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Wireless in the Car

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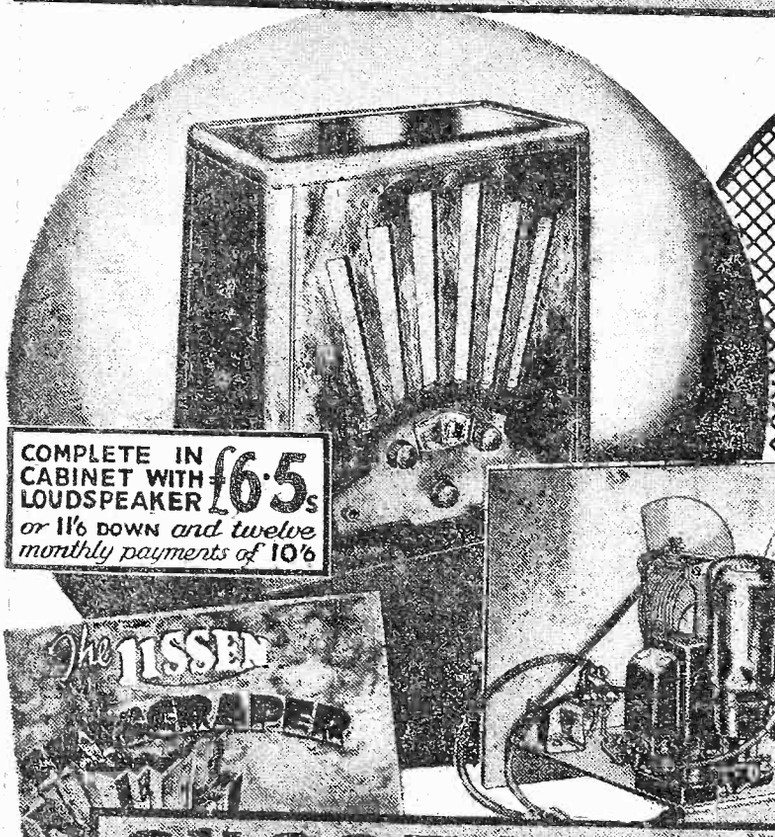

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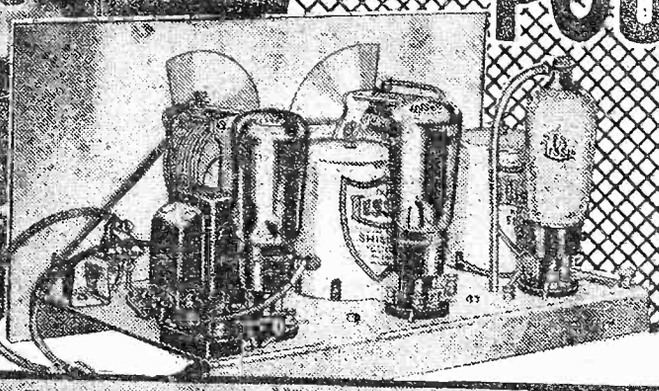

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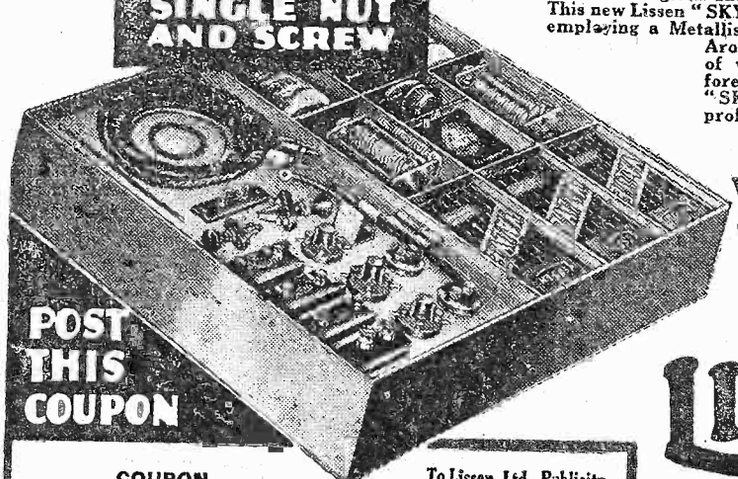

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LISSEN "SKYSCRAPER" KIT 3

ROUND *the* WORLD *of* WIRELESS

International Broadcasts

OF all the European countries Germany is probably the one which has shown most initiative in the development of interchanged programmes with other continental and extra-European States. During 1932 the Reichsfunk broadcast 280 wireless entertainments for the benefit of foreign listeners, and in the same period, relayed 250 programmes from foreign transmitters. These figures include the regular weekly features exchanged with the United States of America.

Two More Finnish High Power Stations

IT is reported that to ensure a better reception of the Helsinki programmes in Finland, the power of the Viipuri (Viborg) transmitter is to be increased from 10 to 40 kilowatts, and that a 10 kilowatt relay station is to be installed at Oulu (Uleaborg). Up to the present, the latter station situated on the borders of the Gulf of Bothnia has relayed the capital on 690 metres (434.7 kc/s) with a 1.5 kW transmitter. With the advent of larger stations, it is possible that some of the smaller relays such as Pietarsaari (Jakobstad), or Pori (Bjorneborg) may be dismantled.

Altered Wavelengths of Short-wave Stations

WITH the increase in number and power of transmitters in certain portions of the short-wave broadcasting band, some transmissions have been severely heterodyned. In order to alleviate this trouble Rome 2RO is now carrying out some of its broadcasts on 48.2 m. (6,220 kc/s) instead of the 25.4 m. channel. Skamleback (Denmark) during the past week or so has also temporarily moved from 31.5 m. to 49.4 m. (6,073 kc/s), and on this new wavelength provides very powerful signals. The station may be easily identified by its musical box interval signal; it is that of Copenhagen from which the programmes are relayed. As most readers are aware a simultaneous broadcast is carried out through the Kalundborg high-power station on 1,153.8 m.

Sponsored Publicity Concerts

THE number of stations in Europe which have adopted this method for supplementing their income is daily growing larger. In addition to such stations as Radio Paris, Toulouse, Fécamp (Radio Normandie), Athlone (I.F.S.), and Ljubljana, listeners may now hear an English musical transmission from San Sebastian (EAJ8) Spain on 456 metres, after midnight on the conclusion of the ordinary programmes. The call and details of the entertainment are given out in the English language by a woman announcer.

Television In Italy

FOLLOWING a series of experiments, short-wave transmitters are to be erected shortly both at Rome and Turin in order to ascertain the useful area of telephony and television broadcasts on the higher frequencies. Several channels ranging from 3 to 7 metres are to be tried out.

Proposed High Power Station on French Coast

ACCORDING to a Paris newspaper the popularity of Radio Normandie (Fécamp) has recently grown to such an extent that its owner seriously contemplates the purchase of a 60 kilowatt transmitter to be installed "somewhere on the coast of Normandy." All efforts, however, would be made to secure a more favourable wavelength, namely, one less liable to interference by the local coastal morse stations.

State Ownership of Norway's Broadcasters

AS a result of a vote in the Oslo Storting (Chamber of Deputies) the Norwegian Government is taking over the existing broadcasting companies from July 1, and will carry out a new plan which calls for a network of some forty-three transmitters. The complete reorganisation will be carried out in three distinct periods, covering the next two years. The first step to be taken is the installation of a new 10 kW. transmitter at Bergen, and the transfer of the present plant to Stavanger or Haugesund. Trondheim may also be allotted a high-power station, and a general change-over will be carried out in respect to the smaller relays. In the second and third stages of the scheme small transmitters to take the Oslo programme will be opened at Arendal, Farsund, Kristiansand, Narvik, Egersund, Floro, Nordfjordeid, Maaloy, Mo, Kragero, Steinkjer, Svolvaer, Vaagaa and Sogndal. Most of these will work on a common wavelength.

When Vienna Closes Down

THE Austrian broadcasting authorities have decreed that at the end of the evening transmission the Vienna studio shall regularly close down with the playing of the National Anthem. In future you will hear the announcer's call: *Hallo! Hallo! Hier Radio Wien. Wir Schliessen mit der Oesterreichischen Bundeshymne* (We end our broadcast with the Austrian Anthem), and it will be followed by the melody of Haydn's *Hymn to the Emperor*.

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

More Relays for Hungary

THE small relay station installed at Pecs, formerly Funfkirchen, broadcasts the Budapest programme daily from 3.45 until 11 p.m. G.M.T., on 210 metres. The power is only 1¼ kilowatts, but its signals have already been heard in many parts of Europe.

France's Ambitious Broadcasting Scheme

IN view of the forthcoming Lucerne conference, at which wavelengths are to be re-allocated to European transmitters, most continental countries have already formulated their claims based either on existing systems or on plans to be carried out in the near future. If the Ferrié scheme matures in France that country, with an aggregate power of 828 kilowatts (aerial), will jump from a much lower position to the top of the list, now headed by Russia. The plan provides, in addition to the stations already in operation, for a further chain of nine stations with powers varying from 60 to 120 kilowatts. Paris PTT, as the "key" of the network, is to be endowed with a 120 kW. transmitter to be erected in the Chevreuse Valley, at some distance from the capital; Toulouse-Pyrenees (120 kW.); Rennes-Thouries (120 kW.); Lyon-la-Doua (90 kW.); Limoges and Bordeaux-Lafayette (60 kW.); Nice-La Brague (60 kW.); Marseilles-Realtor (60 kW.), and Lille-Camphin (60 kW). The cost of these installations is computed at roughly 100,000 francs, and the same amount would be earmarked in the Budget to run the system. It has not yet been definitely decided what is to become of such stations as Radio-Paris, Poste-Parisien and, in particular, the new Radio-Toulouse transmitter at St. Agnan, to which the State has not yet granted a licence to broadcast.

France and British Made Sets

ACCORDING to a report in the *Journal Officiel*, the importation of British wireless sets into France is prohibited until further notice. It is pointed out that the quota for the period ended March 31 has already been reached so great has been the demand for wircless sets bearing the mark "Made in England."

Wireless at the Wheel

AN entirely new built-in radio set which will enable motorists to enjoy programmes whilst actually driving was announced recently. These sets are a standard extra on many makes of American cars, and are widely used in an adapted form by the American police.

They are entirely unobtrusive and take up no room in the car. The aerial is hidden in the roof; a dry high-tension battery is fitted under the driver's seat, and both the receiver and the moving-coil loudspeaker are placed under the scuttle. All that can be seen of the set is a neat illuminated tuning plate fitted with a lock and key beneath the steering wheel.

Built-in radio sets of various types have been tried out before in this country; but, owing to the noises generated by the electrical equipment and to constant variation in volume they have usually only been playable when the engine is shut off.

In the new Transitone, it is claimed, these difficulties are overcome. Special methods of insulation suppress electrical and engine noises, and volume is automatically controlled.

INTERESTING and TOPICAL PARAGRAPHS

BUSH FIRE WARNINGS FROM THE AIR

An aerial bush fire patrol has been formed in Victoria, Australia, to assist in combating the bush-fire menace. The scheme provides for forest officers in timbered country being equipped with wireless receivers. By the aid of the wireless the aerial patrol notifies the nearest forest officer immediately there is an outbreak of fire, and he is thus enabled to summon all available aid in a short time. Our photo shows: A forest officer in Victoria, complete with wireless equipment, receiving instructions from a 'plane overhead.

Cinema Organist for Empire Broadcast

HAROLD RAMSAY, the "Flying Organist" who plays the wonderful organ at The Granada Cinema, Tooting, was recently honoured by being selected to do an Empire broadcast. This took place actually from the Granada, Tooting, at 1 a.m., on the morning of March 3rd, and was broadcast all over the Canadian zone. Mr. Ramsay was a very suitable selection, apart from his abilities as an organist. His youth was spent in Canada, where he received his musical education, taking his degree at the McGill University. He started his career in Canada, and was one of the first broadcasters there. Mr. Ramsay played a programme ranging from jazz to the classics, and also rendered a special item, "The Maple Leaf For Ever," variations on the Canadian anthem which he arranged himself. Amongst his listeners were his old father and mother, who still live in Canada.

Gracie Fields Presses Her Own Record

ON Tuesday, February 14th, Gracie Fields, England's greatest comedienne, enjoyed one of the greatest days of her life. In the morning she visited the "His Master's Voice" factories at Hayes, Middlesex, to press her own four millionth record. After she had been received by the Manager of the Record Factory, she was conducted to the press on which her latest record to be released by H.M.V. in March—"Play, Fiddle, Play" and "So long, lads, we're off"—was being pressed by one of the workers. The pressman rolled up into a soft ball the warm record material for the four millionth disc. Gracie stepped forward, placed the labels on the top and bottom matrices (the metal dies on which her voice and music are engraved), put the ball of record material in the centre of the press and brought the two faces together. She turned a lever to the right, and after the steam had automatically circulated behind the faces of the matrices, followed by cold water, she lifted the top of the press and withdrew the black, shining disc, which was the four millionth impression of her voice. It is interesting to note that if the four million records were weighed together they would total 732 tons, and if they were piled face to face on top of one another they would reach a height of 6 miles 551 yards—higher than the highest mountain in the world.

The New West Regional Station

WORK on this B.B.C. transmitter is well up to schedule time and it is hoped to carry out tests in the course of next month. If the engineers are satisfied with results experimental transmissions for listeners will be made in April.

SOLVE THIS!

Problem No. 26.

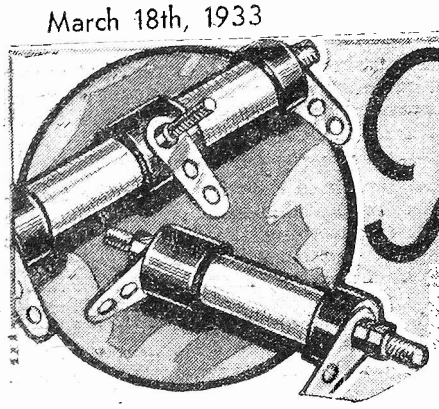
Abrahams made up a portable receiver, and used a small attache case for the containing box. The frame aerial was built in the lid, and this measured 15in. by 12in. A total of sixteen turns covered the normal wave-band, and gave very good results. Owing to the fact that the accumulator was rather small, he decided to build the receiver into a larger case so that larger batteries could be used. He accordingly chose a small suitcase roughly double the size of the former one. He cut a framework to fit snugly in the lid, wound on the sixteen turns, but when he tried it out he found that he could not receive the London National station on the tuning dial. Why? Three books will be awarded for the first three correct solutions opened. Address your envelopes Problem No. 26, The Editor, PRACTICAL WIRELESS, Geo. Newnes Ltd., 8-11, Southampton Street, Strand, and post to reach us not later than March 20th. Do not enclose any other correspondence with your solution.

SOLUTION TO PROBLEM NO. 25

A screen grid valve is of very high impedance, and naturally required a high impedance anode coupling component. As the "Fury Four" only employs a 30,000-ohm anode resistance in the detector anode circuit, the valve did not function efficiently. Simpson should have used at least 100,000 ohms in place of the 30,000-ohm resistance which was originally specified.

The following three readers received books in connection with Problem No. 24.

J. O'Neill, 36, Pearson Street, Lr. Broughton, Salford, E. Lancs. E. Berry, 43, Grafton Road, Keighley, Yorks. K. L. Davy, 94, Queens Gate, S.W.7.



The "COLD VALVE"

A Brief Discussion of the Principles Involved in the New Type of Rectifier

By BARTON CHAPPLE, Wh.Sch., B.Sc.

FREQUENTLY in wireless matters we can trace a very interesting cycle of events which brings us back to some of the early types of apparatus, or at least prototypes of these, although at first glance the components in question may be looked upon as obsolete. A typical example is found in the case of tuning coils which I dealt with quite recently in these columns. Originally we had the large single layer inductances, followed by rapid developments during which many ingenious arrangements were adopted to reduce self capacity and inherent losses, and yet make the inductance in a compact form. There is a tendency now to revert to the single layer type whenever possible.

Valve and Metal Rectifiers

I am reminded of this and similar examples by garnering some details of what the lay Press have been pleased to dub the "cold" valve. Is this another case of coherer, crystal, bright emitter valve, dull emitter valve and cold valve? It is my intention shortly to deal with this question of rectification in its many forms, but at the moment I want first of all to furnish readers with the only available details concerning this cold valve development. To the radio engineer the dream of a cold valve has had almost a parallel with that relating to the transmutation of metals by the alchemist whereby he hoped to change other metals into gold and also discover the elixir of life. We are all familiar with the use of the single or double anode valve as a rectifier when it is desired to work wireless apparatus from the alternating current mains, and an example of an eliminator built up for this purpose and using a valve of this type is illustrated in Fig. 1.

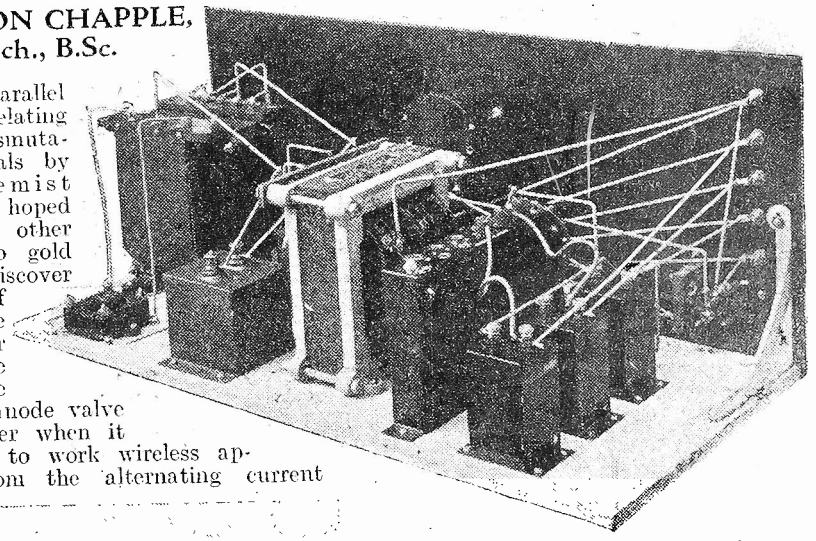


Fig. 1.—An example of a powerful mains eliminator which makes use of the valve for rectifying the applied A.C.

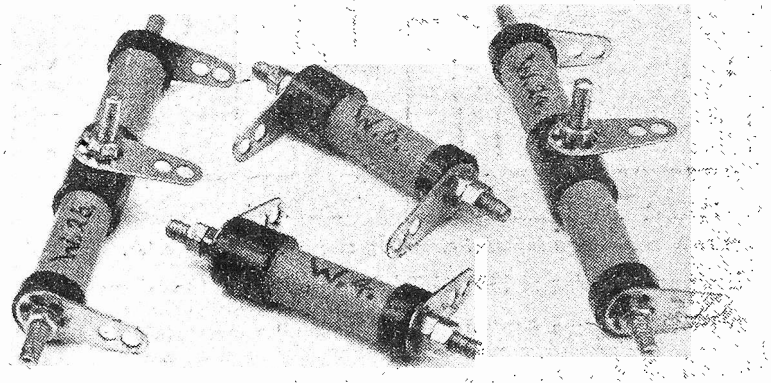


Fig. 4.—Samples of four types of the new cold valve or Westector units.

Rectifier Action

The valve action depends on the emission of electrons from a heated filament, but of more recent date than the first valve rectifier another form of rectifier has come into popular use. I refer here to what is known as the Westinghouse Metal Rectifier. It has many advantages amongst which may be mentioned that there are no moving parts requiring maintenance and, in addition, the unit is reasonably compact. Essentially it is an electronic device depending for its operation on electronic action at a permanent junction between copper and copper oxide. No chemical action takes place during the process of rectification and, moreover, it has quite a high efficiency, something of the order of between 50 per cent. and 60 per cent.

The construction of the unit is shown diagrammatically in Fig. 2. every unit being assembled on steel bolts with the number of discs in series and parallel connections varied to suit the voltage and current output required. This rectifier is virtually a cold electronic valve and depends for its action as a rectifier on the

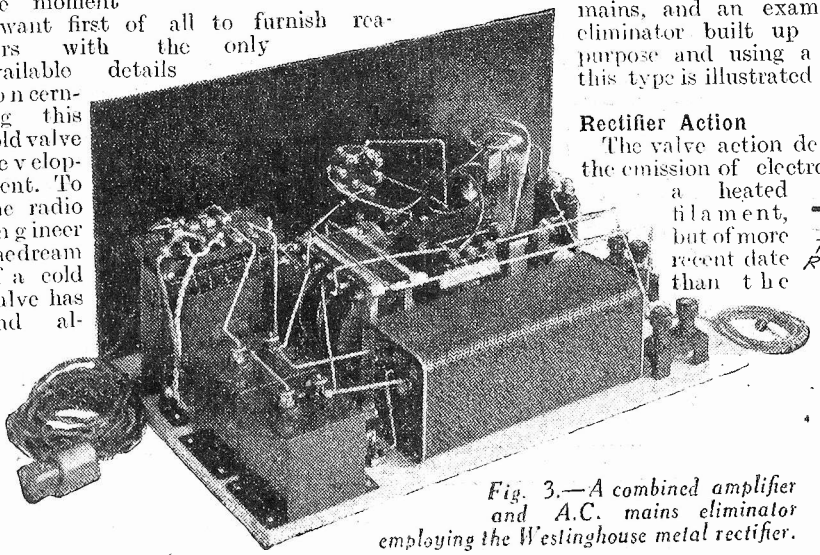


Fig. 3.—A combined amplifier and A.C. mains eliminator employing the Westinghouse metal rectifier.

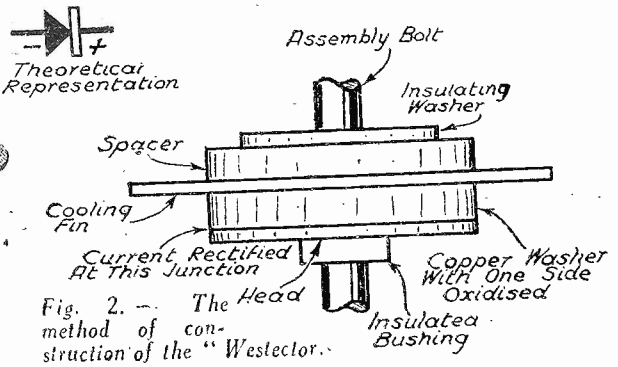


Fig. 2.—The method of construction of the "Westector."

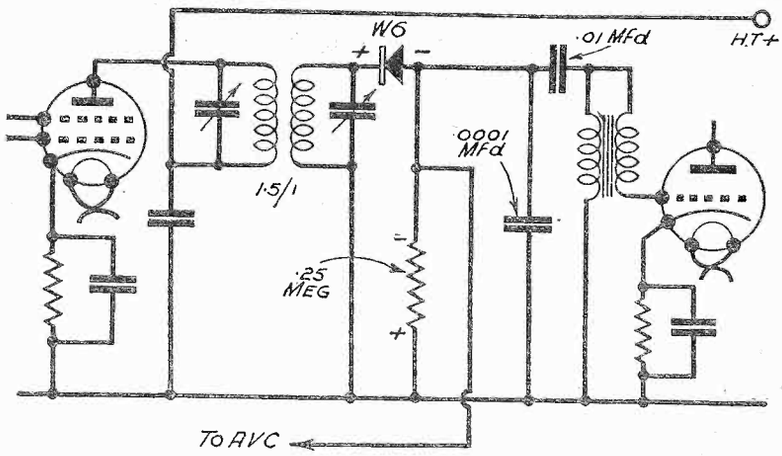


Fig. 5.—A simple method of using a Westector.

fact that the ratio of the resistance from copper to oxide coating is very high compared with the resistance from oxide coating to copper. The ratio between these two resistances is of the order of one thousand, and an example of a combined amplifier and A.C. mains eliminator employing this particular form of rectifier is shown in Fig. 3.

A Natural Corollary

For some time now it has seemed a natural corollary to expect this heavy duty rectifier to be the advance guard of a specially developed type which could find application in high frequency circuits quite apart from those used in measuring instruments. Certain advance information now to hand confirms this, for an announcement has been made that the Westinghouse Brake and Saxby Signal Co., Ltd., have produced what they have termed Westector units.

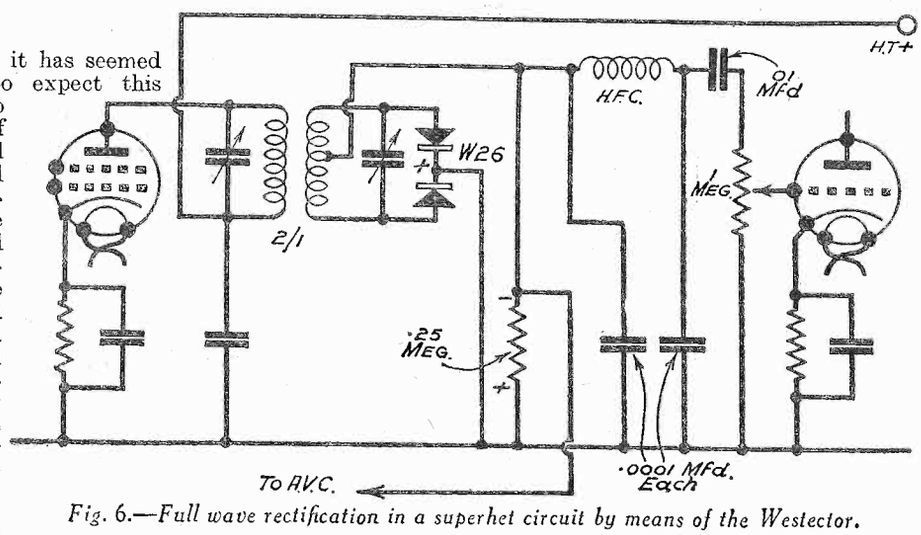


Fig. 6.—Full wave rectification in a superhet circuit by means of the Westector.

