet of the Cossor A.C. Superhet Model 635.

TELE-TALKIE TOPICS

By H. J. BARTON CHAPPLE, Wh.Sch., B.Sc. (Hons.), A.C.G.I., D.I.C., A.M.I.E.E.

IN PRACTICAL WIRELESS dated 14th October, I stated that the first ultra-short-wave Baird television transmissions from the Crystal Palace towers would be on a wavelength of 6.05 metres, but it is now learnt that this wavelength has been altered to 6.25 metres. No further data has yet come to hand, but in the meantime, owing to the great importance which is being attached to this work, it is extremely interesting to see what other experiments have been conducted in this relatively unexplored region.

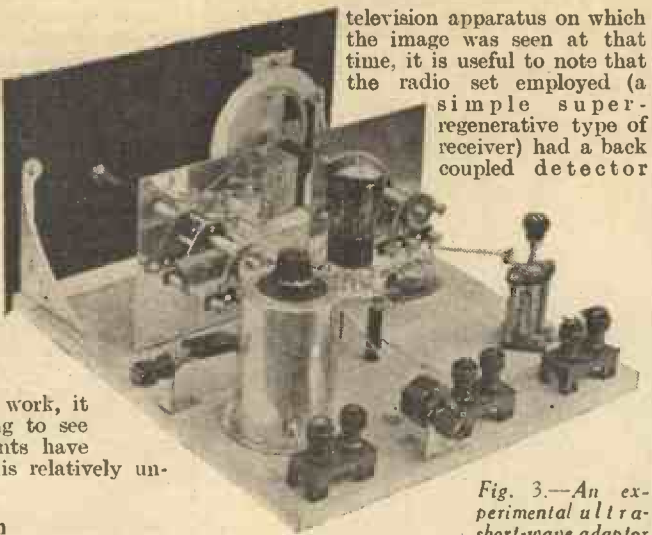


Fig. 3.—An experimental ultra-short-wave adaptor suitable for receiving television signals.

The First Transmission

It was on April 29th, 1932, that the first ultra-short-wave television demonstration was given to the Press in this country, the wavelength then used being 6.1 metres. On that occasion, only a standard vertically scanned thirty-line image was seen, the prime object of the demonstration being to prove the value of work on these short waves. The aerial was situated on the roof of a small brick hut erected on the flat roof of the Baird Company's premises in Long Acre. This is seen clearly in Fig. 1, and consisted of two vertical copper rods with a meter registering the aerial current in the centre.

The total length of the pair of rods was half a wavelength (that is, 3.05 metres), and from a study of the photograph it will be seen that the pair of transmission lines to the aerial made separate connections to the copper rods in such a position that the total length was split into three. Prior to this the parallel wires had emanated from the extremities of a coil inductively coupled to the main oscillator drive and passed through large insulators.

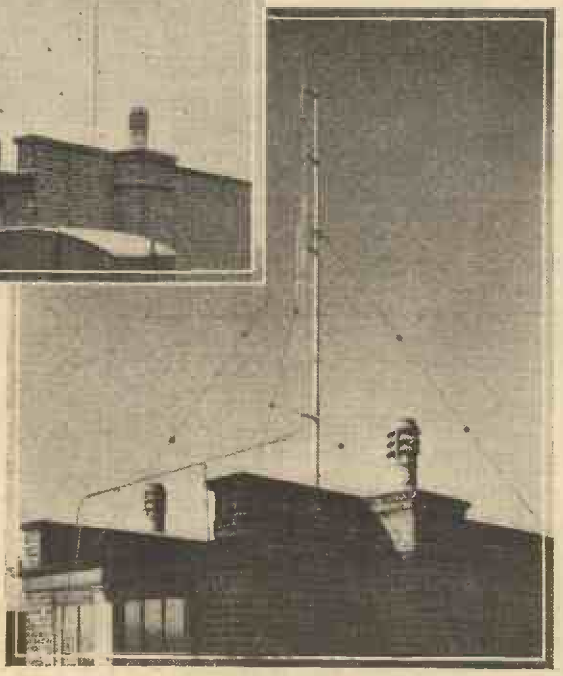


Fig. 1.—(above) The first ultra-short-wave aerial used for television transmissions. Fig. 2.—(below) The improved form of aerial feed which was introduced later.

Aerial Improvements

Apart from the mirror drum television apparatus on which the image was seen at that time, it is useful to note that the radio set employed (a simple super-regenerative type of receiver) had a back coupled detector valve feeding to a resistance capacity coupled low-frequency amplifier fed from the mains. A large number of experiments were carried out in order to effect improvements, and one of the first to be registered was in the "feed" to the aerial system. This will be

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TELE-TALKIE TOPICS

(Continued from previous page)

made clearer by a reference to Fig. 2. Obviously, one of the main criterions of the transmitting end is a perfectly steady signal maintained exactly on its correct wavelength. To assist this, the original pair of feeders was replaced by a pair of burnished ½in. diameter copper tubes. Stayed insulators maintained these at a distance of 4in. apart until they reached the aerial proper. One tube then made metallic and electrical contact with the base of the bottom aerial rod, while the other aerial feed remained free. The object of this arrangement is to neutralize any tendency to radiation which may occur in the main tubular feed.

Another Scheme

The prime consideration of rigidity in construction and simplicity in erection was practically demonstrated by this scheme—known as the "Zepp" aerial, and is admirably adapted to those situations where an aerial has to be erected on the roof of the transmitting hut.

Under some circumstances it is found better to employ two concentric tubes, say, an inner tube of ½in. diameter to serve as a main feed, while the outer tube, of about 2in. diameter, performs the function of neutralizing radiation tendencies.

Another variation is a centre wire or tubular main feed with a ring of four to six wires surrounding this. Details concerning the actual Crystal Palace installation are not yet available, but signals are now on the air, and I am conducting some special experiments in reception for the benefit of readers of PRACTICAL WIRELESS. As soon as definite results can be obtained these will be published, but for the first work the only additional apparatus I am developing is an ultra-short-wave adaptor, and the first model of this, which I have built, is seen in Fig. 3. By connecting this between the aerial system and the ordinary set used for the reception of the broadcast television signals, it has the virtual effect of converting the latter into a superheterodyne receiver. The ultra-short waves open up an entirely new vista in the television field, and readers are advised to watch these columns for the first details of the new developments.

By E. REID-WARR

Heading the List

IN my last notes the great treat of the month was Beethoven's "Fifth." Again we are given another treasure from the same source, *The Third Piano Concerto* played by Artur Schnabel and the London Philharmonic Orchestra. The records are *H.M.V. DB*1940–44. As in all Beethoven's pieces, there is a perfectly painted picture with the most fascinating colours to be found even by perfectly commonplace folk. Beethoven, perhaps, dreamed of the day when there would be thousands of "ordinary listeners," and saw exactly how to delight them. There are no fantastic effects in this concerto: it is just a happy, simple thing really, yet rich in understandable harmony. Hear it and fit your own picture to it. Schnabel and the London Philharmonic Orchestra have striven as one to paint its scenes and to send its message—as noble a musical triumph as you will hear.

Now away to *Russia*. This is the title of a Symphonic Poem by Balakirew on two 10in. *Columbia records DB*1236–7. There is a reason for especial mention of these records which has nothing to do with the merits or demerits of the piece. It was the first work to be recorded under the new conditions at the Columbia Studio, conditions brought about by tremendous alterations in search of that elusive perfect acoustic factor. The engineers did *not* use the word "Eureka!"—it was probably a laconic "Got it!" but that they have made a big advance in orchestral recording was generously agreed by Sir Hamilton Harty who conducts the London Philharmonic in this work. You will hear in this splendid basic example of the modern Russian School instruments with a fidelity never heard before (the harp, for instance), and the musical public must be duly grateful to Columbia in making another great advance for their delight.

A very worthy companion to the last is the delightful *Water Music Suite* by *Handel*. The same fine orchestra and famous conductor as in *Russia* give it. Sir Hamilton Harty, by the way, transcribed the six movements on these records—*Columbia DX*538–9. The legend which goes with this Suite is that it was the *amende honorable* by the composer to George I after a quarrel. The music, played from a boat following the royal barge up the Thames, resulted in the reinstatement of Handel in the King's favour. No wonder the little Hanoverian was captivated. The records comprise a delightful suite showing Handel gay and sad. Not the Handel of the *Origin of Design*, for instance, but the composer of contemplative, spacious music—until we come to the last movement (Allegro deciso). Then music of the Handel we all know, and which no other composer (except Bach) could have written. Hear these two gloriously played records: there have been nothing quite like them for a long time.

Back to Russia for a moment for the *Overture from Russlan and Ludmila* by Glinka on *Parlophone R*1631. This piece sounds astonishingly modern and mostly very un-Russian—but the performance is interesting as a landmark in Russian music.

Handel is having quite a month with Columbia. There are three more records—*The Handel Series* (*DB*1212–4) of a number of well-known Handelian pieces. Now these have a unique interest—they are played by the British Light Orchestra *just as Handel wrote them.* They are strangely simple and intimate, and the lovers of this composer will find much appeal in these records. No elaboration or fine effects—just plain melody.

Distinguished Pleasantries

We can revel in a host of lively, popular music this month. Some old friends appear in new guise; for light music occasionally needs "spring-cleaning," so to speak, and there are many clever performers and arrangers hard at work doing this. Here, for instance are two favourites—*The Forge in the Forest* and the *Turkish Patrol* on *H.M.V. B*8000. These two delightfully vivid pieces are in safe hands with the London Palladium Orchestra. Everybody knows its dashing, clean playing. Then two little tunes with very fragrant names—*Wood Violets* and *Cornflowers* played by the Dajos Bela Orchestra (the new one) on *Parlophone R*1608. Fetras and Waldteufel wrote them, so you know you will be able to whistle both quite easily. Another *Parlophone record* (*R*1628) entertained me greatly. It is *The Pussy Cats' Parade* and *The Gnomes Guard*. Eric Harden's Orchestra do them in a modern "cinema" style which will attract ninety-nine cheerful folk out of every hundred. The "Blue Danube" school have a record in *Maidens of Baden* and *Dream Waltz* (*H.M.V. C*2559). Marek Weber's Orchestra play it—so that's that!

Now for something at once daring and brilliant. Few are unacquainted with Fetras's *Moonlight on the Alster* and Fall's *Dollar Princess Waltz*. Now these in their old form may have seemed a little anæmic to our modern young folk: in fact, I have seen more than one lip curl at the Viennese tradition! Well, here is the answer. These arrangements are by a very clever musician who is at home with anybody from J. S. Bach onwards! There is none of your *Tin Pan Alley* cacophony here, but new arrangements and new orchestration which is most striking.

Do hear *Columbia DB*1208—by the Bohemians—you'll *all* enjoy it.

IMPRESSIONS ON THE WAX

(Continued from previous page)

Two other old favourites, played with much pomp and power, are Sinding's *Rustle of Spring* and Waldteufel's *Tres Jolie Waltz* on *Parlophone R*1632. A Grand Symphony Orchestra are the performers. A pleasant little trifle, with "novelty" effects, is *Pirouette* and *Melodie Caprice* by the Novelty Players on *Parlophone R*1627. Then two superb full-blooded ones by Edith Lorand's Viennese Orchestra, first-rate as ever. Hear the *Merry Widow Waltz* (Paraphrase), and *Dorfkinder Waltz* (Gipsy Princess) on *Parlophone R*1639). Also *I Want to be in Grinzing Once Again* and *My Darling* (Gipsy Baron) on *Parlophone R*1625. There is some wonderful fiddling in the first of these two, by the way. I must give a word of praise to the performance of Luigini's *Ballet Egyptien* (*Sterno* 5004), by Joseph Lewis's Orchestra. There appears to be a prodigious amount of quite well-played music on this 10in. record. A similar successful long-playing Sterno record is Coates's *Symphonic Rhapsody* No. 5005. Here those very good wireless performers—Reginald King's Orchestra—give a very sound rendering of this strange piece, which has had something of a vogue. I liked very much both tune and playing of *Throw Open Wide Your Window,* which is backed by *Gipsy Sing for Me, Sterno* 1253.

Songs of all Kinds

A record about which considerable talk has been heard is the revivified Tetrazzini. She sings *Una Voce Poco Fa* and *Caro Nome* with new orchestral support, on *H.M.V. DB*1979. Frankly, I do not think it quite reaches the uncanny realism of Caruso's rejuvenations. Someone asked a perfectly natural question—why, as this wonderful singer is still happily with us, could she not re-record these two? His view was that electrical recording could then give us Tetrazzini as we are accustomed to hear great singers recorded nowadays.

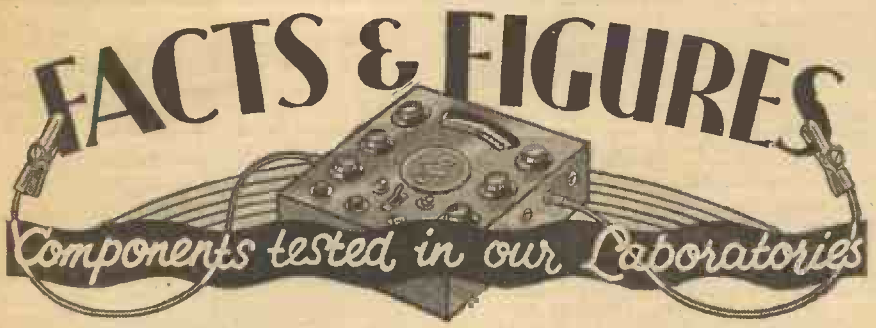
To more H.M.V. vocal records of delightful character are Gigli's *Chanson Indoue* and *Triste Maggio* (*Da*1307). Amazing contrast will be noticed between the dreamy first piece and the fiery second one. But it makes no difference to this singer; his voice and style seem able to surmount any vocal problem. The second is a Spanish singer—Tirado, and his pair of somewhat delicate texture are *Te Quiero Dijiste* and *Cancione Florecita* (*B*4497). You have here a tenor with a beautifully smooth voice, which is under admirable control, and seems to have something in reserve. (This almost sounds like a comment on a motor-car, but I'm sure these qualities are good in both!) Anyway—hear Tirado; he's very good.

RADIO COLLEGE SUCCESS

Mr. R. H. Bradley, Director of Studies of the Technical and Commercial Radio College, tells us that many PRACTICAL WIRELESS readers have enrolled on the register of students and are already making good progress.

As we mentioned a few weeks ago, their courses have been prepared in an easily assimilated and interesting fashion by men who have had extensive experience in all branches of the Radio trade, and hence are in a unique position to comprehend and smooth away students' difficulties.

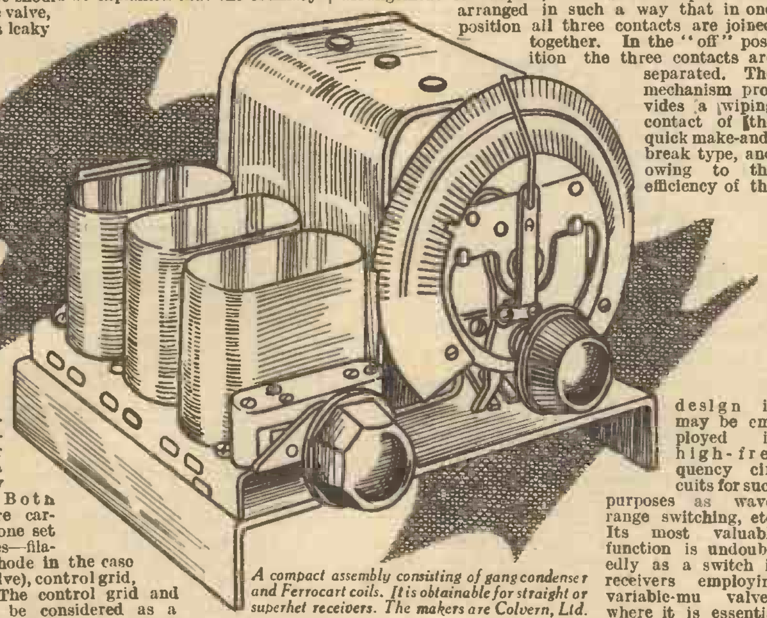
Readers who have not yet obtained details should write to the Technical and Commercial Radio College, Lloyds Place, Blackheath, S.E.



A NEW THREE-IN-ONE VALVE

ONE of the most interesting of the new types of valve produced in a season which has seen many spectacular developments in valve technique is the double-diode-triode, Type T.D.D.4, recently released by the Mullard Company. This type of valve will play a big part in the design of radio sets in the future, and because its design and operation differ so greatly from the ordinary three-electrode valves hitherto used as detectors, some notes upon the principle of the double-diode-triode should be of interest.

First of all it should be explained that the ordinary three-electrode valve, when used as a leaky grid detector, performs two distinct functions; it operates as a half-wave rectifier and also as a low-frequency amplifier. Both operations are carried out by one set of electrodes—filament (or cathode in the case of a mains valve), control grid, and anode. The control grid and cathode may be considered as a two-electrode rectifier, while all three electrodes are used for amplification. Although ordinary detectors function quite satisfactorily, the operating conditions most favourable for good detection are not the best suited for distortionless amplification. Consequently a compromise has to be struck, and neither function is performed quite so efficiently as it would be under ideal conditions.



A compact assembly consisting of gang condenser and Ferrocart coils. It is obtainable for straight or superhet receivers. The makers are Colvern, Ltd.

In the double-diode-triode, the two duties of the valve—detection and amplification—are carried out by separate sets of electrodes. The T.D.D.4 consists of two small diodes (or two-electrode valves), and one triode (or three-electrode valve), contained in one bulb, the only element common to all three sections being the cathode. One method of using the T.D.D.4 is to employ both diode portions for full-wave rectification, the output of this section of the valve being then passed to the grid of the triode portion for low-frequency amplification prior to the output stage.

By the aid of the T.D.D.4, however, a more perfect form of A.V. control can be applied, namely, that which is known as amplified and delayed control. In this system the triode portion of the T.D.D.4 not only amplifies the audio-frequency signal but also amplifies the rectified carrier voltage, thus providing a much larger controlling bias voltage. Moreover, the circuit can be so arranged that no control is exercised on any signal below a certain pre-determined strength so that all signals normally receivable are amplified up to this strength, and up to this strength only, thus maintaining a much more uniform volume level.

The T.D.D.4 is an indirectly-heated valve for use in A.C. mains receivers. The heater takes its supply from the 4-volt winding of the power transformer, but its heater current is slightly greater than that of ordinary triodes, being 1.2 amperes. It is rated for a maximum anode voltage of 200 and, so far as the triode portion is concerned, it has the following characteristics:—

Anode Impedance	..	15,000 ohms.
Amplification Factor	..	30
Mutual Conductance	..	2.0 mA.-Volt.

It should be noted that this valve is supplied with metallized bulb only and that it is fitted with the new standard seven-pin base. The grid of the triode portion is connected to the top cap of the valve. The price is 15s. 6d.

NEW BULGIN ROTARY SWITCH

A NEW switch is now added to the already vast Bulgin range, and takes the form of a rotary 3-point switch. The original pattern of this switch is, of course, well known in connection with its use as a radio-gramophone change-over switch, a function which it fulfils admirably. In the new type the same arrangement is adopted, but the three points are arranged in such a way that in one position all three contacts are joined together. In the "off" position the three contacts are separated. The mechanism provides a wiping contact of the quick make-and-break type, and owing to the efficiency of the design it may be employed in high-frequency circuits for such purposes as wave-range switching, etc. Its most valuable function is undoubtedly as a switch in receivers employing variable-mu valves, where it is essential to switch off not only the L.T. and H.T., but also to disconnect the grid-bias battery from earth to avoid leakage. The switch works with a delightful action, and we can say no more for it than that it is up to the usual high standard of Bulgin switches. It is obtainable with indicating plate for 2s., and may be used in practically any position in a receiver, provided the current does not exceed .5 amps. or so. It fully justifies Messrs. Bulgin's slogan "The Choice of Critics."

PICKETT'S CABINETS

NOT the least important part of the wireless outfit is the cabinet, and many listeners no doubt pay more attention to this part of the equipment than the receiver proper. It is certain that the results from a very good receiver may be marred if a thin, resonant cabinet is used, and it is also equally certain that, when a really good cabinet is employed, not only is the general appearance enhanced, but the tone benefits to a great extent. The Pickett cabinets are known as "Piano-Tone," from the fact that they are built up, not with thin three-ply wood, but from solid timber, accurately jointed, and correctly designed. The illustration shows the

(Continued overleaf)

The Pickett "Royal-Grand" radiogram cabinet.

(Continued from previous page)

latest radio-gram cabinet, the Royal-Grand. As may be seen, a cut-out is provided for the panel portion of the receiver, and a piece of timber matching the cabinet is fitted to receive the controls. This prevents unsightliness by preserving an even appearance over the whole front of the cabinet. Thus, if at any future date it is decided to replace the receiver portion, a new piece of wood may be obtained and the fresh controls mounted without spoiling the cabinet or the control arrangement.

PIX MODULA

CONTROL from the arm-chair. This is in principle the function of the Pix device bearing the above name. We all know how, during an evening's programme, the items vary from those which we like extremely well to those which we detest, and on more than one occasion during an evening's enjoyment the pleasure is marred by sudden blasts of music at such a strength that it either jars on the nerves or overloads the output valve and thus causes a similar distressing effect. Of course, the sound technician will say that the set should not be worked at that point, or alternatively automatic volume control should be fitted, but many receivers are not so equipped, and, moreover, the majority of listeners prefer to work their receivers "full out." With the Modula it is possible, from the arm-chair, to vary the volume at will, even if the receiver is situated many feet away. The device consists of a small cardboard disc bearing a number of holes, a long flexible lead, and a variable resistance at the other end of the lead. The perforated disc is used in conjunction with the output valve of the receiver, and owing to the peculiar arrangement of the perforations it may be used with battery valves, indirectly heated valves, four-pin valves or five-pin valves, and even with American type valves. In some cases it is only necessary to arrange the disc in the correct position to accommodate the valve legs, but in others it is necessary to cut the disc up the centre and to arrange the two halves. All this is explained in the instructions accompanying the device. In effect, the variable resistance has to be joined in the grid circuit of the output valve, and thus it is possible to by-pass a certain percentage of the signal to earth. The device works very smoothly, and in the majority of circuits no further alteration is necessary. In some cases, however, it would be preferable to slightly modify the circuit in order to preserve the original balance of reproduction. At 2s. 11d. this device represents a valuable acquisition for the listener with an ear for better balance, and comfort.

VARLEY ELECTRONIC RESISTANCES

A VERY neat range of resistances is marketed by Messrs. Varley under the above name. These are of a composition type fitted with metal caps and wire ends. The appearance is improved, and the advantages of the resistance increased, by fitting an insulated sleeve completely over the entire resistance. This is of the braided cotton material (similar to systoflex sleeving) having a highly glazed green surface, upon which is clearly marked in bright colour the name of the makers, together with the resistance and the wattage rating. It is thus impossible to be in doubt at any time regarding the value of the resistance, and there is absolutely no risk of short-circuits due to the body of the resistance coming into contact with some other part of a circuit. The resistances are obtainable in ratings of 1 watt, 2 watts, and 3 watts. The lowest rating may be obtained in values from 100 ohms up to 5 megohms, whilst the remaining two ratings are obtainable from 100 ohms up to 50,000 ohms. The prices are respectively 9d., 1s. 6d., and 2s. 6d.

NEW MARCONIPHONE RECEIVERS

TWO new Marconiphone Receivers were released on the 7th instant, one battery and one mains. The battery receiver is Model 269, a 6-valve portable superhet with delayed A.V.C. and a dual output stage, employing two pentodes arranged in the new Parallel Conductance Principle. Provision for extra speakers, gramophone pick-up, and extremely low current consumption are other notable features. The price is 15 guineas. The second model is 271, an all-mains radiogramophone, employing 4 valves for A.C. and 3 for D.C. The price is 23 guineas.

FERRANTI "LANCASTRIA" RECEIVERS

A NEW 5-valve superheterodyne receiver is announced by Messrs. Ferranti. The chassis is the same as in the original "Lancastria" receiver, but a different type of cabinet is employed. The original "Lancastria" will be continued under the title "Lancastria Parva," and the price will be 13½ guineas. The new receiver will be known as the "Lancastria Magna," and will cost 15 guineas.

NEW BAKER SPEAKER

AN ingenious new loud-speaker is announced from Baker's "Selhurst" Radio. This is a massive assembly having an 8in. cone, and a neat enclosed magnet and transformer mounted at the rear. The upper surface of the magnet casing is provided with an ebonite plate upon which are nine sockets and three terminals. Two sets of plugs are used with these sockets, and the impedance may be accurately matched, and the tone varied over wide ranges. The three terminals enable the speaker to be used with triode output valves, or push-pull arrangements. The speech coil is of novel form, employing a four-layer winding, and is able to handle outputs up to 5 watts. The price is 45s.

CATALOGUES RECEIVED

To save readers trouble, we undertake to send on catalogues of any of our advertisers. Merely state, on a postcard, the names of the firms from whom you require catalogues, and address it to "Catalogue," PRACTICAL WIRELESS, Geo. Newnes, Ltd., 8/11, Southampton St., Strand, London, W.C.2. Where advertisers make a charge, or require postage, this should be enclosed with applications for catalogues. No other correspondence whatsoever should be enclosed.

MAGNUM COMPONENTS

A USEFUL range of components, including a twin control unit, a dissolver for controlling the volume of radio gramophones, magnadensers, potentiometers, ganging switches, aluminium screening boxes and panel brackets, is shown in a folder we have received from Burne-Jones and Co., Ltd., Magnum House, 296, Borough High Street, London, S.E.1. The new tone control unit consists of a combined reaction condenser with vanes of a special formation, and also a volume control as a compact and self-contained unit controlled by a single knob. The dissolver is a neat little component which enables the switching over from radio to gramophone, or from one gramophone to another to be progressive by fading-out one programme and, at the same time, bringing in gradually the other programme. A separate leaflet gives particulars of the Magnum slow-motion dial, which is suitable for panel mounting, direct to base-board, or to the frame of a ganged condenser. The drive is 6 to 1 ratio, and is of the smooth non-slipping type, and adequate for driving a four-gang condenser. A well-modelled escutcheon of oxidized copper finish is fitted, and also a pilot lampholder for rear illumination. The dial, which is adaptable to all makes of air-spaced and solid dielectric condensers, is priced at 3s. Copies of either the folder or leaflet can be obtained from the above address.

NEW CLASS "B" MAINS UNIT

FOR a mains unit to fulfil its function satisfactorily it must be built on sound engineering principles with the best quality materials. The new B.M.U. Super, Model No. B.A.55 (for A.C. mains), is a high-class unit built for performance, and contains neither gas-discharge stabilizers, half-wave rectification, nor ballast resistances. Instead, a special automatic voltage regulator is employed which enables the unit to give a really steady voltage output over a very wide range of current values. Although this unit will handle a continuous current of 55 mA., it takes up no more room than an ordinary H.T. battery. Full particulars of the unit are given in a folder we have received from the British Mains Unit Company, "Cromwell House," Fulwood Place, High Holborn, London, W.C.1.

LISSEN COMPONENTS

AN extensive range of these well-known components is given in the latest folder issued by Lissen, Ltd. The new Lissen iron-cored coils are, of course, included, and these coils have iron-dust cores which so increase the efficiency that coils of very small dimensions can be manufactured. Litz wire is used, and every strand is carefully insulated from the others until it reaches the point where it is soldered to the terminal. There are several types of these coils available, suitable either for aerial coils, band-pass, tuned-anode circuits, tuned-grid circuits, and windings are provided for reaction. Amongst the other components listed are the Lissen superhet three-ganged coil unit, dual and four-range coils, variable and fixed condensers, valve-holders, switches, chokes, potentiometers, wire-wound resistances, and the popular Lissen H.T. eliminators. Transformers, loud-speakers, and balanced armature units are also listed, together with the new Lissen permanent-magnet moving-coil loud-speaker. This high-class instrument is fitted with a universal transformer, and is suitable for use with either power valves, pentode valves, class "B," or Q.P.-P. circuits. Copies of the folder can be obtained from Lissen, Ltd., Lissenium Works, Worple Road, Isleworth, Middlesex.

WEBB'S RADIO SERVICE

WE are informed that Messrs. Webb's London branch at 164, Charing Cross Road, London, W.C.2, has been removed to more commodious premises situated at 14, Soho Street (off Oxford Street), London, W.1, from which address the Eddystone Service will in future be carried on.

Replies to Broadcast Queries

RAKEMIN (Nottingham): We can trace the following call signs: G5PH, B. F. Phillips, 144a, Cwm Road, Bonymaen, Swansea (Glam.); G5PL, J. A. Philpot, 21, Casino Avenue, Herne Hill, S.E.24; G5BH, A. V. Simpson, 27, Milnrow Road, Rochdale (Lancs.); G6SM, S. G. Morgan, 3, High Street, Croydon (Surrey); F8WC, P. Blanchon, Fourneaux (Creuse), France; F8TQ, Vermont, 4, rue de la Victoire, Soissons (Aisne), France. Cannot trace Belgian amateur ON4VC, but advise you to write: *Reseau Belge, 33, rue Alphonse Renard, Brussels, XI, Belgium.* A CONSTANT READER (Glasgow): Surely this was W3XL, Bound Brook (N.J.), on 46.69 m. (6,425 kc/s), which has several times lately been heard in communication with the *Graf Zeppelin*. If you are sure wavelength was lower than this, then the 2nd harmonic of 46.69 m. (23.34 m.). G. MATHIAS (Hanwell): G2BY, H. A. Whatley, "Lyndhurst," Great West Road, Lampton (Middlesex). E. A. A. HARDWICK (Somerset): G6OS, J. W. Gill, 37, Parkfield Drive, Hull (Yorks); G6HV, D. B. Large, 25, Park Parade, Roker, Sunderland (Co. Durham). Regret we are unable to trace the other call signs you give as they do not figure in the last published list. R. E. F. (Middlesex): G2CD, W. A. Matthews, 132, Hainault Road, Romford (Essex). Regret, cannot trace Spanish amateur call sign, but advise you to write to: *Asociacion E.A.R., Apartado de Telegrafos, Santander, Spain.* X. G. M. L. (W9): We can trace the following call signs: G6HV, D. B. Large, 25, Park Parade, Roker, Sunderland (Co. Durham); G6HB, G. M. Horn, 1, Hilton Avenue, Urmston, Manchester; G2LZ, F. A. Mayer, "Stilemans," Wickford (Essex); G2GL, Dr. C. G. Lemon, 72a, North End Road, W14; G5CN, F. M. Caine, 75, Warren Drive, Wallasey (Cheshire); G5ZX, J. P. Stove, 35, Melville Street, Pollockshields, Glasgow; ON4PA, Anthievens, La Pinte-lez-Gand, Belgium; HB9H, J. Schaedler, Wiesenstrasse, 2, Wil (St. Gallen), Switzerland; F8VR, Cherpin, Avenue de la Gare, Ambierle (Loire), France; F8HV, Rougeron, rue de l'Abbe-Lemire, Marq-en-Buroeil, France; F8MK, G. Beck, Ingenieur Cie C.F.M., rue de la Republique, Rabat (Morocco); Regret, cannot trace Spanish call sign, but advise you to write to: *Asociacion E.A.R., Apartado de Telegrafos, Santander.* GBC, Rugby, works on the following wavelengths: 60.30, 34.56, 23.47 and 17.56 metres. R. X. (Port Glasgow): We can trace the following call signs: G2OI, W. Lucas, 64, Worsley Road, Winton, Patricroft, Manchester; G5PL, J. A. Philpot, 21, Casino Avenue, Herne Hill, S.E.24; G5PH, B. F. Phillips, 144a, Cwm Road, Bonymaen, Swansea (Glam.); G6DL, A. G. Lapworth, 86, Muntz Street, Small Heath, Birmingham; G6OM, I. Auchterlonie, The Gables, Gayton, Heswall, Birkenhead (Cheshire); G6PF, L. Parfitt, 88, Queen Street, Abertillery (Mon.); G6TF, W. Davidson, 12a, Erskine Street, Alloa, Clackmannanshire, Scotland. J. SHAW, JNR. (Glasgow): Call signs given advertised as: G6BF, S. R. Donaldson, 62, Woodville Road, Golders Green, London, N.W.11; G5MU, C. W. Titherton, West Lodge, Moigne Combe, Dorchester, Dorset. Both are amateur transmitters.

CAR RADIO

A FEW months ago there was a certain amount of controversy going on as to whether a wireless set was really wanted in the motor-car, and as to whether or not so-called car radio would ever become popular in this country. Those readers who attended the recent Motor Show at Olympia will entertain few doubts in regard to the outcome of the controversy I have just referred to. A very large number of the cars exhibited by prominent manufacturers were shown in models fitted with a completely built-in wireless receiver. In all cases the sets were charged as "extras," but the extraordinary amount of interest displayed is proof of the interest which motorists have in the "wireless-in-the-car" idea. Nor was car radio confined to large and expensive models, but it was fitted to quite a number of cars of the definitely low-price class.

It was refreshing to find that at last British wireless manufacturers have turned their attention to receivers for use in cars, instead of leaving the field entirely open to American and other foreign firms. An examination of some of the British-made car receivers shows that they compare more than favourably, on both price and quality bases, with those of American origin. As in every other branch of radio manufacture, Britain leads. P.F.

In order to meet the requirements of readers who prefer to work from a full-size blueprint when building up any of the "Practical Wireless" Receivers, we can now supply full-size Blueprint Wiring Diagrams of all the "Practical Wireless" receivers for 1s. each, post free. When ordering, quote the number. Copies of the paper containing descriptions of the particular receiver cost 4d. each. Address orders to: The Publisher, George Newnes, Ltd., 8-11, Southampton Street, Strand, W.C.2.

Blueprint. No.	Receiver.
1.	Dolphin Straight Three.
2.	Long Range Express Three.
3.	Mains Express Three.
4.	Sonotone Four.
5.	Bijou Three.
6.	Argus Three.
7.	Empire Short-Wave Three.
8.	Solo Knob Three.
9.	Midget Two (6d. only).
10.	Selectone Battery Three.
11.	Fury Four.
12.	Featherweight Class B Four-valver.
13.	Q.P.-P. Three-Four.
14.	Alpha Q.P.-P. Three.
15.	Ferrocart Q.P.-P. Hi-Mag Three.
16.	Supersonic Six.
17.	Beta Universal Four.
18.	A.C. Twin.
19.	Selectone A.C. Radio-Gram Two.
20.	A.C. Fury Four.
21.	Radiopax Class B Four.
22.	Three Valve Push-Pull Detector. (6d. only.)
23.	Double Diode Triode Three.
24.	Three-Star Nicore.
25.	The D.C. Ace.
26.	The Superset.
27.	The Auto-B Three.
28.	The All-Wave Two.
29.	The A.C. Three.
30.	Premier Super.
31.	A.C.—D.C. Two.
32.	Orbit Transfer Print.
33.	Luxus A.C. Superhet.

COMPACT DESIGN

WHILST writing about car radio I am reminded of the extraordinary compactness of design which is now found in nearly all types of commercially-made receivers. Much of the improvement in this direction is due to the almost universal adoption of iron-core coils and to the reduced dimensions of many other components, such as variable condensers, transformers, etc. In addition, one must not forget the advantages which the all-metal valves confer in the way of compactness; they occupy only about half the space taken by many of the mains power valves which are fitted with glass bulbs.

Another feature of the design of many of the commercial mains receivers is the entire absence of smoothing chokes in the H.T. supply circuit. In some cases the field winding of the loud-speaker is used for smoothing purposes, but in certain other popular receivers even that is not used, and smoothing is effected entirely by means of resistances and condensers. There are a number of responsible wireless engineers who maintain that all smoothing should be carried out without the use of chokes; the perfect hum-free reception given by those receivers I know which have no smoothing choke seems to indicate that there is much to be said for this line of thought. P.F.

LET OUR TECHNICAL STAFF SOLVE YOUR PROBLEMS

REPLIES TO QUERIES and ENQUIRIES by Our Technical Staff

The coupon on this page must be attached to every query.

If a postal reply is desired, a stamped addressed envelope must be enclosed. Every query and drawing which is sent must bear the name and address of the sender. Send your queries to the Editor, PRACTICAL WIRELESS, Geo. Newnes, Ltd., 8-11, Southampton St., Strand, London, W.C.2.

SPECIAL NOTE.

We wish to draw the reader's attention to the fact that the Queries Service is intended only for the solution of problems or difficulties arising from the construction of receivers described in our pages, from articles appearing in our pages, or on general wireless matters. We regret that we cannot, for obvious reasons—

(1) Supply circuit diagrams of complete multi-valve receivers.

(2) Suggest alterations or modifications of receivers described in our contemporaries.

(3) Suggest alterations or modifications to commercial receivers.

(4) Answer queries over the telephone.

Please note also, that all sketches and drawings which are sent to us should bear the name and address of the sender.

CATKIN VALVES

"I hope my query will not be out of place, but I have read your book since No. 1, and have found that you are so good at helping readers that I cannot resist putting my problem to you. Whilst I was talking with a friend the Catkin valve was mentioned, and my friend stated that this was *entirely metal*. I told him that there was quite a lot of glass incorporated in the valve (as I had remembered seeing a section in your book once), and I finished by having a bet with him. He wants some ruling on the point, and we have agreed to accept your verdict. Is there any glass in the Catkin valve or not?"—T. G. (Hunstanton.)

You have won your bet, T. G. There is a fair percentage of glass included in the make-up of the Catkin valve. The lower portion of the valve is of glass (inside the metal casing), and this continues a fair way up inside the structure and is connected to the anode by means of a vacuum tight joint. The method of mounting this glass between rubber clamps and other ingenious constructional details guards the glass against breakage.

MAINS AND THE ORBIT

"I have read your preliminary announcement concerning the Orbit with great interest, but am very disappointed to see that it is a battery set. There are thousands of readers like myself who are on the mains and who would like the set to be mains operated. Cannot you cater for us?"—W. K. (Hampstead.)

You will see from last week's issue, W. K., that we have designed two simple little mains units for use with the Orbit on A.C. or D.C. mains. We think you will agree that there are many thousands who only have batteries for the operation of their receivers, and we have given a fair proportion of mains receivers in our pages of late. However, the Orbit may be operated from any type of supply now, and you will find that the results are identical with batteries or mains units.

USING METALLIZED CHASSIS

"I have just completed the construction of your 'Superset' which was recently described in 'Practical Wireless,' and appealed to me very strongly. On connecting up the batteries, however, I have been unable to obtain any reception at all, and the only thing I notice is that one of the fixed resistances gets very hot; all the others remain perfectly cool. In an attempt to locate the fault I measured the voltages to the anodes and screening grid terminals on all the valve-holders. These were quite normal in every case except that of the screening grid of the first V.M. valve, and here I could obtain no reading at all. All the wiring was checked, but no mistake could be found. Can you please suggest the cause of my trouble."—B. V. (Balham).

From your description it seems to be perfectly clear that the screening grid terminal of the first valve-holder is short-circuiting to earth, via the metallized chassis. If you examine the valve-holder you will no doubt find that one of the legs is touching the side of the hole through which it passes, thereby making contact with the metallic surface of the chassis. As a matter of fact, care should always be taken in mounting valve-holders on a chassis of this type to make sure that there is ample clearance between the legs and the sides of the hole. The same precaution should also be taken in mounting other components, and in wiring up, to avoid the possibility of short circuits.

DATA SHEET No. 61

Cut this out each week and paste it in a notebook.

FIXED MICA CONDENSERS

The table gives the effective area of mica for capacities of different value. The effective area is obtained by multiplying the length by the breadth of the overlapping surfaces.

Condenser Capacity.	Thickness of Mica (in.) .001	.002
.0001 F	.075 sq. in.	.15 sq. in.
.0002 ,,	.15 ,,	.3 ,,
.0003 ,,	.23 ,,	.45 ,,
.0004 ,,	.3 ,,	.6 ,,
.0005 ,,	.38 ,,	.75 ,,
.001 ,,	.75 ,,	1.5 ,,
.002 ,,	1.5 ,,	3 ,,
.003 ,,	2.25 ,,	4.5 ,,
.004 ,,	3 ,,	6 ,,
.005 ,,	3.75 ,,	7.5 ,,

Example: Desired to use .002 mica with plates having overlap of ½ x ½in. Capacity required, .0005 mfd. From table area required = .75 sq. in. Overlap = ¼ sq. in. Number of dielectrics is therefore 3.

EARTH RETURNS

"Seeing a description of the 'Auto-B Three' in a recent number of 'Practical Wireless' I realized that this was just the set I wanted, and immediately proceeded to build it. The parts were obtained from a local dealer, and were exactly as specified with the exception of the steel chassis. My dealer was unable to supply this without having a few days notice, and so suggested that I might use a metallized wood chassis in conjunction with an ebonite panel. I did this and soon completed the constructional work, thanks to your excellent blue-print and clear instructions, but when I came to try out the set I could get no reception whatever. I am an entire beginner in wireless construction, and therefore have no idea how to proceed in looking for the fault—naturally, all the wiring has been checked, but no mistake can be found. Could you please assist me?"—N. M. (Bath).

If you examine the blue-print for this circuit you will find that one connection to the on-off switch is made through the metal panel and mounting bush. As you have employed an ebonite panel it will therefore be necessary to connect a wire between the second terminal on the switch and the metallized chassis. This is another instance which stresses the need for using the exact parts specified by the designer.

MAINS TRANSFORMER

"I am making up a mains transformer as given in one of your earlier issues, but the details there given were for a core with a section of 1 sq. in. I find that my particular model will work out slightly smaller than this, and so far as I can see at the moment, the cross-sectional area will only be .5 or .6in. How many turns would I require per volt for this size of core?"—T. U. (Putney).

Assuming that all other things are equal the turns per volt are proportional to the cross-sectional area Thus, as eight turns per volt are required with a cross-sectional area of 1 sq. in., at .5 sq. in. you would need sixteen turns, whilst at 2 sq. in. you would need four turns per volt. You should be able to obtain your data from this information.

COLOURED FUSE

"I have a commercial make of set, and I find that I am getting no H.T. to it since it stopped working some time ago. I have taken the set out of its cabinet, and I find under the chassis that the L.T.— negative lead is joined to one side of a small holder, and the H.T. negative lead is joined to the other side of this holder. Resting in it is a yellow glass tube. After some testing, I pulled this out and twisted a bit of wire across the two ends of the holder when the set worked again. I presume that this is a fuse and that it has blown for some reason. Can you tell me if I am correct, and also what value the fuse is?"—A. M. B. (Dundee).

It is fairly obvious that this is the normal fuse between H.T. and L.T., and that owing to some mishap it has blown. The value, if it is yellow is 500 mA, and you should be able to obtain a replacement from any good wireless store. Alternatively, you may order one direct from Messrs. Belling Lee or Bulgin, whose addresses you will find in our advertisement pages.

FREE ADVICE BUREAU
COUPON
This coupon is available until Nov. 25th, 1933, and must be attached to all letters containing queries.
PRACTICAL WIRELESS, 18/11/33.

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N.P. Battery Chargers for A.C. Mains from 62/6 to £17, one to four circuits, suitable H.T. and L.T. Trade Lists free with photographs. We have a few soiled instruments at bargain prices.—Nash Products Ltd. (Dept. P.W.), Stechford, Birmingham.

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NEW AND BOXED TCC.6 mfd. electrolytic 50v. bias condensers, 7½d., ditto 15mfd. 100v.1/2. Ditto 8mfd. aqueous 440v. 3/11. Hellesen 3/3. 8+4. dry, 3/11.

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NEW Model Famous Lincoln Stewart Permanent Magnet Moving Coil Speakers, with Universal Transformer for matching all type, output valves including Class B. Over 2,000 already sold to PRACTICAL WIRELESS readers. List price, 47/6—special price, 16/11.

BRITISH GENERAL Aerial Bandpass 10 K.C. tuning unit with full constructional details for building Bandpass 3 receiver. List price, 14/6—limited stock to clear, 3/11.

WEATIE Universal Mains Transformers, input 200-240 A.C.; output 60 m.a. tappings, 350-0-350 2 volt 2 amps, C.T. and 2 volt 3 amps. C.T. Shrouded. Made for Set Manufacturer, worth 35/-; to clear, 12/11.

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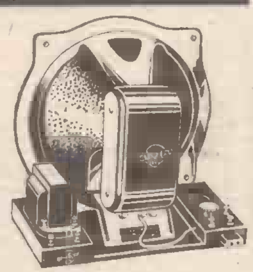

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AK 616122	AM 008989	AN 981720	AO 004887	AP 128065	AQ 014097	AR 89054
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Practical Wireless

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NOVEMBER 25th, 1933.
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Practical Wireless

EDITOR:
Vol. III. No. 62 || F. J. CAMM || Nov. 25th, 1933
Technical Staff:
W. J. Delaney,
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Frank Preston, F.R.A., W. B. Richardson.

ROUND *the* WORLD *of* WIRELESS

Radio Drama Festival

"RED TABS," the next in the series of great plays in the Radio Drama Festival, is to be heard on December 1st, (National) and December 2nd (Regional). This play was written by Val Gielgud, Drama Director of the B.B.C., and first broadcast in October, 1930. It must be unique in post-war literature as a detached discussion of an ethical problem of warfare. The situation faced by General Gore in the play is personal not to him alone, but to every commander of every age, from Thermopylæ to Ypres. "Red Tabs" is a brief play, clearly argued and free from complications. It will be produced by Howard Rose.

Midland Composers' Concerts

MUSICALLY, the week beginning on November 26th is an important one in Midland Regional, for it includes relays of a Tchaikovsky concert by the City of Birmingham Orchestra, the Birmingham Festival Choral Society in Sullivan's "Golden Legend," and the Birmingham Catholic Choir, as well as two of the series of Midland Composers' concerts. These include Clifford Roberts on November 28th and Michael Mullinar on November 30th. Both composers play their own works—Clifford Roberts on the Church of the Messiah organ, and Michael Mullinar in the studio. Mr. Roberts is a native of the Black Country and got his musical training under Bantock in Birmingham. He has written cantatas and choral fantasies as well as works for the organ. Mr. Mullinar had a suite played by the Birmingham Police Band, with Dr. Boult as guest conductor, in 1925. In this programme he plays his miniature suite for the piano, "Grimm's Fairy Tales," and Emily Broughton and Mark Mellers sing some of his songs.

"Boyhood in Industry" Broadcasts

IN the Midland Regional talks department there is the opening of a new "Boyhood in Industry" series, designed to show, from the angle of personal reminiscences, some of the changes of the last forty years. T. A. Waterhouse leads off by telling what things were like in engineering in the early 'nineties. Mr. Waterhouse has had broadcasting experience before as an enthusiastic and entertaining talker on angling.

Old Memories

A POPULAR programme under the title "Old Memories" will be broadcast from Belfast on November 27th, this consisting of well-known orchestral pieces and songs which will be familiar to listeners of an older generation. The artists are Victoria Gordon (contralto) and Cecil Kidd (cornet), while Mr. Godfrey Brown will conduct the Belfast Wireless Orchestra. It is felt that a programme of this nature will be welcome and arouse many memories of pleasant days that have passed.

IMPORTANT NOTICE

Readers who are qualifying for our

POCKET TOOL KIT

should read the Announcement on page 515

Those Readers qualifying for

The ENCYCLOPÆDIA OF POPULAR MECHANICS

should read the Announcement on page 519

Order Next Week's Special Enlarged Christmas Number Now.

Can Aerial Masts Be Too High?

ALTHOUGH there is a general tendency on the part of radio engineers to secure the greatest possible height in aerial masts or towers, it is a moot point whether beyond a certain limit the extra cost of construction warrants the results. (The new Budapest station will possess a tower over 1,040ft. high). In some countries, as, for instance, Germany, wooden towers are replacing the steel lattice masts; Mühlacker, the last one to be built, reaches a height of 627ft. As against this recent experiments carried out in the United States by WABC, Wayne (N.J.), induced the engineers to lower the original height of their aerial by 45ft., with the result that considerable improvement was noticed in the transmission.

Algiers—Tunis—Rabat

THE laying of the underground telephone cable destined to link up Algeria, Tunisia, and Morocco has been steadily proceeding, and of 2,500 kilometres to be spanned some 1,100 kilometres of pupinized land lines have been installed. Apart from assuring the long-distance telephony service to the North African coastal towns, the cable will be used for the interchange of broadcast programmes between Radio Alger, Radio Maroc, and the new station to be built at La Kasbah, Tunis.

Mühlacker and Munich

LISTENERS may have noticed the recent comparatively weak signals heard from both Mühlacker and Munich. The 60-kilowatt transmitters have suspended their broadcasts pending completion of reconstruction as 100 kilowatters. In the meantime the programmes are transmitted by the old 1½ kilowatt Stuttgart-Degerloch and Munich-Stadelheim stations. The high-power stations will be formally reopened on December 1st.

Listen to Bombay

BY arrangement with the Indian State Broadcasting Service the B.B.C. will carry out a special relay of a programme from Bombay on December 13th. The entertainment will include a short concert of native instrumental and vocal numbers as well as a description of typical street scenes in the city.

Dual Station for Turin

IN order to secure alternative programmes, as is the case with Milan, the E.I.A.R. is shortly opening a new transmitter at Turin. It will work on 220 metres (1,365 kilocycles), with a power of roughly 2 kilowatts (aerial).

Budapest's Alternative Programmes

AS it is expected that the new 120-kilowatt transmitter will shortly take over its daily duties on 550 metres, the older 18.5 kilowatt station will provide an alternative programme, at the start from G.M.T. 19.00—23.00, and later at other hours of the day. The wavelength to be used for this station has not been definitely fixed, but it is anticipated that the 227.1 metre channel will be adopted according to the Lucerne Plan.

ROUND the WORLD of WIRELESS (Continued)

INTERESTING and TOPICAL PARAGRAPHS

Station PHI. Broadcasting in Six Languages

FOR two and a half years this famous station at Huizen, near Hilversum, Holland, has been silent, but recently it has been reorganized, and now transmits on a wavelength of 16.88 m. The powerful Philips world transmitter brings new enjoyment and diversion to short-wave listeners all over the world. Although these broadcasts are principally meant for the Dutch East and West Indies, they are also picked up by short-wave listeners in all other parts of the globe. The variety of programmes and the frequency of international announcements, a unique feature of the short-wave station (Dutch, Malay, English, French, German, and Spanish), gives this station a well-deserved popularity.

Station PHI is " on the air " for 5 days a week, *i.e.*, Monday, Thursday, Friday, from 12.30 to 2.30 G.M.T., and from 12.30 to 3 G.M.T., on Saturdays and Sundays.

" G.U.Q." Calling !

TRAVELLERS to and from the Continent, *via* Harwich, are probably unaware that an interesting, and in some ways unique, station is maintained by the London and North Eastern Railway Company at Parkeston Quay. This station is entirely operated by the railway staff, and a continuous day and night service is maintained for the constant logging of messages recording the progress of the regular Harwich-Continental passenger ship services of the L.N.E.R. " G.U.Q.," as the station is called, works on wavelengths of 600 and 700 metres. The station was inaugurated as long ago as 1908, at a time when wireless was in its infancy and before legislation was passed compelling passenger ships to be fitted with wireless. A wireless apparatus was designed for the equipment of a shore station at Parkeston, where the company had already their own electrical power house, the tall chimney of which is actually utilized as one of the aerial masts.