First of all, the makers state that the main use of these Westectors is as a second detector stage in a superheterodyne receiver, and as such will provide half or full wave rectification depending on the circuit used. A point of very special importance which needs to be stressed arises from the fact that no heater current is required with this component (hence the term cold valve) and, furthermore, no anode current is needed, and this in itself disposes of the usual necessity for the very adequate smoothing which has to be incorporated when consideration is given to the normal type of detector valve anode supply with mains driven sets.

Samples and Circuits

Samples of these new components are given in the photographic illustration, Fig. 4, four separate types being shown, namely W. 4, W. 6, W. 24, and W. 26. They are quite small and light, but look very robust and will certainly take up but little space in the normal wireless receiver. Arising from the fact that no heater circuit has to be supplied, and in consequence there is no self capacity between the negative end of the rectifier and earth, it is possible to employ the normal half wave circuit, such as that shown in Fig. 5, instead of the diode circuit in which the positions of the rectifier and reservoir condensers are interchanged.

Turning to Fig. 6 the reader can see the slight modifications introduced when full wave rectification is employed by using the centre tap. In these superheterodyne arrangements it is essential to ensure that the preceding transformer coupling has a ratio matching the impedance of the preceding valve to that of the Westector. In the cases of Figs. 5 and 6 the ratios should be 1.5 to 1 and 2 to 1 respectively when used in conjunction with low impedance type screen grid valves and the units shown and working at 100 to 150 kilocycles.

Automatic Volume Control

With the intriguing possibilities afforded by the suggested applications of automatic volume control to variable mu valves it is necessary to see how the situation is affected by the substitution of a "cold" valve for one of its "warmer" brothers. It is merely a question of arranging suitably the polarity of the Westector so as to utilise the D.C. component of its output in the usual way to provide automatic volume control, using the variable grid bias method.

The makers suggest, however, that a more desirable form of automatic volume control is provided by the scheme shown in skeleton form in the diagram, Fig. 7.

Types and Ratings

According to data issued by the manufacturers the table included here gives the details concerning the types and ratings of the four models illustrated in Fig. 4.

Type.	*Circuit.*	*Max. Input Volts.*	*Max. Current.*
W.4	Half Wave	24 volts peak	0.25 mA.
W.6	Half Wave	36 volts peak	0.25 mA.
W.24	Full Wave	24 volts peak each side of centre tap.	0.5 mA.
W.26	Full Wave	36 volts peak each side of centre tap.	0.5 m.A

No Reaction

This is an interesting feature, but, on the other hand, the man who normally uses his reaction control almost to destruction instead of operating each valve stage efficiently and resorting to reaction on occasions, may look on the absence of amplification and reaction control with a cold valve as something of a mixed blessing. This point can, however, be offset by an appreciation of the truly straight line detector characteristics offered by a Westector and a realization of its value in handling really large input signal volts (see table) coupled with the reminder that the reaction and amplification efficiency can very easily be made good by the addition of a second stage of high-frequency in *lieu* of the single stage which has had such a popular appeal for a long time.

In conclusion one other point must be mentioned in connection with these units as this has an important bearing on design. Due to the remaining self capacity the damping introduced at radio frequencies is high and is equivalent to an approximate load of 10,000 ohms. When used as a straightforward radio frequency detector, therefore, the Westector unit should be preceded by a high-frequency valve of very low impedance and preferably one of the triode class, as in this way the objections arising from the damping factor can be overcome in quite an effective manner.

A circuit somewhat similar to that shown in Fig. 5 will form a basis for any readers who desire to experiment.

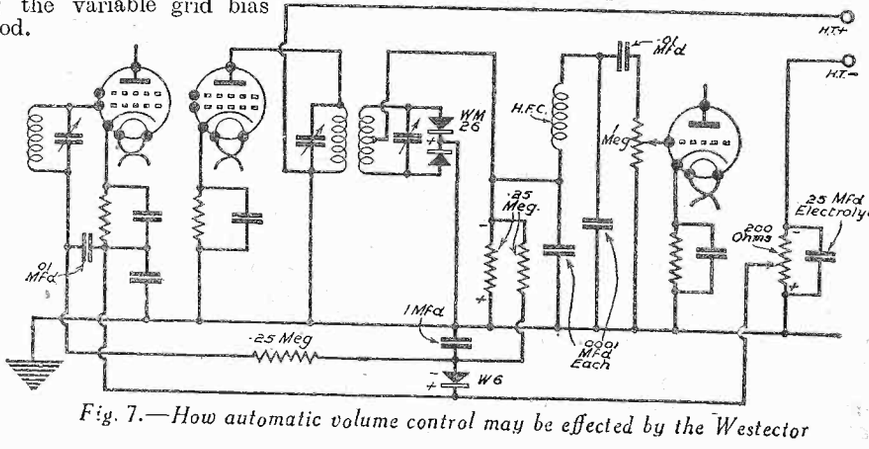


Fig. 7.—How automatic volume control may be effected by the Westector

WHAT IS WRONG?—5

In this, the Concluding Article of the Series, Special Reference is Made to Mains Receiver Faults, and Some Methods of Testing Components are described. By FRANK PRESTON, F.R.A.

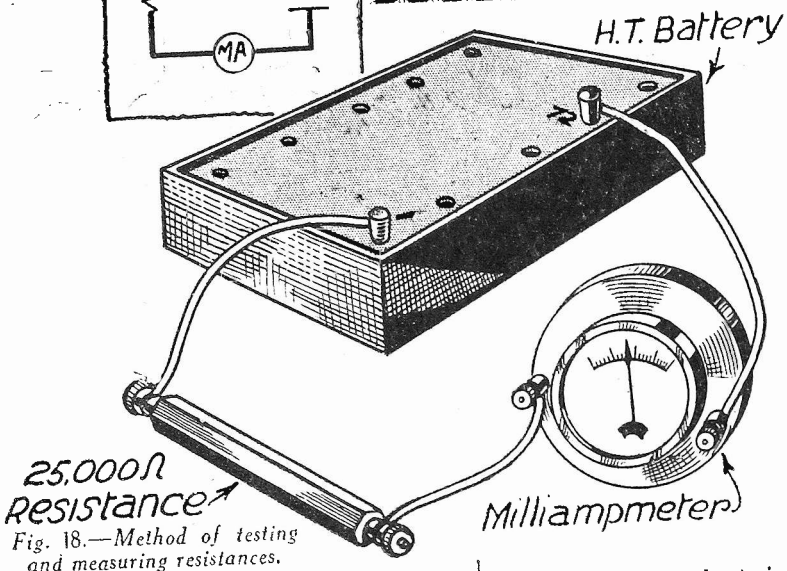


Fig. 18.—Method of testing and measuring resistances.

MOST of the tests I have previously discussed may be applied to any type of set, but before leaving the subject of fault finding it seems that I ought to make rather special reference to a few of the troubles peculiar to receivers which derive their power supply from the lighting mains.

When the mains receiver goes completely dead or begins to emit crackles and other noises, the best thing is to switch off the power supply and carefully examine the internal components. Such faults as burnt-out mains transformers, chokes, rectifiers, etc., are often obvious by the charring of portions of the parts concerned, and any which show signs of having been subject to great heat should immediately be suspected. In the same way, any component which feels excessively hot might be considered as a likely source of trouble, and should therefore be tested. Indirectly-heated valves always become fairly warm in use, but when one valve becomes very much hotter than the others it might be due to lack of grid bias, caused by the bias resistance having burnt out or become short-circuited in some way; this would be indicated by a high anode current. Just as excessive heat may point to a fault, so may the lack of warmth of some component like a receiver or rectifier valve, or even an H.T. feed resistance. Therefore, any of these components which feels cold to the touch should be tested. When smoothing condensers of too low a voltage rating have been employed they will almost certainly give rise to trouble sooner or later, due to the insulation breaking down and causing a short. If this does happen it is more than likely that the mains transformer and rectifier will also suffer, since they will be subject to a heavy load.

Should no fault reveal itself when the set is switched off, turn it on again and watch the inside of the receiver, but keep your fingers out of harm's way. Notice that all the valve heaters glow equally bright (the glass bulbs of mains valves are not usually "silvered" all over, and it is generally possible to see through them). When a valve fails to light up it is either defective or making bad contact with its holder. Should there be no light from any valve, examine the filament wiring for discontinuity or short-circuit. If no fault is revealed it might be helpful to remove the L.T. wires from the mains transformer and connect them to a 4-volt accumulator to find whether the transformer, wiring or valves are at fault. Similarly, when there is no sign of H.T. it is not a bad idea to connect the wires from the rectifier to a high-tension battery or separate eliminator to see if the H.T. supply system is defective. Where this is impossible the H.T. leads can be tested for voltage by means of a high resistance meter; as mentioned before, it is absolutely essential that the meter should be of at least 500 ohms per volt if anything approaching an accurate reading is to be obtained.

Mains Hum

A certain amount of "hum" is almost invariably associated with mains receivers, but if it is so loud as to be audible through the received signals there is probably something amiss. It might be that the condenser in the earth lead has "gone," or that the rectifier valve is losing its emission. In tracing the source of hum it is often of assistance to cut out the various valve stages one at a time, as explained last week, but in doing this great care should be taken to switch off the mains every time any alteration is to be made.

Mechanical Vibration

Hum is not always of an "electrical" nature, but is often caused by mechanical means; for instance, by vibration of the core stampings of a transformer or choke. This can be detected by short-circuiting the loud-speaker terminals; if the hum still remains it must be put down to mechanical vibration. Core stampings can generally be clamped up by means of their holding bolts, but if this is impossible an effective remedy is to pour a small amount of shellac varnish over the edge of the core. The varnish will sink in between the stampings and set hard, binding them together as a solid mass.

D.C. Receivers

With receivers operating from D.C. mains extreme care must be taken in making necessary tests, since the whole of the electrical system is "live"; otherwise the procedure is similar to that followed in regard to A.C. sets. When working a receiver from some D.C. mains a peculiar hum is sometimes observed which cannot be traced to any of the sources mentioned above, and it is, in fact, caused entirely by the mains supply. It is not due to ordinary "roughness," but to a high-frequency voltage being superimposed on the D.C. current. The only cure is to fit an

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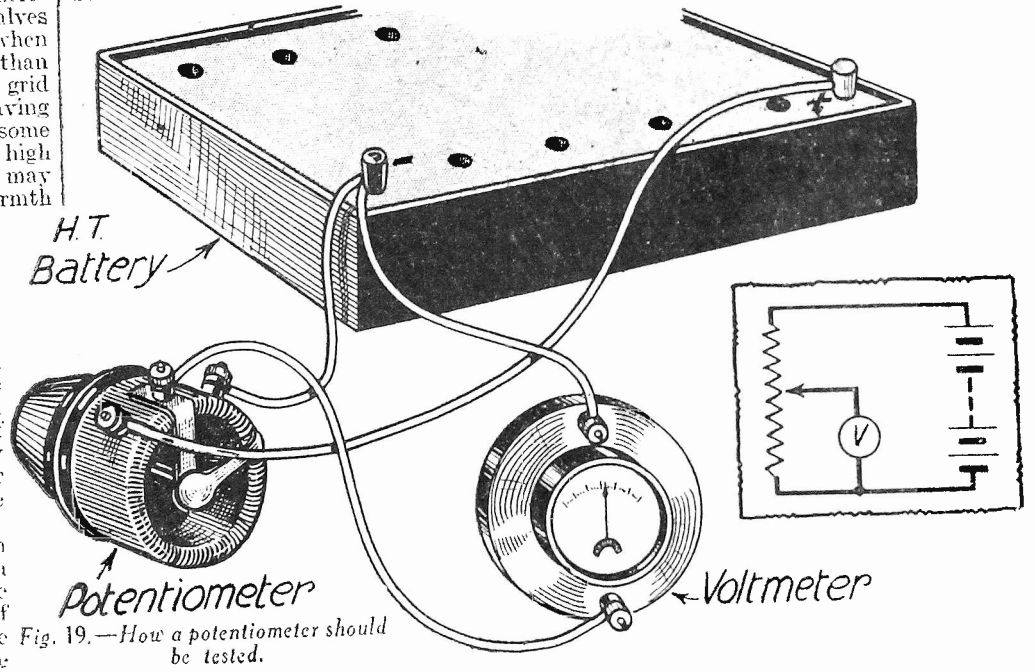


Fig. 19.—How a potentiometer should be tested.

(*Continued from page 1219.*)

H.F. choke in one, or both, of the supply leads. Naturally, the chokes must be able to carry the full current required by the set, and should therefore be of a special type; suitable components are made by a number of firms.

I think we have now dealt with the methods of detecting almost every fault likely to be found in any type of receiver, and I strongly commend my readers to read carefully through this and previous articles before setting to work, in order that they may have a thorough grasp of the principles involved, and appreciate the value of systematic and orderly investigation.

Testing Components

When any particular component appears to be faulty it is best to remove it from the set and give it a thorough examination. In almost every instance the object of the tests will be to ascertain that the part has not developed an "open" circuit (a broken interval contact) or a short circuit, and that its insulation is sound. It will not be necessary to mention every component separately, but it seems desirable to suggest specific tests which may be applied in a variety of cases.

Resistances

Either fixed or variable resistances can be tested, and their ohmic value measured, as shown in Fig. 18. It will be seen that the resistance is connected in series with a battery and milliammeter. If the component has become open-circuited there will be no current indication, whilst if it is short-circuited the needle of the meter will give a sudden "kick" to the top of the scale. So that there will be no danger of damaging the meter, it is advisable to start by using no more than 1½ volts of the battery.

The actual value of the resistance can be found with fair accuracy by adjusting the battery voltage until a reading of, say, 5 milliamps is given; the resistance can then be calculated by dividing the voltage by the current in *amperes* (1 milliampere equals one thousandth of an ampere). As an example, let us suppose that a voltage of 75 is found necessary to drive a current of 5 milliamps through the resistance; the value will be 75 divided by 5 thousandths, or 75 by 1,000/5, which equals 25,000 (ohms). If the needle flickers it will indicate a bad contact in the resistance, and since that would cause a crackle in the receiver, the component should, therefore, be discarded.

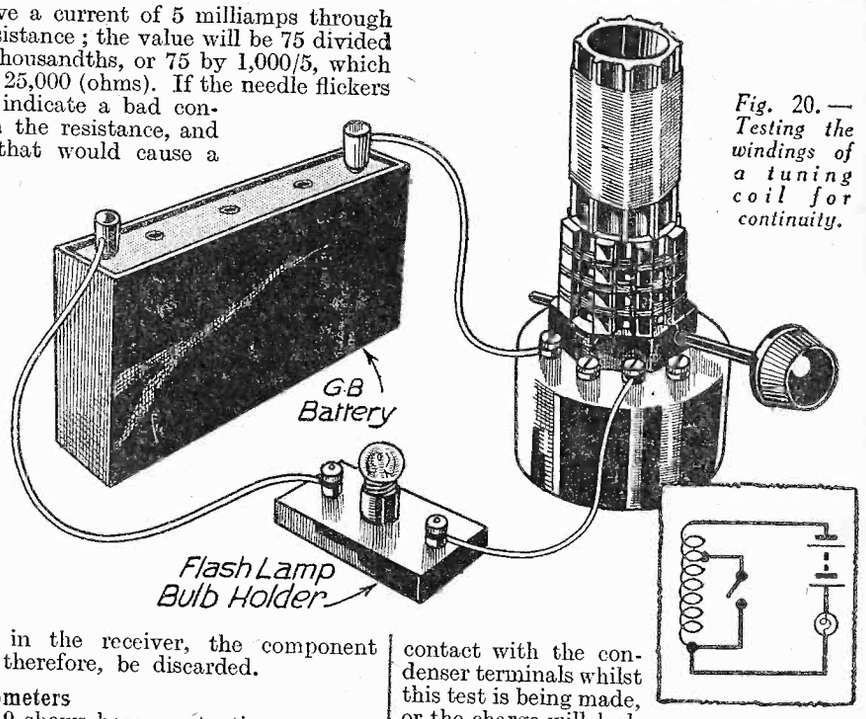


Fig. 20.—Testing the windings of a tuning coil for continuity.

Potentiometers

Fig. 19 shows how a potentiometer may be tested. Its two outer terminals are connected across a high-tension battery, whilst a voltmeter is connected between the centre terminal and one of the others. If the component is in good condition a steadily varying voltage from 0 to that of the battery will be shown as the knob is rotated. A break in the winding will be indicated by a sudden change in voltage as the slider traverses a certain part of the track.

Fixed Condensers

There are several ways of testing fixed condensers, but the simplest and most satisfactory is to connect a battery to the terminals, allow the condenser to stand for some time, and then connect a pair of phone or loud-speaker leads; there should be a loud click as the latter connections are made. It should be borne in mind that the fingers must not come in contact with the condenser terminals whilst this test is being made, or the charge will leak away through the body.

The battery voltage to be employed will depend upon the capacity of the condenser under test, and should be no more than about 10 volts for 4 mfd. condenser, to 100 volts for one of .0003 mfd. or smaller. If the voltage were too great there would be a possibility of damaging the phones by a heavy discharge.

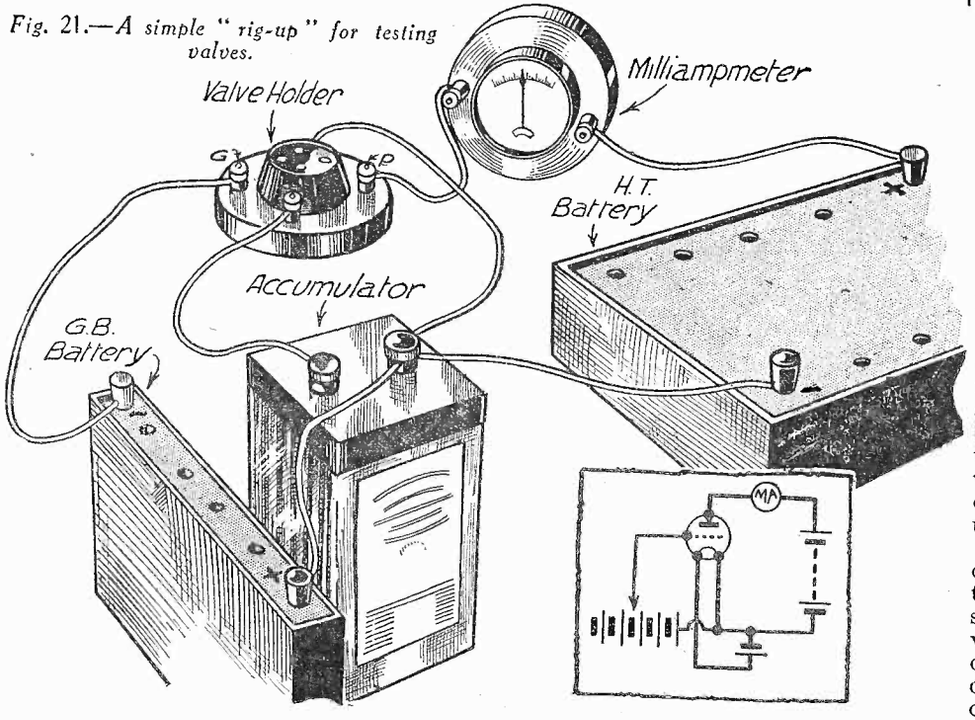
Tuning Coils

These can be tested for continuity of the windings by connecting the latter in series with a G.B. battery and flash lamp bulb, as shown in Fig. 20. First set the wavechange switch to its "medium wave" position and adjust battery voltage until the bulb shows a bright light—probably about 6 volts will be required for a 4-volt bulb, due to the resistance of the windings. Next turn the switch to its "long wave" position; the light from the bulb should become fairly dim, or it might go out altogether, because of the added resistance of the long-wave winding. If the light does go out, try increasing the battery voltage. Should it be found that the light cannot be restored it will be obvious that the long-wave winding is broken or disconnected from its terminal. Were it noticed that the light remained equally bright, no matter which position the switch occupied, you would know that the switch was not functioning. Reaction windings can be tested in the same manner, but, of course, the wavechange switch will have no effect in this case.

The windings of any type of transformer can be tested by means of a battery and milliammeter, in just the same way as resistances. A further test is necessary, however, to discover whether or not there is a short-circuit between different windings or between any winding and the core; this can also be carried out by using the battery and milliammeter.

When previous tests have left some doubt as to whether or not a valve is faulty, the arrangement illustrated in Fig. 21 should be set up. By applying various voltages of H.T. and G.B. the anode current can be measured under different conditions and the readings obtained compared with those issued by the makers.

Fig. 21.—A simple "rig-up" for testing valves.



Energising Electro-Magnetic Moving-Coil Speakers

Some Methods of Obtaining the Necessary Supply for the Field Coils of Loud Speakers

By J. H. WATTS

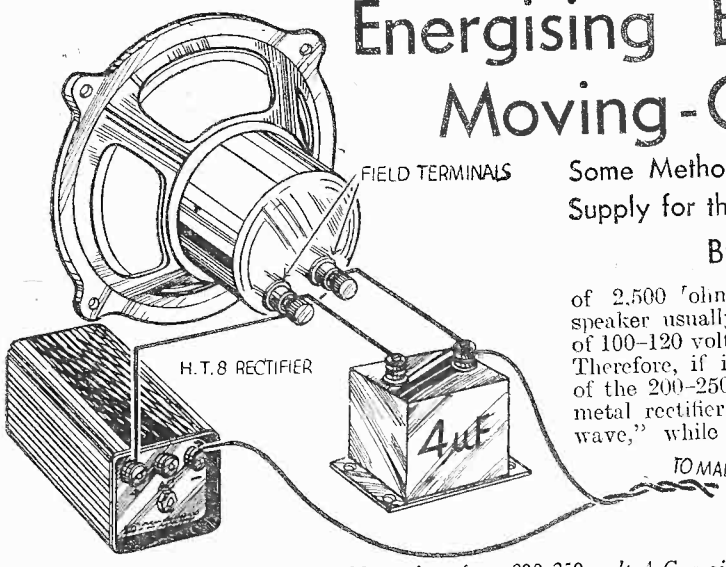


Fig. 1.—Energising a 2,500 ohm field-winding from 200-250 volt A.C. mains.

THE mains energised moving-coil speaker still remains the best type to use, owing to its much greater sensitivity and frequency response than other types, in spite of the great improvements made in modern permanent-magnet speakers. The fact that it has to be energised, however, seems to be regarded as a disadvantage by quite a number of constructors, and they fall back on the permanent-magnet type. In this article it is explained how to energise, without undue extra expense, the D.C. type of electro-magnetic speaker.

Of course, if D.C. mains are available, the speaker can be energised independently direct from the mains. It is to those who rely on A.C. for their supply that the following methods will be found of value.

Independent Energising from A.C. Mains with Rectifier but Without Mains Transformer

In Fig. 1 is illustrated a method of providing field current to a D.C. speaker with the aid of a metal rectifier but without transformer. In both the cases illustrated it is presumed that the field winding has a resistance of 2,500 ohms. This type of speaker usually requires a voltage of 100–120 volts for field excitation. Therefore, if it is used on mains of the 200–250 volt class, an H.T.8 metal rectifier is used as a "half wave," while if the mains are of the 100–120 volts class the same type of rectifier is used, but it is connected for the "voltage doubler" circuit. There are on the market speakers having a field resistance of 5,000 to 7,500 ohms. These can be energised in the same manner as above, but the rectifier to use would be type H.T.7.

When using a speaker in the way described, great care must be taken to see that no earth connection is made to the D.C. side of the rectifier.

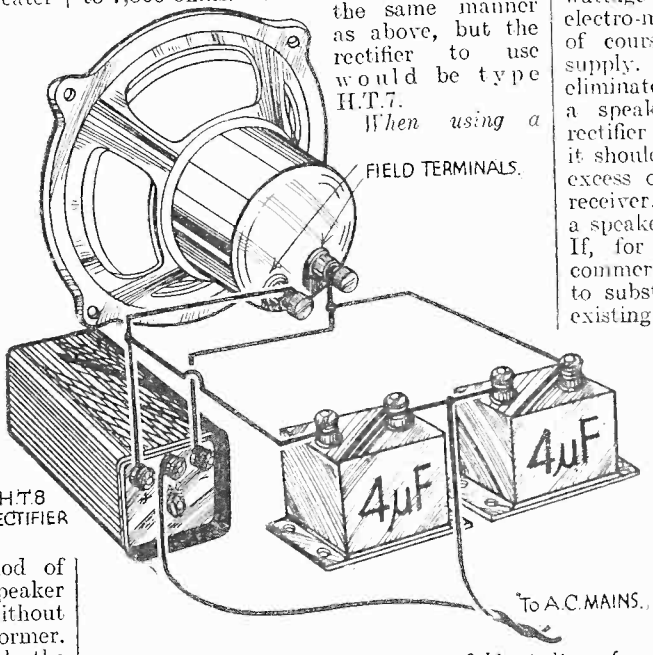


Fig. 2.—Energising a 2,500 ohm field-winding from 100-120 volt A.C. mains.

Using the Field Winding as a Smoothing or Output Choke

Where a mains receiver taking not less than 40 m.a. anode current is in use, the field winding of a speaker designed for D.C. mains operation, and having a field resistance of 2,000–2,500 ohms, can be used as a smoothing choke in the eliminator which provides H.T. to the receiver. The current, in passing through the windings, causes a voltage drop across them (100 volts at 40 m.a.), which produces the necessary wattage dissipation for energising the electro-magnet. This voltage drop must, of course, be deducted from the H.T. supply. Therefore, when designing an eliminator to include the field winding of a speaker as a smoothing choke, the rectifier and transformer incorporated in it should be designed to give 100 volts in excess of the maximum required by the receiver. The connections for energising a speaker in this way are shown in Fig. 3. If, for some reason, such as with a commercial eliminator, it is inconvenient to substitute the speaker winding for an existing smoothing choke, it can be used as an output choke in the receiver. The output valve alone must take 40 m.a. or more if this method is to be used, and it must be borne in mind that a voltage drop will occur, which will be deducted from the H.T. supply to the last valve. In Fig. 4 the connections for this method are shown. It will be noticed that where an indirectly heated output valve is used (such as one of the large A.C. pentodes) as in the illustration, the low potential side of the speaker or output transformer is returned direct to the cathode, and not H.T. negative. The automatic bias resistance is then not included in the speaker circuit. In the same way, where automatic bias is used with a directly heated output valve, this connection must be taken to the filament side of the bias resistance.

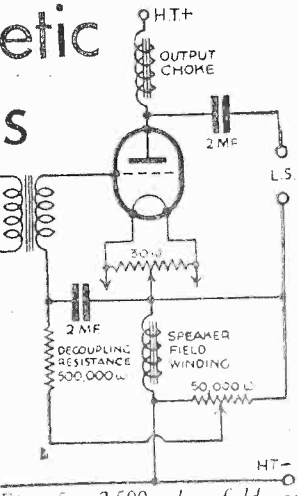


Fig. 5.—2,500 ohm field as automatic bias resistance.

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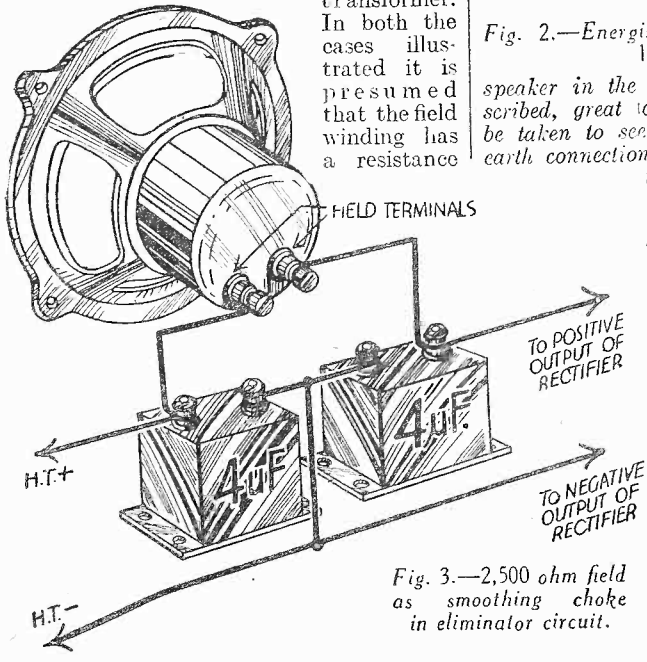

Fig. 3.—2,500 ohm field as smoothing choke in eliminator circuit.

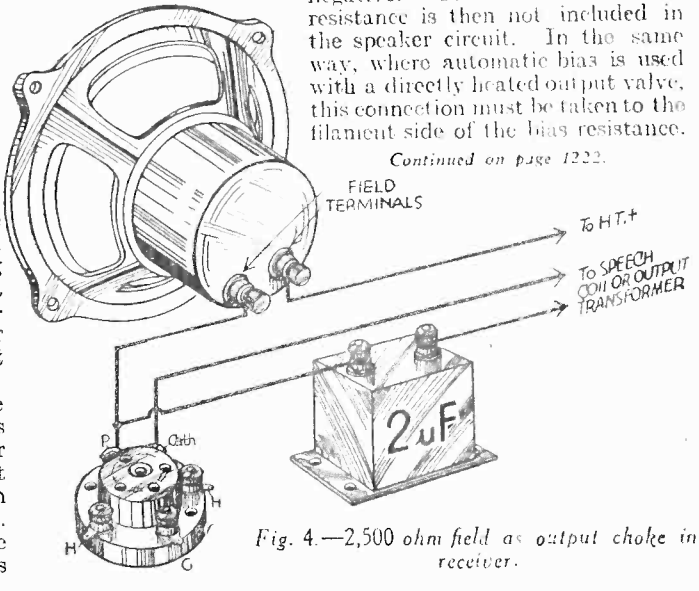

Fig. 4.—2,500 ohm field as output choke in receiver.

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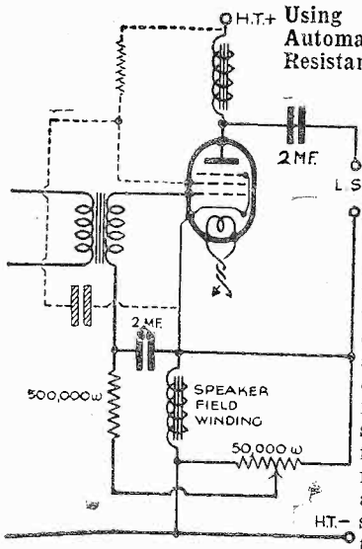


Fig. 6.—2,500 ohm field as bias resistance for indirectly heated output valve. Triode or pentode.

Using Field as Automatic Bias Resistance

Where a large output valve taking about 40–70 m.a. is used in the last stage of a receiver, the most efficient and economical method of supplying field current to a D.C. speaker is to use it as the bias resistance for this valve.

It is well known that, if automatic bias is used in a receiver, the amount of bias voltage produced by the resistances has to be deducted from the H.T. supply. If, therefore, a speaker were included as a choke, this voltage drop would be a further reduction of H.T. voltage. If the speaker windings are used as a bias resistance, we, of course, have to deduct the full voltage drop across them from the H.T., but the bias voltage can be tapped from this voltage drop by means of a potentiometer without further voltage drop. The connections for this method are shown theoretically in Fig. 4 and pictorially in Fig 5. When a valve taking 40 m.a. is used and a 2,500 ohm field, the bias voltage can be varied (by means of the 50,000 ohms potentiometer) from zero to 100 volts, while if the valve takes 60 m.a. it can be adjusted between zero and 150 volts, but this method is really meant where valves requiring above 30 volts bias or more are used.

When the circuit is first operated, the 50,000 ohms potentiometer should be turned to the end connected to H.T. negative. A milliammeter should be inserted in the plate circuit of the output valve, and the potentiometer carefully adjusted until the meter reads the correct anode current for the anode voltage in use. The slider of the 30 ohm potentiometer is turned to the centre of its resistance. The correct anode current for a given anode voltage for a certain valve can be found on reference to the pamphlet supplied with the valve by the manufacturers.

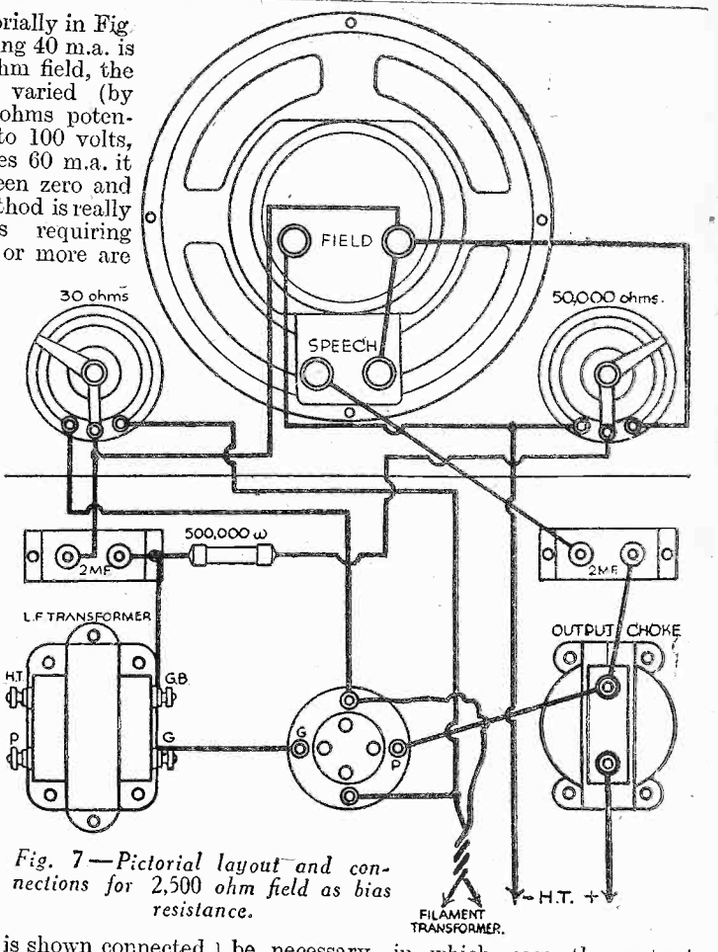


Fig. 7—Pictorial layout and connections for 2,500 ohm field as bias resistance.

In Fig. 5 the output from the amplifier is shown connected direct to the speech coil of the speaker, but, of course, an output transformer may be necessary, in which case the output of the amplifier would be connected to its primary.

Aerial Damping

Examining the curves it will be noted that the addition of the aerial system, while not materially altering the shape of the reaction curve, moves it bodily to the right. This means that a larger reaction capacity is required to make the set oscillate when aerial and earth are connected than is necessary when they are absent. Of course, this is to be expected, and is due to the extra damping introduced by the presence of the aerial system. The incorporation of a .0005 mfd. reaction condenser in sets with no H.F. stages is seen to give particularly good results, and from the previous theoretical reasoning—namely, a reduction in the damping introduced by the small reaction coil required—this was expected to be the case.

The use of a .0001 mfd. reaction condenser is more suited to those receivers where H.F. stages are included and reaction control is effected on the detector valve alone. Here the presence of a somewhat larger reaction winding is offset by the absence of the damping produced by the aerial connections, and as readers have no doubt found for themselves, the reaction control is quite smooth. This was tested out on different sets, but the curves are not shown. They were similar in character to those shown in Fig. 3, but the reaction settings for oscillation to take place occurred over a smaller number of degrees than was the case for the .0005 mfd reaction condenser just dealt with.

This indicates that, wherever possible, it is better to use a .0005 mfd. reaction condenser and a small reaction coil, but the gain is not so material as one would at first imagine. Added to that, consideration of panel space and layout have to be borne in mind, and this often makes it necessary and preferable to use the .0001 mfd. condenser.

REACTION POINTERS

By H. J. BARTON CHAPPLE, Wh.Sch., B.Sc.

(Continued from page 1205, March 11th issue).

Refusal to Oscillate

There is one important point which must be stressed in conclusion, however, and that is the effect produced on the reaction condenser by the addition of the aerial system. Sets have been tested without any acrial connection, and the curve taken indicates that the reaction control involves a fairly uniform change over the scale, *i.e.*, a progressive rise in reaction and aerial condenser readings for the oscillation condition. The addition of an aerial, however, often causes the set to refuse to oscillate at some particular part of the tuning condenser scale.

A little reasoning will show that this is the outcome of a serious load increase of the aerial at that position, and is due to the aerial resonating within the wavelength band over which oscillations refuse to occur. There are several ways of overcoming this, but the most simple is the inclusion of a series condenser in the aerial lead. This will cause the resonant condition of the aerial to occur at a point below the wavelength range covered by the tuning circuit, and while a reduction in signal strength also takes place, this is generally small, and is to be preferred to an absence of reaction control.

In order to find the capacity best suited to one's own aerial a convenient type of series condenser for this work is a preset one. When connected in the aerial lead, it can then be adjusted until the reaction control over the whole of the tuning-condenser scale is reasonably uniform, and obviously with this condition the user of a set is in a far better position to search for stations than would be the case when there are prominent irregularities.

Curve (a) gives the variation on the normal broadcast band (250/550 metres) without aerial and earth, while curve (b) shows the alteration introduced when the aerial system is connected. It will be observed that in both cases the variation over the whole of the scale is reasonably smooth, there being a progressive increase of the reaction condenser reading as the aerial tuning condenser was increased.

The experiment was repeated for the long waves, and curves (c) and (d) are for similar conditions to (a) and (b) respectively. It is interesting to note that whereas on the medium waves the reaction condenser had a wide range for bringing the set into oscillation, on the long waves this oscillation effect generally was confined to a much smaller part of the reaction scale.

TONE CORRECTION AND TONE CONTROL

An Article of Interest to All Those Who are in Search of "Quality" in Loud-Speaker Reproduction.

By FREDERICK BRIDGES

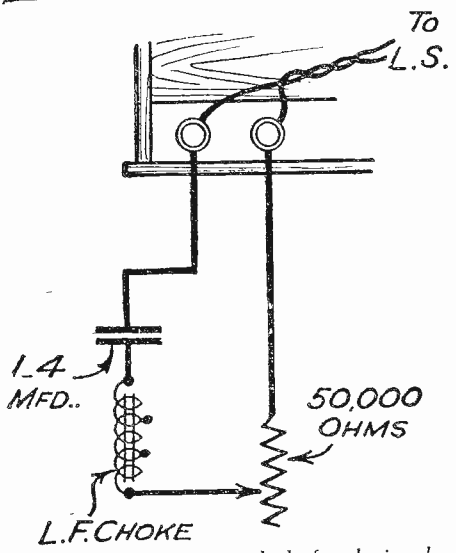


Fig. 1.—An effective method of reducing bass response by connecting a choke, condenser, and variable resistance in series across the loud-speaker terminals.

"TONE control" and "tone correction" are very popular expressions with the wireless amateur these days, but I am afraid they are not always understood quite so well as they might be. In the first place, tone correction is not a means of curing the evil commonly known as distortion, but is rather a system of compensating for high-note or low-note loss which occurs in the reproduction given by the loud-speaker. Tone control, on the other hand, enables the operator to adjust the *degree* of high- or low-note response of the set at will.

Tone Correction

The need for tone correction is brought about by the uneven response of various components of the receiver to different parts of the musical scale. As an example, it is well known that a very selective tuner gives full response to the bass notes, whilst its response diminishes as the notes increase in frequency. In consequence, if the rest of the receiving circuit gave uniform amplification to the full range of audio frequencies (sound frequencies, if you like) the resultant output from the loud-speaker would be very low pitched or "boomy." But the average set does not give "straight-line" amplification—very far from it: the L.F. transformers usually emphasise higher frequencies, as does a pentode output valve; the loud-speaker, also, might give greater response to any part of the frequency range according to its particular design. It is clear, then, that a fair amount of tone correction is often obtained automatically in the set itself, so it remains to find what part of the musical scale is over-emphasised, and then to devise a means of reducing amplification at that part.

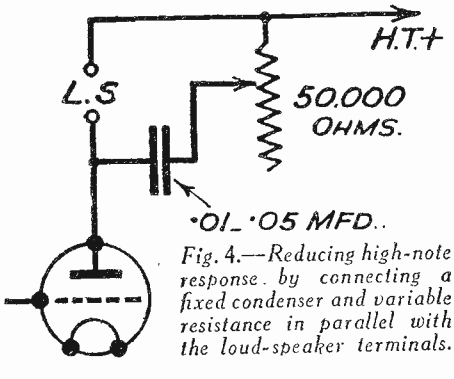


Fig. 4.—Reducing high-note response by connecting a fixed condenser and variable resistance in parallel with the loud-speaker terminals.

Bass Emphasis

In the case of the average present-day ultra-selective receiver it is usual to find

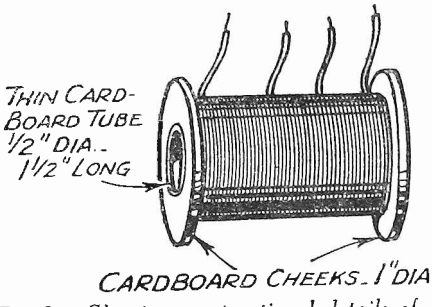


Fig. 2.—Showing constructional details of an easily-made tone corrector choke.

that low notes predominate, whilst the higher ones are somewhat neglected. This is indicated by the fact that a symphony

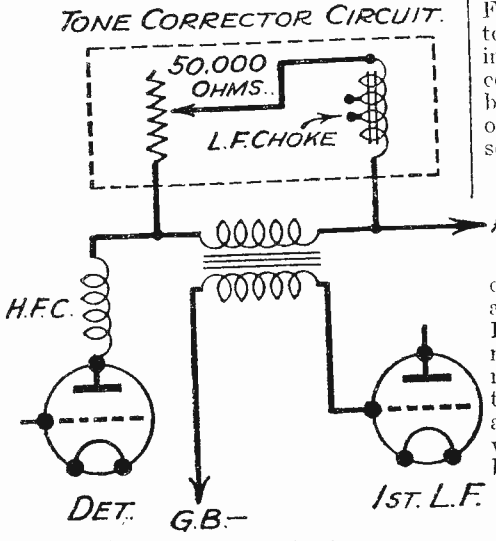


Fig. 3.—A tone corrector circuit connected across the primary winding of the first L.F. transformer.

orchestra sounds more like a quartet of double-bass and 'cello's, and the announcer seems to have a cold on his chest; organ music is very heavy and monotonous, and a dance band is reproduced principally as a series of "dull thuds." Having recognised the symptoms we must find a cure. If a three-electrode power valve is in use the necessary correction might be obtained by replacing it by a pentode. Alternatively, it might be possible to change the moving-coil loud-speaker for one of the balanced armature or electrostatic type, either of which is more sensitive to the upper register. Where neither of these "automatic" schemes is practicable, some modifications must be made to the set itself. Perhaps the simplest is to connect a small L.F. choke, variable resistance and fixed condenser in series across the loud-speaker terminals, as shown in Fig. 1. Where an output transformer or choke-capacity filter is employed, the corrector circuit should be wired in parallel with the transformer primary, or with the choke, and not across the loud-speaker windings. The object of the choke is to provide an easy leakage path for the low frequencies, though being an effective barrier to the higher ones, and by varying the value of resistance in circuit the degree of low-note "cut-off" can be changed as desired. Since the fixed condenser is of high capacity (at least 1 mfd.) it offers no restriction to any audio frequencies, but merely serves to prevent the D.C. high-tension supply from passing through the choke. It will be seen that we do not actually increase the strength of the higher notes, but to achieve the same (apparent) effect the bass is curtailed. For this reason the fitting of any additional tone correction device necessarily results in a reduction in overall volume, and to counteract this it might in some instances be desirable to increase the amplification of the set by adding another valve, or by some other means.

Making a T. C. Choke

Before proceeding further it might be as well to give some practical details of the L.F. choke shown in Fig. 1. It should have an inductance of something between 1 and 3 henries, and may be bought ready-made from one of the firms of transformer manufacturers. Those who prefer to make their own, however, can do so by winding about 2,000 turns of 36 s.w.g. enamelled wire on a core consisting of a ¼in. diameter bundle of soft iron wires. The winding

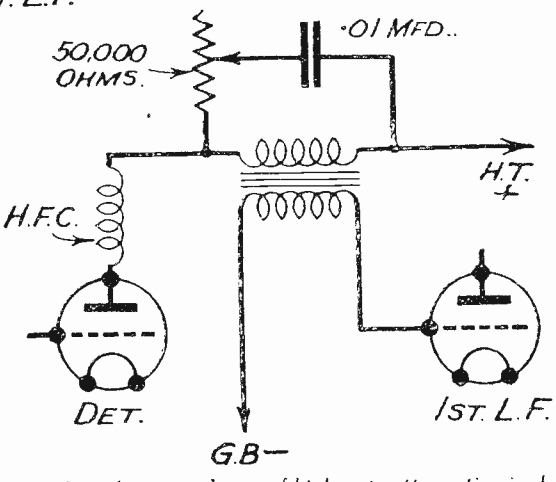


Fig. 5.—A greater degree of high-note attenuation is obtained by putting the condenser and resistance in parallel with the primary winding of the L.F. transformer.

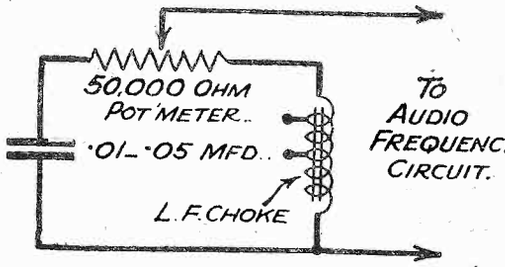


Fig. 6.—A simple tone control circuit which may be used for giving either high- or low-note attenuation.

may be placed on a small bobbin like that illustrated in Fig. 2 and, so as to enable the best value of inductance to be chosen experimentally, tappings should be taken after putting on 1,000 and 1,500 turns.

Increasing the Degree of Correction

The latter method is only satisfactory when a comparatively small amount of correction is required, but a more pronounced effect can be obtained by connecting a similar choke-resistance combination in parallel with the primary winding of the first L.F. transformer, as shown in Fig. 3. The fixed condenser is not necessary in this case, since the choke will be quite able to carry the small amount of D.C. current which will be passed through it. Although this system gives a greater degree of correction, it also reduces amplification to a much greater extent and, to overcome this loss, it is best to use a transformer of higher step-up ratio than that originally employed.

Band-pass Tuning

When a band-pass tuner is employed, a fairly even response is given to the full harmonic range, although even then there is a distinct falling-off in strength beyond some 4,500 cycles. This is not so noticeable or objectionable because it does not affect the "fundamental" notes of any musical instruments, but it does reduce the intensity of overtones or harmonics, and as it is these which constitute the "individuality" of any particular instrument, they are very important to the trained musician and, in fact, to anyone with a critical, musical ear. In consequence, a certain amount of correction is sometimes deemed necessary even when a band-pass tuner is used. Either of the two methods described can be applied, but a little more care must be exercised in choosing the optimum value of inductance, and so it might be better to take more tappings from the choke.

High-note "Cut-off"

Where loud-speaker reproduction is "shrill"—that is when emphasis is given to higher notes, either due to the use of a pentode, an unsuitable L.F. transformer, or a speaker which favours the upper register—an entirely different method of correction must be applied. It was explained above that a low-frequency choke tends to "short-circuit" notes of low frequency, so it need only be pointed out that a condenser behaves in exactly the opposite manner. In other words, a condenser provides an easy leakage path for high frequencies, and a comparatively difficult one for low frequencies. In consequence, we can get the very reverse effect to that referred to above if we replace the choke by a fixed condenser in the manner illustrated in Figs. 4 and 5. The most suitable capacity for the latter condenser will obviously depend upon the amount of correction required; the larger the condenser the greater the degree of high-note attenuation which will accrue. Generally speaking, a capacity of from .01 mfd. to .05 mfd. will prove suitable, and, in any case, a fair degree of latitude is permissible, since the variable resistance controls the condenser's effect upon the circuit.

Another very simple way of curtailing high-note response, is to join a condenser across the secondary winding of the L.F. transformer. It is usually found that sufficient correction can be obtained by the use of a fixed condenser of about .0003 mfd., but it is a good plan to employ a .0005 mfd. variable or pre-set one so that the optimum capacity can be found under normal conditions of operation. In a set with which shrillness is extremely pronounced the .0005 mfd. condenser might not give sufficient correction, and in that case another fixed condenser may be connected in parallel with it until the desired effect is produced.

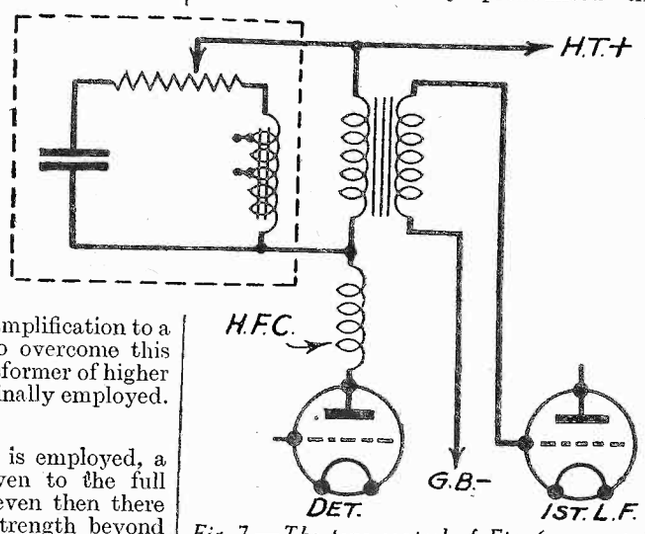


Fig. 7.—The tone control of Fig. 6 connected across the transformer primary winding.

Tone Control

In general, tone control is much more satisfactory than tone correction, especially in a set which is used for the reception of a number of stations. As explained before, tone control makes it possible to reduce amplification at either end of the scale, as desired, and is thus very useful in enabling the operator to vary the tone of his loud-speaker to suit his own requirements, as well as to compensate for losses at various freqencies due to the peculiarities of individual components.

Those who make a practice of listening to distant stations know that the "tone balance" of different transmissions varies tremendously; some are "thin" and high-pitched, whilst others have a distinct tendency toward bass accentuation. It is more for this reason than any other that long-distance reception is considered by some to be not worth while, but by the use of a good system of tone control any station which is received at good strength and free from interference can be made to give the same quality as the local. Tone control has another very marked advantage from the point of view of long-distance reception,

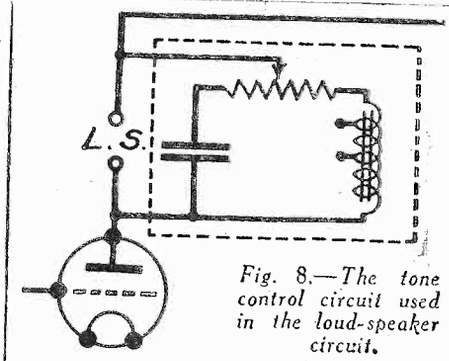


Fig. 8.—The tone control circuit used in the loud-speaker circuit.

in that it may be used to eliminate, or, at least, to minimize, heterodyne whistles and various forms of "mush." The whistles are, of course, high-pitched notes, and can, therefore, be considerably reduced in intensity by cutting down the treble response of the set. This necessarily reduces the strength of the higher frequencies in the transmission being received, but it is generally quite easy to strike a compromise so that the heterodynes are removed without making too great a sacrifice of quality.