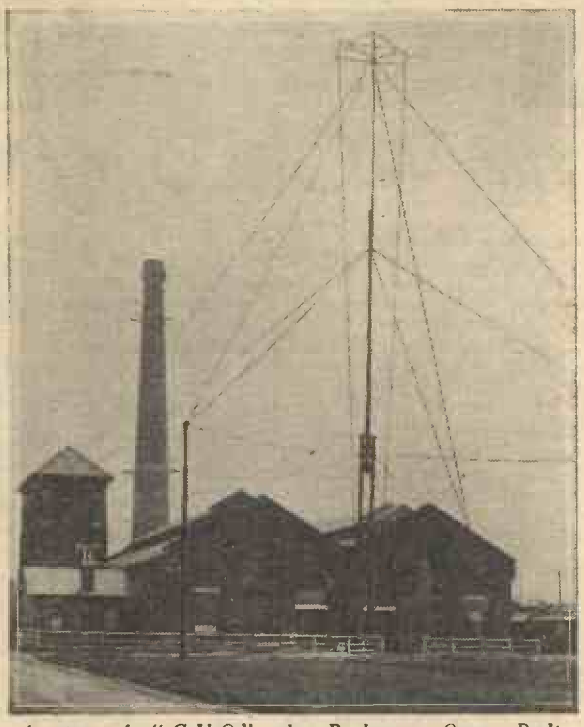
The working of Parkeston Quay Radio Station, an illustration of which is given on this page, is maintained by three operators, who work in eight-hour shifts. Apart from a radio station at Newhaven, which is under the direction of the Southern Railway, the Parkeston Quay Station is believed to be the only private wireless station on the British railways which has been regularly maintained in the interests of the safety of the travelling public and to assist navigation and railway operation.

Navigation by Wireless

FOLLOWING the example of many of the principal maritime nations of the world, the coastal authorities in countries as distant as Uruguay, Roumania, and China are among the most recent to adopt the Marconi automatic wireless beacon as an aid to navigation for ships approaching and leaving their shores. Automatic wireless beacons, transmitting omni-directional signals which enable ships fitted with wireless direction finders to take bearings as and when required, have now become firmly established in the confidence of navigators on account of the convenience and simplicity of utilizing their services.

The Marconi beacon transmitters are characterized by extreme simplicity in operation, and ability to run for long periods without attention by skilled personnel. The entire apparatus is controlled by a master clock which switches on the transmitting apparatus at predetermined times, when the transmitter sends out a characteristic signal incorporating the call sign allotted to the beacon, after which the plant shuts down until the next call is again automatically transmitted.

THE UNIQUE RADIO STATION AT PARKESTON QUAY



A view of " G.U.Q."—the Parkeston Quay Radio Station. The chimney which is utilized as one of the aerial masts is seen in picture.

SOLVE THIS!

Problem No. 62.

Atkinson made up a small mains receiver which when finished gave very bad hum. He tried all kinds of tests, but could not cure it, and as a final expedient he purchased another smoothing choke and connected this in the negative high-tension lead on the mains unit. To his surprise, however, this made the hum worse. Why was this so? Three books will be awarded for the first three correct solutions opened. Address your attempts to The Editor, PRACTICAL WIRELESS, Geo. Newnes Ltd., 8-11, Southampton Street, Strand, London, W.C.2, and post to reach here not later than November 27th, 1933. All envelopes should be marked Problem No. 63.

SOLUTION TO PROBLEM No. 61.

When mounting the coils, Rawlinson had fitted one with the wave-change switch in the long-wave position and one with the switch in the medium-wave position. Thus when turned to either waveband the coils were working at different wavelengths.

The following three readers solved Problem No. 60, and books have therefore been forwarded to them :—

H. F. Walker, 70, Ashenden Road, Clapton Park, N.1; N. Postles, 33, Chapel Road, Sale, nr. Manchester; C. R. Willis, 53, Salisbury Road, Everton, Liverpool, 5.

B.B.C. Symphony Concert at Queen's Hall

AS Arnold Schonberg is unfortunately prevented from appearing at the Queen's Hall Symphony Concert on November 29th, and in view of his wish to direct the first performance of his Concerto Grosso, it has been decided to revise the programme. The works to be given are: Overture, A Midsummer Night's Dream (Mendelssohn); Concerto No. 1 in C for Pianoforte and Orchestra (Beethoven); and Symphony No. 9 in D minor (Bruckner). The solo pianoforte is Alfred Cortot and the full Symphony Orchestra will be conducted by Adrian Boult (leader, Arthur Catterall).

International Broadcasting Union

THE International Broadcasting Union, which includes among its members nearly every European broadcasting organization, held recently a series of meetings at Amsterdam under the presidency of Vice-Admiral Sir Charles Carpendale (Great Britain), with the assistance of the new Vice-Presidents, Baron van den Bosch (Belgium), Mr. (Chamberlain) Lerche (Denmark) and Dr. (Engineer) Marchesi (Italy). The broadcasting organizations, and the P.T.T. Administrations of twenty-four countries were represented, including the P.T.T. Administrations of Algeria, Turkey, and Soviet Russia. The Council of the Union has studied the report presented by Ravag (the Austrian broadcasting organization) with regard to broadcasts for reception abroad in the presence of the representatives of the two organizations interested. Following a letter from the Union to the R.R.G. (German broadcasting organization), the latter stated that they were ready to get in touch directly with Ravag.

One of the principal objects of the meeting was to study the conditions in which the Plan of Lucerne, relating to the allocation of wavelengths in the European region, could be put into force on January 15th, 1934, taking into account that some Governments have not so far given their consent to the said plan.

A Welsh Choral

ON December 2nd, the Ystalyfera Choir, which won the National Eisteddfod Championship in 1928, 1930, 1931, and 1933, comes to the Queen's Hall, London, and the B.B.C. is relaying their performance in the National programme. Soloists to be heard during the relay are Josephine Wray (soprano), Parry Jones (tenor) and David Richards (organist). The conductor is W. D. Clee. The programme includes compositions by Bach, Parry, Mendelssohn, and Vaughan Williams, also Welsh National and Folk Songs by the Choir.

Making a FERROCART H.F. BAND-PASS UNIT

By "LAMBDA"

In this Article the Author Describes the Construction of an Efficient Instrument

CONSTRUCTORS often write to me asking how they might increase the selectivity of their receivers. Many of them are well aware of the numerous circuits now available employing the new iron-cored coils, but they are not anxious to incur the expense of entirely re-designing their receivers. There is also another class of constructor, who possesses a straight receiver of the detector and low-frequency type. He is desirous of increasing the range and selectivity of his set; he wants just that extra punch that an additional valve would give, but he does not want to entirely re-design. In some cases it would involve scrapping an excellent cabinet, or dispensing with a set, the low-frequency side of which in his opinion gives perfect quality. What can these enthusiasts do?

Well, here is the solution. This little unit will definitely give increased selectivity, will increase range, and enable them to obtain all the advantages that iron-cored coils can give with a minimum of expense. The circuit of this unit has been designed around the well-known Ferrocart coils. A more compact type has been placed on the market by the manufacturers, and advantage has been taken of these to make the unit as compact as possible. The wave-change switch rod also controls the on-and-off switch, located in the rear of the coil unit, which also breaks the circuit of the volume control shunted across the grid-bias battery, thus preventing the discharge of this battery when not in use.

LIST OF COMPONENTS REQUIRED

2 Battery Clips, Bulgin type No. 1.
Dial, 1 Polar Horizontal type.
Ebonite Panel, 12in. by 7in., Becol.
Grid-bias Battery.
Fixed Condensers:
Two 1 mfd. T.C.C. type 50.
One .0005 mfd. T.C.C. type 34.
Ferrocart Coils.
Types G.1, G2, with battery on and off switch, Colvern.
H.F. Choke, Lissen.
Plywood Baseboard, ⅜in. thick, 12in. by 7in.
Tuning Condenser, Polar Star Minor, Twin Gang .0005 mfd.
Valve, Cossor 220 VS. Metallized.
Valve Holder, Graham Farish.
Wire and Sleeving.
Wander Plugs.

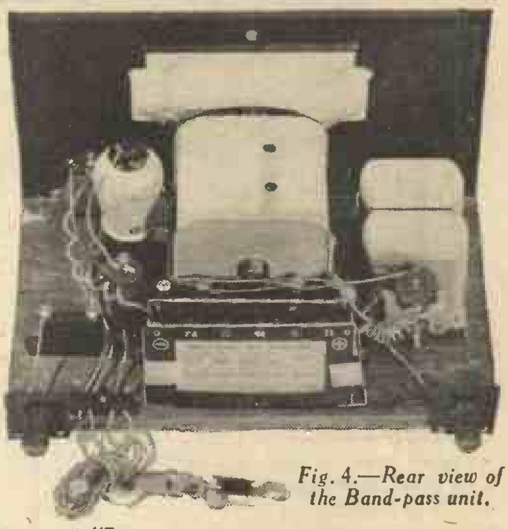


Fig. 4.—Rear view of the Band-pass unit.

If you are situated near a regional transmitter here is the unit to increase your selectivity. If you are situated some distance from a transmitting station it will give you increased range. By the aid of this unit the owner of a two- or three-valve straight receiver will quite definitely obtain increased range and selectivity. There are no snags, no ifs or buts. A variable-mu valve is employed; you know, of course, that it enables practically distortionless control of volume to be obtained and also minimizes cross modulation.

To connect this unit to your receiver is simplicity itself. Just disconnect your existing aerial lead-in wire and connect to terminal marked Aerial on the H.F. unit, the output terminal being connected to the aerial terminal on your existing receiver. The coils and twin gang condenser, together with the variable-mu valve, constitute the nucleus of the unit, and there are only a few other items to obtain, so that in an evening the unit

(Continued overleaf)

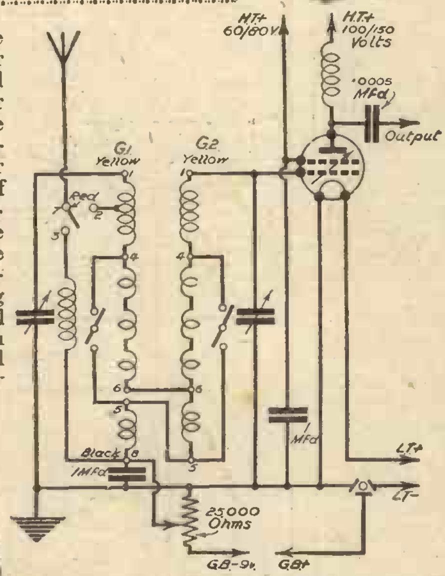


Fig. 1.—Circuit diagram of the unit described.

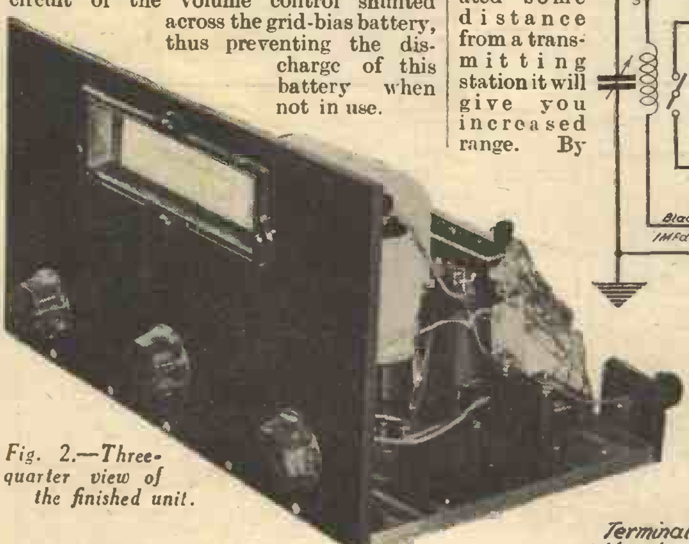


Fig. 2.—Three-quarter view of the finished unit.

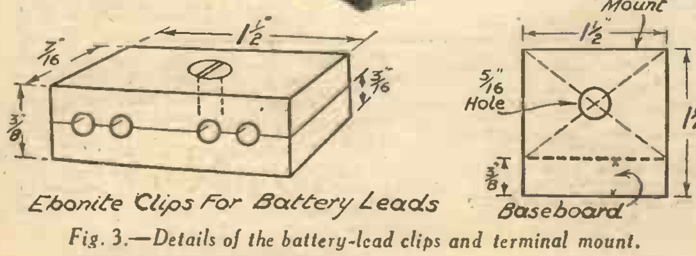


Fig. 3.—Details of the battery-lead clips and terminal mount.

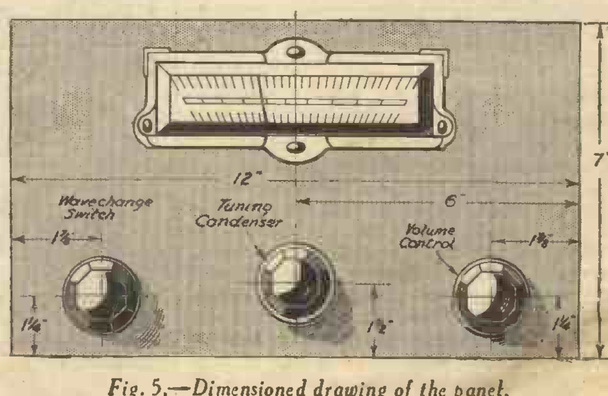


Fig. 5.—Dimensioned drawing of the panel.

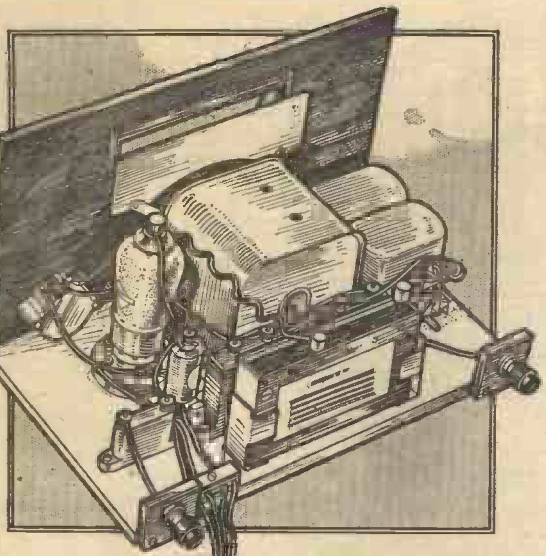


Fig. 6.—Perspective sketch of the unit.

(*Continued from previous page*)

should be completed and connected up to your set. Additional leads are, of course, provided for the low-tension and high-tension batteries; the grid-bias battery is incorporated in the unit itself, being accommodated just behind the ganged condenser.

Assembling the Components

This is quite a simple matter, and the wiring diagram gives the position of the various components. All the details for drilling the panel are shown in Fig. 5. The two ebonite pieces provided for mounting the aerial and output terminals are made from the piece of ebonite cut out from the panel for the Polar Horizontal Drive. If care is taken in cutting out the rectangular piece from the panel there will be no difficulty in providing sufficient ebonite for these two mounts. Two small pieces of ebonite have also been used to provide clips to secure the leads to the high- and low-tension batteries to the baseboard. They measure 3-16in. by 7-16in. each, and are provided with four grooves to accommodate the leads. The details are shown in Fig. 3. No panel brackets have been employed as they did not appear to be necessary, but if you so desire they can be fitted, as sufficient space has been left for this purpose.

In the wiring diagram, the coloured leads fitted to the coils are shown together with the appropriate terminal numbers, so that no mistake will be made. If your coils are not provided with these coloured leads you will notice that the terminal numbers are stamped on the coil base adjoining the soldering tags. The leads to the panel lights have not been connected, but if you wish to employ them, all that is necessary is to connect two leads to the filament terminals on the valve-holder, and solder to the lamp-holders behind the horizontal dial.

Operating

Incorporated in the base of the coils is the switch gear, and this is provided with definite location for four positions:—Off; Medium Wave (M); Long Wave (L); and Gramophone (G). The latter position does not interest us in this particular instance. When switching off your main receiver, the switch knob on the H.F. unit should be rotated anti-clockwise into the off position, otherwise your grid-bias battery will discharge itself through the 25,000-ohms volume control shunted across it. No difficulty will be encountered in connecting to your existing receiver. All you have to do is to disconnect your existing aerial lead from your set and transfer to the aerial terminal on this unit. Then connect the output terminal on the unit to the aerial terminal on the main receiver. The H.F. unit should be placed as near as possible to your existing receiver.

Switch on and tune in a station such as the London National or Fécamp, towards the lower end of the tuning scale. Then adjust the trimmers until maximum response is obtained. Do not screw up the trimmers any tighter than is absolutely necessary, as this will restrict the tuning range at the lower end of the wave band. Many constructors complain of being unable to receive Fécamp, but no difficulty was experienced in tuning in this station, which in daylight was received at good strength, when connected to a very inefficient and ancient detector-L.F. receiver. The voltage applied to the variable-mu valve should be at least 100 volts and the screen voltage should be between 60 and 80 volts.

In some instances you may find tuning exceptionally sharp; this may happen when connected to receivers employing aperiodic aerial coupling. In such cases the output lead from the H.F. unit should be connected directly on to the tuned secondary winding, preferably to the grid end of the coil. An example of such a circuit is that of the Selectone Three described in PRACTICAL WIRELESS for January 7th last. In this case you will find it necessary to connect to terminal number six on the coil.

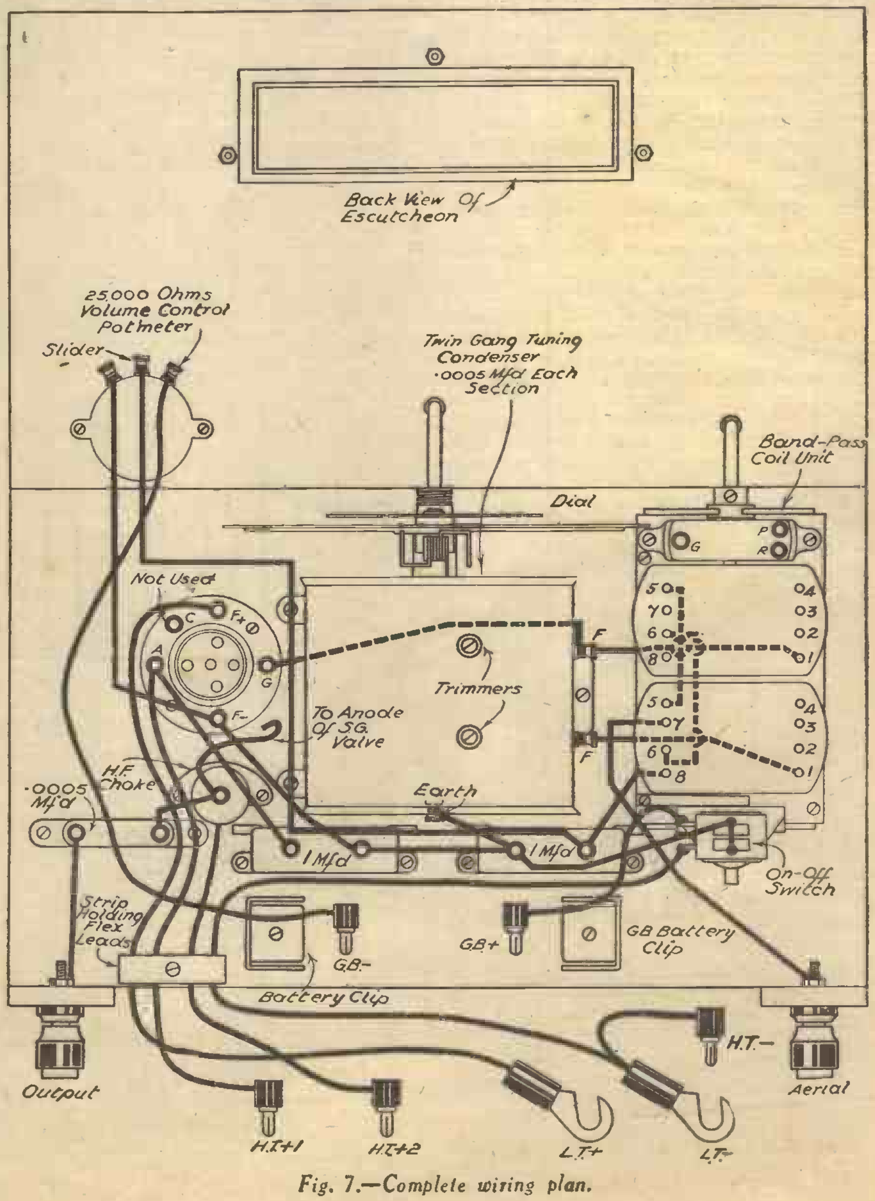
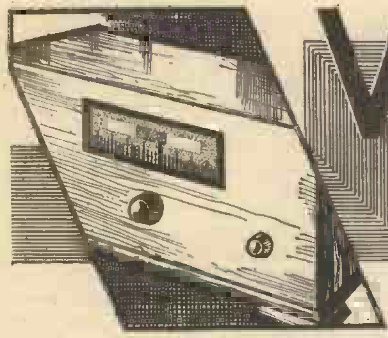


Fig. 7.—Complete wiring plan.



VISUAL TUNING INDICATORS

Automatic Volume Control Makes Accurate Tuning Impossible by Ordinary Aural Methods, and This Article Explains Some of the Interesting Systems of Visual Tuning. By BERNARD DUNN.

AUTOMATIC volume control has at last proved its worth so completely that it is being used in nearly every powerful receiver on the market, both in this country and in America. There are, of course, certain objections to A.V.C. and these have previously been dealt with in these pages. Another point which merits close attention, however, is that of obtaining accurate tuning with a set provided with effective automatic volume control. If you have had much experience in handling a receiver of this kind you will have noticed an apparent flatness of tuning; tuning is not *really* flat—and there is no more difficulty in separating different stations than with a set of the older kind—but it seems to be.

With the ordinary type of set which is not fitted with A.V.C., signals from any station are loudest at some particular setting of the tuning condensers, and above and below that point they become noticeably weaker. The object of A.V.C., however, is to prevent changes in volume, and, as the signal strength applied to the detector becomes less, the variable-mu valves are caused to give greater amplification in order to counteract the reduction in signal voltage to the detector. Thus the greater "tuning spread" on the dial.

Inaccurate Tuning Causes Distortion

The effect just mentioned might perhaps be considered as of no consequence since it does not really affect selectivity—but is it? When the set is not exactly tuned to the station a certain amount of distortion is inevitable, because one-half of the side band is not made full use of and reproduction becomes "unbalanced." You can soon verify this by slightly detuning any selective receiver; you will find that reproduction at once becomes most unnatural and, probably, rather "scratchy." On some kinds of music the distortion is more marked than on others, but it is always present. With an ordinary type of receiver the distortion is readily detected, due to the fact that, as distortion commences, the volume of reproduction falls off. In the case of an A.V.C. set, however, the position is somewhat different, and a certain amount of difficulty is frequently experienced in finding the exact tuning point.

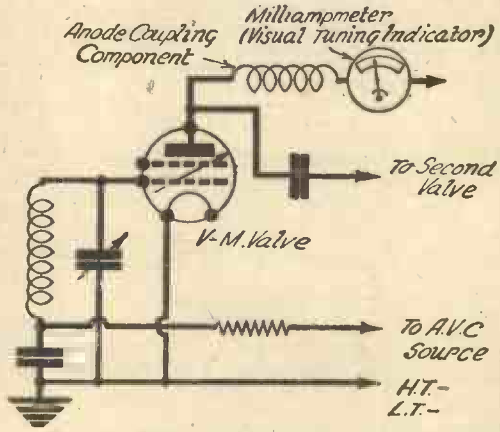


Fig. 1.—The simplest form of visual tuning indicator consists of a milliammeter inserted in the anode circuit of the first A.V. controlled valve.

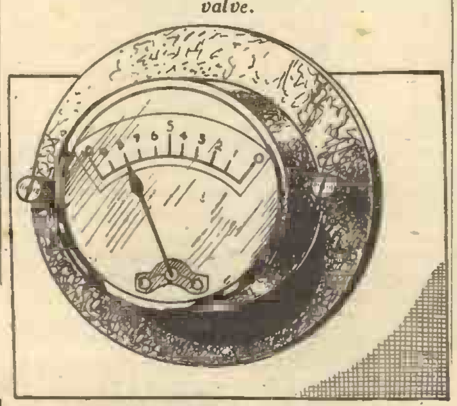


Fig. 2.—An ordinary milliammeter can conveniently be converted for use as a visual tuning indicator by pasting on a new scale which reads "backwards." The scale is simply divided into a number of equal divisions.

Tuning by Meter

This brings us to the point when we must have some other means of tuning than merely by ear. Sight is our most sensitive faculty, and thus a system of visual tuning would overcome all our difficulties. As a matter of fact, visual tuning is not by any means new, and many of us made use of it upwards of ten years ago when anode-bend detection was widely used. In those days a milliammeter was connected in the anode circuit of the detector valve, and the reading of this was increased as a signal was tuned in. Maximum deflection of the needle on any particular signal indicated the exact resonant point. A very similar idea is equally applicable to the problem we considered above in relation to receivers provided with automatic volume control.

Every reader knows the principle of A.V.C., which is that as a strong signal is applied to the detector valve (the second detector, in the case of superheterodynes) a negative bias voltage is applied to the variable-mu amplifiers. The bias voltage is proportional to the strength of the signal, and has the effect of reducing the amplification afforded by the V.M. amplifier. It is also well known that as the bias voltage to a valve is increased, the anode current is reduced. It can be seen from this that, if a milliammeter were connected in the anode circuit of the controlled valve(s), it would show a minimum reading on the most powerful station. In the same way, its reading on any particular station would be at a minimum at the exact resonant point.