A Simple Tone Control Circuit

It is quite clear that if we are to get a full control of tone from the bass right up to the treble we must combine the two systems dealt with above, and the simplest way of doing this is to connect the choke, condenser and a potentiometer in the manner indicated in Fig. 6. The combination may be connected across any audio-frequency circuit, and by moving the potentiometer slider from one end to the other of the resistance element, the opposite effects of the choke and condenser can be brought to bear in greater or lesser degree upon the circuit. As the slider is moved towards the "condenser" end there will be a gradual high-note attenuation, and when it is moved in the opposite direction the lower notes will be reduced in comparative intensity, whilst when the slider is at the centre of its track the circuit will give uniform response to all audio frequencies. Most of the tone control transformers on the market employ this system, and have a suitable choke and condenser built into the case; it is thus only necessary to connect an external potentiometer.

The tone control circuit of Fig. 6 may be connected across the primary winding of the first L.F. transformer, as shown in Fig. 7, but when used in the loud-speaker circuit it should be wired in series with a large-capacity fixed condenser, in the manner illustrated in Fig. 8, so that it will be isolated from the D.C. anode current.

T.C. With a Pick-Up

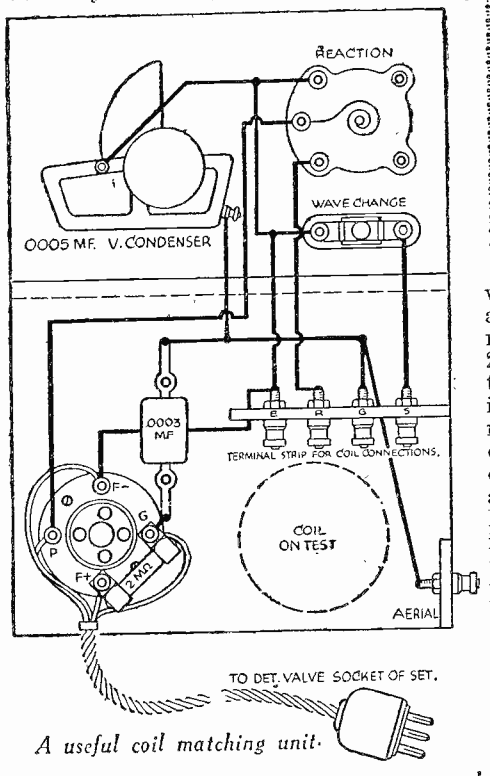
The advantages of a tone control circuit apply in equal force when a gramophone pick-up is being used. By suitable adjustment of the potentiometer it is possible to compensate to a certain extent for the lack of bass in the recording, and at the same time, to reduce needle scratch to a minimum. If scratch is entirely eliminated there will be a consequent "cutting" of high notes, but it is generally possible to find a setting at which scratch does not approach an objectionable intensity, and yet the loss in high-note response is not noticeable.

THE HALF-GUINEA PAGE

Radio Wrinkles FROM READERS

Coil Matching Unit

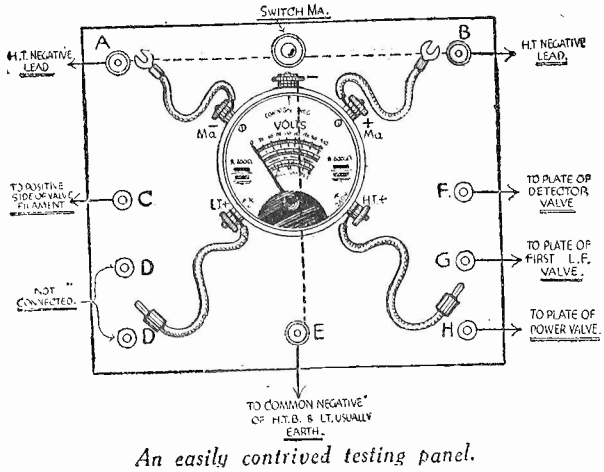
FOR enthusiasts who, like myself, make their own coils, the following idea may be useful; although not original in its theory, maybe the idea of its use in this manner is. In construction the arrangement resembles a common tuning unit with an adaptor, the accompanying illustration showing the layout and wiring. The connections are as for the detector stage, the detector valve being placed in the socket and the plug into the set socket. Tuning is done by the unit and the coils can then be tuned and altered without much trouble. —V. M. RIX (Croydon).



A useful coil matching unit.

A Handy Testing Panel

HERE is a handy testing device which I have installed in my receiver (Det.—2 L.F.). It consists of a small panel upon which is mounted a meter reading volts and milliamps. The remaining parts required are 6 plugs and sockets (4 red, 2 black), one 2-point switch and three terminals. The whole forms a useful instrument for taking instantaneous readings of batteries and also the total consumption of the receiver. The connections are as shown by the accompanying sketch. The negative lead from the H.T. battery to the set is broken and the two ends are connected to A and B. Terminal E goes to the common negative of L.T. and H.T., usually earth. Socket C is taken to the positive side of valve filaments. Sockets F G and H are taken to the plate terminals of the three valves. Sockets D and D are not connected, but are used for inserting the two plugs when not in use and so prevent them from dangling in set. When set is normally in use the switch MA is kept on, thus completing the H.T. negative lead. Breaking this switch will give an instantaneous reading of the total current being taken from the H.T. battery. When it is desired to ascertain the filament voltage the L.T. + plug is inserted into socket C. H.T. readings are obtained by inserting the other plug into either F, G, or H, and the reading shown will be the actual voltage on the plate of that particular valve. When voltage readings are taken the spade connection should be disconnected from A or B. This panel I have fitted to my baseboard with the idea of eliminating the trouble of getting at the batteries, which are usually stowed away in some other compartment.—A. W. MANN (Petworth).



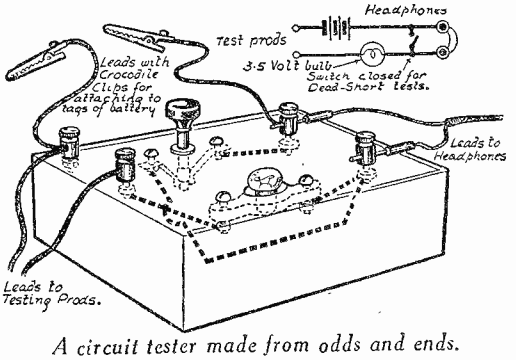
An easily contrived testing panel.

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? For every item published on this page we will pay half a guinea. The latest batch is published below. 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 Compact Circuit Tester

READERS of this page may be interested in this compact, but efficient, circuit tester. I have made it from odds and ends. From small pieces of scrap wood I constructed a box almost 3in. long by 1⅝in. wide and 1¼in. deep. By cutting an old terminal strip I obtained an ebonite panel to fit, measuring 3in. by 1⅝in. On this, as shown in the sketch, I mounted two pairs of telephone terminals, a small toggle switch, and through the panel, a fuse holder. When wired as shown and connected to an ordinary flash-lamp battery one has a tester capable of showing a dead short or continuity in a circuit having a resistance of one megohm or more, simply by pushing over the switch. The toggle switch was used solely because it happened to be a spare one. Of course, a push-pull switch would do equally well. I find this little tester a great help when testing for continuity in the "inwards" of a radiogram, where space is very limited and where one appreciates being able to see the flash of the light for a short, or hear the double make-and-break "plop" in the 'phones.—G. COLEMAN (Finsbury Park).



A circuit tester made from odds and ends.

A Sectional Panel

FIRST obtain a length of quadrant moulding (Fig. 1), and some odd pieces of plywood of suitable size. Next cut two lengths of moulding the size of baseboard (Figs. 2 and 3), leaving a small gap for the thickness of your plywood panel sections to slide in. Cut the plywood into different size squares so as to make up the length of your panel, as indicated in Fig. 4. I have found this idea to be very successful.—H. WEBSTER (Dulwich).

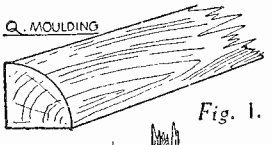


Fig. 1.

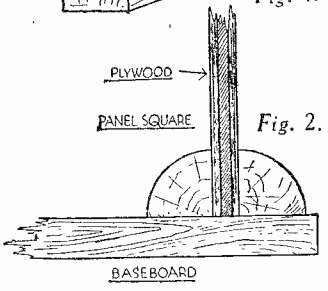


Fig. 2.

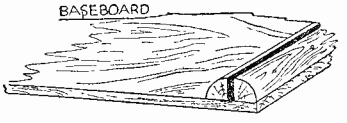


Fig. 3.

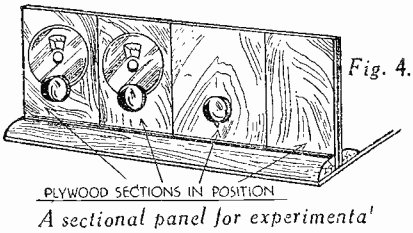
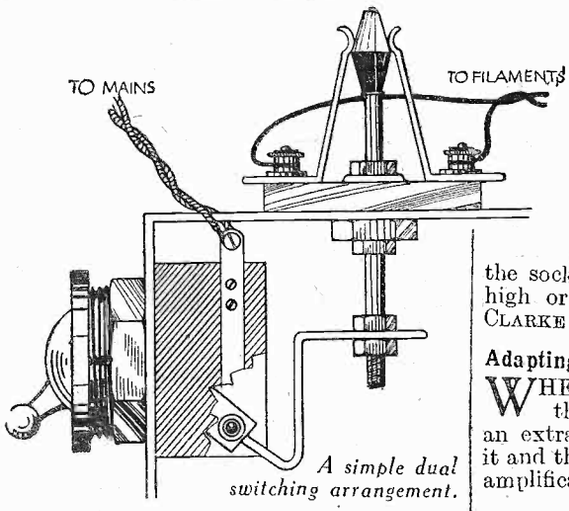


Fig. 4.

A sectional panel for experimental purposes.



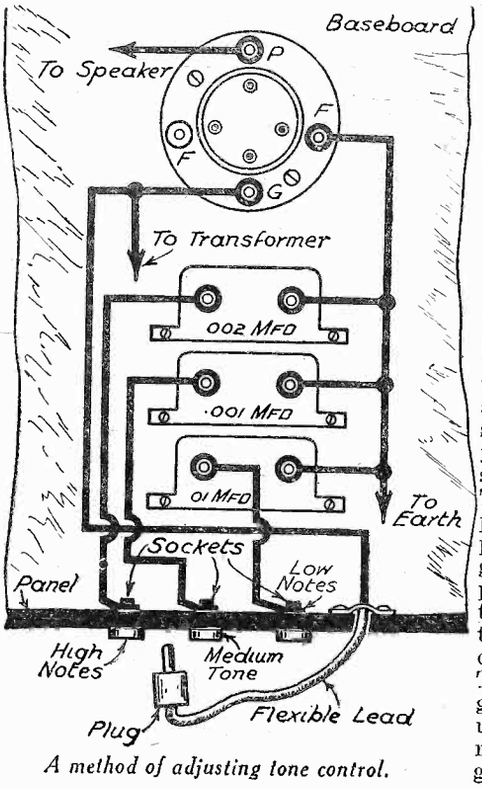
A simple dual switching arrangement.

Dual Switching Device

WHEN using a set employing battery-heated valves in conjunction with a high-tension eliminator, it is often found troublesome to have to switch the set off at two points. A switch to combine these two actions can easily be made. One of the small toggle mains switches is fitted with a strip of aluminium, bent at a right angle, a small "push-pull" switch being then mounted as shown in the sketch. To the spindle of this latter switch is clamped a short length of stiff wire, which is bent to engage with a hole drilled in the end of the switch arm, which point of course is usually insulated from the contact piece. Those "push-pull" switches having a definite "snap" action are difficult to adapt, but it will be found that those with a straight contact plunger work quite easily.—G. E. DRIFFIELD (York).

Simple Tone Control

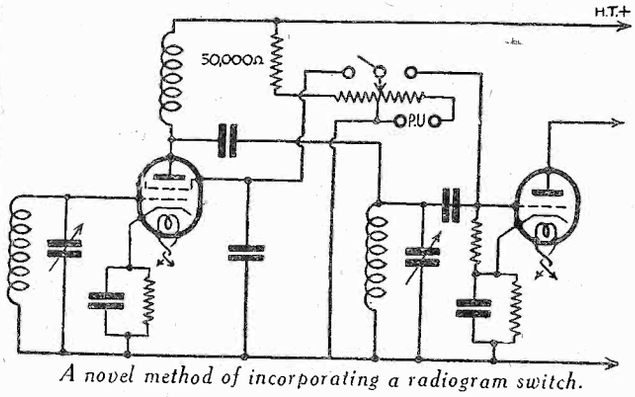
TO make the simple tone control device shown in the accompanying sketch, the following components will be required:—Three fixed condensers .002, .001, and .01 mfd.; three sockets for the panel and one plug. These are connected up as shown, and the plug attached to a short length of flex connected to the lead from the grid terminal of the valve-holder. These three condenser values should suit most speakers and by plugging into one or other of the sockets a marked improvement in the high or low notes can be obtained.—G. CLARKE (Tulse Hill).



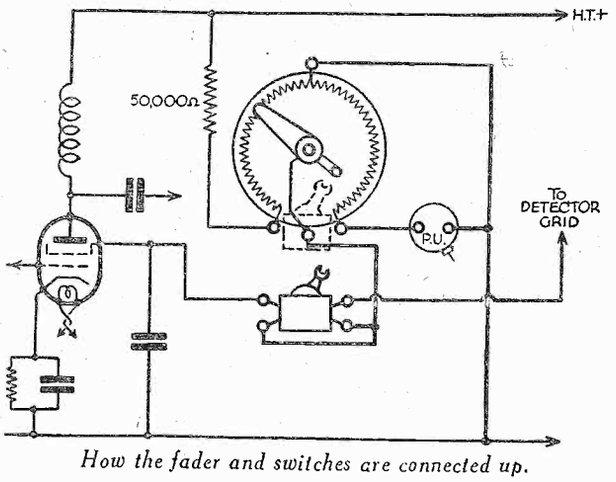
A method of adjusting tone control.

Adapting a Radiogram Fader

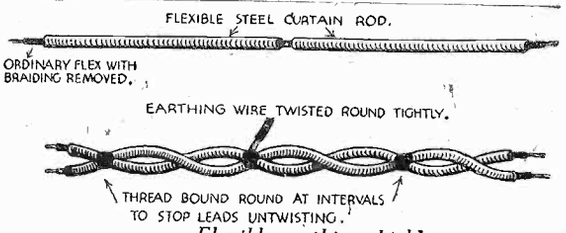
WHEN a radiogram fader is used in the usual way, following the detector, an extra L.F. valve is necessary between it and the output valve to provide sufficient amplification for the pick-up. My own set is a 3-valve H.F.-Det-L.F., so I devised the following arrangement to work as a radiogram fader. A 100,000-ohm Bulgin volume control combined with single pole change-over switch is connected as shown in the diagram. It will be seen that an extra connection has been made to the centre of the resistance element, and that the switch control arm has been set to throw over the switch just as the potentiometer slider passes this connection. Turning the fader to control position either reduces the potential applied to the screen grid of the H.F. valve or the pick-up potential applied to the detector valve grid and the switch changes over the circuit at zero volume. Turned to the left maximum gives me maximum radio volume and turned to the right maximum gives me maximum gramophone volume, and I only have one control now instead of three (two volume controls and radiogram switch).—L. R. COWELL (Boscombe).



A novel method of incorporating a radiogram switch.



How the fader and switches are connected up.



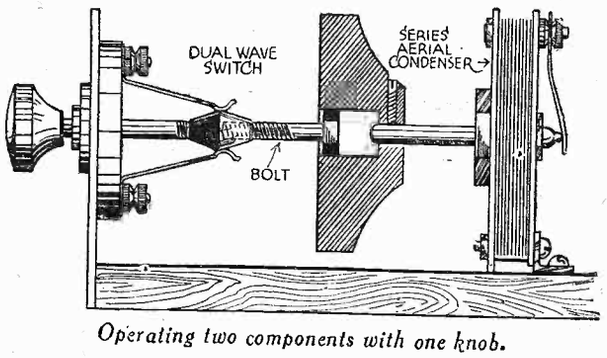
Flexible earthing shields.

Earthing Shields for Pick-up Leads

THIS is a handy way of earthing pick-up leads. First obtain a quantity of flexible spring curtain rod, and some ordinary black and red flex. Cut the flex to length required, unwind and strip off the braiding. Cut off two lengths of curtain rod about two inches shorter than flex, and push flex through. Then twist the two leads together and bind at intervals with thread to stop untwisting. Then twist tightly round the two leads another piece of flex which is earthed. This effectively earths any interference which otherwise would be picked up by the leads.—E. BARNES (West Ealing).

Eliminating Knobs

EVER since wireless sets have ceased to be scientific-looking instruments and become pieces of furniture, it has always been my desire to reduce the number of knobs on my set. The sketch shows how I ganged a wave-change switch to a series-aerial condenser. The switch was of the push-pull type and the pear-shaped bulb unscrewed slightly from the spindle to allow for the insertion of a hexagonal-headed bolt. The spindle hole in the condenser knob was then drilled right through and part filed with a small square file to take the hexagon-headed bolt. The condenser was mounted on the baseboard by means of a small (brass) bracket. The selectivity could thus be controlled from the panel. A smaller degree of selectivity is normally required on the long waves, thus this device proved very convenient.—D. J. HOULDEN (Twickenham).



Operating two components with one knob.

SUPERHETERODYNE FAULTS *and* THEIR CURE

Some Peculiarities of the Circuit Explained by W. WINDER

IN these days listening to foreigners can be a most annoying game. Aerial power has increased by leaps and bounds, and stations have crept closer and closer together in wavelengths, so that a receiver thought to be highly selective a year or two ago to-day finds itself quite incapable of dealing adequately with the interference problem. The straight three or four valve receiver, consisting of H.F. stages, detector and pentode, can give a very good account of itself, especially since the use of variable mu valves and band-pass filters have become standard practice, but for the very best interference-free foreign listening the claims of the superheterodyne cannot be ignored. Here is a type of receiver in which a very high standard of selectivity and sensitivity is fundamental to the design.

Unfortunately, most people are, without just cause, afraid of the design. The word "superheterodyne" has so many syllables and sounds so scientifically imposing that the uninitiated uncover their heads and bow down in awe whenever it is mentioned. In my meanderings round wireless emporiums I have even heard salesmen disparage superhets on the grounds that service problems would be more intricate. Now this is all wrong. The superhet certainly contains one process more than straight H.F. sets, but the idea behind it all is not really complicated. Some of the troubles are of the type liable to occur in any kind of set, whilst others are peculiar to the superheterodyne, and it is the purpose of this article to discuss a few of the latter, together with their causes and cure. Before dealing with these, however, a short description of a typical superheterodyne is given to make the following remarks quite clear.

The big difference from ordinary sets is the "frequency changer." Signals picked up by the aerial vary, as you know, from 200 metres to 2,000 metres in wavelength. The frequency changer receives any signal between these limits and changes the wavelength to a fixed one in the neighbourhood of 3,000 metres. Whether the set is tuned to London National on 261 metres or Radio-Paris on 1,724 metres, by the time the signal has passed through the frequency changer it has a wavelength of 3,000 metres. A superhet is simply a wavelength changer (or frequency changer if you want to be more scientific), followed by an ordinary H.F. set, the H.F. set part being permanently tuned to 3,000 metres. If you have followed this simple explanation you will see that there are two kinds of "high frequency" in a superhet, one at the wavelength of the broadcasting station and the other at 3,000 metres. To avoid confusion we will call the first "high frequency" and the second "intermediate frequency."

After this brief explanation of the bare principle behind the design let us proceed to the special faults that may arise.

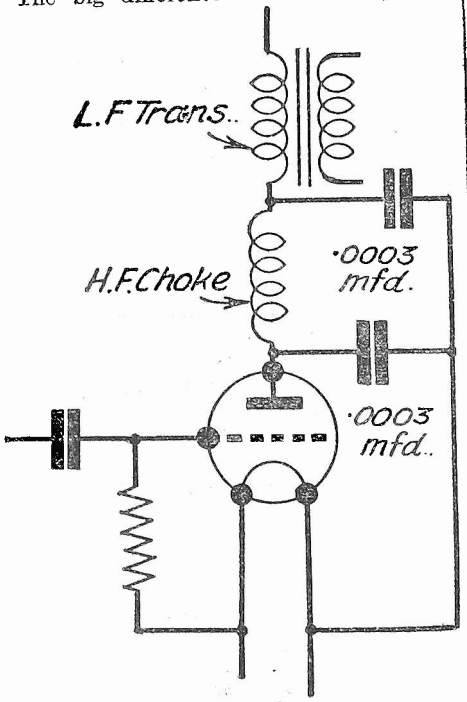


Fig. 2.—An H.F. filter circuit.

Noisy Background

A hissing background to foreign programmes is not an essential fault of superhets, but it is a most common one. It occurs on sets working from an inefficient aerial, and generally only in sets not provided with H.F. amplification in front of the frequency changer. This hiss has its origin in the oscillating valve which forms part of the frequency changer, and when a station is tuned in, this unfortunate noise, known as the "Schrott effect," gets impressed on the radio signal, gets amplified in the intermediate frequency stage, and under certain circumstances can attain to an objectional roar. The obvious remedy, as we cannot design a hissless valve, is to limit the amount of amplification after the hiss occurs—in other words turn down the volume control. To allow this to be done and yet retain good volume on the weaker foreigners a good aerial is essential, and the provision of such an aerial is the cure for the trouble. Those readers having no facilities for fixing up a good aerial should be sure to buy or build a superhet containing a stage of H.F. amplification in front of the frequency changer. The common idea that superhets will work off any old aerial is an unfortunate legacy from the days when they could not be attached to an outside aerial for fear of interference with one's neighbours. Just one word of warning. If a preliminary H.F. stage is fitted it should use a variable mu valve—otherwise the benefits accruing from the selective design are largely thrown away through cross modulation troubles.

Instability and Whistles

A misleading trouble to which superhets are prone is the appearance of whistles all round the dials. They are exactly like the whistles that are heard on a normal set when tuning through carrier waves with the reaction knob turned too far. The reader who has had previous experience of H.F. amplification will at once say "instability" and proceed to fix up more elaborate

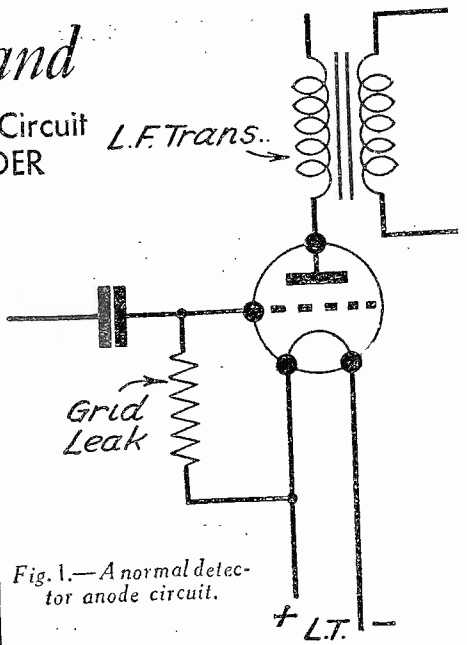


Fig. 1.—A normal detector anode circuit.

screening between the stages, but nine times out of ten he will be wrong, for the trouble is usually due to quite a different cause. If whistles occur on every station then the set definitely is unstable, in which case the cure does not generally lie in more elaborate screening, such as metallised valves, screened connecting wire, etc. These things are useful, but they do not touch the main cause of instability in superhets—the presence of intermediate frequency currents in the L.F. amplifier. The cure for this is to place in the second detector anode circuit (the detector proper) a good H.F. filter, consisting of a good H.F. choke connected to the anode of the valve, with a .0003 fixed condenser between each side of the choke and earth. (See Fig. 2.) All three components of this filter should be placed as close to the detector valve holder as is possible.

Second Channel Interference

H.F. instability is not usually pronounced in superheterodynes. The whistles are nearly always due to what is called "second channel interference," and as an explanation would take up many pages we will proceed at once to the cure, which is to pay attention to the preliminary tuned circuits. Nearly all superhets contain three tuning condensers, one for the oscillator and the other two for the tuned circuits (at radio frequency) preceding the frequency changer. A set such as this, when used in the London area, would whistle about the Poste Parisien setting, and again in the neighbourhood of Prague, and perhaps there would be one or two other whistles, too faint to cause annoyance. Midlanders would be more lucky in that no strong whistle should appear, whilst listeners in the Huddersfield and Manchester area would find only one strong one—somewhere about Midland Regional.

A set using more tuning condensers would be less prone to second channel interference, but a set with only one tuned circuit, in addition to the oscillator, would get whistles all round the dial. This description of average results of the various designs has been given to enable the reader to see whether his own receiver is up to standard or not in this important respect. If there are more whistles than outlined

above, attention should be paid to the ganging of the tuning condenser.

Ganging

No manufacturer, and presumably, no reader building his own set, would be so foolish as to use a gang condenser unless the associated tuning coils were matched, so ganging merely resolves itself into adjusting stray capacities. Tune in as accurately as possible a station about 250 metres, and then adjust the trimmers for maximum volume. That is all that is necessary if the oscillator condenser is not ganged with the others, and any further misganging could only be due to poorly matched coils or condenser. Where the oscillator tuning is ganged with the others, *i.e.*, where there is only one tuning control on the set, adjusting trimmers can be tried without fear of upsetting things, as long as such adjustments are carried out on stations between 200 metres and 250 metres. If, however, such adjustments do not mend matters, further efforts are rather beyond the average amateur, being bound up with the question of intermediate frequency.

Harmonics

It is sometimes found that the local station comes in at several settings of the dial, thereby cutting out so many foreigners. This is due to the generation of harmonics by the oscillator valve, and is a question of design rather than something that can be tackled with a completed set. For the benefit of set builders, harmonics are not so troublesome if the anode circuit of the oscillator is tuned in preference to the grid circuit. This is, of course, just the opposite of our old friend the ordinary reacting detector, which has its untuned coil in the anode circuit and its tuned coil connected to its grid.

Intermediate Frequency Interference

This takes the form of interference, usually of morse, which is quite independent of the dial setting, and is due to telegraphy stations working on a wavelength about 3,000 metres, that is, at a frequency about equal to the intermediate frequency. One cause of this trouble is the use of a capacity-coupled, band-pass filter as the preliminary tuning arrangement, the coupling condenser offering an impedance to these very long waves sufficient to set up an appreciable voltage on the grid of the frequency changer. Changing over to inductive coupling between the two units of the band-pass filter usually clears the trouble, but if it still creeps in on the long waves, a wave-trap, tuned to the intermediate frequency, should be inserted between the aerial and the set. The coil for such a wave-trap should have many turns—say, 500 in slots on a 2in. former—and the tuning capacity should be a pre-set condenser of .001 microfarads.

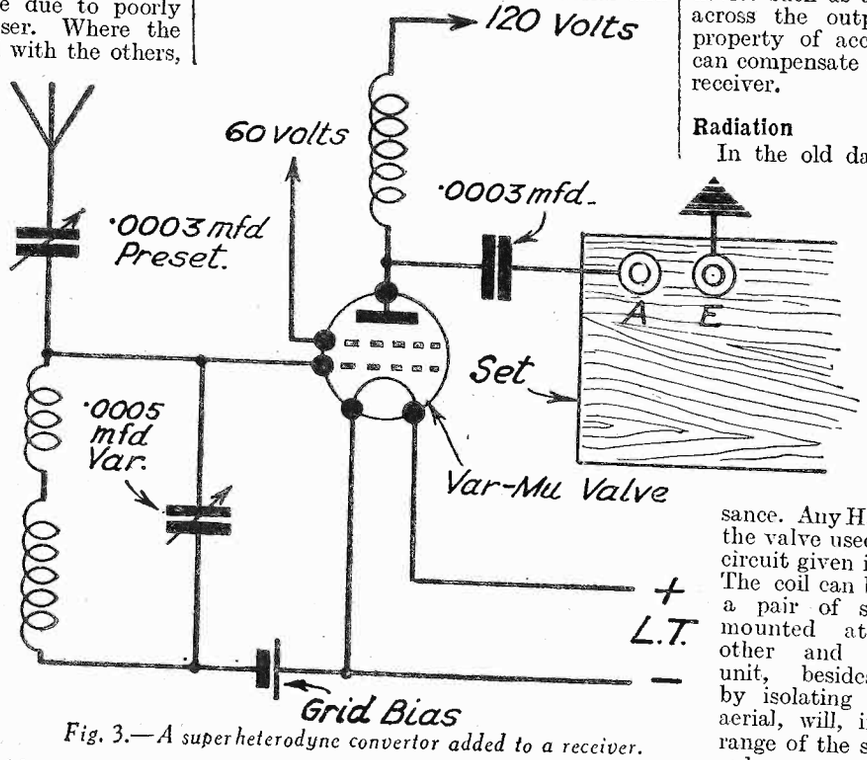


Fig. 3.—A superheterodyne convertor added to a receiver.

Poor Quality

A properly-designed superheterodyne can give as good reproduction as any other type of set. The design is, however, so selective, that most of the high notes will be lost unless suitable precautions are taken, and as you all know, absence of high notes leads to boominess and lack of clarity. In these days an intermediate transformer will nearly always consist of a pair of slab wound coils placed close to each other inside a metal container—something like an ordinary coil screen. The position of the coils relative to each other is usually adjustable, and if quality is thin they should be brought closer together. This will help put back the high notes at a slight expense of selectivity.

If the output valve is a pentode, it should be used without any corrective device such as a resistance and condenser across the output. A pentode's natural property of accentuating the high notes can compensate for those lost earlier in the receiver.

Radiation

In the old days superhets were always worked off frame aerials, because of the annoyance caused to neighbours when more ambitious collectors were used. A modern set should not offend in this way, but if it does, and if the reader does not feel sufficiently competent to undertake structural alterations, he can easily build a choke-coupled screen-grid unit to stop the nuisance. Any H.F. unit will do, so long as the valve used is a variable-mu, but the circuit given in Fig. 3 is as good as any. The coil can be any dual-wave coil, or a pair of suitable "plug-in" ones mounted at right-angles to each other and wired in series. This unit, besides preventing radiation by isolating the oscillator from the aerial, will, incidentally, increase the range of the set, reduce oscillator hiss, reduce second channel interference and to a small extent increase selectivity. Its disadvantage is that there is another knob to turn.

It is to be hoped that the few possible troubles will not put intending builders off the idea of a superhet. A similar number of ills to which other types are heir would be quite as long, and the advantages of range and selectivity must be experienced to be believed.

ODDS and ENDS

Full State Control of German Stations

ACCORDING to a recent decision taken by the Berlin authorities, the control of the German Broadcasting System has been withdrawn from the Ministry of Posts and Telegraphs and has been handed over to the care of the German Chancellor (Adolf Hitler).

The Flying Doctor

AUSTRALIA has organised a flying Medical Service of which the base is situated at Clancurry (Queensland). It has been established to serve a large number of bush cattle stations. To secure medical assistance when required, the stations, which are provided with a small wireless transmitter, broadcast a special S O S call, on receipt of which a fully equipped aeroplane with staff consisting of mechanic, doctor and nurse is immediately sent to attend to the patient. The aircraft is so fitted that in case of necessity it can take an ambulance stretcher and thus rapidly convey the sick person to the nearest hospital. The service has proved very successful and larger planes are being built in order that a surgeon and anaesthetist may be added to this air ambulance.

Make a Note Of It.

LISTENERS would do well to tune in Prague (488.6 m.) on the evening of Monday, May 1st, when the station celebrates the tenth anniversary of the opening of the Czech broadcasting system. Special programmes in which all the stations in the network are taking part have been arranged for this occasion.

Shanghai's 44 Radio Stations

OF all Chinese cities Shanghai without doubt is the one which possesses the greatest number of broadcast listeners. There are at present no less than forty-four transmitters in daily operation and radio programmes are given in seven different languages. Most of these stations are privately owned and many are used for publicity purposes.

Dressmaking by Radio

A FEATURE which has achieved considerable popularity amongst women listeners in Holland is one which is broadcast twice weekly through the Hilversum transmitter. It consists of lessons in dressmaking. The paper patterns obtainable against payment of a small fee from the studio are made to one size, but bear a series of numbered perforations. From instructions received by microphone the listener need only connect up these perforations with a pencilled line to secure a pattern made to a special size. On a recent occasion when a child's frock was designed, the studio received applications for over twenty-thousand patterns!

THE DETECTOR OF *TO-MORROW*— AVAILABLE *TO-DAY!*

Type W.4 half-wave Westector (actual size). Suitable for use as a radio-frequency or intermediate-frequency detector.

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Manufactured in England by:—
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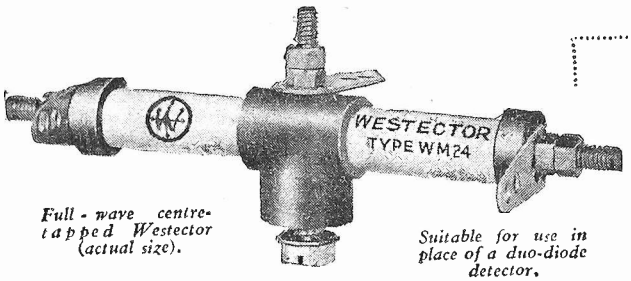
W.4	Half-wave	1 15/16in.	24v. peak	0.25mA.	7/6
W.6	Half-wave	1 15/16in.	36v. peak	0.25mA.	7/6
WM.24	Centre-tap, full wave	3in.	24v. on each side of centre tap	0.5mA.	10/-
WM.26	Centre-tap, full wave	3in.	36v. on each side of centre tap	0.5mA.	10/-



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Wave-Change Switching

Selected Methods of Changing from One Wave-Band to Another

By P. E. BARNES, B.Sc.

ONE of the features in which the modern radio receiver differs most noticeably from that of seven or eight years ago is the method of tuning. This is due in a large measure to the different conditions which existed then, for it was necessary for the amateur to have a means of tuning almost anywhere between 100 and 3,000 metres in order to obtain sufficient listening matter to justify the construction of a receiver. The earliest arrangements of huge coils, either tapped or arranged with a slider, had innumerable defects, for instance, considerable dead-end looses, copper dust collecting between the turns and shorting them, excessive size and so on.

The plug-in coil, which is still in use in many home-made receivers, provided a solution to many of these defects. They were simple, efficient, cheap to purchase or make and provided for tuning to any wavelength without the use of excessively large variable condensers. Even to-day, their only drawbacks are the difficulty of making tappings, the necessity for changing perhaps as many as three coils, and the large external fields. If suitable screening can be arranged, sets can be built incorporating such coils which will compare very well with present tuning systems, and at a considerably lower cost. If the need for occasional coil-changing is not objected to, these coils may well be adopted in a set intended mainly for short-wave reception.

The problem of continual coil-changing can be overcome by using loading coils, short-circuited on the medium wave-band; but if this is done, then why not construct a dual-range coil in the first place? Nowadays tuning systems are becoming more and more standardised: aperiodic aerial coupling is now almost universal, for instance, while tuned grid coupling is now the usual method of handing on the signal to the detector valve.

Simplifying Connections

There are one or two points in connection with the wave-change switching of receivers which are often neglected, sometimes with unfortunate results. In general the tuning coils have one end at earth potential—this is one of the advantages conferred by the tuned-grid system—and switching can be carried out with two or at the most three points of the switch at a high-frequency potential on long waves, and all points joined together and to earth on the medium waves. This avoids the need for insulating bushes, and simplifies the connections when a metal panel and baseboard are in use.

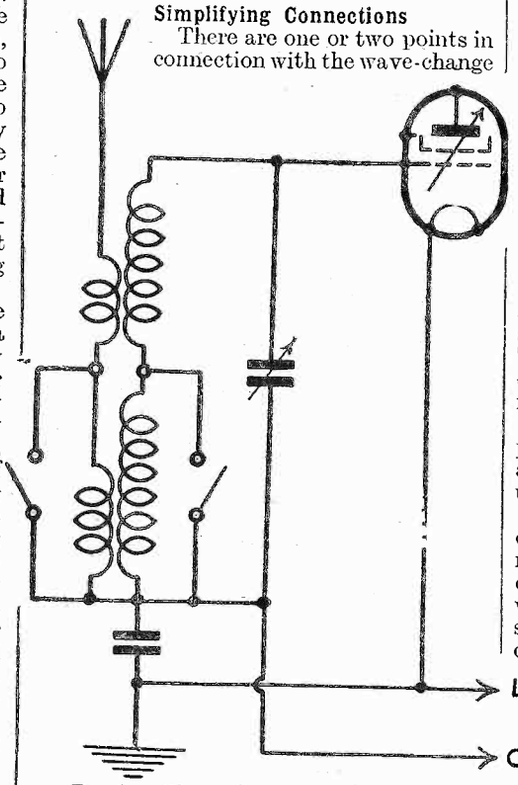


Fig. 1.—Wave-change switching in a variable-mu stage.

Very often, however, a variable-mu or ordinary S.G. valve is biased according to the system shown. This is often mentioned where a change from ordinary S.G.'s to variable-mu's is concerned, but this will require alteration, and sometimes complete scrapping of the wave-change gear. We can no longer use an earthed plunger through the panel nor can we join all the contacts for medium waves.

It is very easy to overlook this point in making any alterations to a receiver, and as a result the bias battery is shorted. With the small .9 volt bias cells used for S.G. valves, this is not a serious matter, but if the main bias battery is shorted, then there is danger to the output valve, and also the H.T. battery. In most cases, however, it will be obvious that something is wrong before the damage is serious, but it is rather an elusive fault to track down if the real cause is not suspected.

Sometimes this alteration of switching is not a practical proposition, either because of the difficulty of obtaining a suitable switch (this applies particularly to cases of band-pass coils or H.F. transformers), or from practical objections, such as lack of space or inconvenient layout. The alternative method shown in Fig. 2 will enable the difficulty to be overcome.

Preventing Break-through

Another point in dealing with wave-change switching is the provision of some means of preventing medium wave break-through on the long wave-band. The simplest solution is to use a choke (a 60-turn coil will often suffice) in the aerial circuit, shorting it for medium-wave reception. Often, however, it is possible to arrange that this choke is automatically shorted by the ordinary wave-change switch. The system shown in Fig. 3, for instance, does not require more switch contacts than if the choke were not used.

Remember that this choke must be so positioned that it has its axis at right-angles to that of the coil, in order to avoid undesired couplings.

In some dual range tuners, the reaction coil is included in the switching arrangements, with the intention of providing convenient control of reaction on both wave-bands. This is not always necessary, as the same effect can usually be obtained by re-positioning the reaction coil, which will require to be nearer to the long-wave portion of the tuning coil than to the short-wave portion. It is often exceedingly useful to be able to save a switch contact in this manner, as it can often be put to a better use, *e.g.*, to provide constant selectivity on both long and medium wave-bands, by transferring a tapping point on the aerial or H.F. transformer coil.

A further useful saving may be effected by "earthing" one end of the reaction coil on some types of dual range coil.

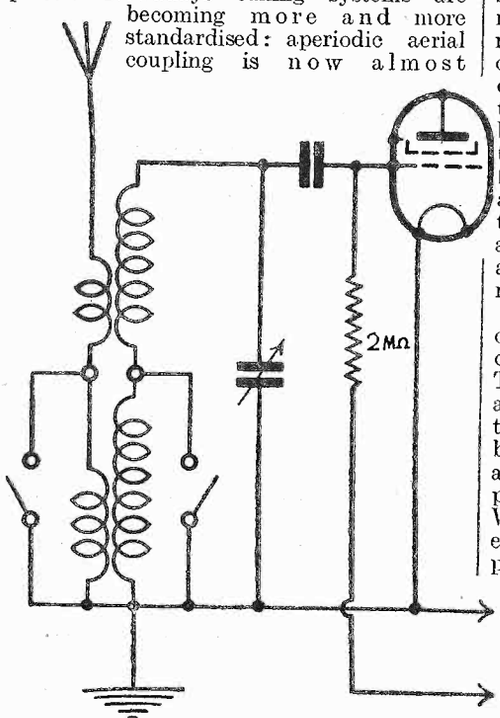


Fig. 2.—Wave-change switching in an ordinary H.F. stage.

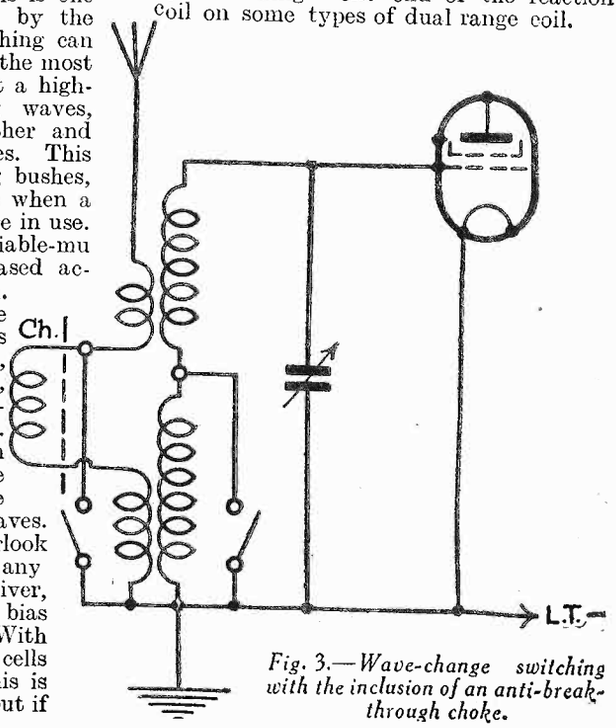


Fig. 3.—Wave-change switching with the inclusion of an anti-break-through choke.

Receivers and their Records

We shall be pleased to advise readers regarding purchase of complete sets.

PHILCO 8-VALVE SUPERHET (Model 247) for D.C. Mains.

IN view of the peculiar conditions obtaining in the United States, where most cities possess a number of broadcasting stations on the medium waveband, selectivity and sensitivity are the main qualities required in a receiver by the listening public. It is for this reason that, in America, the superheterodyne circuit has achieved so much popularity. In their model 247, Philco have demonstrated that it is a practical proposition to pack eight valves, and all the necessary components, including a moving-coil loud-speaker, into a cabinet which in size does not exceed that of the majority of three-valve sets. In performance, the model under test was in every respect equal to that of its A.C. prototype, an achievement with which the makers may be well satisfied.

Both the radio frequency input, and the modulator oscillator circuits are identical with those of their other models, such as 56, 237, 248, etc. Briefly reviewed, we have a band-pass input circuit between the aerial and first valve of the screen-grid type delivering a substantially flat-topped wave-form to the grid. Incorporated in this valve anode circuit are four inductive circuits, the first of these being a series connected network of inductance and capacity, part of this tuning to the incoming frequency (at the grid of the valve) and this part, with, in addition, the first intermediate frequency transformer primary tuning to the intermediate frequency of 125 kilocycles, this forming the second inductive circuit.

The third and fourth circuits constitute the main part of the oscillator circuit, and are both inductively coupled to the above-mentioned. The local oscillations are generated by coupling the first of these two last circuits (tuned to a frequency of 125 kc/s higher than that of the incoming signal) to the second circuit, in this case aperiodic, and which is located in the cathode return of the valve. In its turn, it continues through a paralleled biasing resistance and by-pass capacity to a further aperiodic circuit inductively coupled to the aerial before passing to earth. The energy is fed to the control grid by varying the potential of the cathode at the oscillatory frequency in respect to the control grid. The oscillatory circuit is completed *via* a small, common, trimming condenser (which is the capacity already mentioned in reference to the first valve anode circuit); this condenser serves the triple purpose of tuning the anode circuit to the input frequency, and the primary of the intermediate frequency transformer to its operating frequency of 125 kilocycles, and oscillatory coupling condenser. If, therefore, we receive a signal on, say, 300 metres (1,000 kilocycles), it will be brought in amplified form to the anode of the first valve. At this input frequency, the valve oscillatory circuit generates oscillations at 1,125 kilocycles, a frequency of 125 kilocycles higher than that of the incoming signal. As we have these two frequencies present in one common circuit (anode) it follows that a beat note will be generated of which the frequency will be, respectively, the sum and difference of 1,000 and 1,125, namely, at 2,125 and 125 kilocycles.

The beat note resulting from the sum of these two fundamentals is constantly changing as the input signal frequency is altered when tuning in broadcasts on different frequencies, but their difference always remains constant, namely, 125 kilocycles. In consequence, as the primary of the intermediate frequency transformer is tuned to this frequency, it is passed on in this form to the next valve for amplification. The unwanted signal frequency, the oscillatory frequency, and the sum of these two are rejected. The 125 kilocycle signal is then passed through two pentodes, and again to a detector valve. Part of the rectified voltage is fed back through a resistance-capacity filter to the control grids of the two pentode intermediate frequency amplifier valves, of the variable-mu type, as grid bias, and thus controls the amplification of the signal passing through them. This, in effect, is the automatic volume control. The rectified signal from the detector is then again amplified (resistance-capacity coupling), and finally passed through a centre-tapped secondary input transformer to the control grids of two pentode output valves, operating in push-pull. These valves deliver 6 watts undistorted output to the moving-coil speaker. The speaker field coil, in the D.C. mains receiver, is placed in the positive mains lead in order to effect the smoothing of any ripple in the valve-heater circuit supply. General high-tension smoothing is effected by iron-cored chokes in circuit with large-capacity condensers. The voltage-dropping resistance for the heater circuit of the valves is in the form of a regulator lamp; when in operation it plays an important part in determining the value of the grid bias applied to the output valves.

The station selector knob, immediately below the grid, operates the triple-ganged tuning-condenser; its working is remarkably smooth, and the slow movement such that it is possible to tune a station in and out within a fraction of a degree. The figures on the illuminated scale are always visible; they represent channel numbers which, with the addition of an "imaginary" zero, correspond with the kilocycle frequencies on which the transmitters operate, as shown in the wavelength lists of broadcasting stations. The high-frequency band or lower wavelengths are indicated on the upper portion of the scale, and the low-frequency band or long wave stations, at the bottom of the scale. The actual range of the receiver is 200 to 545 metres (1,500 to 555.5 kc/s), and 1,000 to 2,000 metres (300-150 kc/s). For the use of the British listener, however, although kilocycles are, no doubt, more accurate, it would perhaps be more useful to calibrate the dial in wavelengths, or, better still, to give both readings. The wave-change is effected by a small knob on the right-hand side of the front panel. Its opposite number on the left is a combined "on" and "off" switch and volume control. Here, again, the pattern used is an efficient one. Actually, the automatic control incorporated in the receiver tends to equalise the reception strength of all signals tuned in at the sound level for which the manual control has been set. This prevents the blaring of the more powerful transmissions whilst tuning is taking place, and somewhat reduces the fading of more distant stations. With the volume-control knob in a given position the reproduction on all signals will not vary greatly in strength even *when passing from a weak to a strong broadcast*, or *vice-versa*. This equalisation of volume is a principle which might well be adopted by more manufacturers of wireless receivers. In addition, immediately below the main tuning knob, you will find one which also fulfils a very useful duty. It is a special control which permits the user to adjust the tone quality of the broadcast according to his taste. It is possible to compensate for small differences by emphasising the high notes, or by accentuating the lower notes. In the former case, this enables one to make speech particularly crisp and clear and, alternately, giving more emphasis to the lower notes reduces, to a great extent, static and other electrical interferences.

The only three connections to be made to put the receiver into operation are the

(Continued on page 1256.)

WIRELESS IN THE CAR

Our contributor JACE here discusses the problems which arise when using a receiver in a motor-car.

WIRELESS sets are not supplied as standard fittings on any British cars, but they do form part of the regular equipment of a few luxury "automobiles" made in America. Whether or not a receiver is desirable in the family car, I am not prepared to discuss, but it is both interesting and instructive to attempt to use one whilst the car is in motion. When a first attempt is made to use a receiver under such circumstances a number of difficulties immediately present themselves.

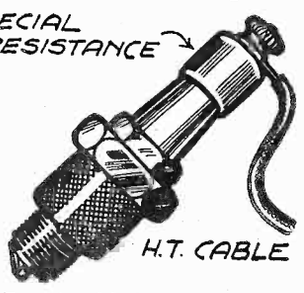


Fig. 1.—Method of fitting special "anti-interference" resistance to sparking plug.

If the set is of the ordinary type and the car has not been specially modified, the only "signals" that can be heard when the engine is running are those "transmitted" by the ignition equipment. And these are reproduced as a very loud and continuous crackle which completely drowns the reception of any legitimate broadcast. Thus, the first problem that arises is "How can the ignition interference be cured?" The simplest way is to insert a 100,000 ohm resistance in the lead to each sparking plug. If reliable metallized resistances are employed they will have no effect on the normal running of the engine, but will reduce interference very considerably. The easiest way to fit the resistances is to cut all the high-tension cables, solder each side of the cut to the resistance connecting wires and then cover the whole very thoroughly with insulation tape.

A neater job will result if use is made of the special resistances made by Messrs. Dubilier and also by the makers of Lodge sparking plugs. These latter take the form of a small cylinder fitted with a terminal. They screw on to the plug in place of the usual terminal nut and the high-tension wire is then attached to the terminal of the resistance as shown in Fig. 1.

An Earth Lead

Sparking plug resistances do not entirely eliminate ignition interference and the next step is to fit an earth lead to the set. It is obvious that an earth connection of the normal kind is entirely out of the question, but the chassis of the car provides almost as good an earth as does a water pipe or buried plate. All that is required, then, is a wire to a convenient chassis nut, or in the case of a car with a single wire lighting system, to the negative battery terminal. If the set is a portable, and not fitted with an earth terminal, connection should be made to the negative terminal of the low-tension accumulator.

Screening

After making the two alterations suggested above there should only remain a faint sign of interfering crackles which should certainly not be so loud as to drown reception. A further improvement can be effected by screening the set; this can be done by lining the containing case with tin foil and connecting the foil to the negative low-tension lead. Before going to the trouble of removing the "innards" for this purpose a trial can be made by covering the outside of the case with foil, or better still, with thin sheet copper.

Whatever form of screening is adopted, care should be taken that all the sheets of metal forming the screen are effectively connected together. If copper sheet is employed the joints should be soldered, but with foil the easiest way is to cover the joints with strips of metal screwed to the case as shown in Fig. 2. When the set works from a frame aerial, this should certainly not be screened, for if it is, no signals will be received at all.