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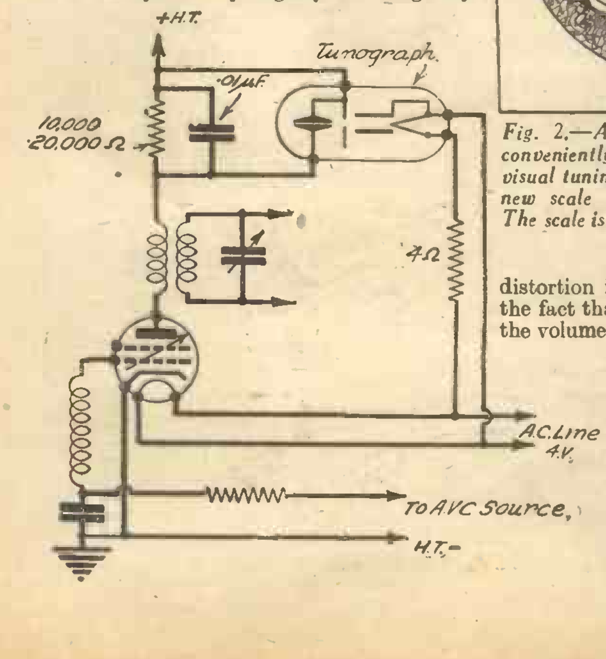


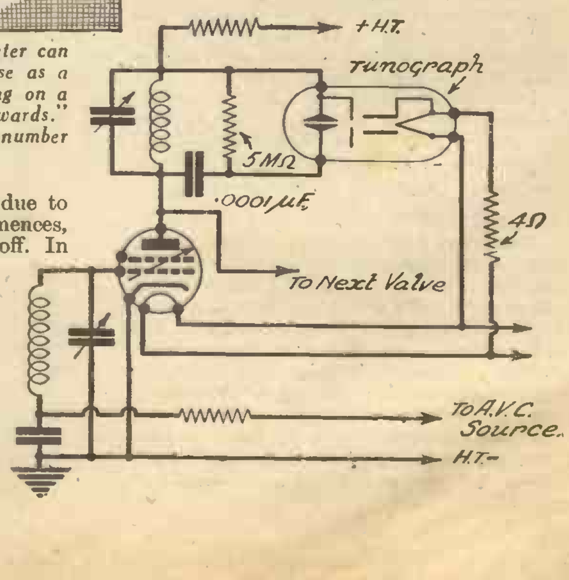
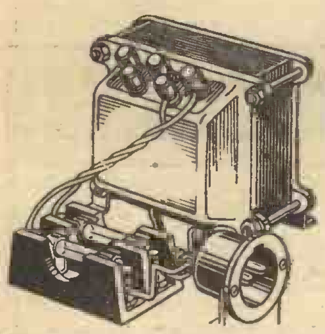


Fig. 3.—Alternative connections for the "Tunograph" cathode-ray visual tuning indicator.



FUSES & FUSING

A Practical Article Dealing With the Various Types of Fuses, Their Action, and How They are Connected in Various Circuits

By L. A. HODGES

FUSES are important in all electrical circuits, and their omission means, very often, danger and disaster. Yet I wonder how many radio set owners do not use them? Because they do not actually play an important part in the functioning of the set or increase its efficiency, their employment is often neglected. How often do we decide to incorporate them after building a set, then we either forget, or think that there is nothing to go wrong, so they are left out. They should always be included amongst our components, and fitted when we commence to build or install a new set, for it is often during the trying-out period, connection changing, etc., that a fuse would save our valves or H.T. battery. It is so easy to make a wrong connection or catch the low-tension spade across the high-tension circuit with the consequent burning out of the valves.

Fuses are definitely a pronounced safeguard for battery-operated sets and particularly for mains sets, and the object of this article is to show why, and to stress the importance of their inclusion in any wireless set.

What is a Fuse?

It is usual in small electrical circuits to employ means for cutting off the electric current when more current passes than that for which the wiring system and apparatus were designed. To make this clear, let us take the action of an electric current flowing in a wire. When current flows three things occur. Firstly, a magnetic field is set up, but this does not concern us here. Secondly, the wire is heated to a greater or less extent by the current. Thirdly, there is a fall of electrical pressure in the wire proportional to the current flowing. The heating effect, and the fall of pressure, depend upon the size and material of which the wire is made. If a wire carries more current than is intended, it will get hot enough to injure the insulating covering; it may get red hot, or even white hot, or, if the current is increased still more, the wire will melt.

This latter fact is made use of in the provision of fuses to protect wiring and apparatus, and even a building itself should too large a current flow for any reason.

Action of a Fuse

Fig. 1 will explain the function of fuses. Here it is supposed that the terminals + and — are connected to the electric supply mains and that current is supplied to a number of lamps, or radio set. Two fuses are shown, F_1, and F_2, one in each wire coming from the supply, and they are capable of carrying the usual current for the lamps with an almost imperceptible rise in temperature, but, nevertheless, the fuse wire is so thin that it will melt if for any reason the normal current is greatly exceeded.

Now supposing that two wires forming the flex are worn, that the insulation is rubbed off, and the two wires come into contact. This would occasion what is known as a short circuit. The amount of the current that would flow would be many times normal, one or both fuses would melt, and the current would be automatically cut off as there would be no path over the gap left by the melted fuse wire; there would be no electrical circuit, hence fuses are sometimes called cut-outs. Had there been no fuse the excessive current would have been quite sufficient to melt the flex altogether, or set fire to it. Fortunately, when we connect our mains set up to the mains the house fuses prevent such a catastrophe as this taking place.

It will be seen, therefore, the necessity for a fuse in any circuit where it is possible for an abnormal current to flow, and such a thing can quite easily occur in our set as explained at the beginning of this article. Although any receiver, eliminator, or trickle-charger which is connected to the mains will be drawing current through the ordinary house fuses, it is very advantageous, in view of the relatively low consumption of such apparatus, to fit additional fuses in some convenient position in or near the receiver. Having seen the necessity for safeguarding our apparatus, we will just see what types of fuse are available before determining their position and size.

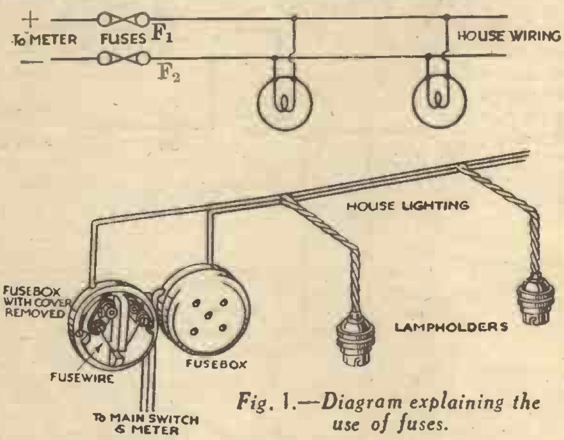


Fig. 1.—Diagram explaining the use of fuses.

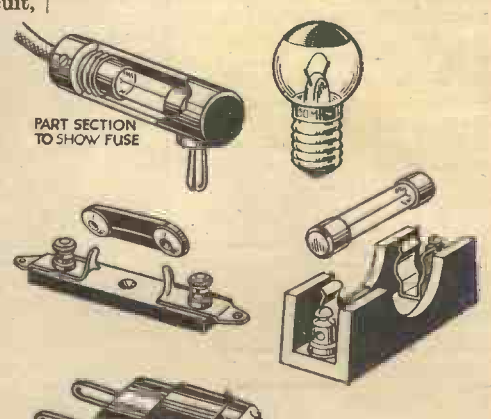
Flash-lamp Bulb Type

The two most popular types of fuses for radio work are the flash-lamp bulb type and the cartridge fuse type (Fig. 2). In the bulb type, use is made of a very fine filament wire fitted in an evacuated glass bulb mounted on a standard M.E.S. (flash-lamp type) cap. This bulb provides an instantaneous action fuse which will blow when overloaded in ample time to prevent damage to valves and other apparatus. They can be obtained with current-carrying capacities of 60, 100, 150, 200, 250, and 300 milliamps, price about sixpence. They are, of course, readily replaced, and are particularly suitable for battery-operated sets. They fuse at about 50 per cent. overload.

The ordinary flash-lamp bulb should not be used in any set as a fuse as the majority of these bulbs will not fuse under ½ amp., and cannot, therefore, protect the filaments of the average valve.

Cartridge Fuse Type

A good cartridge type of fuse is also shown in Fig. 2. Here a thin low-resistance wire of lead-tin alloy is glass enclosed (ensuring no risk of fire) between metal end caps, and hermetically sealed. The most popular size is 1¼in. long, and can be obtained for about sixpence in the following ratings: 150, 250, 500, and 750 milliamps, 1, 2, and 3 amps., etc. These fuses, held in clips of the baseboard type, are easily replaced, and fuse at about 50 per cent. overload. Because of their heavier rating, and the greater distance between contacts, they are



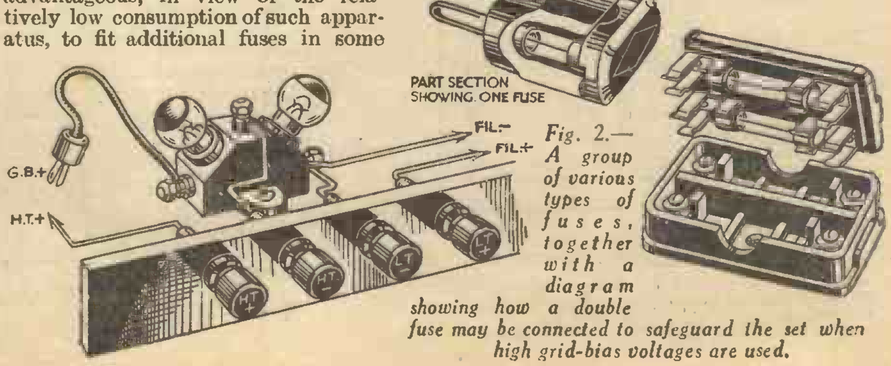


Fig. 2.—A group of various types of fuses, together with a diagram showing how a double fuse may be connected to safeguard the set when high grid-bias voltages are used.

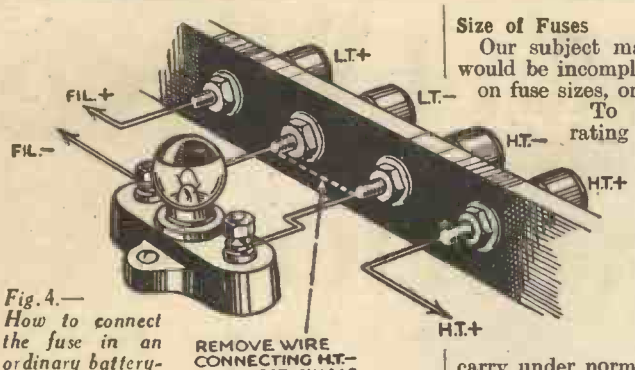


Fig. 4.—How to connect the fuse in an ordinary battery-operated set.

ideal for mains sets and eliminators. In the flash-lamp bulb fuse the contacts are rather close together, and the higher voltages met with in mains working may jump across them, thus forming a dangerous circuit.

Where to Fit the Fuses

Coming to the actual employment of fuses, a bulb-type fuse should certainly be connected in a battery-operated set as shown in Fig. 4. The bulb is merely screwed into one of the many types of holders and connected in circuit between the L.T.— and the H.T.— terminals. A 60 or 120-milliamp fuse fitted in this position will safeguard both valves and H.T. battery against overload. It should be noticed that the wire to the filaments is taken from the low-tension side of the fuse-holder, as otherwise the low-tension current would be passed through the fuse. Another simple way of fitting a fuse in this part of the circuit is to replace the H.T.— wander plug with a type of fuse called the wander fuse which accommodates a cartridge type of fuse. These wander fuses (Fig. 2) are also useful when fitting fuses in the H.T. positive tappings or in grid-bias circuits.

In the mains-driven receiver, where metal rectifiers or half-wave valve rectifiers are employed, a single 1¼in. cartridge fuse should be placed in the H.T.— side between the rectifier and the mains transformer as in Fig. 5. With full-wave valve rectifiers, a fuse should be placed in each of the two leads from the anodes of the rectifier to the mains transformer. Except with very powerful sets these fuses should be about 150 milliamp. rating.

For protection of the primary winding of the transformer a pair of 1 amp. cartridge fuses (mounted on a double base for convenience) should be placed in the mains leads, as shown in the heading sketch. If more than 60 watts is drawn from the mains, or if an electric gramophone motor is supplied with current, the fuse rating will have to be 2 or 3 amps.

In the case of commercial battery eliminators which are not already fused, it is impracticable to put a fuse in the transformer secondary circuit, so that the valves and set can only be protected by placing a 150 milliamp. fuse in the H.T. — lead from the eliminator to the receiver. This fuse, of course, does not protect the eliminator, so for greater safety a pair of 1 amp.-fuses should also be placed in the mains leads.

Size of Fuses

Our subject matter dealing with fuses would be incomplete without a few points on fuse sizes, or ratings.

To determine the correct rating for a fuse in a certain position, the normal current to be carried must be considered, also the current surges which take place when switching on and off. The general rule is for the fuse to have a rating of about twice the current that it is expected to carry under normal circumstances: it will then withstand the harmless instantaneous surges.

For readers who wish to make or experiment with their own fuses, the accompanying table will give all that is required concerning the fuse wires of 1 amp. and over, material, and fusing current. The normal rating of these wires will be about half the fusing current. It will be observed that lead-tin alloy is the wire most suitable for wireless circuits, whilst copper (tinned) wire is used for house fuses, domestic purposes, etc., owing to its high conductivity and comparatively low watt loss. It is fairly clean in fusing and mechanically strong. The tinning acts as a protection against oxidization in the air.

In conclusion, it is always advisable for the constructor to keep a small supply of this wire which fuses at about 6 or 8 amps. It should be remembered that fuse wire should be taken off a reel, as an odd piece with a " kink " in it, or a slight cut would considerably diminish its fusing current capacity.

Nearest S.W.G. for Given Fusing Current and Carrying Current.

Fusing Current.	Carrying Current.	Tinned Copper.	Lead Tin Alloy.
1 amp.	.5 amp.	47 S.W.G.	33 S.W.G.
2 „	1 „	43 „	28 „
3 „	1.5 „	41 „	25 „
5 „	2.5 „	38 „	22 „
10 „	5 „	33 „	18 „
15 „	7.5 „	30 „	16 „

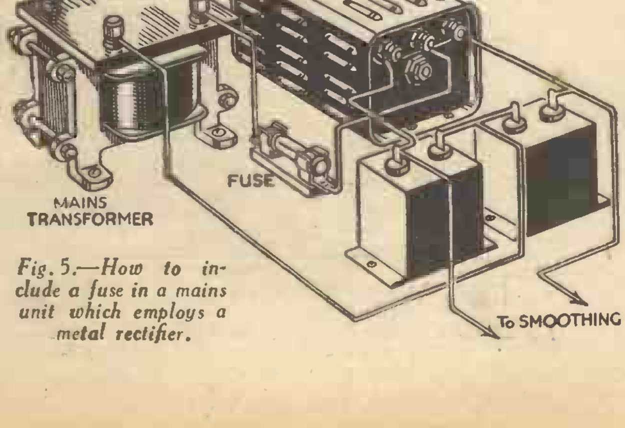
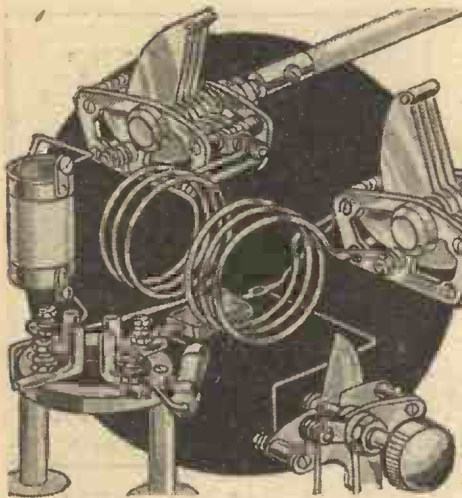


Fig. 5.—How to include a fuse in a mains unit which employs a metal rectifier.



Short Wave Section

Points to Be Considered in Order to Ensure Efficient Working.

By "NEMO"

IN designing a short-wave receiver there are certain points which must be attended to if the completed set is to give the greatest satisfaction, and it is hoped that these notes will assist intending designers to avoid some of the worst faults that arise from inexpert lay-out.

Before discussing the placing of individual components, we will consider the arrangement as a whole. In the first place, it is essential that manipulation of the controls should not tire the operator, that they should fall easily to his hand so that he does not suffer from severe cramp after a bare half-hour's DX hunting. The usual place for a tuning control in front of the set is by no means ideal from this point of view, because the user's wrist is bent the whole time his hand is at the knob, and so easily gets tired. It is much better, therefore, to put this control at the side of the receiver, as is occasionally done in commercial receivers. While still on the question of convenience of controls we may make two other recommendations: take care that the knob is not too high up the side of the receiver case, or the hand will have to be held in the air all the time, and so will still get tired; and choose a large diameter knob so as to avoid cramp.

Next we must decide at which side of the set to put our main tuning control, and where to put the reaction control. The first question is settled by whether you are a right or left-handed writer; one is always wishing to write when using a short-wave set, either to record the station heard, and some details of its programme, or, if one can read morse, to write down the messages received. Hence, if you write right-handed, put the tuning control at the left-hand end of the receiver, and vice-versa. The reaction control does not, generally, need as much adjustment as the tuning control, and may therefore go at the front, in the orthodox manner, but if it can be arranged simply, it may just as well be placed on the side also. This control would, of course, go at the opposite end to the tuning condenser, but the builder need not make any provision for a dial indicating the setting of the condenser on the front panel. Something of this sort will be necessary on the tuning condenser, however, in order to know where to tune for any particular station, and for this purpose, a drum dial protruding through the front panel is satisfactory.

The rest of the lay-out is determined chiefly by the requirements of short wiring in the high-frequency circuits, but as far as possible it should be arranged so that the on-off switch and telephone (or loud-speaker) terminals, or jack, are conveniently placed and at the same time do not cause any external leads to get in the way of the operator's hand.

We must also decide whether a simple baseboard is going to carry our components, or whether to use the popular raised baseboard which permits mounting some instruments underneath. The latter method is to be preferred, but some constructors may consider it undesirable, because they want to experiment with different components, and it might complicate shifting them about. We will therefore discuss a simple above-baseboard set first, although there is much to be said for either method.

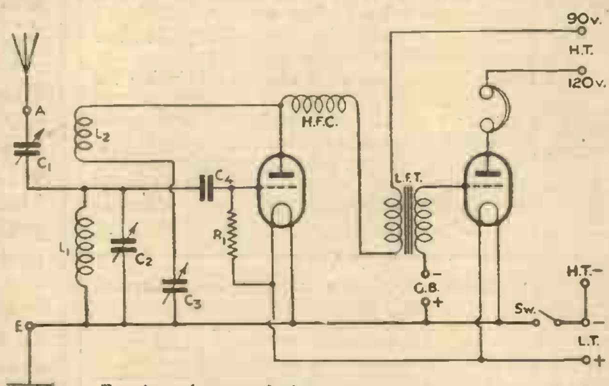


Fig. 1.—A typical short-wave receiver circuit which is taken as an example.

Above Baseboard Layout

Let us take a concrete case and arrange a lay-out for the well-known circuit shown in Fig. 1. First of all, the position of the tuning condenser C_2 is determined by the considerations outlined above, and by the diameter of the drum dial available; it will have to go somewhere about the spot indicated in Fig. 2. Then we must place the valve-holder and coil-holder in such a way that the leads to C_2 can be kept short. In drawing Fig. 2, I have assumed that valve base coils will be used, and have shown a second valve-holder to take them, but the lay-out will suit any other kind of coil, except that it will be complicated if a dual-range coil operated by a switch is used. In this case, it will probably be best to mount the switch on a small bracket near to the coil, and provide it with an extension handle so that it may be worked from the panel. If large diameter coils are used, they should not be placed nearer to C_2 than about two-thirds of so of their diameter, even if this does lead to rather long leads; better long leads than increased H.F. resistance due to eddy currents in the metal plates of C_2. The pre-set aerial condenser, C_1, should be placed so that it is quite near to the coil-holder, and it may

(Continued on page 519)

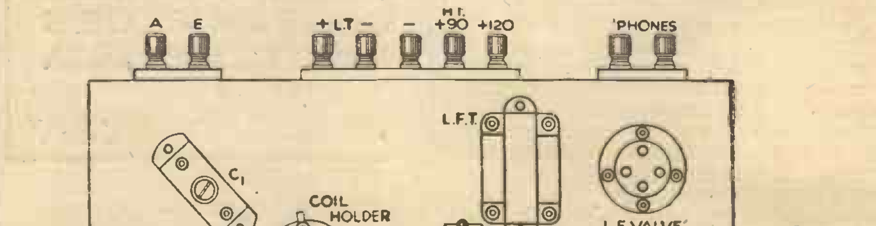


Fig. 2.—A recommended layout for a two-valve (non-S.G.) short-wave receiver.

(Continued from page 516)

conveniently be laid diagonally between the aerial terminal in the upper left-hand corner and the coil-holder, as in the figure. The valve-holder is placed so that a short lead can be taken to it from the condenser C_2 via the grid condenser C_4, although at the same time the valve should not be allowed to be in the field of the coil. The reaction condenser, C_3, is mounted fairly close to the valve-holder, either on the front panel in the position C_3 (Fig. 2) or at right angles to the panel, as C_4, so that it can be operated from the side of the set; in this case, an extension handle will be necessary because the L.F. stage earthed metal baseboard; such a lead is the one from the aerial terminal to the top of the coil, the grid condenser, and the grid of the valve. The reaction circuit also carries high-frequency currents, but since these are only wanted to give regeneration and not to operate the detector, greater leakage can be tolerated in them, but they should be kept away from the grid leads or uncontrollable feed-back will be obtained which will make the set very unhandy; covered wire can be used here. In connecting the coil to the tuning condenser C_2, it is desirable to run the connecting wires straight to the condenser; in order to avoid a large area loop circuit which

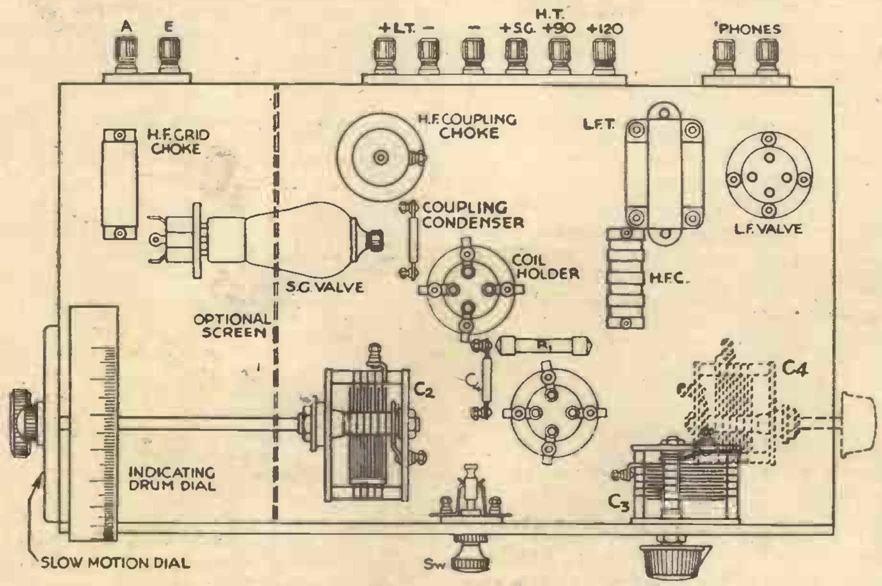


Fig. 3.—A very useful layout employing a screen-grid valve.

makes it impossible to bring the reaction condenser right up to the edge of the base. The H.F. choke, HFC, is put close to the anode terminal of the valve-holder in order to make it easier to prevent the high-frequency currents from straying out of the plate circuit. The L.F. components may be mounted more or less at random at the back of the baseboard, the chief precaution to be taken being to ensure that they are not in the field of the H.F. components.

Sub-Baseboard Considerations

If the sub-baseboard form of construction is adopted, slight modifications only will be necessary. The baseboard should preferably be metal or metal covered. The reaction condenser C_3 may as well go underneath and so ensure that the wires in the reaction circuit are completely shielded from the grid circuit; this leads to improved reaction control and stability. Similarly the H.F. choke and L.F. components can be placed under the baseboard and a sub-base type of valve-holder used for the L.F. valve; this type of holder should not be used for the detector valve or coil-holder however, because it is desirable to keep the grid leads in this circuit above the earthed base.

Making Connections

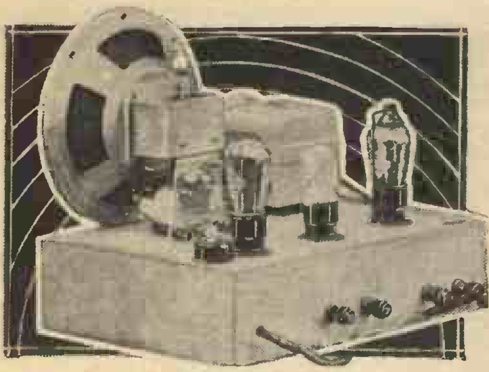
So much for laying-out the receiver; now for the wiring up. A good deal has been said about this subject incidentally while talking about layout, but some points may be emphasized. Bare wire should be used for leads at high H.F. potential, taking care to keep them at least an inch above the

might have a large field and cause hand-capacity effects these wires should be kept fairly close together. Where possible, the leads to earth should be taken to one central point, such as the earthed end of the grid coil on the coil-holder, and a single wire run from thence to the earth terminal. It is also as well to take wires from two or three widely separated points on a metal base-board direct to the earth terminal rather than earthing it at one point only and relying on its own conductivity to earth the rest of the base.

If it is desired to add an untuned H.F. stage to the two-valve circuit shown, the baseboard in Figure 2 may be extended towards the left, and the extra stage mounted on the extension, the tuning condenser of the detector stage being controlled through an extension spindle. A simple screen between the stages is an advantage, as indicated in Figure 3. The same precautions should be taken as in arranging the detector stage, especially in keeping the H.F. coupling choke out of the field of the detector coil and reaction H.F. choke.

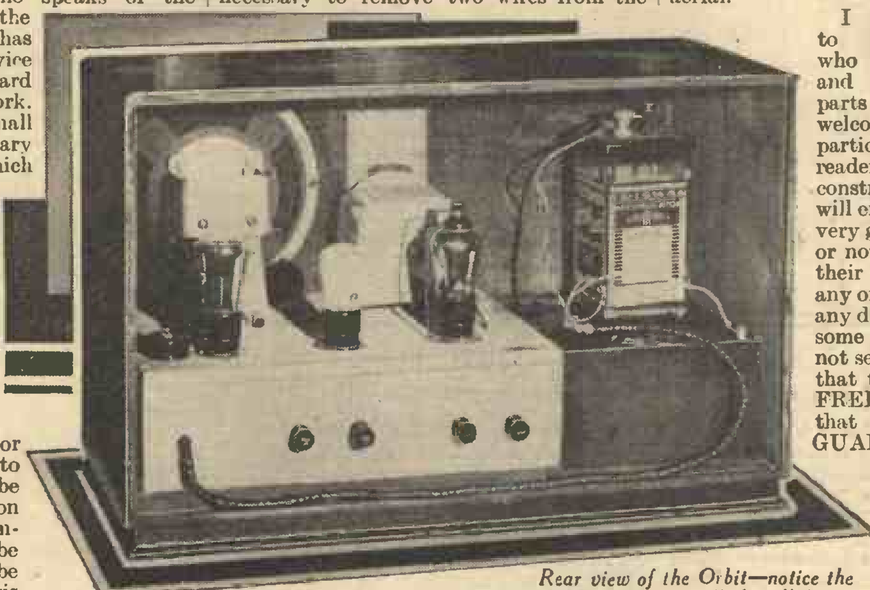
Further Notes on the "Orbit"

Details Regarding the Use of a Frame Aerial with this Ingenious Receiver



Note the absence of components and wiring on the upper surface of the chassis.

SINCE the full constructional details in regard to my latest and most successful receiver were published (three weeks ago) I have been in receipt of a constant stream of letters from satisfied constructors. Everyone speaks of the enormous success of the receiver, and not one has yet had to ask my advice on any problem in regard to the constructional work. This is due, in no small degree, to the revolutionary transfer-print idea which simplifies receiver construction more than any other scheme which has ever been presented to the home-constructor. Not only is the transfer print very valuable when the set is first made, but it will prove to be more valuable than ever at later stages when any alteration or modifications are made to the set. Should it be necessary for any reason to remove a wire or component, it will at once be obvious where it must be replaced, since the chassis will carry a permanent record of the complete layout.



Rear view of the Orbit—notice the "clean" lines.

On every hand readers are appreciative of the novel chassis arrangement of the "Orbit" and of the entirely new idea of mounting the speaker unit in its rightful place along with the remainder of the components. This method might not have been practicable a few years ago, when valves were rather prone to microphony, but to-day it is ideal. It enables the complete receiver to be tested and adjusted whilst it is out of its cabinet with every part easily accessible; it also makes it possible to employ the very latest type of horizontal cabinet without having to employ a container of unwieldy dimensions. The scheme is theoretically sound and practically ideal.

The "Orbit" on a Frame Aerial

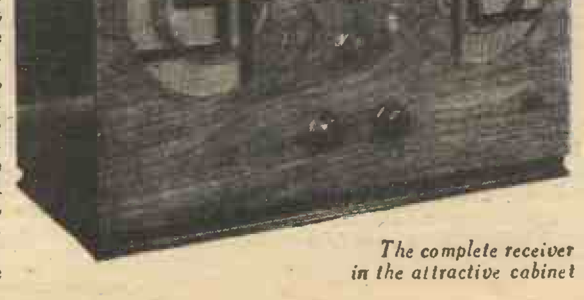
Several readers have already found that the "Orbit" performs extremely well when used on the poorest of indoor aerials and under the most adverse conditions, but a few flat-dwellers and folk who have no facilities whatever for erecting an external aerial have asked if the "Orbit" can be used with a frame aerial. I have no hesitation in saying that it can! Naturally, it will not receive very distant stations when used in that way, but it will bring in the locals at excellent loud-speaker strength. Indeed, the set is so flexible and adaptable that it can be used in a variety of ways. I have already described how the set can be operated from A.C. or D.C. mains supplies, so perhaps a few notes in regard to frame aerial operation will be helpful to some readers.

It is well known that a frame aerial cannot be used with a receiver which is fitted with an aerial tuning coil unless slight modifications are made to the wiring. The "Orbit" has an aerial coil, and it will, therefore, be evident that this must be disconnected before the frame is placed in circuit. The alterations to wiring are very slight, it only being necessary to remove two wires from the F.10 coil and to take two flexible leads from the set to the appropriate terminals on the frame. The wires to be removed are those from terminal 1 to the fixed aerial series condenser and from terminal 5 to the .1 mfd. by-pass condenser. Flexible leads to the frame can then be taken from the back terminal on the two-gang condenser and from the terminal on the .1 mfd. condenser to which the coil was previously connected. Practically any type of frame can be used, but if it is provided with a centre-tap the middle terminal will not receive any connecting wire. It must be remembered that some frame aerials are only designed to operate on medium waves, and in that case the set cannot be made to provide long-wave reception. On the other hand, frames intended for use on both medium and long waves are available, and these are fitted with a wave-change switch, which must be used in conjunction with that fitted on the set.

When using the connections above described the automatic fading compensator device is left in circuit and continues to function in the same manner as in the original "Orbit." In order to obtain best results from a frame aerial it is, of course, necessary to rotate the windings until their edge is pointing in the direction of the station to be received. The correct position is easily found by tuning the set until the carrier wave of the desired station is heard as a faint whistle, and then moving the frame until the whistle attains its maximum strength. After that, reaction can be slacked off and the final tuning adjustments made. There need be no fear that interference will be caused with neighbouring receivers by allowing the set to oscillate, since the oscillations will be confined to the detector stage, and so cannot be radiated by the aerial.

I shall be pleased to hear from readers who build the "Orbit," and reports from various parts of the country will be welcomed. These will be particularly useful to other readers who contemplate the construction of the set, and will enable them to form a very good idea as to whether or not it will be suitable for their requirements. Should any of my readers experience any difficulty, or come across some little point that does not seem quite clear, I hope that they will write for my FREE ADVICE. Remember that the "Orbit" is fully GUARANTEED, and I am anxious that every constructor should obtain the wonderful results of which I know it to be capable. C

Order next week's Special Enlarged Christmas Number without delay!



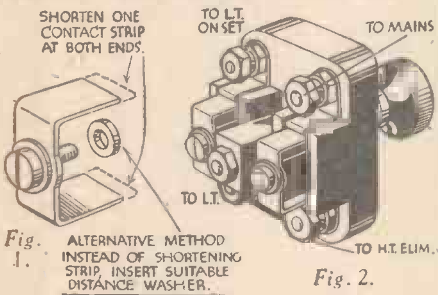
The complete receiver in the attractive cabinet

READERS' WRINKLES

THE HALF-GUINEA PAGE

A Combined H.T. and L.T. Switch

WHEN using an H.T. eliminator on a battery type receiver, it is advisable always to switch on the filaments before the high tension, and to switch off the high tension before the filaments. To be absolutely certain of this, and to enable it to be done by one switch, the following idea may be used.

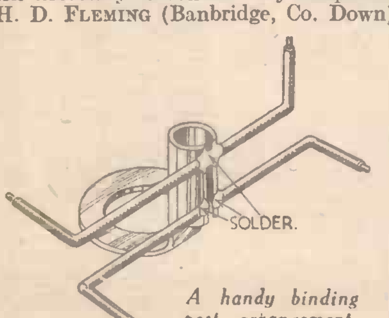


A useful switch conversion.

Obtain a 2-pole 4-point switch of the pattern shown in Fig. 2, remove the small screw which holds one side of the contact plate, cut off or file shorter (say about $\frac{1}{16}$in. from each side) as Fig. 1 and refit the contact plate to switch. Fit this switch in place of the usual single pole on-and-off filament switch common to most sets, and connect the L.T. side connections to the un-cut side of the switch, and connect one of the leads from the eliminator and mains plug to the shortened sides of the switch. When the switch is operated the filament side works as usual, but the H.T. side makes contact (by reason of the shortened plate) shortly afterwards, and when the switch is operated to switch off the H.T. side switches off first. This arrangement also makes it possible to leave the mains plug from the eliminator permanently connected to the mains supply socket.—THOMAS GEORGE BARKER (Seaford).

A Simple Binding Post

A SIMPLE and effective binding post arrangement can be made with an eye-end, as shown in the accompanying illustration. If spade-ends are used, and connections made by this method, the removal and replacement of components when necessary is considerably simplified. —H. D. FLEMING (Banbridge, Co. Down).



A handy binding post arrangement.

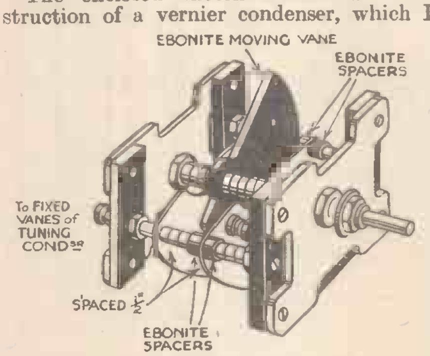
THAT DODGE OF YOURS!

Every reader of "PRACTICAL WIRELESS" must have originated some little dodge which would interest other readers. Why not pass it on to us? We pay £1-10-0 for the best wrinkle submitted, and for every other item published on this page we will pay half-a-guinea. Turn that idea of yours to account by sending it in to us addressed to the Editor, "PRACTICAL WIRELESS," George Newnes, Ltd., 8-11, Southampton Street, Strand, W.C.2. Put your name and address on every item. Please note that every notion sent in must be *original*. Mark envelopes "Radio Wrinkles." Do NOT enclose Queries with your Wrinkle.

A Vernier Condenser

IT is well known that one of the factors which determine the capacity of a condenser is the dielectric constant. Ordinarily, of course, this is never altered in a condenser.

The enclosed sketch shows the construction of a vernier condenser, which I



A vernier condenser for short-wave work.

find extremely useful for short-wave work, and which possesses the advantages of being free from hand capacity effect and noiseless in operation.

This is effected by dielectric tuning, by which I mean that the capacity of the condenser is varied by an alteration of the dielectric constant, the plates being fixed.

The condenser is connected in parallel with the ordinary tuning condenser, but in case a smaller minimum capacity is required, it may be placed in series.

Dismantle an old .0005 variable condenser, leaving one fixed plate at the rear in position. Next, take another fixed plate and enlarge the holes through which the supports pass, so that, when the plate is again mounted it will not be in metallic contact with the support.

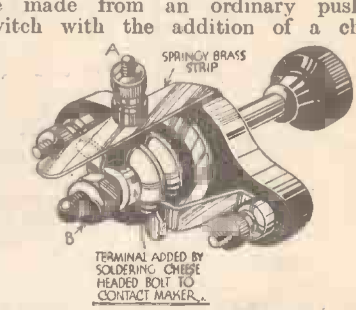
Obtain, or make, four ebonite washers to take the place of the ordinary spacing washers, and place them on either side of this fixed plate as shown in the sketch.

A small hole should be drilled in a convenient position in this plate for a terminal bolt before it is fixed in position.

Cut out of a piece of $\frac{3}{16}$in. ebonite a piece the shape of a moving condenser vane, and fix it to the spindle, so that when it is rotated it will pass centrally between the two fixed plates.—R. P. PRINGLE (Newcastle-on-Tyne).

A Combined Filament and Dial-Light Switch

THIS combined filament and dial-light switch has the advantage of being also a three- or a four-point switch. It can easily be made from an ordinary push-pull switch with the addition of a cheese-



A combined filament and dial-light switch.

headed bolt (with milled or hexagonal nut) a small terminal and two small pieces of springy brass.

When the switch is connected in the usual way to the + filament of the valve and to L.T.+, and a wire is connected from terminal A to the + terminal of the dial-lamp, the lamp can be switched on or off at will while the set is working simply by rotating the knob of the switch. —C. E. GREAVES (Birtley).

A Weatherproof Lightning Arrester

A WEATHERPROOF arrester can be made from a standard electric light two-plate ceiling rose. Two gap pieces are made up from scrap brass about $\frac{3}{8}$in. by $\frac{1}{16}$in. bent to suit the bridge piece of porcelain base. One end of each piece is drilled for the screws which hold down the existing brass plates, the other ends being serrated with a fine file. The two gap pieces when completed are clamped under the existing plates mentioned. The whole unit is mounted on a standard wood block, which is carefully cut away at back to make a snug fit round aerial and earth wires to prevent rain, etc., entering.— O. E. SCASE (Birmingham).

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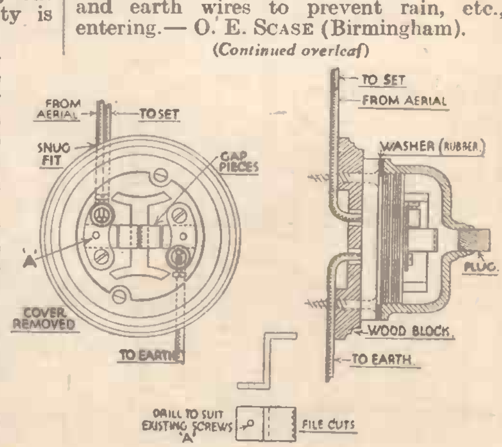

A weatherproof lightning arrester.

READERS' WRINKLES

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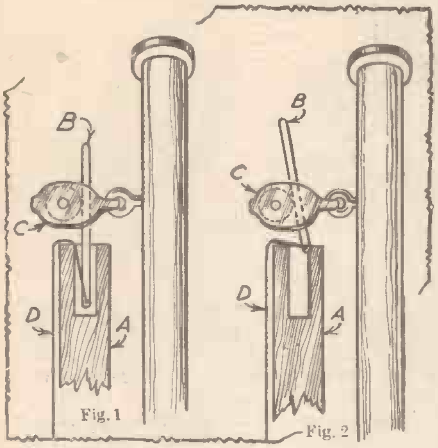


A handy dodge for replacing a broken aerial.

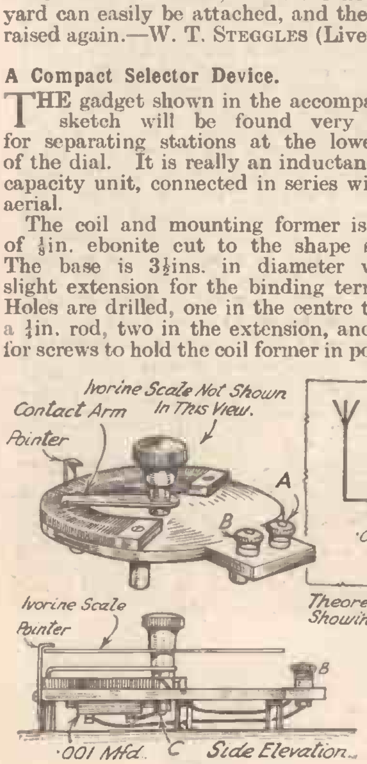
An Aerial Dodge

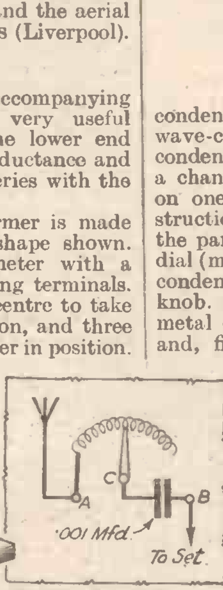
FELLOW readers who have experienced the trouble of having their aerial halyard break at the insulators and run out through the pulley will find this dodge useful. In the end of a long piece of wood (A) about 1½ins. square (a clothes prop in my case) I bored a ¾in. hole 3ins. deep into the end grain. I next secured a piece of iron 6ins. long and ¼in. diameter (B). A hole is bored in one end of the iron and one end of a ball of string is threaded through and tied. The iron rod is placed in the hole in the wood, tied end down (see Fig. 1) and the projecting part of iron pushed through the pulley wheel (C). A sharp pull on the string (D) will shoot the iron up and its own weight will cause it to topple over (Fig. 2) and drop over the front of the pulley to the ground, leaving the string through the pulley. It is a simple matter to pay out the string until the iron comes down to earth, when the new halyard can easily be attached, and the aerial raised again.—W. T. STEGGLES (Liverpool).

A Compact Selector Device.

THE gadget shown in the accompanying sketch will be found very useful for separating stations at the lower end of the dial. It is really an inductance and capacity unit, connected in series with the aerial.

The coil and mounting former is made of ⅛in. ebonite cut to the shape shown. The base is 3½ins. in diameter with a slight extension for the binding terminals. Holes are drilled, one in the centre to take a ¼in. rod, two in the extension, and three for screws to hold the coil former in position.





Theoretical Circuit Showing Connections.

A compact selector device.

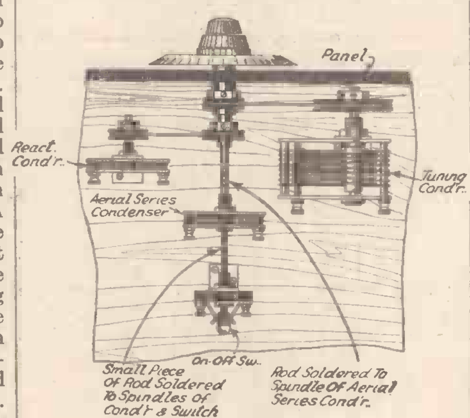
The coil former is ⅜in. wide and is wound with No. 28 d.c.c. wire, the exact number of turns being immaterial. The wire is shellacked to the former, and, when dry, the insulation is scraped from the turns in the path to be followed by the contact arm. The rod is a piece of ¼in. threaded brass, and the contact arm is obtained from an old rheostat. A celluloid dial, and a pointer cut from sheet brass, and mounted on one of the three short wooden feet that support the unit, complete the assembly.

One end of the coil is connected to one of the terminals and the other end is left dead. The small fixed condenser, of .001 mfd., is wired in series with the contact arm and the other terminal.—S. E. ARMITAGE (Ossett).

A Simple Multiple Drive

AN efficient and practical one-knob drive for a receiving set is shown in the illustration herewith. I have been using this device for a considerable time, and have found it satisfactory in every way.

The pulleys are light brass ones and the drive is transmitted by string well resined to prevent slip. Once the string is so treated it will last indefinitely, and there is no perceptible backlash. The tuning

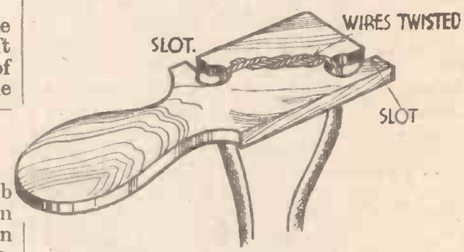


A simple multiple drive.

condenser in use on my set is an automatic wave-changing unit, but an ordinary condenser could be used by incorporating a change-over switch for the long waves on one of the driving shafts. The construction is a very simple matter, and the parts required are one large condenser dial (mine was taken off an old slow-motion condenser) and one large and one small knob. Next obtain two small pieces of metal tubing, one to fit inside the other, and, finally, a metal rod to go through the smaller tube. These, together with two brackets and two pulleys, comprise all that is required for the assembly.

Drill the large combined dial and knob to take the larger of the two tubes, then drill the large knob to take the small tube. The rod will usually be found to suit the bore of the small knob without any trouble.

Fit the pulleys and fix them with grub screws. Solder the end of the driving rod to the spindle of the aerial series condenser, and also solder a small piece cut off the same rod to the rear end of the aerial condenser. Finally, solder the free end of the small rod to the spindle of an insulated type on-off switch, and the whole drive is complete. The assembly can now be fitted through the panel, and the knobs secured to their respective spindles. The two small angle brackets are required to fix the on-off switch and reaction condenser to the baseboard. It will be noted that the aerial series condenser is floating on the drive rod; it is, however, prevented from turning round by the baseboard. The driving string can be fitted on after fixing the pulleys to the reaction and tuning



A useful soldering accessory.

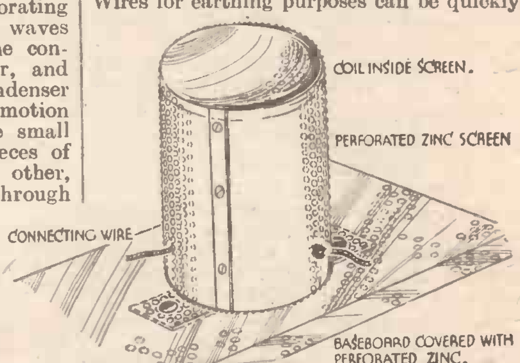
condensers. Operation is simple and is effected as follows: To switch on the set, pull the small knob, tune in the required station by means of the dial knob, and increase the volume, if desired, by turning the large knob. Extra selectivity is attained by turning the small knob in a clockwise direction.—E. D. WILLIAMS (Salford).

A Soldering Dodge

WHEN the ends of two flexible wires have to be soldered, the job is made easier by using a piece of plywood shaped as shown in the sketch. The narrow end is held in the hand, or clamped to the edge of the work-bench, and the two wires, after being twisted together, are slipped into the slots in the plywood holder and pulled tight. When soldering no difficulty is then experienced through the wires slipping away from the iron.—L. J. STEVENS (Bristol).

Coil Screen of Perforated Zinc

PERFORATED zinc, such as is used for meat safes, is an excellent and cheap substitute for copper or aluminium foil. It is easily handled, and can be used for coil screens, covering baseboards, etc. Wires for earthing purposes can be quickly



Using perforated zinc for making coil screens and baseboard covering.

screwed down under a washer, for the holes in the metal are already there. Coil screens, again, are easily constructed, for the edges may be soldered or bolted together as shown in the sketch. The connections to other components are carried out with thin rubber-covered flex passed through any hole which may be convenient.—A. E. PAUL (Wokingham).

Is the Battery Pentode Misunderstood?

In This Article the Advantages of the Pentode are Clearly Explained.

By H. J. BARTON CHAPPLE, Wh.Sch., B.Sc., A.M.I.E.E.

IT appears that to-day the pentode output valve is not enjoying the popularity which it deserves. The reasons for this are interesting and worthy of consideration.

First of all comes the question of price. To-day, a battery pentode valve costs 16s. 6d., as against 8s. 9d. for a small power valve and 12s. for a super-power triode. It is, of course, scarcely fair to compare a pentode valve with a small power valve on the score of price, for even a "low-consumption" pentode gives three times the output of a small power valve, and yet its price is less than twice that of the small power valve.

A fairer comparison can be drawn between a low-consumption pentode at 16s. 6d., and a super-power triode at 12s. For example, on referring to my valve lists, I find that the P.M.22A pentode can give an output of 600 milliwatts, while a P.M.202 super-power valve gives approximately 350 milliwatts—a balance of nearly 60 per cent. in favour of the pentode, and for an extra cost of only 4s. 6d. Furthermore, even this 4s. 6d. will be saved several times over during the life of the valve, when we take into consideration high-tension economy. Let us work this out. A typical three-valve set employing a screened-grid valve, a detector, and a super-power valve will take about 18 milliamps., including the 14 milliamps. taken by the super-power valve mentioned above at 150 volts H.T.

The same set, fitted with the pentode valve quoted, and operated again at 150 volts H.T., would take about 14½ milliamps., as the anode current of the pentode at 150 volts H.T. is only 9.5 milliamps., and the auxiliary grid current about 2.0 milliamps.

H.T. Consumption

There is thus a saving of 3.5 milliamps., which will make a substantial difference to the life of the H.T. battery, for it represents practically 20 per cent. less H.T. drain. Many listeners keep some record of their expenditure in H.T. renewals, and they can soon convince themselves that a saving of 20 per cent. in this direction more than offsets the slightly higher price of a pentode.

The second objection, namely, the larger H.T. consumption, has already been answered in part, for it has been shown that a typical pentode valve actually uses 3½ milliamps. less H.T. than a super-power valve, yet gives 60 per cent. greater output.

When comparing a pentode with a small power triode on the score of H.T. consumption, it is necessary to reduce the valves to a common basis of output. Now a small power valve operated at 150 volts H.T. gives about 150 milliwatts output, and takes 6 milliamps. anode current, or 900 milliwatts H.T. A similar output—150 milliwatts—can be obtained from a pentode when operated at 100 volts H.T., the anode current, plus the auxiliary grid current, then being approximately 6 milliamps., representing 600 milliwatts. The actual high-tension *currents* of the two valves for equal power are thus identical, but a 100-volt battery can be used with the pentode, instead of 150 volts, an actual saving of 33⅓ per cent. in H.T. power.

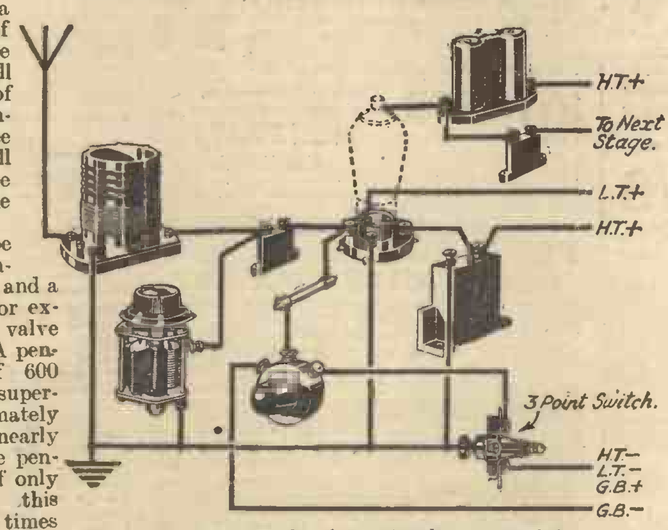


Fig. 1.—A very popular form of volume control for use in conjunction with a variable-mu screen-grid valve.