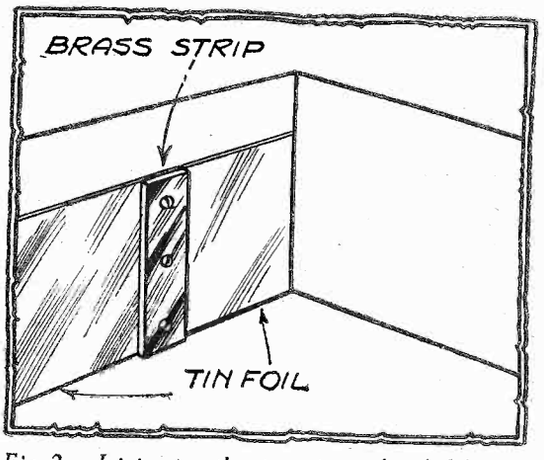


Fig. 2.—Joining together two pieces of tinfoil forming a screen.

The Aerial

A frame aerial does not generally provide an efficient "collector" on account of the very great shielding effect of the metal bodywork panels, so it is better to employ a larger aerial exterior to the set. The best aerial would be one elevated slightly above the roof, but that would certainly affect the appearance of the car and would, in most cases, be undesirable. A fairly good substitute can be provided by using a length of "Pix" aerial material. This consists of a 30ft. length of adhesive tape through which runs a strip of copper-foil. The tape can be attached round the edge of the fabric roof and a lead-in taken through a window, louvre or roof ventilator; since the material is very thin it will not interfere with the normal closing and opening of either the window or ventilator. The "Pix" aerial material is supplied in various colours

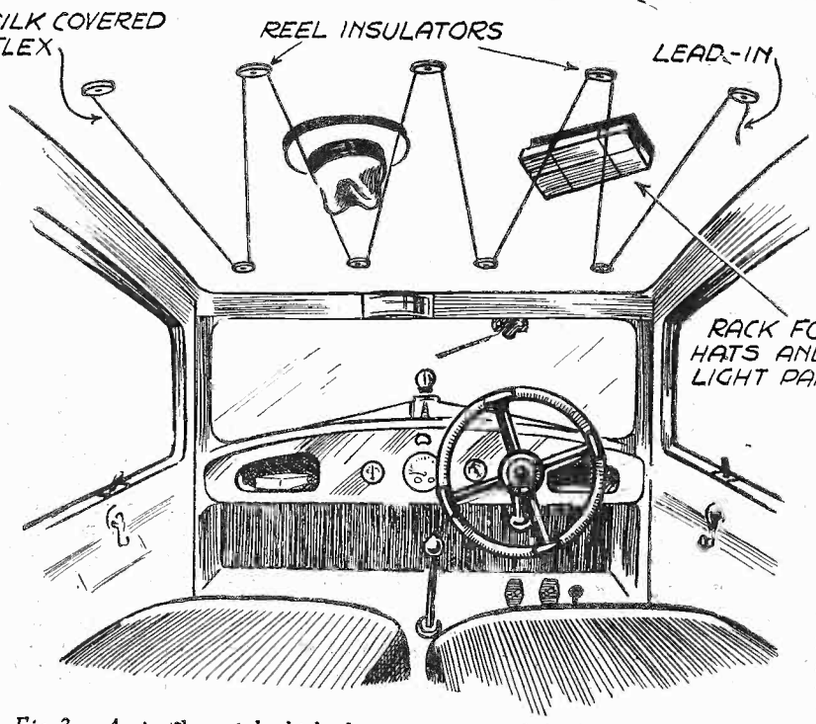


Fig. 3.—An inside aerial which also serves as a rack for hats and light parcels.

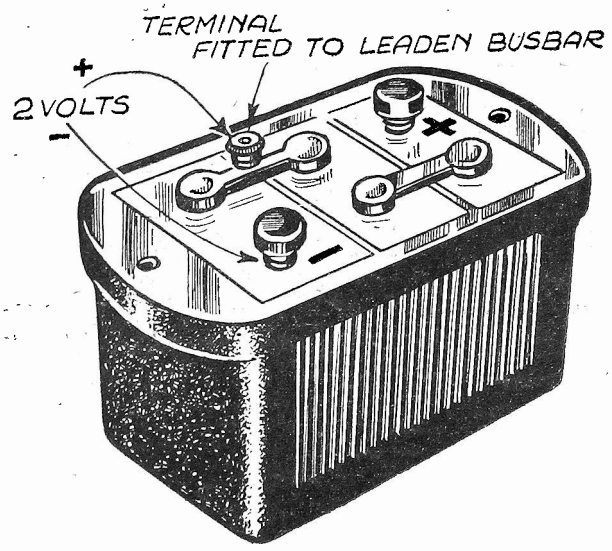


Fig. 4.—A terminal fitted to a lead busbar to provide a 2-volt tapping on the car battery.

and one can be chosen to match the colour scheme of the car. It is not really intended for outside use so it is best to apply a thin coat of varnish after sticking it down in order to protect it from the weather. In most cases the car will not be sufficiently large to take the whole 30ft., but even a much smaller length will give satisfactory results. When the car has fabric body-work, an inside aerial will be fairly efficient since the body will not exercise any great shielding effect. A suitable inside aerial can be made from one of the many kinds of silk-covered wires sold for use as ordinary domestic inside aerials. The wire is obtainable in several colours, and so it can be chosen to match the interior furnishings.

The aerial can simply be wound round the sides of the roof or it can be made in the form illustrated in the sketch of Fig. 3; it is taken from end to end of the roof in zig-zag fashion and is supported on small reel insulators, screwed to the top. As an alternative to reel insulators ordinary insulated hooks could be used. In addition to acting as an aerial the wire will prove useful as a rack for hats or light parcels.

Power Supply

Having decided on the type of aerial to be employed we might give some consideration to the matter of the power supply. Most portable sets have self-contained batteries, so these can be employed if desired, but putting extra batteries into a car does seem rather like "taking coals to Newcastle." The car battery can be employed for low tension supply, and the extra drain on it will be quite inappreciable. But since the set will only require 2 volts, whilst the battery gives either 6 or 12 volts, a regulating resistance will be necessary. The correct value for this can be calculated by the use of our old friend, Ohm's Law; thus Resistance Required equals voltage to be dropped (4 or 10 according to voltage of battery) divided by the L.T. current consumption of the set. A suitable resistance can be made in the manner described in a recent article; it will be advisable to make it to have a resistance somewhat in excess of the calculated value, and to use a tapping clip so that the best position can be found by trial. From the point of view of valve life it will be best to use the highest value of resistance with which satisfactory reception is possible.

As an alternative to using a regulating resistance the L.T. supply can be taken from a single 2 volt cell of the accumulator by attaching a terminal to one of the lead busbar connectors (see Fig. 4), and taking wires from the extra terminal and the negative accumulator terminal.

Connecting to the Car Battery

Connection to the car battery can generally be made through sockets provided on the facia board (for connecting an inspection lamp, etc.), but where these are not fitted, leads must be taken to the battery itself. In the former case it will be necessary to determine the polarity of the sockets, and this can be done by connecting a lamp bulb between the negative battery terminal and each socket in turn; the socket which causes the bulb to light will be positive. When the lighting is on the single wire system (only a single wire connection being made to each lamp) the voltage regulating resistance, if used, should be connected in the positive lead. The negative will already be connected to the chassis, and so no other earth connection will be required.

Making a Special Set

Our attention so far has been confined to the question of using an ordinary fixed or portable set in the car, but there might be a number of readers who would prefer to make a set specially for the job and to instal it as a permanent fitting.

Circuit Details

First we must decide on the most suitable type of circuit. As the principal requirement will be ample volume from the nearest Regional, a single S.G. valve followed by a detector and two L.F.'s will fill the bill. A small and comparatively inefficient aerial will be employed, and so our S.G. stage must be as good as possible. Tuning must be easy and "steady" so that it will not readily be upset by vibration or jolts. A very high degree of selectivity is not called for and therefore a band pass tuner is not in the least necessary.

Solid Construction

The next essentials are that the set should be very strongly constructed and housed in a substantial case. It should not fit rigidly into the containing case, but must be mounted on rubber buffers which will insulate it from road shocks. These latter can best take the form of sponge rubber pads fitting between the receiver chassis and the case. Compactness is a desirable feature which should be studied in conjunction with the question as to where the outfit is to be placed. To accommodate the components in a small compass it will be best to use a "box-form" chassis and to mount most of the low frequency-components on the under side of the base-board. As is always the case when components have to be crowded to a certain extent, all parts associated with the tuning circuits should be fitted with screening cans.

The Position of the Set

In a large car there is not likely to be much difficulty in finding a place for the set; it will generally fit either below the facia board or behind the front seats. But in the case of a car coming within the "baby" class the question of accommodation is more difficult.

I recently solved the problem fairly satisfactory by making a set to fit into a container 12 inches square by 4 inches deep and fixing it to the side of the car above the rear wheel arch. A speaker of similar dimensions was mounted opposite the set over the other arch as shown in the sketch of Fig. 5. Of course, this limited the seating room of the back seat to a single person, but in any case it would have been a squash for two. Whenever a set is made specially for the car it should always be designed so that it can take the whole of its power from the accumulator so that battery replacements will never become necessary.

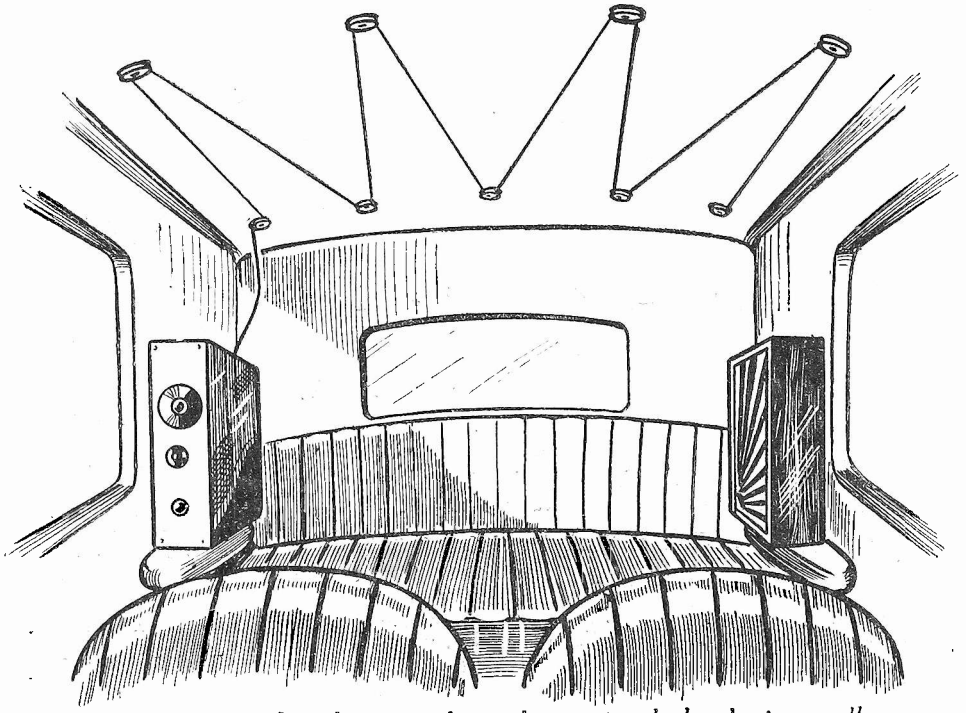


Fig. 5.—Receiver and speaker mounted over the opposite wheel arches in a small car.

Reducing the Number of Controls

In this Short Article a Contributor Explains how many of the Panel Controls can be Ganged Together so as to Simplify the Operation of the Set

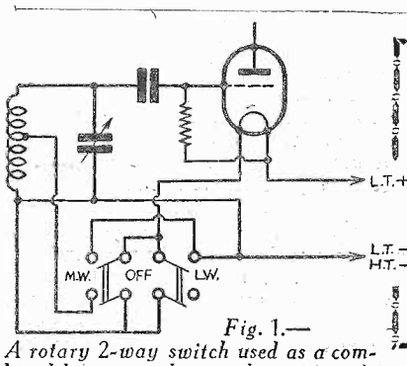


Fig. 1.— A rotary 2-way switch used as a combined battery and wavechange switch.

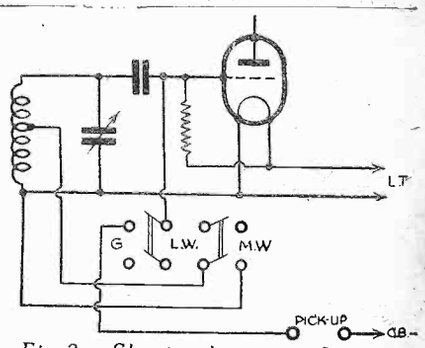
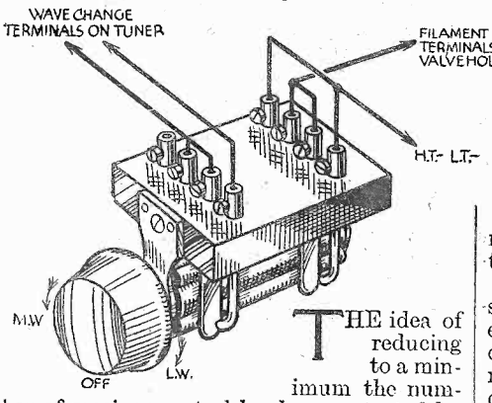


Fig. 2.—Showing how a single component can be used as combined wavechange and radio-gram switch.



THE idea of reducing to a minimum the number of receiver control knobs was started by the manufacturers of commercial broadcast sets some years ago, and it has proved very popular indeed. The great simplification effected in this way has considerably improved the appearance of contemporary receivers, and has made it much easier to build them into cabinets which are more in keeping with furnishing schemes. It has also simplified the operation tremendously, bringing easy tuning within the possibilities of the most inexpert and unmechanical listener.

I would not suggest that the experimenter should attempt to reduce the number of controls on his receiver to the bare minimum of a tuning knob and on-off switch, as some manufacturers have done, because he can get infinite delight from making delicate adjustments of all sorts, but I do think the time has come when he should give more attention to the matter of combining controls in such a way that one knob may be used for two or more purposes. Nearly every amateur now uses ganged condensers, but how many are there who "gang" the other controls such as on-off and radio-gram switches, pick-up potentiometer and reaction condenser, wave-change switch and radio-gram switch, to mention just a few examples? All these, and many more, operations can now be combined by the use of components already on the market. In many cases it is cheaper to use combined controls than separate ones, and there is no doubt that the appearance of the complete receiver is considerably enhanced by so doing. As there are probably a number of readers who do not realize the possibilities which lie in the direction I have indicated, perhaps a few practical examples will be of assistance.

Combining On-off and Wavechange Switches

It is a very simple matter to combine the battery and wavechange switches in the manner indicated in the sketch of Fig. 1. A simple 2-way rotary switch takes the place of the more usual pair of push-pull switches, and the connections are just as simple as when separate components are used. When the knob points "straight up" the set is switched off; turning the knob to the left switches on to "medium waves," and turning it to the right puts the set on to "long waves." The only point to watch when buying the switch is that it is of the low-capacity type, because otherwise it might have some effect on the correct tuning of the set.

The 2-way switch shown is only suitable where a single tuning coil is employed, but by using a 3-point or 4-point component it could be made to operate on two or three separate coils in precisely the same way.

R.-G. and Wavechange Switching

A similar type of switch can be connected in the manner shown in Fig. 2 to serve the dual purpose of changing from radio to gramophone and from one waveband to another. When the knob is in its central position all the contacts are "open" and the set is on long waves, but by turning it to the left medium-wave tuning is obtained, whilst turning it to the right transfers the connection going to the grid terminal of the valve holder from the tuning coil to the pick-up terminal. This method is only applicable when the pick-up is connected in the grid circuit of the detector valve, or of an L.F. valve using resistance capacity coupling. If it were used with a transformer coupled valve the pick-up would be put in parallel with the transformer secondary winding, and that would have the effect of reducing volume and also of impairing the response of the pick-up to the high notes.

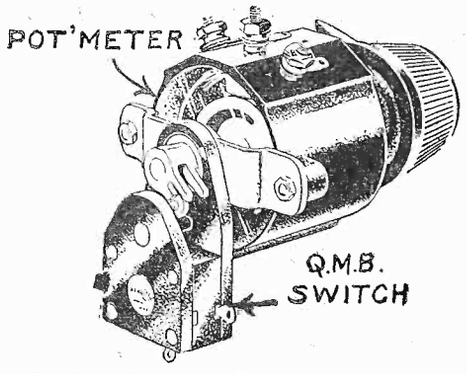
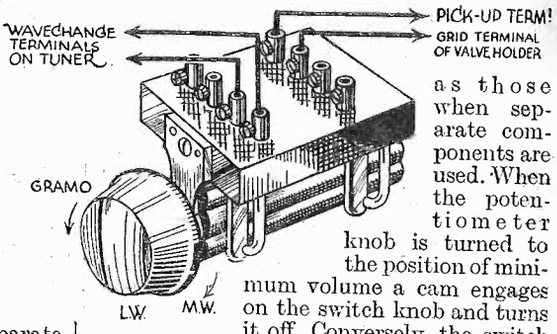


Fig. 3.—A combined potentiometer and battery switch.

Volume Control and On-off Switch

Where a potentiometer is used as a volume control, either in the grid circuit of an L.F. valve or for varying the screening grid potential to an S.G. valve, a knob can be saved by employing a combined potentiometer and switch of the type shown in Fig. 3. All connections are just the same as those when separate components are used. When the potentiometer knob is turned to the position of minimum volume a cam engages on the switch knob and turns it off. Conversely, the switch is turned on by moving the knob slightly in a clockwise direction, and then the potentiometer can be used in the normal way while the switch remains in the "on" position. This idea is very convenient with a mains set because after first switching on, the potentiometer can be left in the position of minimum volume until the cathodes heat up, thus reducing initial mains hum to the lowest possible limit. Incidentally, it might be added that all the switches used on combined components of the type suggested are of the quick-make-break variety, and are therefore equally suitable for use in either a mains or battery set.



Potentiometer Reaction Control

By slightly modifying the receiver connections the potentiometer can be used as an excellent reaction control, for which purpose it is generally a good deal more efficient than the usual reaction condenser. It is only necessary to remove the variable reaction condenser, replace it by a fixed one of similar capacity, and connect two terminals (the centre and an outside one) of the potentiometer in series with it. The exact wiring is clearly shown in the sketch and diagram of Fig. 4, from which it will be seen that the potentiometer is used as a series variable resistance between the anode of the detector valve and the reaction winding; as the resistance value is increased the degree of reaction coupling is reduced, and *vice versa*. This is an excellent, though little known, method of reaction control, and I have just embodied it in a new receiver with great success. Besides acting as a reaction control the resistance also serves to decouple the reaction winding, and so entirely prevents the instability and hand-capacity effects so frequently met with in a sensitive receiver. The best value for the potentiometer is not by any means critical, but is generally about 15,000 ohms. Incidentally, a rather smoother reaction adjustment is possible if a "graded" type of potentiometer is used.

Dual Volume Controls

It is very convenient to use a pair of ganged potentiometers for reaction and

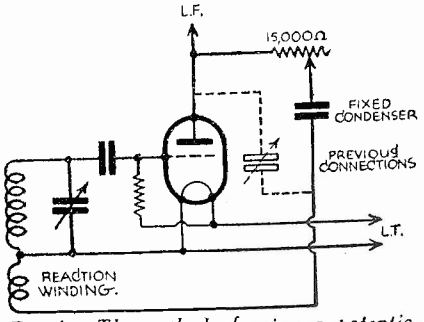
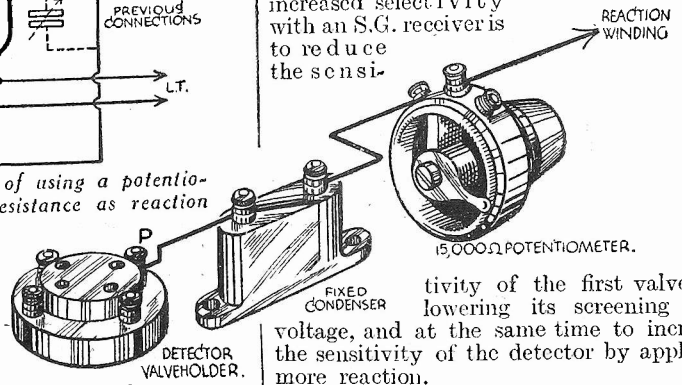


Fig. 4.—The method of using a potentiometer or variable resistance as reaction control; the potentiometer may be combined with an on-off switch if desired.



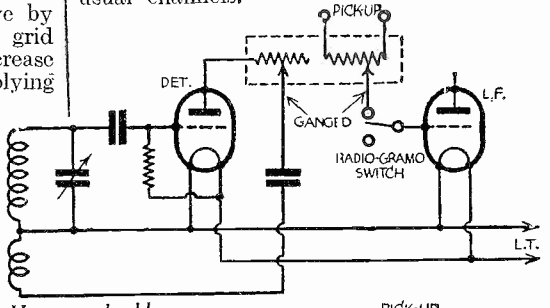
pick-up volume control in the manner suggested in Fig. 5. One unit is wired up exactly as described above, and the other is connected to the pick-up terminals and also to the radio-gram switch. This is a very logical system because it makes possible the regulation of volume on either radio or gramophone by the same knob.

Other Arrangements

A similar pair of potentiometers can be used for a set fitted with a variable-mu valve; one component is arranged to provide a variable grid bias voltage to the V.-M. valve and the other is used as pick-up volume control. If a little care is taken in choosing suitable resistance values, one potentiometer can be used to vary the screening grid voltage to an S.G. valve, whilst the other controls the degree of reaction. In this case the two components must be wired in "opposition," that is, in such a way that whilst one reduces the S.G. voltage, the other simultaneously increases reaction by reducing the series resistance. This combination is a very good one and gives the very effect that is aimed at when using separate controls. As you know, the method of obtaining increased selectivity with an S.G. receiver is to reduce the sensitivity of the first valve by lowering its screening grid voltage, and at the same time to increase the sensitivity of the detector by applying more reaction.

I have not by any means mentioned all the possibilities of dual controls, but I think that sufficient has been said to enable the reader to devise similar schemes which will be applicable to his own receiver. If a word of warning is necessary it is this: take great care that the wires to the dual-purpose components are not allowed to run parallel to each other because, since the terminals are of necessity fairly close together, unwanted capacity might be introduced which would affect the set's stability. This applies principally, of course, to wires in high-frequency circuits, like those going to radio-gram switches, S.G. volume controls and wave-change switches, but it is well to play for safety by making the rule of general application.

If by chance there are any readers who are unfamiliar with the components referred to, it may be stated that all types of combined and ganged volume controls and switches are made by Messrs. Bulgin and Messrs. Wearite. Both makes are available in any required combination or resistance value. The multi-way anti-capacity switches are also made by the latter firm, and can be obtained with either lever or knob operation. Needless to say, any good radio dealer can supply the parts, so there is no need to order specially from the makers unless some difficulty is encountered in obtaining them through the usual channels.



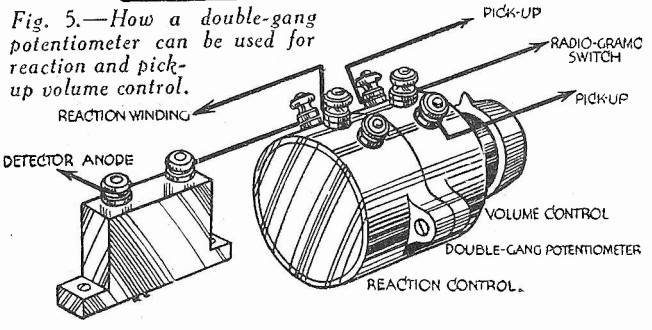


Fig. 5.—How a double-gang potentiometer can be used for reaction and pick-up volume control.

FROM THE FLASHLAMP

By Photon

THE value of magnet steel to the user, whether it be the field magnet of a loud-speaker or for any other purpose, depends primarily upon the energy which, when correctly applied, a magnet will sustain in its external field. There are exceptions to this so far as the commercial value of a magnet steel is concerned, but for the time being these can be ignored.

To those not accustomed to this manner of expressing the value of a magnet the meaning may seem a little obscure. To make it clear let us suppose that a magnet be constructed, jointed in some way, so that its poles could come together, then in coming together they could be made to do work, such as lift a weight through a height, and this could be at once expressed in ft./lbs. energy. As a matter of fact, in this way a magnet could do more work than at the outset existed in the gap, because there is also energy in the magnet itself which partly comes out and becomes available when the gap is closed, but this need not trouble us, the idea of a definite quantity of energy in the gap has been made clear.

Now the unit of energy employed to match B (expressed as lines of force per cm.^{2}) and H (in gauss) is the *erg*. We shall say nothing about this unit except that 10,000,000 ergs go to the joule, which is the electrical engineer's unit of energy, such that 1 joule per second=1 watt, or 746 joules per sec.=1 h.p., or 1 joule=.7373 ft./lbs. The ergs per cubic centimetre are given by the expression $\frac{B \times H}{8n}$, or conveniently, $\frac{B \times H}{25}$, or Joules$=\frac{B \times H}{25 \times 10}$.

The most favourable or optimum value of B×H for different grades of magnet steel is usually to be found in the manufacturer's catalogue or handbook, thus as average figures, we may take the following Col. 2 as representing "BH max." for cobalt steels of the percentages given:—

% Cobalt	BH max.	Joules per lb. of steel	Price per lb. pence.	Price per Joule s. d.
3%	350,000	.080	13	13 6
6%	420,000	.096	16	13 11
9%	480,000	.110	19	14 6
15%	600,000	.136	25	15 4
35%	900,000	.205	45	22 0

Col. 4 gives the cost per joule on the basis of prices given in Col. 3.