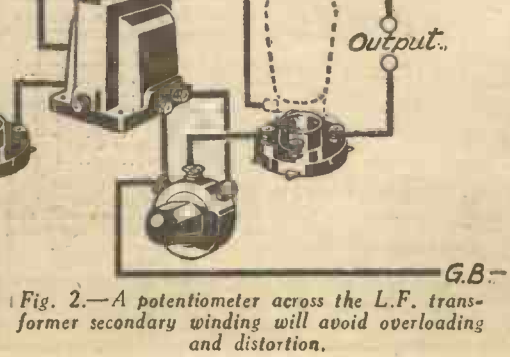


Fig. 2.—A potentiometer across the L.F. transformer secondary winding will avoid overloading and distortion.

Quality

Now comes the vexed question of pentode quality. The general complaint is that the tone is too high-pitched and shrill. Now I admit very readily that all pentodes amplify the higher notes to a greater extent than do triodes, but this statement must be qualified by saying that if the pentode is *correctly* used, the extra amplification of the upper register only adds to the brilliance of the overall performance of the receiver.

The trouble is that, in the great majority of cases, pentodes are regarded with disfavour simply because they have been heard under very unfavourable conditions. The three most common faults on the point of quality are first, overloading; second, incorrect load matching; third, use of an unsuitable loud-speaker.

It is common knowledge to readers of PRACTICAL WIRELESS that one of the most important advantages of the pentode is that it is a much more sensitive type of valve than the triode, that is to say, for equal power output it requires a smaller grid input voltage. Again, readers need hardly be reminded that the effect of applying an excessive signal to the grid of any valve is to produce distortion—a distortion which takes the form of *harsh and unpleasantly shrill* reproduction. It is also clear that if a pentode gives its full rated output for a smaller grid input than a triode of similar rating, it will be overloaded seriously if the input applied to it is sufficient to load the triode.

Yet I have found from experience that this is what happens time and time again. Pentodes are tried in modern sets having efficient high-frequency and detector stages, giving an audio-frequency signal ample to load a large super-power triode. Enormous volume is obtained—and also shocking distortion, and the blame is laid on the pentode! If only some form of volume control were incorporated

(Continued on page 534)

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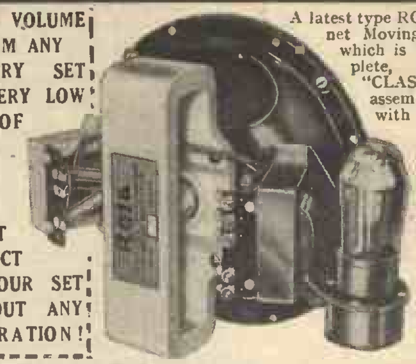

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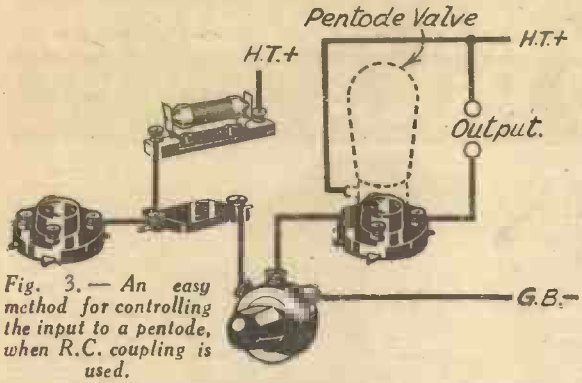


Fig. 3.—An easy method for controlling the input to a pentode, when R.C. coupling is used.

IS THE BATTERY PENTODE MISUNDERSTOOD?

(Continued from page 532)

—by a variable-mu valve for example, as in Fig. 1, or a potentiometer across the pentode grid input, as in Figs. 2 and 3, overloading could be avoided, and quality thereby greatly improved, while the additional sensitivity of the pentode is still available to give an extra fillip to weak or distant programmes.

Load Matching

In order to obtain the maximum output from a given valve, the impedance of the load (that is the loud-speaker or combination of speaker and choke or speaker and transformer) must bear a certain relation to the impedance of the output valve. Valve manufacturers usually state the "optimum" or "best" value of load impedance for each type of valve, and it must be noted that these optimum loads are calculated to give the *largest output consistent with good quality*.

When using a pentode output valve, therefore, it is essential to see that the load impedance is of the correct order. The first thing to do is to ascertain the actual impedance of your loud-speaker. In the case of a moving-iron speaker, the resistance in ohms marked on the speaker may be taken as representing the approximate impedance, while for a moving-coil speaker, if the actual impedance is not specified by the maker, you can obtain an approximation by multiplying the resistance in ohms by $1\frac{1}{4}$.

If the impedance thus found is not equal to the optimum load of your pentode, you must use an output transformer of suitable ratio.

For really good quality it is best to calculate the correct ratio, and this may be done in the usual way by dividing the optimum load of the valve in ohms by the impedance of the speaker in ohms and taking the square root. Thus :—

$$\text{Transformer Ratio} = \sqrt{\frac{\text{Optimum Load of valve in ohms}}{\text{Speaker Impedance in ohms}}}$$

For those readers who experience a little difficulty in calculating the square root in the formula above, the following table should prove useful. All that is necessary is to divide the optimum load by the speaker impedance, and read from the table the approximate transformer ratio.

Value of $\frac{\text{Optimum Load}}{\text{Speaker Impedance}}$	Transformer Ratio.
Up to 0.75	0.75 : 1
0.75 to 1.25	1 : 1
1.25 to 1.75	1.25 : 1
1.75 to 2.25	1.5 : 1
2.25 to 2.75	1.6 : 1
2.75 to 3.5	1.75 : 1
3.5 to 5	2 : 1
5 to 8	2.7 : 1
8 to 12	3 : 1
12 to 20	4 : 1
20 to 30	5 : 1
30 to 40	6 : 1
40 to 55	7 : 1
55 to 80	8 : 1
80 to 120	10 : 1
120 to 200	12 : 1
200 to 300	15 : 1
300 to 450	20 : 1
450 to 550	22.5 : 1
550 to 800	25 : 1
800 to 1500	35 : 1
1500 to 2500	45 : 1
2500 to 4500	60 : 1

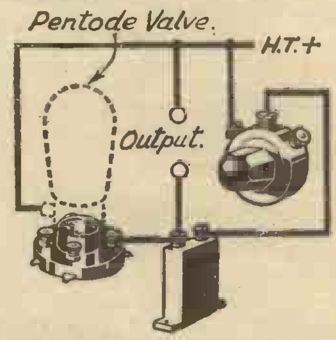


Fig. 4.—The simplest type of tone control suitable for pentode valve output working.

OUR VIEWS ON RECEIVERS

The Lissen Three-Valve All-Electric Model

DESPITE the growing interest in superheterodyne receivers there is still a great demand for the simple "straight" set of the S.G.,-Detector-Pentode type and, in point of fact, some statistics recently taken show that during last season more receivers of the latter type were sold than of any other. For the average listener we believe that the simpler three-valve set gives all that is required—volume in plenty, sufficient selectivity for most purposes, excellent quality of reproduction and simplicity of operation. Additionally, of course, the three-valver is inexpensive and within the reach of nearly everyone.

The Lissen Three-Valve All-Electric receiver which we have recently had on an extended test employs the popular combination of valves mentioned above, and for performance, beauty of appearance, and most reasonable cost it will take some beating. The set is of the self-contained console pattern, being housed in an attractive walnut cabinet of the now popular horizontal type. The front of the cabinet is in quartered veneer which is inlaid in a very attractive and modern scheme, whilst the speaker fret takes the form of three squares which give a distinctive "touch."

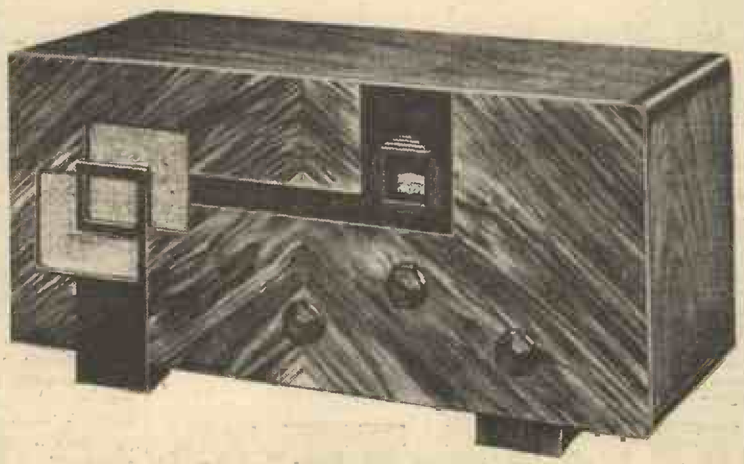
Wavelength Calibrated Dial

There are only three controls, and the centre one is the tuning knob which drives a two-gang condenser through an illuminated wavelength-calibrated scale. The scale is set out in two concentric curves, the outer one being for long waves and marked off in red figures, and the inner one medium waves and calibrated in black. Both scales can easily be read and were found to be accurately calibrated. This system of calibration is one which we consider excellent, since it is easy to use and will not become obsolete if and when the wavelengths of the European transmitters are "re-shuffled." To the left of the tuning knob is another which serves as a volume control; it operates simultaneously a reaction condenser and also a potentiometer which serves to vary the bias on the first (Variable-Mu) valve. This control was found to be very effective and to produce a perfectly smooth variation in volume from maximum right down to inaudibility. A third knob situated on the right is for wavechanging; by turning it in a clockwise direction the coils are set to long waves, and turning it anti-clockwise gives medium-wave reception. Our only point of criticism in regard to the controls is that there is no on-off switch provided on the panel, but is fitted in the mains supply lead instead.

Many Refinements

Turning to the back of the chassis we find a series of screwed sockets into which a screw is placed in order to adjust the receiver for use on any A.C. mains voltage from 100 to 250. Beside these sockets there are two others into which a wander plug is fitted in order to obtain either high or low tone. This simple method of tone control proved very effective, despite its rather limited range, and one of the positions was found to produce pleasant reproduction from any station.

Next to the tone control there are three aerial sockets (into which the aerial plug can be connected to obtain varying degrees of selectivity) and also a mains aerial plug by means of which the set can be used without an outside aerial when desired. There are also two sockets to which a pick-up may be connected when gramophone reproduction is desired. It will be seen that altogether this Lissen receiver is particularly well equipped and very adaptable to every requirement.



The New Lissen three-valve all-electric receiver.

Efficient Circuit Arrangement

The circuit follows standard practice, and although it is on simple lines it has obviously been worked out with thoroughness. Very ample decoupling and smoothing systems are employed. and nothing is skimped. The aerial tuning circuit consists of a winding loosely coupled to the tuned grid winding, and the aerial can be connected directly to its end, or through one of two different capacity fixed condensers when increased selectivity is called for. An input volume control (which is ganged to the reaction condenser) consists of a variable resistance in the cathode lead of the V.-M. valve. Tuned grid coupling is used between the first two valves, and pick-up terminals are included in the grid circuit of the detector. The latter terminals are connected to the grid of the valve and H.T. negative respectively, the grid leak being connected to the "top" end of a bias resister in the cathode circuit, which comes into action only when a pick-up is being used.

A resistance-fed transformer couples the detector to the output pentode (a Lissen PT425) and an H.F. "stopper" resistance is included in the grid lead to the latter to prevent any possibility of instability. The pentode, by the way, is of the directly-heated type, the other two being indirectly heated, and it is biased by means of a resister connected between the centre tap on the L.T. winding of the transformer and high-tension negative.

High-tension supply is provided by a Lissen U650 half-wave rectifying valve, and the output from this is smoothed by means of a large efficient choke and a pair of 8 mfd. condensers. The mains plug is fitted with a pair of .5 amp. fuses, so making the instrument perfectly "safe."

Excellent Results

On test we found the receiver well up to the high standard with which we associate Lissen products. It was first tested on a fairly good outside aerial situated some ten miles west of Brookmans Park. During the afternoon, and in broad daylight, we found no difficulty whatever in obtaining signals of real entertainment value from at least twelve stations. The London transmitters, Midland Regional, North Regional, Athlone, Fécamp, Rome, Langenberg, Warsaw, Eiffel Tower, Daventry, Radio-Paris and Huizen could all be brought in at excellent strength, and in every case the dial calibration was found to be practically dead accurate. With the aerial connected to the "medium selectivity" socket the local stations caused no interference at all, whilst by transferring it to the "maximum selectivity" position, tuning was so sharp that even the locals had to be tuned in with care.

In a later test after dark, there were literally "stations all round the dial"—and most of them could be received at real "programme" strength. We employed the aerial connection with which maximum selectivity was provided, and experienced no difficulty in separating any of the worth-while stations.

With the Mains Aerial

In our final tests we made use of the mains aerial connection, inserting the plug into the least selective tapping socket. Even then it was an easy matter to obtain perfect reception of the local stations at any hour of the day, whilst most of the powerful European transmitters could be brought in at good strength after dark. There was ample selectivity and *only the very slightest trace of hum*; in fact, the hum was audible only when the receiver was off tune, or during a silent period in the programme.

We were very favourably impressed by the Lissen Three-Valve All-Electric receiver, and at the modest price of £10-10-0, consider that it represents excellent value.

THE PROGRESSIVE EXPERIMENTER

(*Continued from page 530*)

the drop in strength, it will be noticed that tuning is sharpened.

If the H.T. battery is past its prime of life, it is possible that tuning will not be sharpened—it might even become flatter—and that reproduction will become "coarse." This effect would be produced by feed-back between the L.F. and H.F. portions of the circuit, and a certain cure can be effected by decoupling the grid circuit of the V.M. valve. The method of doing this is illustrated in Fig. 3, from which it will be seen that a 50,000-ohm fixed resistance has been inserted between the "bottom" end of the aerial coil and the grid-bias wander plug. In addition to this, a .1 mfd. fixed condenser has been connected between terminal 2 and earth.

You have now found that the volume can be varied by changing the value of the grid-bias voltage applied to the V.M. valve, but you will appreciate that there are several objections to the somewhat crude methods which have been employed to achieve that object. A far better system is that illustrated pictorially and in circuit form in Fig. 4. Here a 50,000-ohm potentiometer is connected between the positive and negative terminals of the grid-bias battery, a lead being taken from the slider, through the 50,000-ohm fixed resistance, to terminal 2 on the aerial coil. It will be evident that by rotating the knob of the potentiometer and so moving the slider over the resistance element a perfectly even and gradual variation of bias voltage can be provided for the V.M. valve. The actual connections for the potentiometer, fixed resistance, and fixed condenser are shown in Fig. 1, where the new components are shaded so that they can easily be recognized. Besides the new connections to the coil and biasing components, it will be noticed that the wiring to the two-point on-off switch has been slightly modified. The difference is that, instead of the G.B.+ lead being connected to the chassis, it is joined to one terminal on the switch. The reason for this is that if the previous connections were retained, the grid-bias battery would quickly be exhausted by the potentiometer, whose windings would constantly be in parallel with it. When using the new connections, the potentiometer is automatically disconnected from the battery when the set is switched off.

You will now find that the potentiometer can be employed as a very useful and distortionless volume and selectivity control; as the knob is turned in a clockwise direction volume is increased and the degree of selectivity reduced whilst counter clockwise rotation produces the very opposite effect. In addition to simply rotating the potentiometer, however, it will be found worth while in the first place to obtain the best voltage tapping for plug G.B. — 3. If too low a voltage is used, the control will not be so effective, whilst if too high, it will be more difficult to obtain the best setting.

LIST OF COMPONENTS REQUIRED FOR THE EXPERIMENTS DESCRIBED THIS WEEK.

- One Bulgin 50,000 ohm "Compact" Potentiometer.
- One Graham Farish 50,000 ohm "Ohmite" Resistance.
- One British Radiogram Component Bracket, type 22.
- One "Goltone" Screened H.F. Choke.
- One T.C.C. .0003 mfd. Fixed Condenser, type 34.
- One T.C.C. .1 mfd. Fixed Condenser, type 50.
- One Clix Wander Plug, marked "G.B.—3."

DISTORTION FROM A NEW ANGLE

The First Step Towards the Cure of Distortion Lies in a Definite Recognition of the Form It Takes. In This Article the Author Tells First of All How to Determine What Kinds of Distortion are Present in a Receiver, and Then Explains Their Cause and How to Remedy Them. By W. B. RICHARDSON

PEOPLE often say to me that their sets are not working properly. "There is a lot of distortion," they complain. They then ask how to cure distortion.

It should be remembered that "distortion" is a term which has a very wide meaning, and unless the enquirer is a little more explicit as regards the particular form it takes, it is very difficult to make a satisfactory suggestion as to a cure. Of course, some people find it difficult to describe the symptoms clearly. They simply know that the receiver does not sound quite right, but cannot say in what particular manner it falls short of the accepted standard. For this reason I am going, first of all, to devote some space to an explanation of how different forms of distortion may be recognized. Naturally a realization of exactly how the reproduction differs from the original means a definite step towards its diagnosis and cure.

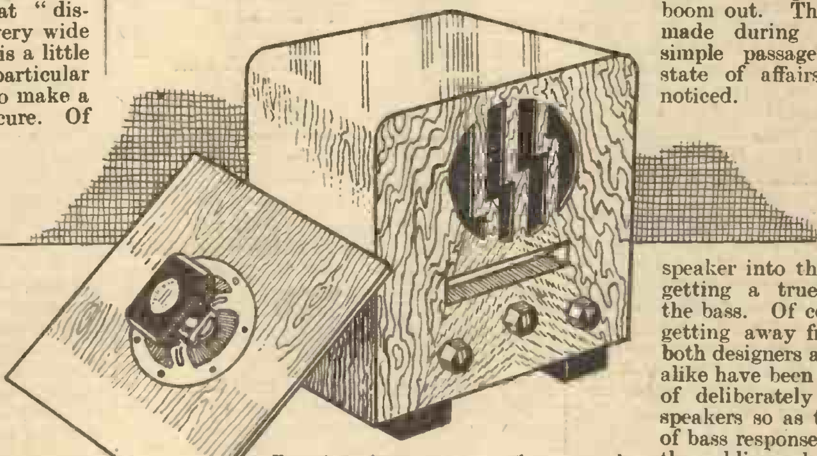


Fig. 1.—A resonating effect may be caused by the vibrating of a baffle-board or a cabinet of too thin a material.

How to Recognize Resonation

Let us take a simple case. Suppose a receiver has a "gramophony" quality, that is to say, it sounds something like one of the early metal-horn gramophones. This effect is most probably due to the speaker resonating on certain notes. Listen carefully when some simple music is being received and notice if all the notes of the scale are reproduced equally well. You will most likely find that a certain note bursts out much louder than the others, so that when that particular note is received it comes out with a loud "brassy" sound. If this is somewhere near the middle register it can be very objectionable.

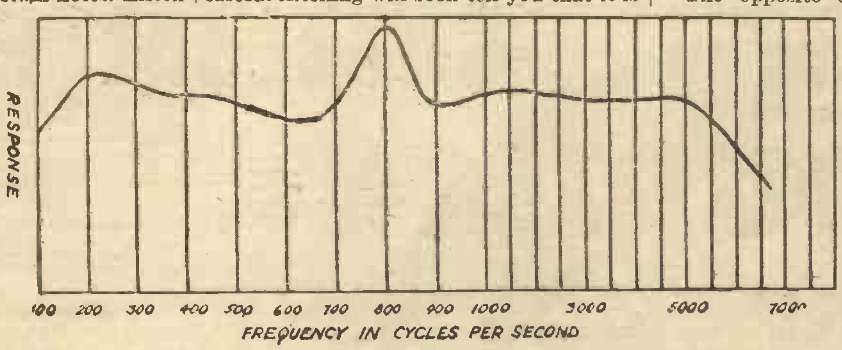


Fig. 2.—Response curve of a speaker showing a tending to resonate at 800 cycles.

Sometimes a receiver will have a tendency to resonate on two parts of the musical scale. One resonant spot may occur somewhere in the treble and another in the bass. Careful listening while different notes are being received will determine where the peaks occur.

A much more common though less obtrusive form of distortion is that produced by a falling off of the response of the set to notes at the upper or lower end of the musical scale, or indeed to both. It is quite easy to recognize. You may be receiving piano music, and you will notice, especially if you know the piece being played, that the pianist appears to use the soft pedal on the treble passages, that is to say the higher notes do not appear to be as loud as they should be. Again, the bass notes instead of coming out full and deep may appear to be thin and lacking in "punch." It is not unusual to find all these forms of distortion in one receiver. The treble may be lacking, and so may the bass, but owing to a resonant peak somewhere in the bass, this may at first appear to be all right. However, careful listening will soon tell you that it is not so. If you listen to a passage of music which runs down the scale to the very lowest notes, you will observe that as you get further down the scale so the notes with one exception get weaker. This exception is the few notes at which the resonance occurs. As these are passed they literally boom out. This test should be made during the reception of simple passages when the real state of affairs will be clearly noticed.

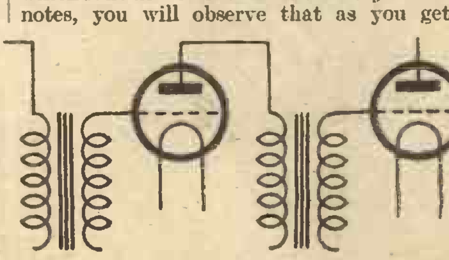


Fig. 3.—Two transformers in cascade should not be of the same type, as any tendency towards resonance in one will be greatly amplified by the other.

False Bass

It is surprising how listeners were at one time deceived by a "boomy" loud-speaker into thinking they were getting a true reproduction of the bass. Of course, there is no getting away from the fact that both designers and manufacturers alike have been guilty in the past of deliberately using resonating speakers so as to disguise a lack of bass response. Now, however, the public are becoming more and more familiar with true reproduction, and are not so easily foisted off with the counterfeit. Even if they cannot definitely recognize where the difference lies they know when a set is not doing justice to the programmes being broadcast.

The opposite effect of the falling off just mentioned is that of an over-emphasis of the high notes. This gives a high-pitched over-brilliant quality to reception, although again there is no definite harshness as there is when a speaker resonates. The type of distortion I refer to is that which is commonly associated with the use of an uncompensated pentode output valve. However, I will not go into details of its cause until I have finished these few paragraphs on the recognition of the various forms of distortion.

"Attack"

A form of distortion which is present to a greater or lesser degree with most loud-speakers is lack of "attack." It is due to the inability of the cone of the speaker to move rapidly enough to follow the fluctuation in the current caused by the music being received. The effect is that the notes are slurred, and tend to run one into the other. It gives the impression that the musicians are tired or lazy. I know many instances where orchestras have been blamed for slovenly execution when the fault lay entirely with the speaker.

(Continued overleaf)

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Blurred or Muffled Reception

Probably the most objectionable kind of distortion is that known as wave-form distortion. This is caused by the signal currents losing their original wave-form in passing through the receiver. Naturally this is more serious than any frequency distortion such as falling off or over-emphasis of certain notes as it means the notes themselves are distorted. The result is usually a discordant rendering of all tones, although it may sometimes be restricted to certain frequencies only. For instance, a valve may be overloading on the heavy bass passages in a musical item, but may be working within its capacity where the treble is concerned. This will, of course, give rise to distortion of the bass notes, but will give clear reproduction when there are only high notes coming through. Generally speaking, however, distortion due to the mutilation of the wave-form is manifested by a general roughness, blurring, or muffled effect over the whole frequency range. Extreme wave-form distortion caused by serious overloading is known as *blasting*.

A tip worth trying in determining the form of distortion present in a receiver is to stand well away from the speaker. In this way a better perspective is obtained, and faults which are not evident to the ear when close up are more easily recognized. Having determined as near as possible what kind of distortion is present, it remains to discover the cause or causes and to apply the necessary remedies.

Cause of Resonating Effects

First let us take the case where the speaker resonates badly on one particular note. This may be caused by a variety of things. The most obvious is that the speaker itself has a peak in its response curve. Such a curve is shown in Fig. 2. You will notice that at a frequency of 800 cycles, the speaker in question gives a greatly increased output, thus whenever the musical note of this particular frequency is received it will resound above the other notes of the musical scale.

With modern speakers, it is rather unlikely that there will be sufficient resonance in the speaker itself to cause noticeable distortion, but if there is any tendency towards resonant peaks in L.F. transformers or chokes in the set, and these peaks happen to coincide in frequency with the peak in the speaker then the total effect may become very pronounced.

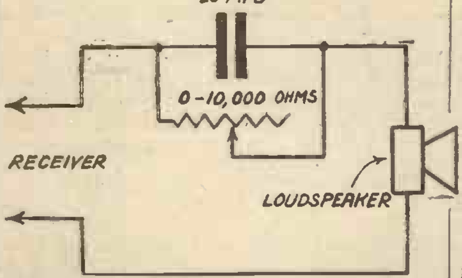

Fig. 4.—Simple tone control for reducing the bass response of a speaker.

Baffle Acting as a Sounding Board

Another cause which may accentuate resonant peaks in the speaker is an unsuitable baffle or mounting. It may happen that the natural vibration period of the baffle coincides or nearly coincides with the frequency of the "peaky" note of the speaker, the result being that when that particular note is received it is over-emphasised by the speaker itself, and then magnified again by the baffle, which acts as a kind of sounding board.

In attempting to cure resonating in the receiver a good plan is to first of all examine the circuit and see if there are any such likely causes of resonance as two L.F. transformers of the same type in cascade, as in Fig. 3. Obviously a resonant peak in one will be greatly exaggerated by the time the signal passes through the other. Replacing one of them by one of another type or make is a step which is clearly indicated. An output choke following transformer coupling may also cause a repetition of resonances in the transformer. A different transformer or a different choke may be tried with advantage. As regards the speaker itself, little can be done to the unit, but a different cone may cause an improvement. Alternatively, the cone can be given a coat of thin cellulose enamel. The reason for doing this is because the cone may have a natural vibratory period within the range of audible frequency. This will cause a dithering or resonating effect when a musical note of the frequency corresponding to this period is reproduced. In treating the cone the endeavour is to alter its natural frequency so that it comes outside the audible range.

The resonating caused by the baffle or the cabinet to which the speaker is attached is quite a common fault, and is due to the use of material which is too thin. In the case of a flat wooden baffle it should be at least a half-an-inch thick, but naturally a cabinet need not be quite so stout.

(To be continued)

FROM THE FLASH LAMP

"ACTION AND REACTION"

By "Photon"

IN electrical problems, just as in mechanical problems, the essential equality or balance between action and reaction must never be lost sight of or ignored. The word *reaction* is not used here in the specialized sense in which it is applied to a radio receiver, but in its wider sense as the equal and opposite force or E.M.F., which is always present but too often forgotten. It is common to find in the text books, or in an examination question, a problem presented beginning with the words: "If a force of . . . be applied to a . . . etc." or "If an E.M.F. of . . . volts be applied to . . . etc.," and sometimes there is no harm done; it is legitimate, perhaps, thus to deal with an abstract problem. But when we come to *real* problems such as dealt with by the engineer, the better form in which to state a case would be, "If a force of . . . pounds acts between an abutment A and a body B . . . etc.," because every force (and every E.M.F.) acts between two points or on two bodies, the one of which being defined as the *force* the other is the equal and opposite *reaction.*

The older text books were very slack in this matter; even the great Todhunter fell into a trap of his own making due to ignoring the importance of this principle. Thus the lever was dealt with merely as a beam to which three forces are applied, one of which is defined as acting at the *fulcrum* which was stated to be "fixed." But the lever is an engineering appliance and is not only a mean of transmitting force, but also a machine for doing work, and the *fulcrum is the point on the lever which is rigidly fixed in relation to the abutment.* Thus in the case of a row-boat the work done is by a force applied to the hand-grip of the oar, and the oarsman applies this force, using the stretcher (and in some degree. the seat) as the *abutment;* hence the *fulcrum is the rowlock* which is fixed in relation to the structure (hull of the boat) to which the stretcher is anchored; it is not, as stated by Todhunter* the blade of the oar where it grips the water. The effect of this error is striking. If the fulcrum were the blade of the oar the force of propulsion on the boat would be greater than the pull exerted on the hand-grip actually with an oar in which the lengths of the inboard and out-board portions are in the relation of one to three, the force of propulsion is only one-third. Todhunter would have been correct only if the rower had been standing on the shore instead of being in the boat!

The present writer some years ago hit on a very neat way of stressing the importance of this question of abutment. Probably every reader has been asked the ridiculous question on more than one occasion: "What happens when an irresistible force is brought to bear on an immovable post," the intention is that there can be no answer; but actually the answer is simplicity itself: "The abutment gives way!" To rub the matter in and to incite the student, and others, to be always on the *qui vive* on this question of abutment and *reaction*, Fig. 1 has been drawn to represent the catastrophe that takes place to the abutment when the "*irresistible force*" comes into action.

There are exceptions, but these are confined to dynamics that are not Newtonian, and electrodynamics of an advanced kind.

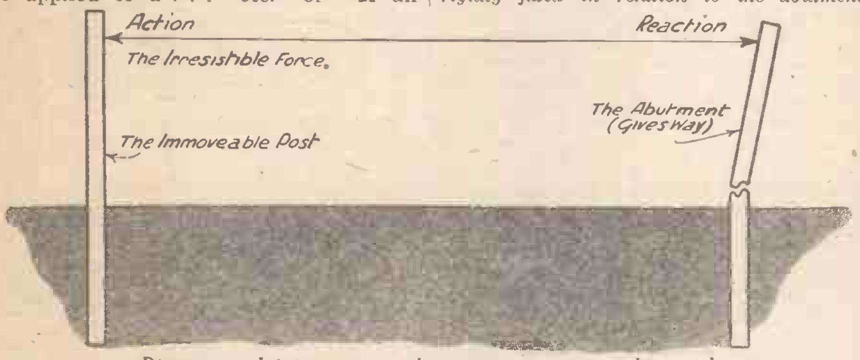

Diagram explaining action and reaction as set out in this article.

* "Mechanics for Beginners." § 163, "The fulcrum is the blade of the oar in the water," etc.

Does a CONDENSER CONDENSE?

A Condenser Seems a Very Inappropriate Name for Such a Useful Piece of Radio Apparatus. The Author Here Clears Up Any Misconceptions That May Exist

MOST of the basic electrical phenomena can be fairly easily comprehended even by the lay mind. The effects of voltage, for example, or of current or resistance are not difficult to understand. Others, on the contrary, present a certain amount of difficulty—in particular, the

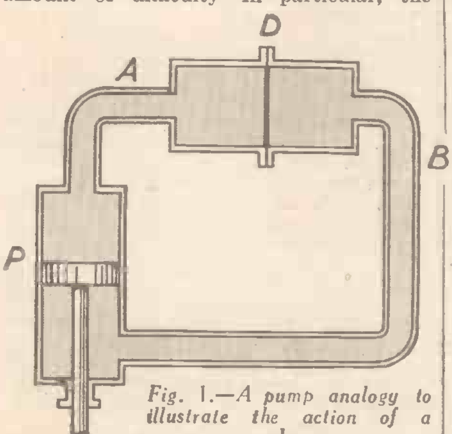

Fig. 1.—A pump analogy to illustrate the action of a condenser.

property known as "capacity" possessed by pieces of apparatus termed "condensers."

Of course, listeners know something about the effects of capacity. They know, for example, that by varying the capacity of a condenser in the tuning circuit of their receiver they can select the programme to which they wish to listen. Again, they accept, although they cannot always understand it, the statement that a condenser will allow alternating currents to pass, but presents an insurmountable obstacle to direct currents.

Tidal Flow

In an endeavour to clear up some of these mysteries, let us first of all consider the last question—how can a condenser, which consists of two conductors, separated by an extremely good insulator, permit any current, alternating though it be, to pass?

To understand this, we must try to accustom ourselves to consider electric currents, not necessarily as a *flow*, but as a movement. A flow is most certainly a movement, but all movements are not flows. For example, a river consists of a flow of water, but a tide is not a flow—it is ebb and flow—an alternate movement, first in one direction and then in the opposite direction. Yet there is no one who will deny that both are movements of water, and both represent power.

Now an alternating current compared with a direct current is very like the tide of the sea compared with a river. Both are movements of electricity, but only the direct current can be called a stream or unidirectional flow.

An Analogy

In order to give a clearer conception of the action of a condenser when an alternating voltage is applied to it, let us have recourse to that very useful device, the mechanical analogy. Figs. 1, 2 and 3 represent an arrangement of water pipes in which an alternating water pressure can be generated by working the piston of the pump, P, backwards and forwards. Across the pipe is placed a rubber dia-

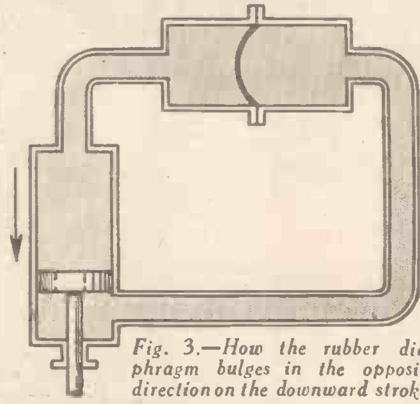

Fig. 3.—How the rubber diaphragm bulges in the opposite direction on the downward stroke.

phragm, D, which entirely prevents water from passing from the part of the pipe A to the part B. Yet as we operate the pump backwards and forwards, the rubber diaphragm expands and bulges, first to one side and then to the other, so that the backwards and forwards movement of the water can proceed very much as if no diaphragm were there. A very similar

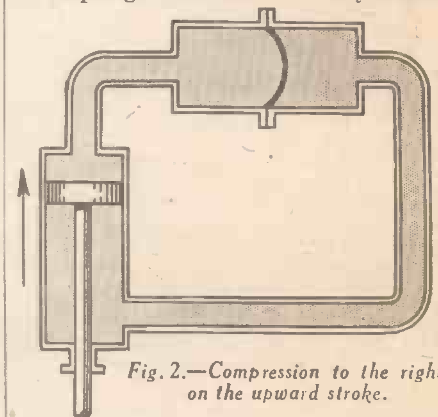

Fig. 2.—Compression to the right on the upward stroke.

state of affairs occurs with an electric condenser.

When an electric pressure is applied, say in one direction, the insulating material between the plates is put into a condition of electrical strain which corresponds to the bulging of the diaphragm. When, as in the case of an alternating voltage, the pressure is released, the insulating material, or "di-electric" as it is called, is released from its condition of strain. Then the alternating voltage is increased again, but in the opposite direction, and the di-electric is once more stressed. All the time energy flows into and out of the "bag" formed by the bulging of the rubber diaphragm in Figs. 2 and 3.

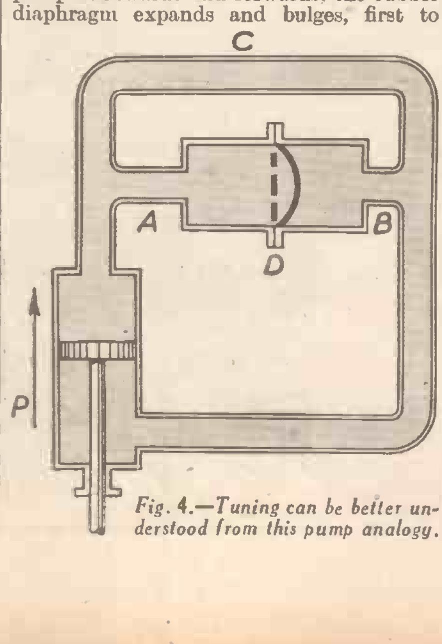

Fig. 4.—Tuning can be better understood from this pump analogy.

Tuning

Let me now try to give you a simple idea of how a condenser is employed to tune a radio receiver, although this is a little more difficult to explain. In Fig. 4 is shown a somewhat similar arrangement of water pipes to that illustrated in Fig. 1, but you will see that there is another branch of the circuit, marked C. Now, suppose that we give just one stroke to the pump, say, in an upward direction. As the system is quite full of water, the inertia of the water will cause a little delay in the movement in the arm C, but the pressure on the rubber D will cause this to bulge as shown.

As soon as the pump has reached the top of its stroke and has stopped, the rubber will tend to return to its normal shape, and will thus push water back in the direction of the arrow, see Fig. 5, and round the arm C. But once the water

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VISUAL TUNING INDICATORS

(Continued from page 513)

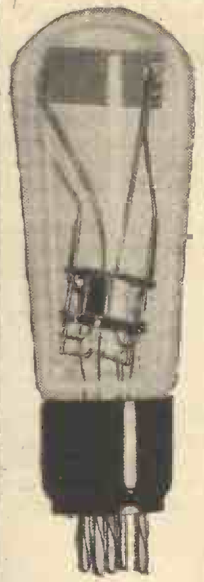


Fig. 4.—This is a photographic illustration of the cathode ray "tunograph."

This, the simplest form of visual tuning indicator, is widely used in commercial receivers, being the simplest and one of the most satisfactory. The method of connecting the milliammeter in circuit is clearly shown in Fig. 1. For best results the meter should be one which reads up to a slightly higher current than the V.M. valve consumes at minimum bias; for most types of battery valves a 5 m.a. instrument will be suitable, whilst one reading up to 10 m.a. is required for A.C. valves.

The only slight disadvantage of this simple form of visual tuning indicator is that a lower reading is obtained as the set is tuned to resonance. For that reason it is often preferred to paste a new scale on to the meter which reads "backwards." There is no need to calibrate the scale at all, since the actual current readings are not required, but it is only necessary to divide it up into a number of small divisions as shown in Fig. 2.

Other Mechanical Systems

There are innumerable other methods of "mechanical" visual tuning indicators, but they all depend upon the same principle, that is the variation of the V.M. anode current. Some of them are so arranged that when the current is at a minimum a relay is caused to switch on a light; the light thus comes "in" when a station is accurately tuned. The action may be reversed so that the light shows only when the set is off tune, and is extinguished when a signal is accurately tuned in. Several American receivers employ "shadow tuning," in which a shadow appears on an illuminated celluloid window placed above the tuning scale. The shadow becomes narrower as the set is tuned to a more powerful station, and resonance is thus indicated when the shadow reaches its narrowest point. In America, where A.V.C. has been in common use for the last few years, many other spectacular methods have been evolved, but all are similar in principle to those mentioned above.

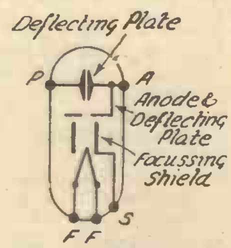


Fig. 5.—Showing the electrode arrangement in the "Micromesh Tunograph."

Using the Cathode Ray tube

An interesting scheme which has recently become available in this country is one whereby resonance is indicated by an illuminated line behind a darkened window. The length of the line is dependent upon the signal strength, and it varies in precisely the same manner as does the needle of the milliammeter previously mentioned. This new system

(Continued on page 548)

A.V.C. SIMPLY EXPLAINED

The Different Methods and How They Function.

By J. E. RICH

AUTOMATIC volume control is employed almost universally in modern superheterodyne sets, so that when listening to a distant programme that is subject to fading the volume is kept practically constant. The way in which A.V.C. operates does not seem to be widely understood, so it is my intention to describe its action as simply as possible.

In order to keep the strength of a signal steady it is necessary to decrease the sensitivity of the set when the volume tends to increase above that required, and increase it when it tends to fall below that volume.

Now a very convenient method of controlling the amplification of the high-frequency part of the set is by varying the grid bias on the variable-mu valves, the amplification being decreased as the negative bias is increased.

We have now to find a method of obtaining the negative bias voltage from the carrier wave of the station being received, and this is done by rectifying the carrier-wave current in a manner similar to the rectification of A.C. for use as a high-tension supply.

Delayed Diode Method

The accompanying illustration shows the circuit used for delayed-diode A.V.C. using a double-diode valve. The amplified high-frequency oscillations are applied to the tuned circuit L_1 C_1, and normal signal rectification occurs at the diode anode A_1. The resultant L.F. potentials are produced across the potentiometer P_1, which acts as a manual volume control as well as a diode load resistance. The L.F. oscillations are passed on to the audio-frequency valves for amplification in the ordinary manner.

The high-frequency voltages produced across the tuned circuit are also applied to the diode anode A_2 through the small coupling condenser C_2. This anode, however, is held at a negative potential with respect to the cathode by means of the potentiometer network R_1, R_2. Rectification therefore cannot take place at this anode until the H.F. potentials are greater than this voltage, when the anode will become positive with respect to the cathode.

This negative bias is known as the delay voltage, and it prevents the A.V.C. becoming operative until the signal strength reaches a predetermined value, so that the sensitivity of the receiver will not be impaired.

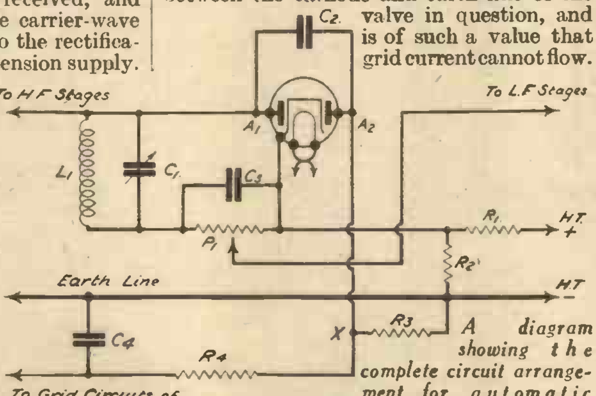
Now, if an extra strong signal is received, the high-frequency oscillation applied to the anode will reach such a magnitude that the anode A_2 will become positive, and anode current will flow through the load resistance R_3, and develop a potential across it, so that the end marked X in the illustration will become negative with respect to the earth line.

This negative potential is fed to the control grids of the variable-mu valves through the decoupling resistance R_4, with the result that the amplification of these valves is reduced. The condenser C_4 is important, as it prevents the variations in bias potential due to the modulation of the carrier wave by a low audio-frequency signal being impressed on the grids of the H.F. valves.

By carefully adjusting the values of the components in this circuit the negative potential applied to the H.F. valves will keep the signal quite steady except when the maximum amplification of the set is incapable of bringing the volume up to the required strength.

For the A.V.C. to be operative for a decrease or increase in strength, the anode current must be continually flowing in the diode anode circuit A_2, then should the signal grow weaker the anode current will be reduced in this circuit, and the potential developed across the load resistance R_3 will also be reduced. This decrease in bias on the H.F. valves will cause an increase in amplification, and so the volume will be steady.

The minimum bias on the H.F. valves is fixed by means of ordinary bias resistors between the cathode and earth line of the valve in question, and is of such a value that grid current cannot flow.



A diagram showing the complete circuit arrangement for automatic volume control using a double-diode.

When using the kind of A.V.C. just described, it is essential that several stages of H.F. are used, or otherwise the potential developed for biasing will be too small. The potential required is often as much as 20 volts when dealing with a loud signal.

Delayed Amplified A.V.C.

Another method of A.V.C. is known as delayed amplified A.V.C., and this kind is suitable when the available high-frequency amplification is limited.

The valve that is used for this type of circuit is the duo-diode-triode. One diode is used for normal rectification, the triode portion for normal L.F. amplification, as well as for supplying potentials to the second diode, so that considerably amplified potentials are available for A.V.C. purposes.

It will be obvious that as the sensitivity of the set increases as the signal strength is reduced, that the set will be at its maximum sensitivity when it is not tuned to a carrier wave, with the result that the set is extremely noisy between stations.

A method of quiet A.V.C. is sometimes used, but the extra circuit complication it involves is seldom worth while in practice.

Another method of suppressing the excessive amplification is to have a local-distance switch, by which we can reduce the maximum amplification when tuning by increasing the minimum bias values on the H.F. valves.

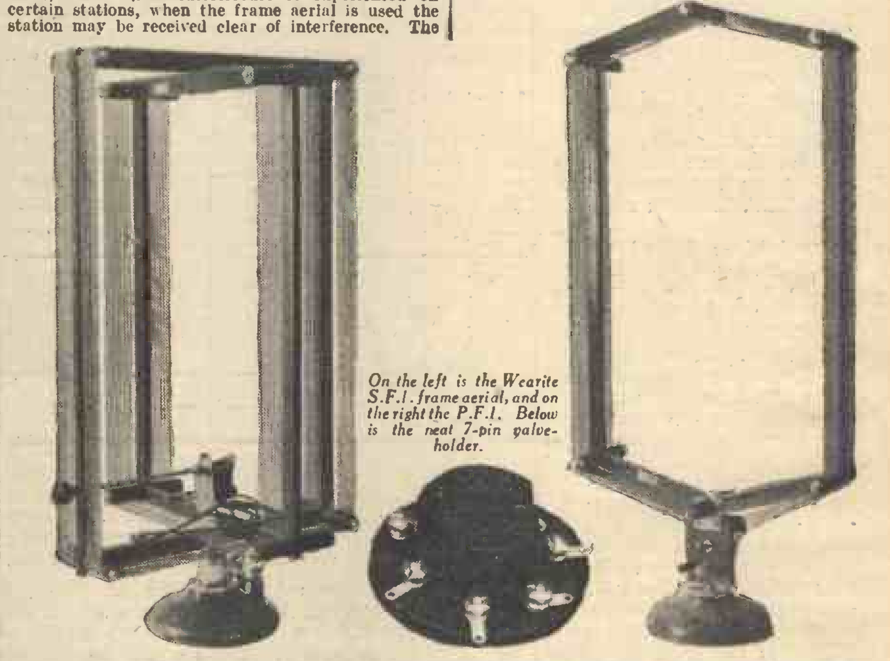
Facts and Figures

Components Tested in our Laboratory

BY THE PRACTICAL WIRELESS TECHNICAL STAFF.

WEARITE COMPONENTS

IT might be thought that the frame aerial has now no further application to modern radio reception, but this is actually far from the case, and there are many occasions where the use of this type of aerial may be of the greatest value. For instance, in districts where man-made static is very troublesome a frame aerial may often be used to the greatest advantage. It is also found that on certain parts of the coast, where morse interference is experienced on certain stations, when the frame aerial is used the station may be received clear of interference. The



On the left is the Wearite S.F.I. frame aerial, and on the right the P.F.I. Below is the neat 7-pin valve-holder.

manner of using a frame has, of course, already been explained in these pages, and the two aerials illustrated herewith are products of Messrs. Wright and Weaire. The super model has the two sections (medium and long wave) wound on separate frames arranged at right angles. The change-over is effected through the medium of a substantial rotary switch with an extension rod to bring the control knob outside the actual frame. Terminals are fitted to the base, and the frame may be rotated through 180 degs., so that it may be orientated for any desired station. It is wound with Litz wire, and covers wave-bands of 180–590 and 900–1,950 metres. The popular model is wound in the usual series fashion on one frame and covers bands of 180–598 and 880–2,300 metres. A wave-change switch is also fitted to the base of this aerial. The first-mentioned type costs 42s., whilst the smaller one costs only 32s. 6d. The tuning capacity for each type is .0005 mfd. The 7-pin valve-holder, which is illustrated, is made from a high-grade bakelite moulding, and is rather unique in shape. Special types of spring sockets are employed which provide not only a good grip on the valve legs (either solid or spring type) but also furnish a really sound electrical contact. The terminals which are fitted are soundly locked and the heads of these are provided with a slot, so that they may be tightened with ease. They are equally suitable for battery- or mains-operated valves and will prove absolutely trouble-free in use. The price is 1s. 9d.

NEW BULGIN H.F. CHOKE

A NEW addition to the range of chokes manufactured by Messrs. Bulgin is known as the Junior. This is encased in a green moulded case similar to the well-known S.G. choke, but in the new model the total height is only two inches. A similar terminal arrangement is provided, namely, one at the lower end and one situated centrally on the top. The choke itself is wound on a short length of ebonite tube and is in two sections. These are filled with enamelled wire providing quite a high inductance with a moderately low D.C. resistance. This was measured in the model submitted and found to be only 380 ohms. The price is 2s.

GRIPSO ACCESSORIES

THREE interesting Gripso accessories are illustrated at the foot of page 547, and they represent respectively an earthing clip of the push-on variety, a patent expanding earthing clip and an indoor aerial hook insulator. The first named is intended for fitting instantly to any type of pipe, and it is provided on the inside with two points which embed themselves in soft pipes, thus making a very sound connection. The lead to the receiver is taken from the terminal on top of the clip. The size of this component is such that it forms best contact on a pipe ⅜in. in diameter. The expanding clip has no provision for fixing the earth wire to it, but this is threaded through the hollow centre of the clip, and is passed between one side of the clip and the pipe to which it is attached. The wire is thus firmly held, and makes solid contact with the pipe. The wing nut on top of the clip may be tightened up to reduce the size of the clip so that it will clamp tightly round a pipe having a diameter from ⅜in. to ⅞in. The advantage of this clip is, of course, that the earth lead itself is in contact with the pipe. The hook insulator is provided with a strong pin, which may be forced into the picture rail or wall, and the aerial wire is then passed round the clip where it is firmly held, and by using two or three of these at equal distances round the wall the aerial may be kept taut, and will present a neat and tidy appearance. A sixpenny carton contains 12 of these clips. The push-on clip costs 4d., whilst the patent expanding clip costs 6d.

MAGNAVOX SENIOR P.M. SPEAKER

THE Magnavox speakers are, of course, well known to all radio enthusiasts, although there is little in their appearance to-day to identify them with the original tall horn type of speaker which not so many years ago was recognized as the standard upon which loud-speaker performance was based. The present form of Magnavox is on more or less standard lines, although there are still many features incorporated which render the Magnavox in a class by themselves. The magnet structure, for instance, is larger than usual, and is made up on the composite system, the

(Continued overleaf)

FACTS AND FIGURES *(Continued)*

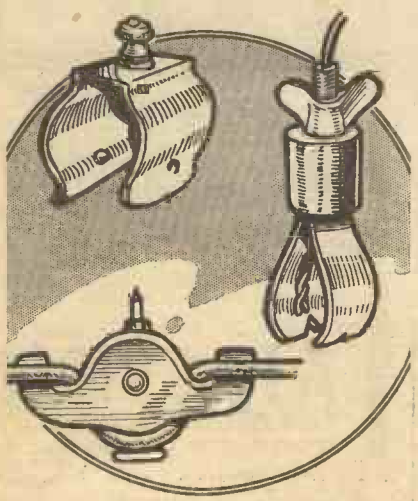
magnet itself being made from a chromium alloy, and the pole piece being made from high-grade cobalt. No spider appears in the centre of the cone, the suspension device being attached to the rear, and is designed in such a manner that the cone is extremely free in its movements. The transformer, which is bolted to the chassis, is of generous dimensions, and has a number of coloured tapping points, which provide for matching with practically any type of valve from triodes with an impedance as low as 1,000 ohms up to pentodes requiring a load of 19,000 ohms, in addition to Class B and push-pull circuits. The finish is in grey cellulose, and the speaker is enclosed in a dustproof bag with an ornamental gold silk front which enables it to be placed direct behind a baffle without the necessity for covering this first with artificial silk or other material. Tested for sensitivity, it was found to be exceptionally high in this direction, quite good signals being obtained from a single valve (pentode) receiver. At the extreme ends of the musical scale the tailing off was found to be nice and gradual and of such a rating that adequate high and low-note response is obtainable without any subterfuges in the way of introducing resonances, etc. The bass notes are particularly natural and not due to any bass thump, with the result that the drum in a dance band, for instance, can be heard in a remarkably clear tone without intruding in any way. Speech is particularly pleasing and crisp, and the general effect, when the speaker was used on a high-quality receiver, was one of finely balanced and unforced tone. We can thoroughly recommend this speaker to those who require a high-class component. The makers are Benjamin Electric, Ltd., and the price of this model is £3 3s. 0d.

MAGNUM I.F. TRANSFORMER

An intermediate frequency transformer for superheterodyne receivers is announced by Messrs. Burne-Jones and Co., Ltd. It is fitted with adjustable trimmers having an insulated bush in the top of the metal screening so that adjustment may be made by means of a long wooden rod or similar device without introducing hand-capacity effects, etc. Variable coupling is provided between primary and secondary windings so that an adequate band-pass effect may be obtained to suit the particular receiver. The finish is in grey cellulose, and the price is 10s. 6d. It may be obtained for chassis or baseboard mounting, and the exact type required should be stated when ordering.