The makers of magnet steel find it impossible to ensure every casting, or length of bar, coming out exact to sample, and the question of rejection limits is thus a matter of difficulty. Also, when deliveries are below sample, but not down enough to reject, the same difficulty arises. The fair solution in the latter case is clearly to pay on *computed energy content;* when buying magnets it is *field energy* that is the commodity purchased. Thus in the case of a given magnet assembly the energy value is the measure of the B in the gap *squared*, the sample being taken as datum.

Loss of Field Strength

Another point of importance is the loss of field strength with time. In this different magnet samples differ greatly amongst themselves. It is commonly found that a sample which is exceptionally good, or above the average, holds its field better than one that is below standard in the first instance. Most of the loss takes place within the first month after being magnetized, after that the magnet has reached a stable condition, but there are exceptions even to this. The reduction in field strength is commonly about 5 per cent. and 10 per cent., but is sometimes as much as 15 per cent., or even more.

THE DESIGN OF LOUD-SPEAKERS—3

The Method of Suspending the Conical Diaphragm is Dealt With in this, the Third Article of the Series, by W. J. DELANEY

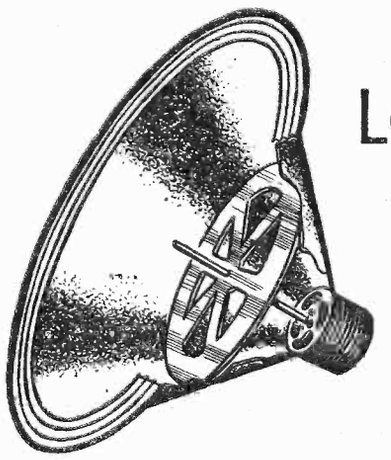


Fig. 1.—An ingenious double spider arrangement for ensuring centralisation of the speech coil.

LAST week we saw how the apex of the cone, or the point at which the speech coil is attached, is held so that the speech coil is accurately centred in the air gap surrounding the pole piece. It will be obvious to anyone that the weight of the cone, if the edge of it were not held in any way, would cause the cone to pivot about the axis formed by the centring spider, and consequently the speech coil would not remain truly centred. There must, therefore, be some arrangement to support the front of the cone, and it is here that the whole design of the majority of moving-coil speakers is spoilt. Last week we saw that the cone could be held, so far as the rear portion was concerned, so that, with a suitably designed spider, the speech coil was free to move in a true piston movement, over quite a considerable distance in the air gap surrounding the pole piece. Obviously this will enable more faithful reproduction to be obtained than with any of the other types of speaker previously mentioned. But this freedom of movement must not be destroyed in the remaining parts of the speaker make-up, and as the edge or front of the cone must be supported in some way, we seem that we have struck a snag. The commonest, and the oldest, form of holding the cone was to use a ring of rubber or leather stuck to the periphery of the cone, and clamped in a ring of plywood or similar arrangement, as shown in Fig. 1 last week. The method of attaching this was to turn over the edge of the cone for a distance of about a quarter of an inch and coat this with some sort of adhesive. It was then pressed against a square of rubber or leather, and when set the centre portion was cut away. The distance between the edge of the cone and the surrounding clamping ring was about half an inch, and to ensure that the cone would not twist, the material was stretched slightly when being clamped. What is the result of this arrangement? Obviously we have got back to the same fault that was found with the ordinary moving iron type of speaker—namely, a restoring force. If you can examine a speaker of this type you will find that the cone is held, almost rigidly, in a position where the surround, as we must call the leather, rubber, or other material, is perfectly flat. Now when the cone is drawn inwards it draws with it the surround, and as soon as the pulling motive is removed the surround pulls the cone back to a "normal" position. If the cone is driven forward, the same effect is present, and this naturally destroys quite a lot of the advantage which has been obtained from the moving-coil principle.

Round's Spider

One of the first developments which was introduced to overcome this defect was the idea known as the Round Spider, after the inventor, Capt. Round. This is illustrated in Fig. 1, and it will be seen that this is nothing more nor less than a second spider fixed towards the front of the cone. The pole piece was drilled centrally and tapped to accommodate a brass rod about 5-16ths of an inch thick. This projected almost to the front of the cone. About two-thirds of the distance along the cone a spider having only five thin radial arms was attached, and by suitable choice of the substance of this spider, and the length of the arms, great freedom of movement was obtainable, and the restoring force was almost entirely removed. There was still the tendency, however, to return to the position of rest, and although a great advance on previous arrangements it was still not perfect.

Moulded Cones

The next step forward was the employment of vulcanized fabrics or other patented preparations which had the apex moulded to form a spider, and the speech coil was cemented to them. The periphery of the cone was moulded to form a number of circular corrugations (Fig. 2). This permits of the extreme edge being clamped, and the corrugations allow the cone to travel backwards and forwards fairly freely. This is a very good arrangement and is still adopted in a number of speakers at present on the market. A further advantage of this method of building a cone is the avoidance of a seam which tends to break up the cone into sections and so produce unpleasant resonances. In Fig. 6 last week I illustrated a method of avoiding the centralizing spider, and mentioned that this was one of the most satisfactory solutions to the problem of centralization. This particular loud-speaker employs a material surrounding the edge of the cone, and this is secured to a wooden baffle. But to avoid the restoring force which is usually obtained by a surround, this firm employs a most interesting device. The cone is first of all cemented to the surrounding material, and when perfectly secured, this material is attached to the baffle by a slow-drying adhesive. The speaker is then placed on a raw A.C. supply of about 50 cycles, and this naturally causes the speaker diaphragm to vibrate backwards and forwards over a fairly large movement. It is left connected to this supply and allowed to vibrate until the adhesive has dried, after which it is, of course, still free to carry out movement at this low period. This device is, needless to say, patented and is, in my opinion, one of the most effective devices as yet developed.

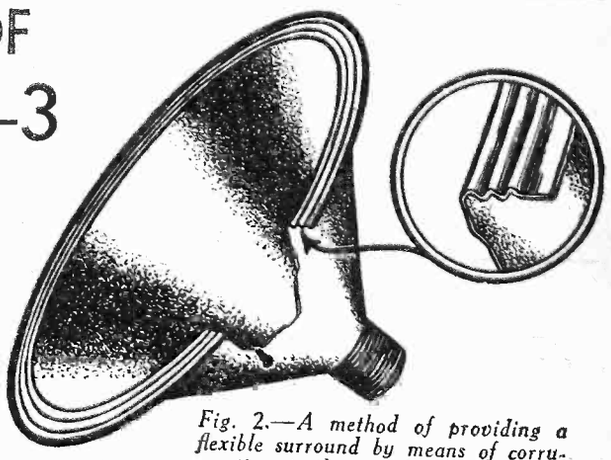


Fig. 2.—A method of providing a flexible surround by means of corrugations in the actual cone material.

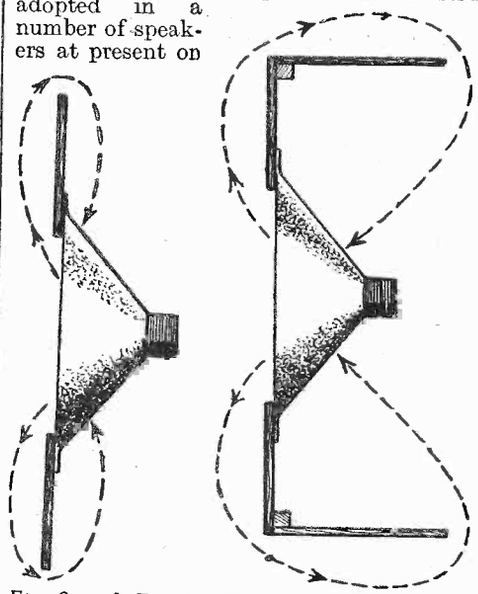


Fig. 3 and Fig. 4.—The manner in which a baffle prevents the sound waves from passing speedily from the front to the back of a cone.

Angle of the Cone

There are many other features which enter into the quality of the reproduction, and the volume obtained from a moving-coil speaker, and it is possible to write a book upon the subject. Before closing this short series of articles, however, I must mention the fact that the actual shape of the cone has quite a large effect upon the output of the speaker. If the cone has steep sides, that is, if it resembles the cone in which ice cream is obtainable in the summer, it suffers from what is known as "focussing," that is, the sound is directed forward in a narrow beam, and the intensity of the sound when the listener stands a little to one side falls off tremendously. As the cone becomes more flat, so the radiation spreads out, and it would seem from this, that the ideal would be a flat diaphragm. So far, however, I have only seen one speaker which employed such a diaphragm, and this was at one time on the market in a commercial radiogram costing over one hundred pounds. A flat diaphragm requires very much more energy to set it in motion, and also presents a difficulty in attaching the speech coil, so that it may be positioned within the air gap of the magnet system. This particular model to which I have just referred employed a disc of wood,

(Continued on page 1240.)

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(Continued from page 1238.)

and to break it into sections and prevent resonances, small pieces of wood were glued to it at various positions. It certainly gave a wonderful response.

Dual Units

From what has already been said it is clear that there must always be present a fault of some kind, and this means that the speaker has resonances at one end or other of the frequency spectrum. For instance, if the speaker diaphragm is too firmly held, it will fail to do justice to the low vibration of our drum. On the other hand, if too freely suspended, the high notes, which require a very quick movement, will tend to be sluggish; or the particular material of which the diaphragm is made may result in a certain frequency receiving undue prominence. To attempt to overcome these faults it has now become popular to produce what is known as compensated, or dual units. This consists of two loud-speakers mounted on one large assembly. One unit is designed so that it does justice to one part of the musical range, and the other attends to the remainder of the range. In this way it is possible to get a better over-all response than is possible from one unit which is designed to attempt to cover the entire range.

Baffles

It is now well known to all listeners that the moving-coil type of speaker requires a baffle. Why? In the first article of this series, I illustrated the principle of sound reproduction by showing the movement of the air caused by the vibration of a drum-head. If you refer back to this, you will see that the movement was slow—actually fifty vibrations a second. Now our loud-speaker possesses quite a small diaphragm, and it will be assumed that it is capable of travelling at this slow speed. If you remember, I said that the sound was caused by a rarefaction and compression of the air, and we must now see how this affects our cone diaphragm. When it is drawn inwards the air will follow the cone and become rarefied. Obviously, it is not possible to leave a "space" in the air, and naturally all the surrounding air will rush in to fill up the gap which is being created. Some of this air will naturally come from the front of the cone, but as the cone is pushing the air at the back into a state of compression, obviously this air will prefer to slip round to the rarefied part in the front, instead of being compressed. The same thing will happen when the cone is driven forward on the other half of the note—the air in front, in preference to being compressed, will slip round the edge of the cone to the rarefied atmosphere which is being created at the back. We will not, therefore, get our piston movement of the air at a distance from the speaker. In other words, the sound vibration is cancelled out. To prevent this, we use what is known as a "baffle." This consists in the simplest form, of a flat wooden board, sufficiently thick to prevent it resonating at a frequency within the audible range, and having a hole cut in the centre, just a little bit smaller than the overall diameter of the mouth of the cone. When the cone is pushed forwards the air in front is compressed (as in our drum illustration), and it cannot get round to the rarefied area at the back without travelling along the front of the baffle and then along the back. The same thing occurs on the opposite movement, and so the air receives the full effect of the movement of the cone. Fig 3 shows the effective size of the baffle, which, it will be noticed, is from the front of the cone, back to the rear of the cone, and not simply from the cone to the edge of the baffle. Three feet is the smallest size which is advisable.

AT the present moment there are two new wireless features which are being introduced to the wireless amateur. The first is, of course, Quiescent Push-Pull, about which quite a lot has already been said in these pages. The other which has so far only been introduced to our readers, is the new type of coil known as Ferrocart.

This introduced, in the manner described in an earlier issue, a very high degree of selectivity into a receiver—much higher, in fact, than has hitherto been thought possible without introducing the super-heterodyne principle. We have given circuits and constructional data relative to the Q.P-P. principle, and all that remains is to introduce a receiver employing the Ferrocart coils. Unfortunately, these have not been obtainable until now, and therefore our readers have not been able to receive any constructional hints.

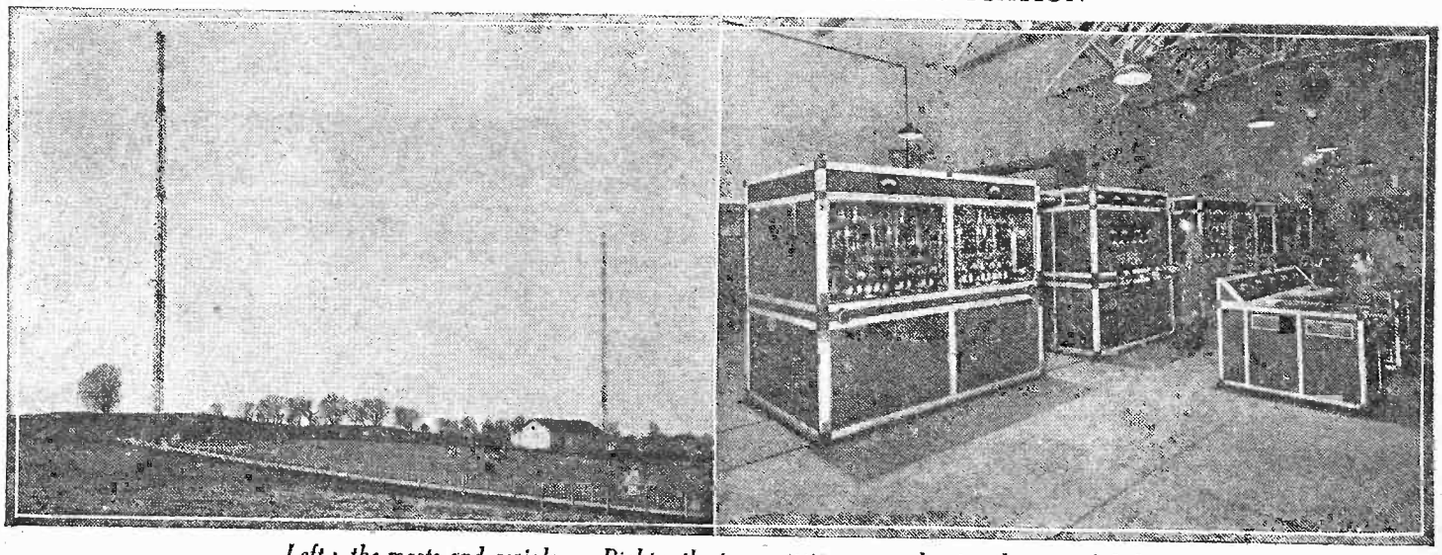
After tests, we have decided that the interests of the keen amateur would best be met by employing this type of coil in a receiver employing a variable mu valve for the H.F. stage, with a high efficiency detector valve. This would introduce a high-gain receiver with a high degree of selectivity, and would naturally enable a large number of stations to be tuned-in free of interference. The question then arises as to what form of L.F. amplification to adopt in order to ensure that these numerous stations shall be reproduced at a signal strength which is desirable, if the station is to offer real entertainment value. Obviously a pentode could be used but the anode current is high for this type of valve, and this would require a large capacity H.T. battery. Two L.F. stages would introduce difficulties in choosing the transformers or other coupling units. It was decided, therefore, after a few experiments, to incorporate Quiescent Push-Pull, and so introduce into the one receiver the very latest in wireless practice, both for the H.F. side of the receiver and also the L.F. side.

As the coils are fairly expensive, and a three-gang condenser was chosen, it was decided to keep the total cost of the receiver within the limits of the purse of the majority of our readers, and therefore, in place of pentode valves in the output stage, high-efficiency power valves, of the low-consumption type, have been used. The result is a receiver of phenomenal merit, receiving dozens of stations at really good volume, on a moving-coil loud-speaker, without the slightest trace of interference. The selectivity is of such a high order that it must be heard to be appreciated. The volume also will satisfy the most critical, and the receiver is therefore one of the most advanced designs which has yet been produced in the wireless art. Constructional notes and further details will be given next week.

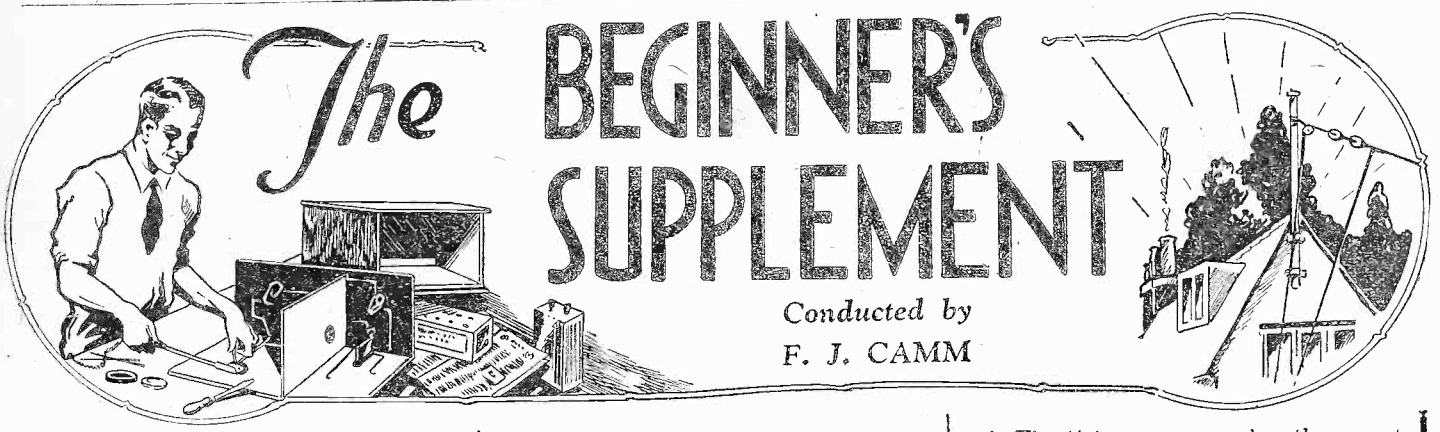
NEXT WEEK!

THE FERROCART Q.P.-P. HI-MAG. THREE

ATHLONE—IRELAND'S NEW BROADCASTING STATION



Left: the masts and aerials. Right: the transmitting room, showing the control desk.



The BEGINNER'S SUPPLEMENT

Conducted by F. J. CAMM

HOW YOUR SET WORKS

Part 5.—The Power Valve

THE second valve in our set, the one we dealt with last week, is generally known as the *first L.F. valve*, whereas the last one, which we are going to study now, is called the *second L.F.* or *power* valve. The term "L.F." stands for *low frequency*, and I will explain why it is used.

You will remember that the waves given out by the transmitting station follow one another at enormous speed and strike our aerial a million or more times a second, thus producing correspondingly rapid currents in the aerial circuit.

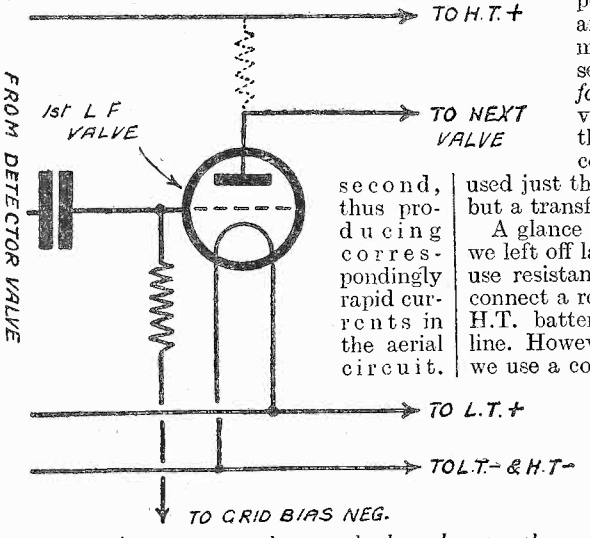


Fig. 1.—A resistance used to couple the valves together.

These currents, you will remember, are called *high-frequency currents.*

The Meaning of "Low-frequency"

I explained that the speech or music sent out was represented by a variation in the amplitude (height) of the waves. This meant a rise and fall in the strength of the high-frequency currents. This rise and fall occurs at a comparatively slow rate or *low frequency.* It is this low-frequency variation in the strength of the high-frequency current which corresponds with each vibration of the voice or of the musical instrument being broadcast. You will recollect that by means of the grid in the detector valve these variations in the strength of currents in the aerial circuit were able to make similar variations in the *plate current.*

There are thus *low-frequency* variations in the plate current of the detector valve, and it is because the work of the following two valves is to amplify these that they are called *low-frequency* or *L.F.* amplifiers. The one we are going to study this week is also called the *power valve*, because it has to handle larger fluctuations in current than either of the other valves and produces more power.

Using a Transformer

Last week I said that there were two popular methods of adding amplifier valves—firstly by means of a *resistance* and secondly by means of a *transformer.* The last or "power" valve in our set is coupled by the transformer method. Of course, a resistance *could* be used just the same as for the second valve, but a transformer has certain advantages.

A glance at Fig. 1 will show just where we left off last week. If we were going to use resistance coupling again, we should connect a resistance from the plate to the H.T. battery, as shown by the dotted line. However, we do not do this. Instead, we use a coil of wire. This coil of wire is known as the *primary winding* of the transformer.

How It Works.

The action of the transformer is somewhat different from that of a resistance. To understand it we must first see what a transformer is.

A simple type consists of two coils of insulated wire wound round an iron rod. They may either be wound side by side, as in Fig. 4(a), or one over the other, as at (b). When a fluctuating current is passed through one of the coils it acts something like the resistance we were studying last week. That is to say, a difference of pressure or *voltage* arises between one end and the other. Another thing that happens is that *the current passing through the one coil induces a current in the other coil.*

If each coil has the same number of turns, then the difference in *voltage* between the ends of the second coil will be the same as that between the ends of the first one. If, however, the second coil has *more* turns than the first, then the voltage produced will be *greater* than that across the first coil.

This is where the usefulness of the transformer comes in. It enables the voltage to be "stepped up" any desired amount. Thus, if we make the second coil twice the size of the first one, then the voltage across the second will be twice that across the first. If the second coil has three times as many turns as the first, the voltage produced will be three times as great, and so on.

How It Is Made

Incidentally, the type of transformer just described is rather primitive and would not be very efficient. The type used in a wireless set is much more carefully made. The chief difference is, however, in the iron "core." This is not a simple iron rod, but is made of a number of sheets of a special iron alloy, also it does not merely pass through the middle of the coils, but extends right round the outside of them. Fig. 4 (c) and (d) will show what I mean.

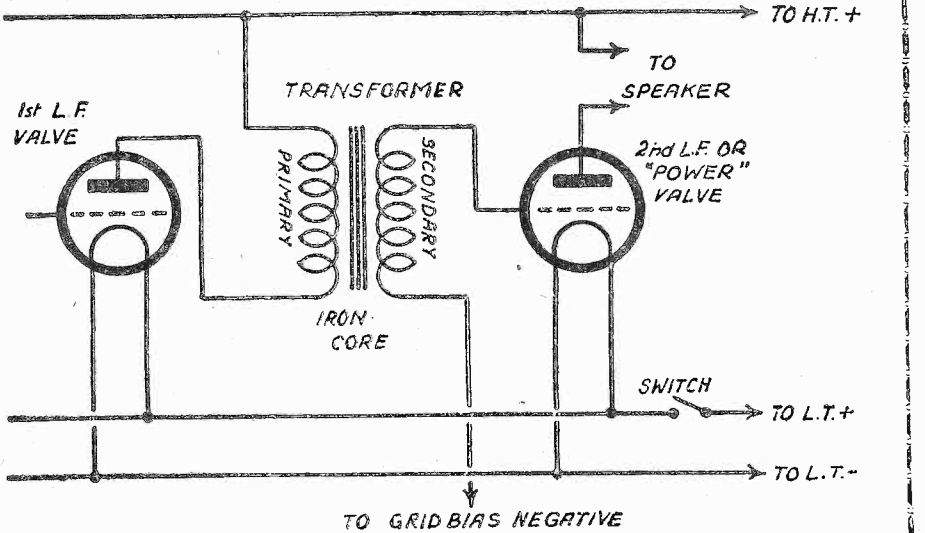


Fig. 2.—A transformer used for coupling purposes.