NEW H.M.V. RECEIVER

Another addition to the range of H.M.V. receivers is announced and is worthy of mention at this point. It is a six-valve superheterodyne portable fitted with a moving-coil speaker and a Q.P.P. output circuit, thus bringing the receiver into the eight-stage class. In addition, it is fitted with automatic volume control. The makers state that they have endeavoured to produce in a self-contained battery portable receiver the characteristics of the radio section of the ninety-five guinea radio-gramophone, and it would certainly appear from the specification and the theoretical circuit that they have succeeded in their object. The dial is calibrated with the names of the principal stations, and the principal circuit details are as follows: A combined first detector and oscillator. Cold valve (or dry rectifier) for second detector—automatic volume control. Two frame aerials. Permanent magnet speaker with special diaphragm, capable of doing full justice to the 1.25 watt output stage. Gramophone switching arrangement to enable the receiver to be used for the reproduction of gramophone records. A total of 1,445 separate parts are stated to be used in the construction of this receiver. The price is 15 guineas.



Some of the Gripso components described on page 546.

CATALOGUES RECEIVED

To save readers trouble, we undertake to send on catalogues of any of our advertisers. Merely state, on a postcard, the names of the firms from whom you require catalogues, and address it to "Catalogue," PRACTICAL WIRELESS, *Geo. Newnes, Ltd., 8/11, Southampton St., Strand, London, W.C.2. Where advertisers make a charge, or require postage, this should be enclosed with applications for catalogues. No other correspondence whatsoever should be enclosed.*

WATMEL RESISTANCES

YEARS of research work and practical experience place the house of Watmel in a unique position for the manufacture of high-class resistances, and the new Hy-Watt wire-wound resistance is a good example of this firm's scientifically designed products. Wound on a former of ceramic porcelain, the iron-free resistance wire is unaffected by temperature changes and will stand considerable overloading without deterioration. The element, which is electrically welded to the lead wires, is coated with a special heat-resisting enamel. The result is a highly efficient resistance having the advantage of a wire-wound element of high wattage rating, and designed for use in voltage dropping, decoupling, biasing, etc., and costing no more than resistances of far less reliable design and composition. The new resistance is made in all values from 1 ohm to 50,000 ohms, 3 watt rating, price 1s. A descriptive leaflet, on which is printed a useful chart for aiding in resistance calculations, can be obtained from Watmel Wireless Co., Ltd., Imperial Works, High Street, Edgware, Middlesex.

TRIOTRON VALVES

TRIOTRON valves are so well known that they need little introduction, but to those readers who have not tried them in their sets we would recommend a very useful booklet just issued by Triotron Radio Co., Ltd., Triotron House, Bloomsbury Street, London, W.C.1. In addition to giving complete information regarding each type of valve in the very comprehensive range which is now available, it also includes several popular types of circuits to enable you to obtain the best results from the valves. A technical appendix gives some useful information explaining in simple terms the working of auto-grid bias, decoupling, etc., and a selection of hints and tips on better reception. All interested readers are advised to write for a copy of this booklet to the address given above.

TUNING INDICATORS

(Continued from page 544)

depends upon the use of a miniature cathode ray tube which may be connected in the anode circuit of the variable-mu valve in one of the methods shown in Fig. 3. The tube itself, which is the "Micromesh Tunograph," is illustrated in Fig. 4, whilst its electrodes are diagrammatically represented in Fig. 5.

Changes in anode current to the variable-mu valve cause different voltages to be set up across the deflecting plates of the "Tunograph." and these, in turn, vary the length of the illuminated line which appears on the anode.

The filament of this new tube takes from .85 to 1.0 amp. at .5 to .6 volts and cannot therefore be operated very economically from an accumulator. In addition to this, the "Tunograph" does not function when the H.T. voltage is less than about 180, so it is of chief value for use in mains receivers. In such sets, and where the heater voltage is 4, the filament is connected to the 4-volt supply through a 4-ohm fixed resistance. In fitting this interesting tuning indicator into a receiver, it should be placed somewhere near to the tuning dial with its anode immediately behind a small window consisting of ground glass. In order that the illuminated line should easily be visible, even in bright sunlight, it is also a good idea to recess the window slightly or to use glass which is of a greyish colour.

RADIO CLUBS AND SOCIETIES

Club Reports should not exceed 200 words in length and should be received First Post each Monday morning for publication in the following week's issue.

SLADE RADIO

A lecture, entitled "Gas-filled relays," was given by Mr. F. Inchley, of the General Electric Co., Ltd., at the meeting last week. After dealing briefly with rectifiers and rectification, he went on to the thyratron or gas-filled relay and described how these valves work. A demonstration was then given (D.C. and A.C.) showing the current through the valve and how the grid can take control. Another showed how the relay can control lighting or power, and in this case it was explained that a great saving in usage of current can be made. The inversion 230 D.C. into 4,000 A.C. 50 cycle without mechanical means was also shown. This is done by means of two gas-filled relays, the circuit for which was fully explained. A demonstration was also given of an apparatus which counted persons passing in one direction, but would not respond if they passed in the reverse direction. It was also shown how various coloured lights affected photo electric cells. The lecture proved to be one of exceptional interest and was greatly enjoyed by those present.—Hon. Sec., 110, Hillaries Road, Gravelly Hill, Birmingham.

SMETHWICK WIRELESS SOCIETY

At the meeting of this society, held at the New Talbot Inn on Friday, November 3rd, Mr. F. Inchley, of the G.E.C., gave details of the new Osram Catkin valves. After tracing the development of the valve from the early days, he described how the idea of using a metal envelope arose. The abolition of the glass container enables a greater degree of heat to be applied in manufacture to dispel occluded gases, and provides a ready means of rigid and constant construction. Other improvements in the cathode, the capping and base were described. Details of manufacturing processes involved were illustrated by lantern slides. Finally, Mr. Inchley compared the new valves with their glass counterparts and maintained that the Catkin was at least equal to the best glass valve made.—Hon. Sec., Mr. E. Fisher, M.A., 33, Freeth St., Oldbury, Nr. Birmingham.

ILFORD AND DISTRICT RADIO SOCIETY

On Thursday, November 2nd, a party of members visited the Osram Works at Hammersmith, where the latest types of valves were seen in the various stages of manufacture. The Catkin type were naturally of particular interest, and the unique construction was closely followed in all the processes. Then the transmitting valve department was visited, where a number of water-cooled valves were examined, including the latest C.A.T.14,500 kw. valve, which consumes no less than 15 kw. in the filament alone. The visit concluded with the visitors being entertained to tea. Later in the evening, at the Society's clubroom, Mr. G. L. Deal, of the Mullard Wireless Service Co., Ltd., lectured on "Modern Radio Practice," and this was illustrated with a number of good lantern slides. The various forms of automatic volume control, classes A, B, and C amplification, and the new types of multiple valves were among the subjects dealt with, the whole of which were of great interest. It was emphasized that the home constructor must acquire technical knowledge if he wishes to keep in touch with latest advances in radio practice, which will become even more complicated shortly.—Hon. Sec., Mr. C. E. Largen, 44, Trelawney Road, Barkingside, Ilford, Essex.

HACKNEY RADIO AND PHYSICAL SOCIETY

At our meeting on Monday last Mr. Gilbert gave an interesting talk entitled "Selenium Cells." After briefly explaining how selenium was obtained, and the modern methods of applying it to form a light sensitive bridge, the lecturer explained that as the amount of light falling on the bridges varied so its resistance to an electric current varied, and this fact made it possible to use the bridge to operate a relay. We were then shown many methods of making up a light-sensitive circuit. The lecturer had a large quantity of apparatus with him, ranging from a small radiovisor experimenter's kit to a large bridge of the type used for operating street lighting systems. All the apparatus was demonstrated, and a large number of lantern slides shown to illustrate the lecture. In a practical way these showed the many uses to which the apparatus can be put. Details of future meetings will be gladly sent to any local reader of PRACTICAL WIRELESS on request to the Secretary.—A. F. Rogerson, Hon. Secretary, 19, Sewdley Street, Clapton, E.5.

FULHAM AND DISTRICT RADIO AND TELEVISION SOCIETY

Having obtained a few new members the above society is endeavouring to increase the number, and by doing so to foster the interest in Television and ultra-short-wave reception in this society. Interested readers residing in the neighbourhood are invited to write to the Hon. Sec., A. L. Nagels, 267c, Fulham Court, London, S.W.6.

PRACTICAL LETTERS FROM READERS

The Editor does not necessarily agree with opinions expressed by his correspondents. All letters must be accompanied by the name and address of the sender (not necessarily for publication).

An Appreciation from South Africa

SIR,—I was very pleased with the presentation set of B.A. spanners and thought you may like to know how we in this far-away corner of the Empire appreciate these little gifts, which are very difficult to obtain locally.

I should like to see published an A.C. all-wave three, with one of the new H.F. pentodes, a detector and pentode output. I am sure many readers in this country would appreciate it, especially now that we can link up with the Mother Country through Daventry.

Hoping to see the A.C. all wave three described in an early issue and thanking you for many hours of pleasant reading.—J. BOSMAN (Standerton, Transvaal, S. Africa).

A Berlin Reader's Complaint

SIR,—In No. 54 of PRACTICAL WIRELESS (September 30th, 1933) I read a paragraph entitled "The Freedom of the Ether," and am surprised that you should publish such a paragraph. First, it is untrue that our "Volksempfänger" permits its owner to listen only to the Deutschlandsender and to the local transmitter. A listener living 200 miles or so off the Deutschlandsender who is able to hear this station with his V.E. must be able to receive foreign stations of similar power, and there are plenty of such high-power transmitters. I can assure you that the V.E. receives up to fifteen foreigners in the evening.

The steps which are to be taken to prohibit owners of other types of sets from listening to foreign broadcasts have *not* been taken and *will* never be taken. I can tell you that I often listen to English programmes with my windows wide open. I like the English programmes very much, and there will never come the police to take hold of me. I never heard anti-Nazi broadcasts from England. Those of our other beloved neighbours are so silly that German listeners don't waste their time with such nonsense, but forbidden it is not!

The true reason for the great effort that is made to spread the V.E. is only the will of our government that every German family shall be able to partake in great events of general interest. None shall be excluded, and therefore the sets are produced at a very low price. Four hundred thousand sets have been given in order as yet, Do you not believe, too, this is a very good mark?

I hope I will never see any more of such unbelievable paragraphs in your paper, which are only apt to make your readers angry.—HARRY FALL (Berlin, Nariendorf).

[*Unfortunately we cannot accept the statements of our correspondent, conditions in Germany to-day are such that we prefer to rely upon our own judgment rather than inspired, fettered, and Hitlerised opinions.*—ED.]

Our Short-Wave Feature

SIR,—I thank you for your letter indicating possible causes of the trouble I was experiencing with my S.W. set. I now believe this was due to the inductance of the transformer primary being reduced by D.C. through it. Anyhow, by using parallel feed to the transformer, the trouble has disappeared and the set is now quite stable. I have now given up taking all wireless papers except PRACTICAL WIRELESS. My particular interest is in short-wave work, and your paper gives me more real help in this than any other. I hope you will find opportunity to extend this section, and publish a really useful list of short-wave transmissions, including amateurs and commercials.—W. E. HUGHES (Seaford).

"All about Fixed Condensers": A Correction

SIR,—A slight error occurs in my article regarding the capacity of a plate condenser, which appears in the November 4th issue.

In stating that the capacity varied inversely as the *square* of the distance I had in mind, the electrostatic force existing between the two plates instead of the charge producing this force. As you know, the force *does* follow the law of inverse squares. The capacity is, however, inversely proportional to the distance. I had forgotten for the moment that the capacity of a parallel plate condenser equalled :—$\frac{AKN}{4d}$ mfds., otherwise I should not have made the slip, for clearly from this formula halving d will merely double C.

W. B. RICHARDSON

CUT THIS OUT EACH WEEK

DO YOU KNOW?

—THAT a condenser having a larger value than 4 mfds. should not be used following a valve rectifier in a mains unit unless the valve makers recommend a higher value.

—THAT to enable a frame aerial to be used with ganged coils a small aerial in series with an adjustable coil should be employed so that matching is possible.

—THAT when trimming a receiver employing a ganged condenser unit one trimmer should always be kept at its minimum or as near that value as possible.

—THAT the metal coating of mains valves should not be joined to earth under any condition. It should be connected to the cathode of the valve.

—THAT failure to observe the above rule may result in damage to the valve due to the short-circuiting of a bias resistance.

—THAT care should be exercised when purchasing flex for supplying the heaters of a mains receiver. If this is of the multi-valve type there will be a current of many amps passed, and thin flex will result in a voltage drop.

—THAT when all the usual tests for mains hum have failed it is a good plan to alter the position and angle of the mains transformer.

NOTICE.

The Editor will be pleased to consider articles of a practical nature suitable for publication in PRACTICAL WIRELESS. *Such articles should be written on one side of the paper only, and should contain the name and address of the sender. Whilst the Editor does not hold himself responsible for manuscripts, every effort will be made to return them if a stamped and addressed envelope is enclosed. All correspondence intended for the Editor should be addressed: The Editor,* PRACTICAL WIRELESS, *Geo. Newnes, Ltd., 8-11, Southampton Street, Strand, W.C.2.*

Owing to the rapid progress in the design of wireless apparatus and to our efforts to keep our readers in touch with the latest developments, we give no warranty that apparatus described in our columns is not the subject of letters patent.

LET OUR TECHNICAL STAFF SOLVE YOUR PROBLEMS

REPLIES TO QUERIES and ENQUIRIES by Our Technical Staff

The coupon on this page must be attached to every query.

If a postal reply is desired, a stamped addressed envelope must be enclosed. Every query and drawing which is sent must bear the name and address of the sender. Send your queries to the Editor, PRACTICAL WIRELESS, Geo. Newnes, Ltd., 8-11, Southampton St., Strand, London, W.C.2.

SPECIAL NOTE

We wish to draw the reader's attention to the fact that the Queries Service in intended only for the solution of problems or difficulties arising from the construction of receivers described in our pages, from articles appearing in our pages, or on general wireless matters. We regret that we cannot, for obvious reasons—

(1) Supply circuit diagrams of complete multi-valve receivers.

(2) Suggest alterations or modifications of receivers described in our contemporaries.

(3) Suggest alterations or modifications to commercial receivers.

(4) Answer queries over the telephone.

Please note also that all sketches and drawings which are sent to us should bear the name and address of the sender.

PICK-UP TRACKING

"Could you, through the medium of your valuable periodical, give me the correct tracking position for a pick-up and tone-arm?"—'Radiomic'—(No Address.)

The actual mounting position for the tone-arm will vary according to the particular make of component, and, therefore, the makers' instructions should be followed and the template which is supplied should be used when mounting a new pick-up. In the event, however, of your having a pick-up and tone-arm of different makes, or for some reason having no template, the following method should be adopted to mount the arm to ensure accurate tracking. Obtain a straight-edge, such as a rule, and place this on a record on the turntable with the edge of the rule resting against the centre spindle. Now place the tone-arm in some rough position and, with a needle in the pick-up, place this on the first groove of the record and move the rule so that its edge touches the needle as well as the spindle. Next place it in a position half-way across the record, and then on the last groove. In each of these three positions the front of the pick-up casing should be parallel with the straight edge of the rule when this is touching spindle and needle point. If it is found impossible to obtain a position where it is exactly parallel in all positions, the final mounting point should be such that the error occurs on the outside of the record, and the edge should be parallel on the last groove. The angle of the needle will be decided by the actual pick-up itself.

A.C.—D.C. TWO AND PICK-UP

"I have built up the neat Universal Two-valver which you recently described and am very pleased indeed with it. I get quite a number of stations, but the most important point is the freedom from hum, and the splendid quality. I should like to use the set for reproducing gramophone records, and I want to build it into a radio-gram cabinet. Can you give me the correct connections?"—G. Y. (Lambeth.)

The pick-up is simply joined between the grid of the first valve and its cathode. This may be left permanently in position if desired, or a change-over switch may be used. In the former case, join one pick-up lead to the fixed condenser on the upper surface of the baseboard where that component is joined to the grid of the detector valve, and connect the other pick-up lead to the large fixed condenser at the rear edge of the chassis. If a switch is required, the wire joining the first mentioned condenser and grid should be broken and joined to one side of a single-pole change-over switch, whilst the grid should be connected to the arm of the switch. The pick-up lead is then taken to the other contact on the switch. The lead to the large fixed condenser is used, of course, in either case.

PREMIER SUPER AND INSTABILITY

"I have made up the Premier Super and find that it is rather erratic in its behaviour. Sometimes it works fairly well, but other times it oscillates violently at all parts of the dial. I have checked wiring and find this quite in order according to the blue-print. Can you give me any idea what has gone wrong?"—A. L. P. (Wembley.)

A super-het of this type should give very little trouble, but we have examined one or two readers' efforts, and find that the principal difficulty arises when fastening down the screening cans of the coils and I.F. transformers. When the nut is tightened up on top of these components, you should make quite certain that the lower edge of the screen makes firm contact with the metal base. If it does not, the coils are not screened, and this point may be verified in cases of instability by placing a hand on each coil or transformer in turn. If there is any alteration in signal strength, the screening is not operating, and this point should be attended to. In the unlikely event of the nuts not pressing the can firmly on the chassis a piece of copper foil should be rolled up and placed under the edge of the can in order to provide the link between can and chassis.

DATA SHEET No. 62.

Cut this out each week and paste it in a notebook

METAL RECTIFIERS FOR H.T. SUPPLY.

Type No.	Output (Smoothed)		Condensers		Mains Transformer Secy. Input Voltage.			
	Volts	mA.	Capacity of each voltage-doubler condenser	D.C. working voltage	Half-wave Volts	Half-wave mA	Voltage Doubler Volts	Voltage Doubler mA.
H.T.5	120	20	4 mfd.	200	135	30	80	60
H.T.8	250	60	4 mfd.	350	375	90	200	200
H.T.9	300	60	4 mfd.	400	—	—	240	200
H.T.10	200	100	8 mfd.	250	250	150	150	300
H.T.11	500	120	6 mfd.	500	—	—	300	550
H.T.12	200	30	4 mfd.	200	250	80	140	120
H.T.13	150	25	Res. Condenser 8 mfd.	350	150	40	—	—

REPLACING OLD VALVES

"I am bringing my set up to date after seeing how the new sets have improved on the old ones. I think I shall only fit new valves, and I attach a sketch of my set with the different details and the names of the new valves I think I shall use. Do you approve of this?"—T. Q. A. S. (S.W.11.)

We have many times stated in our pages that a set *may* be improved by fitting new valves, and although, generally speaking, these are vast improvements on the older valves, you will have to guard against instability. It must not be thought that because a valve with an amplification of 500 is used in place of one with an amplification of only 100 that five times the volume will be obtained. The set will certainly be improved by the addition of the new valve, but owing to the higher efficiency there is risk of instability unless the old set is efficiently wired. Therefore, you should buy the new valves and see what happens. If instability results, then you may rest assured that your old set is not of efficient design, and you should rebuild it to modern requirements so that the full advantage may be taken of the new valves. You will not regret it.

TELEVISION DIFFICULTIES

"I have become very interested in Television through reading your various articles, and I should like to build up a television receiver. Some of my friends, however, tell me that it is very difficult to adjust and say that I shall be unable to get good results. Can you reassure me on this point. Is it hard to work the television, or can any one do it?"—B. V. (Cardiff.)

The operation of a television receiver should be no more difficult than the accurate adjustment of an ordinary wireless receiver. It is true that there appear to be more adjustments to make, but if you build up a sound piece of apparatus you will find that it is just as simple as tuning in a distant station, and you should certainly not hesitate to enter this field. Remember that to obtain best results you require a wireless receiver capable of delivering a really strong signal, and provided care is taken in making and assembling the various parts you will be able to obtain really worth-while results.

A.V.C. AND THE ORBIT

"I have finished the Orbit and find results splendid. I have tried to get one or two friends to make this up, and one of them, on examining the circuit, said that the fixed condenser in the anode circuit of the detector valve was out of order. He said this stops the A.V.C. from functioning, and I should like you to tell me whether this is so, and also how it is possible to find out whether there is any fading compensation or not. I have not got another set like you had to stand by the side to compare. Is there any easy way of doing it?"—G. T. (Blackpool.)

The value of the condenser which has been chosen for this position is such that smooth reaction is obtainable, while, at the same time, the anti-fading device works at a fairly good strength. If it is found that fading in your locality is still prominent on this receiver, you should disconnect the condenser from the anode lead when the unit will function to a slightly better advantage, but you will find then that reaction will be inclined to be fierce. It has already been mentioned, in the articles on the Orbit, that the condenser definitely fulfils a function, namely, smoothing the reaction control, and, therefore, if it is left out it will be found that some of the weaker stations will be unobtainable, owing to the fierceness of this control. To test the functioning of the A.V.C. Unit, the receiver should be tuned to a fairly powerful station, and the aerial lead removed from the lead-in tube, or alternatively a length of about two feet of wire attached to the aerial terminal. When the station is obtained at the maximum strength, the lead should be slowly moved towards the earth wire and otherwise moved about to give the effect of a varying capacity or length of wire. Without the unit, you will find that the signal will vary as the wire is moved, but with the unit the signal will remain practically constant.

FREE ADVICE BUREAU
COUPON
This coupon is available until December 2, 1933, and must be attached to all letters containing queries.
PRACTICAL WIRELESS, 25/11/33.

PRACTICAL WIRELESS MISCELLANEOUS ADVERTISEMENTS

Advertisements are accepted for these columns at the rate of 3d. per word. Minimum charge 3/-. All advertisements must be prepaid.

PREMIER SUPPLY STORES Offer the following Set Manufacturers' Surplus New Goods at a fraction of the Original Cost, all goods guaranteed perfect, carriage paid over 5/-, under 5/- postage 6d. extra (Ireland, carriage forward).

ELIMINATOR Kits, including transformer, choke, Westinghouse metal rectifier, T.C.C. condensers resistances and diagram, 120v. 20 m.a., 20/-; trickle charger 8/- extra; 150v. 30 milliamps, with 4v. 2-4 amps. C.T., L.T. 25/-; trickle charger, 6/6 extra; 250v. 60 milliamps. with 4v. 3-5 amps. C.T., L.T., 30/-; 200v. 100 milliamps. with 4v. 3-5 amps. C.T., L.T., 49/6; 300v. 60 milliamps with 4v. 3-5 amps. C.T., L.T., 37/6.

T.C.C. Condensers, 750v. working, 2 mf. 3/6, 4 mf. 6/-, 4 mf. 450v. working 4/-, 250v. working 1 mf. 1/3, 2 mf. 1/9, 4 mf. 2/6; aqueous electrolytic 440v. working, 4 mf. 3/-, 8 mf. 3/6.

ALL the Following Lines 6d. each or 5/- per dozen: 4- and 5-pin chassis mounting valve holders; shielded screen grid or pentode leads 1-watt wire end resistances, any value; 0.1 condensers; on-off switches push-pull; 0.02 condensers, 0.5 condensers.

AMSCO Triple-gang 0.0005 Condensers, with trimmers, 4/11.

T.C.C. Electrolytic Condensers, 100 volts working 15 mfd.; 1/3.

PREMIER Chokes, 40 m.a., 25 hys., 4/-; 65 m.a., 30 hys., 6/-; 150 m.a., 30 hys., 10/6.

PYE Chokes 20 or 32 hys., 4/-; Premier multi-ratio output transformers, giving 15 different ratios, 7/6.

HARLEY Pick-up, complete with arm and volume control; 12/6.

BRITISH RADIOPHONE Wire Wound Potentiometers, with mains switch incorporated, 5,000 ohms, 10,000 ohms, 50,000 ohms, 100,000 ohms, 250,000 ohms, any value; 3/6.

KOLSTER BRANDES Gramophone Motors, dual type, can be worked by clockwork or mains, induction type 100-250 volts, 27/6; complete with all fittings and turntable.

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SPECIAL Offer of Mains Transformers, manufactured by Philips, input 100-115v. or 200-250v., output 180-0-180 volts, 40 m.a., 4v. 1a., and 4v. 3a., 4/6; 200-0-200v., 4v. 1a., 4v. 3a., 4/6.

ALL Premier Guaranteed Mains Transformers have engraved terminal strips with terminal connections, input 200-250 volts, 40-100 cycles, all windings paper interleaved.

PREMIER H.T.8 Transformers, 250v. 60 m.a., rectified, with 4v. 3-5a. C.T., L.T., and screened primary, 15/-; with Westinghouse rectifier, 25/-.

PREMIER H.T.9 Transformer, 300v. 60 m.a., rectified, with 4v. 3-5a. C.T., L.T., and screened primary, 15/-; with Westinghouse rectifier, 26/-.

PREMIER H.T.10 Transformer, 200v. 100 m.a., rectified, with 4v. 3-5a. C.T., L.T., and screened primary, 15/-; with Westinghouse rectifier, 26/-.

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FOLLOWING VALVES USED FOR TEST ONLY. CALLERS ONLY. MS4B, MS4, DSB, DS, PT4, S4VB.

MAGNAVOX, D.C.144, 2,500 ohms field, with humbucking coil, Pentode transformer, 17/6; complete with A.C. conversion kit, 27/6.

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McMICHAEL 2-screen Grid Pentode Transportable 4, complete; gets many stations, £6/15.

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RELIABLE Canned Coils with circuit; 3/- per coil accurately matched; dual range.

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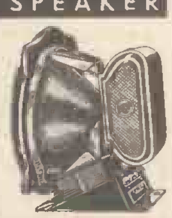

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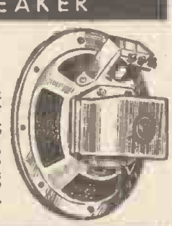

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P. W. Gift Stamp
"Popular Mechanics" No. 5
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