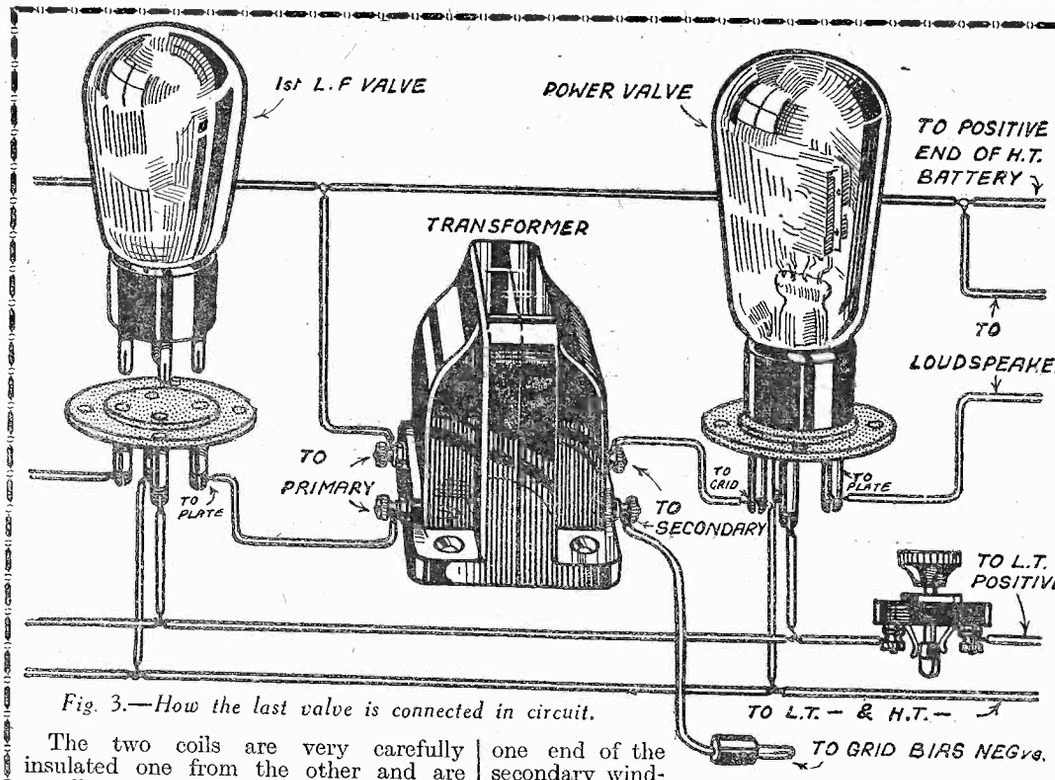


Fig. 3.—How the last valve is connected in circuit.

The two coils are very carefully insulated one from the other and are usually wound on the same bobbin. First the *primary* winding is wound on. Then a layer of waxed paper or similar insulating material is wrapped round it, and finally the *secondary* winding is put on. This latter usually has from three to five times as many turns as the primary, but it may have as many as eight times.

The core is made in two parts—one T-shaped and the other U-shaped—each part being composed of many sheets of the iron alloy. The two parts are fixed in position, as in Fig. 4 (c) and (d), after the bobbin is wound, and then the whole thing is sealed inside a bakelite case fitted with four terminals connecting to the windings inside. It then presents the appearance shown in Fig. 3.

The Power Valve

Of course, the object of the transformer, as you have probably guessed by now, is to increase the variations in voltage applied to the power valve. You will see how it is connected up from Figs. 2 and 3. Notice that one end of the secondary winding is joined to the grid of this valve.

The action of the power valve is exactly similar to that of the previous valve, small variations in the voltage of the grid giving large variations in the plate current. This amplifying property of the valve itself added to the step-up effect of the transformer causes the total amplification to be considerable, so it is now that we join up the loud-speaker. This is connected in the plate circuit of the power valve, that is to say, between the plate and the positive end of the high-tension battery, as shown in Figs. 2 and 3.

The Loud-speaker

To explain the working of the loud-speaker I am going to describe the simplest type. It consists of a magnet N (Fig. 5), a strip of iron known as the *reed*, a coil of fine insulated wire, and a paper cone attached to the reed by a small metal rod. There is also a knob and spring for adjustment purposes.

The coil is wound on to a small bobbin which fits over one end of the magnet while the reed, which is of a springy nature, is screwed to the other end of the magnet. The free end of the reed is just opposite the coil end of the magnet. Although the magnet attracts it, the springiness of the reed prevents it from actually touching. The distance it is away, however, can be adjusted by means of the adjusting knob shown. This knob, through the medium of the little coil spring, pulls on the reed and so enables the gap between it and the magnet to be adjusted to within fine limits.

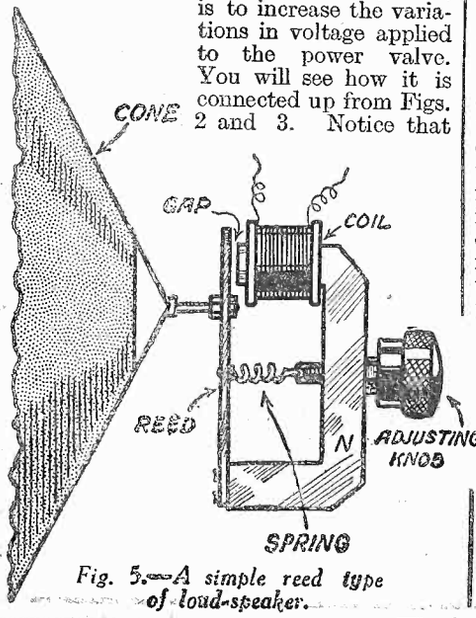


Fig. 5.—A simple reed type of loud-speaker.

Its Action

The speaker works as follows:—The current from the plate of the power-valve passes through the coil. This tends to increase the power of the magnet.

It is quite a well-known fact that if you pass an electric current through a coil of wire wound round a piece of iron, the iron will become magnetised. In this case the iron is already magnetised, as it is a permanent magnet. The current through the coil therefore *increases* the magnetism. But we already know that when music is being received by our set this current fluctuates all the time in harmony with the sound vibrations of the instruments being played. This means that the increase in magnetism produced by the current will also fluctuate even as the current fluctuates.

Now, let us see what effect this has. Well, briefly, it varies the attraction of the magnet for the reed, so that the reed vibrates backwards and forwards all the time. Being attached to the paper cone, it pushes that backwards and forwards also. The vibrations of the cone cause ripples or waves in the air. These waves are waves of *sound*, that is to say, they are pulsations in the air which when they reach our ears produce the sensation of sound. That is, in fact, what all sound waves are—pulsations in the air. In fact, without air there could be no sounds at all. However, that is beside the point. The point is that the sounds of the studio miles away are reproduced with exactness in our own home.

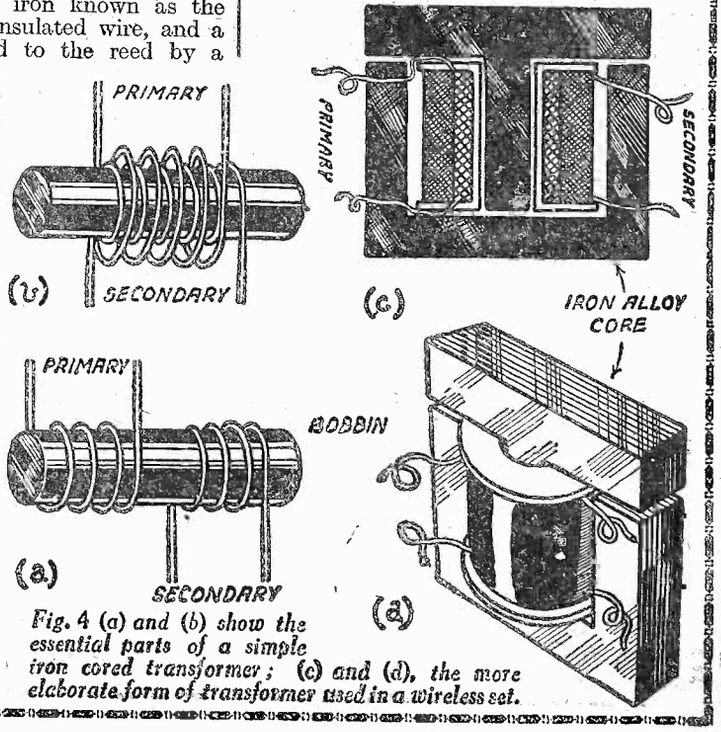


Fig. 4 (a) and (b) show the essential parts of a simple iron cored transformer; (c) and (d), the more elaborate form of transformer used in a wireless set.

LOW-FREQUENCY INSTABILITY:

Its Cause and Cure

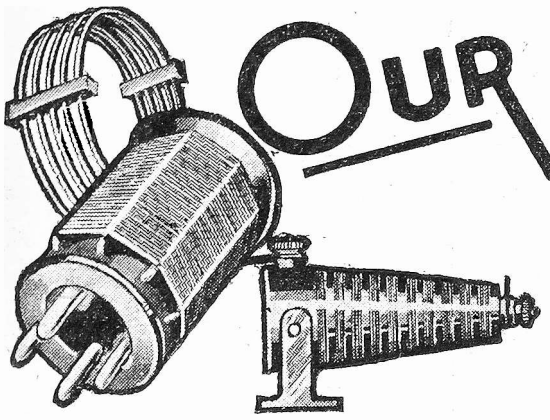
IN addition to a high degree of freedom from distortion, the operation of a good wireless receiver should be characterized by perfect stability. It is appreciated by nearly all readers now, that by the use of screened grid valves and by careful screening, the risk of high-frequency instability due to unwanted capacitative and magnetic coupling between different radio frequency circuits and components can be avoided. Naturally, the careful operator will also take care to keep reaction under proper control. Some prefer to eliminate it altogether, and thus remove a possible cause of instability. There is, however, a further form of instability which may make itself manifest, namely, low-frequency oscillation.

The most usual cause of low-frequency instability is feed-back, due to the presence of a fairly high impedance component which is common to the anode circuits of several valves. It is clear that the variations in the anode current of one valve will produce a corresponding varying voltage drop across the common impedance, and that this will modulate the anode current of other valves. This modulation will then be amplified and re-amplified in the earlier stages, just as though it were a genuine signal and, the process being cumulative, a very strong spurious signal will be built up in the output circuit.

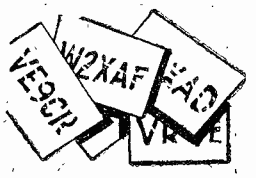
Low-Frequency Variations

To take a concrete example, the average high-tension supply unit, whether employing a valve or a metal rectifier, possesses a fairly high impedance, and this impedance is common to the anode circuits of every valve in the set. The anode current of the output valve contains very powerful low-frequency variations. A varying voltage drop will therefore exist across the impedance of the high-tension unit and low-frequency variations in sympathy therewith will be impressed upon the anode currents of the earlier stage valves, and will be amplified in the following stages. Further, if any part of the anode circuits should be modulated by mains ripple owing to bad smoothing, or to direct magnetic pick up from the mains leads or from the valve heater circuits, such ripple will be impressed on the anode currents of all the other valves, and considerable parasitic signals at mains frequency will be present in the output current of the set.

Fortunately, there is a simple and inexpensive cure for this trouble. It is termed decoupling, and consists in including in the anode circuit of each valve a resistance which is large compared with the common impedance. A large condenser is connected from the end of this resistance nearer the anode of the valve to earth, thus by-passing any parasitic modulation to earth. The minimum value of decoupling resistance to give any real protection is about 10,000 ohms, but the value should be as high as is consistent with maintaining the correct voltage on the anode of each valve. By-pass condensers should be of 2 mfd. capacity for low-frequency valves, and .1 mfd. in the high-frequency stages.



OUR SHORT-WAVE SECTION



IF, as an interval signal, above the 40 metre point, you log the crowing of a cockerel, you should make an entry to the effect that the dial reading corresponds with a wavelength of 43.75 metres (6,865 kc/s) or that of F8LH, Radio Vitus, Paris (the programmes are simultaneously broadcast on 308.5 metres). A further slight shift to 45 metres (6,667 kc/s) may produce a Spanish call from San Sebastian (EARTBO), heard fairly well on Mondays, Wednesday, and Fridays between 19.30–21.00 G.M.T.; also there appears to be a new station in the Canary Isles (Las Palmas ?) testing on that wavelength. On 45.11 metres (6,650 kc/s) I have often heard a powerful carrier wave which, when resolved, has been confirmed as IAC, Coltano (near Pisa, Italy). It appears in my log as a channel for a telephony service with the "crack" Italian trans-Atlantic liners. Some little way above this reading, on 45.38 metres (6,611 kc/s), there is a 10 kW. Moscow transmitter worked by the Central Club of the Red Army. In the early hours of the evening it broadcasts relays of concerts and operatic performances and is a different programme from that of Moscow (REN) on 50 metres (q.v.). On 46.6 metres (6,438 kc/s) you will discover another Russian relay; this time of Moscow (1,000 metres).

Passing over a number of commercial stations, we reach W8XK, a further relay of KDKA, East Pittsburgh (Pa), on 48.86 metres (6,140 kc/s) and for which the best time to listen is from 21.30 G.M.T.; it is a very powerful signal from 23.00. In fairly close proximity, 49.1 metres (6,115 kc/s) you should hear YVIBC, Caracas (Ven.); its signals, although strong, may be somewhat distorted, but you will recognize the Spanish language. The interval signal is a distinctive one; four chimes on a clock gong. W3XAL, Boundbrook (N.J.), on 49.18 metres (6,100 kc/s) should prove one of your star stations at this period of the year. It acts as relay to WJZ, one of the N.B.C. group and can be tuned in on almost any evening from 22.00 G.M.T. UOR2, on 49.4 metres (6,072 kc/s) gives you the Vienna programmes on Tuesdays and Thursdays, between 13.30–21.00, G.M.T.; it is also a strong signal, of which quality is good and fading but little pronounced.

Finally, to finish up our little trip on this portion of the short-wave band, we may search for W4XB on 49.67 metres (6,040 kc/s); it relays WIOD, Miami Beach (Fla.) entertainments, or W9XF on 49.83 metres (6,020 kc/s), which is the short-wave transmitter of WENR, Chicago, and we end up on 50 metres (6,000 kc/s) with Moscow RW59, the powerful Trades Union station of the Soviet Republic. It is already on the air in the afternoon,

ON THE SHORT WAVES

(Concluded from page 1203, March 11th issue)

By J. GODCHAUX ABRAHAMS

gives its main programme towards 18.00 G.M.T. and International talks in English, French, German, etc., at 20.00–21.00. At the latter hour, Moscow time being three hours *ahead* of G.M.T., you are taken over to the Red Square for chimes from the Kremlin, as a midnight time-signal. In another article I will deal with transmissions above 50 metres and below 25 metres.

Having dealt, in previous articles, with the favourite portion of the short-wave band, namely, 25 to 50 metres, by now we should have acquired sufficient experience to tackle channels of a higher frequency. Although, as a general rule, mention is less frequently made of wavelengths between 12 and 25 metres, this section is well worth exploring, as in this band there are powerful transmitters of which the reception, at this time of the year, during daylight and twilight hours, is particularly good.

Providing you possess an efficient receiver, you should find no difficulty in picking up W3XAL, Boundbrook (N.J.) on 16.878 m., almost on any day from 13.00 G.M.T., in fact, a careful search in most instances will reveal a powerful carrier wave at a few minutes before that hour. It is 08.00 Eastern Standard time as the station takes the air, and the first announcement made will be: *This is W3XAL, Boundbrook, New Jersey, a short-wave station of the National Broadcasting Company of America operating on* 17,780 *kc/s; Good morning, Ladies and Gentlemen.* The interval signal consists of three xylophone-like notes (the N.B.C. call) and it is given regularly every fifteen or thirty minutes. If atmospheric conditions are favourable, signals from this transmitter may be received at readable loud-speaker strength, and the programme, barring perhaps a few periods of high speed fading, may be held until 16.30 or 17.00 G.M.T. From that time it may prove fitful and it is then wise to search for W8XK, East Pittsburgh (Pa.), which also relays N.B.C. entertainments from New York and other North American cities. You will find it, at some distance above W3XAL, namely, on 19.72 m. (15,210 kc/s). There is no mistaking the transmitter as the announcer will tell you that *Your station is Westinghouse KDKA*, or *W8XK, East Pittsburgh.* Again providing conditions are good, you should be able to hold this transmission from roughly 17.30 to 19.30 or 20.00, when a change is usually made to 25.27 m. (If you refer to my previous articles you will observe that mention has already been made of the W8XK broadcasts on 48.86 m.; at present, this is one of the "star stations," of that band.)

Immediately below W8XK (19.72 m.) a search should be carried out for W2XAD (relaying WGY, Schenectady, N.Y.) on 19.56 m.; it is one of the General Electric Company's transmitters and this fact is usually made clear in the call. It only operates between 19.30 and 20.30 on Mondays, Wednesdays and Fridays and for an extra hour on Sundays, after which the broadcasts are carried out on 31.48 m. (q.v.).

Now, within a hairsbreadth of W8XK (19.72 m.), and only separated by 10 kc/s, on some afternoons you may pick up a Berlin programme through DJB, Zeesen (19.737 m., 15,300 kc/s). It is an experimental channel which may later be abandoned for a more favourable one, but is still used from time to time until 17.00, as an alternative to DJA, on 31.38 m., working during the rest of the evening.

As you will see, in view of the different times at which these stations work, it is essential that an accurate log with exact condenser dial readings should be kept; it is the only way in which you will successfully find broadcasts in relatively difficult portions of the short-wave band. Having established the exact position required for Zeesen, turn your condenser to this point on any weekday between 10.00 and 10.30; a slight movement with an increase in capacity will almost inevitably bring in HVJ, Vatican City (Rome) on 19.84 m. (15,120 kc/s). This station regularly opens up with the words *Laudatur Jesu Christu*, followed by *Radio Citta Vaticana.* The call is given in Italian, French, Spanish and German. You may always recognise this studio by the fact that a clock may be heard loudly ticking throughout the broadcast.

Between this station and 25 metres you will come across a number of commercial (morse) and public telephony service transmitters as well as ships (around 22.50 metres), and experimental amateurs of many countries working on channels between 20.9 m. and 21.3 m. One or two stations, however, are worthy of mention, in particular PDV. Kootwijk (Holland), on 24.9 m. (12,050 kc/s), which is habitually used for the rebroadcast of Dutch programmes to the Netherlands East Indies (Sumatra, Java, etc.). Whenever any event of importance takes place in Holland in almost every instance you may pick up a rebroadcast of it on this wavelength. In the same way, I have often found interest in conversations overheard between Rabat (Morocco) and Paris on 23.858 m. (12,605

(*Continued from page 1245.*)

kc/s), which are preceded by a tuning signal—a tone modulated morse C, and also have tuned in interesting messages sent by Ste. Assise (Paris) to Buenos Aires, on 23.25 m. (1,290 kc/s). The opening signal of this station is a morse F (. .—.) followed by three musical notes (A. F. D.). Then, again, working downwards (in wavelength) between W2XAD (19.56 m.) and W3XAL (16.878 m.) we find a host of wireless telephony stations. Liners work on and around 17 m., but slightly below the "yank," on 16.85 m. (17,804 kc/s), PCV, Kootwijk (Holland), broadcasts press news, in Dutch, French, German, and English on Sundays at 14.40, also occasionally towards midnight on week-days.

In the early hours of the afternoon you will be able to log PLF, Bandoeng (Java), on 16.81 m. (17,850 kc/s) which with PLE on 15.93 m. (18,821 kc/s) assures the public telephony service with Holland. You will identify it by its peculiar opening and interval signal, a three-note motor-horn. To tune in transmissions on wavelengths above 50 m. is a simple matter. As you have probably logged Moscow T.U. on 6,000 kc/s (50 m.) you may take it as a starting point. Almost on top of this station, if you switch on at 19.00 G.M.T., you will pick up the carrier wave of HVJ, Vatican (50.26 m.); the same observations apply to this broadcast as to the one on 19.84 m., except that it is the channel always used as the "night" wave. In this band up to 80 m. or so, whilst twirling the condenser, you will come across a number of harmonics of stations in the broadcast band. As an example, on 50.7 m., the sixth harmonic of Bordeaux Lafayette; on 52.5 m. (roughly) Radio Normandie, but obviously this will vary according to the fundamental wave. If the station is working on 222.4 m., you will tune in a harmonic on 55.6 m., namely, a quarter of its true wavelength. (You will also meet with a powerful one on about 70 m.) On 57.66 m. there is the fifth harmonic of National relays to be heard; on 59.4 m. the sixth of London Regional; on 72.07 m. the fourth of National relays, and so on. It is necessary that you should make a note of them as otherwise, if you casually find the transmissions you may jump to the conclusion, much to your disappointment later, that you have captured some very distant broadcast! But to revert to the 50 m. band. On roughly 52 m. Prague carries out experimental transmission every Tuesday and Friday between 19.30 and 21.30 G.M.T. Passing a number of wireless telegraphy transmitters, occasionally on 56.9 m. we may hear a test relay of the Berlin programme through DTG, Königswusterhausen, and also experimental transmissions carried out by N.B.C. studios through WQN, on 57.03 m. (5,260 kc/s). Between roughly 63 m. and 73 m., ship telephony from liners or from WOO, Ocean Gate, N.J. (63.12 m.), working with them, may be brought to your ears; and on some nights a relay of Columbia or N.B.C. programmes may come through WAD, Rocky Point (N.J.) on 66 m. On roughly 72 m. we again find a harmonic of the National relays, and a few metres higher, namely, 75 m., tests made by Budapest. Bear in mind that between 75 m. and 85.7 m. (4,000–3,500 kc/s) you strike another amateur band which is, you will notice, greatly prized by Dutch and French radio "fans." Such landmarks are useful for calibrating your receiver.

Adjusting and Operating— THE Q.P.-P. THREE-FOUR

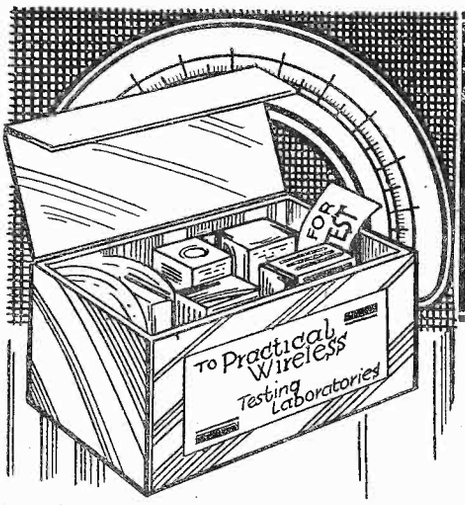
(*Continued from page 1186, March 11th issue.*)

Balancing with No Meter

IN the event of the reader not possessing a meter, or being unable to borrow one, the adjustment may be carried out by ear in the following manner. Proceed as outlined previously—that is, remove one valve, plug grid bias plug No. 2 into the 15-volt tapping, and apply an H.T. voltage of between 100 to 120 volts to the priming grid. Tune in the station to its very loudest, using as much reaction as possible without actually producing oscillation. Signals will, of course, owing to the double value of grid bias which is applied, be distorted. Ignore this distortion and switch off. Remove the pentode, and insert the other valve in the other socket. Switch on again, and note the volume which is obtained. If it is louder than with the other valve, you must reduce the voltage on the priming grid. As before, ignore the distortion. Now, upon inserting the second valve, signals should immediately clear up and the volume will be as great as before but all distortion should be gone. It may be found that the voltage on H.T.1 and H.T.2 may be 120 volts with no noticeable alteration in the quality of reproduction. This does not mean that the circuit is not working correctly, but it must be borne in mind that the voltage on these two leads should be as low as possible, or the valves are not working on the Q.P.-P. principle. With the receiver built with the components specified, and connections made in the manner indicated last week, the matching of the loud-speaker is correct, and the remaining constants of the circuit are accurate. There is, therefore, only one further point to be mentioned, and that is, that the H.T. battery will naturally discharge at a faster rate than the grid battery. This will, unless certain steps are taken, result in an unbalancing of the Q.P.-P. stage. It is therefore advisable periodically to remove one of the pentode valves, and reduce the grid bias until signals with one valve are clear and undistorted. Then increase the value of the bias which has to be used for this purpose, to roughly double. For instance, suppose that after two months it is found that on removing one valve the bias on the remaining valve has to be reduced to 6 volts to produce a clear signal; then the grid bias plug should be altered to the 12-volt socket for the two valves in Q.P.-P.

Using a Pick-up

To use a gramophone reproducer, no alterations whatever are necessary, the requisite terminals being already fitted at the rear of the cabinet. The two leads from the pick-up are joined to the two pick-up terminals, and the grid bias leads attached to one of these is plugged into the 4.5-volt socket of the grid battery. To prevent the break-through of radio signals, the tuning dial should be set to zero. The receiver will be found quite stable and the pick-up may be left permanently connected to the receiver if so desired.



Facts and Figures

Components Tested in our Laboratory

BY THE PRACTICAL WIRELESS TECHNICAL STAFF

WEEDON EVER-DAMP EARTH

STILL another earthing device has been received for review. This time it emanates from the Power Link Company, and consists of a flat copper box roughly 4ins. by 3ins. To this is soldered a length of insulated wire, and the upper surface of the box is provided with a number of small holes. The box contains one of the now popular chemical earths, which is guaranteed non-corrosive. It is claimed that it is equal to a three-foot square copper earth plate, and it is used in the same manner as others which have been reviewed, namely, it is buried about a foot below the surface of the ground, and well-watered. The nature of the chemical ensures that the ground is always moist. The price is 2s. 6d.

DRYDEX H.T. BATTERIES

THE Exide Company have now produced four special batteries for use with receivers employing the Quiescent Push-pull system. Type H.1060 has a total of 130 volts, and is tapped at 50, 60, 64½, 69, 75, 100, 120 and every 1½ volts up to 130. No grid-bias is included in this battery, which sells at 12s. 6d. Type H.1062 totals 159 volts, plus 9 volts grid-bias, and is tapped at every 3 volts from 120 to 150 volts. Type H.1063 totals 135 volts plus 18 volts grid-bias, and is tapped at every 1½ volts from 120 to 135. Type H.1064 totals 150 volts plus 24 volts G.B. and is tapped at every 3 volts from 125 to 135, and at every 1½ volts from 135 to 150 volts. Type H.1062 costs 17s. 6d., type H.1063 costs 18s. 6d., and the last mentioned costs 21s. These batteries will, of course, prove very useful to the listener who is experimenting with, or has a receiver adapted for, the Quiescent Push-pull principle.

WEARITE MAINS TRANSFORMER

A MOST interesting mains transformer has recently been received from Messrs. Wright & Weaire, Ltd. and is illustrated below.

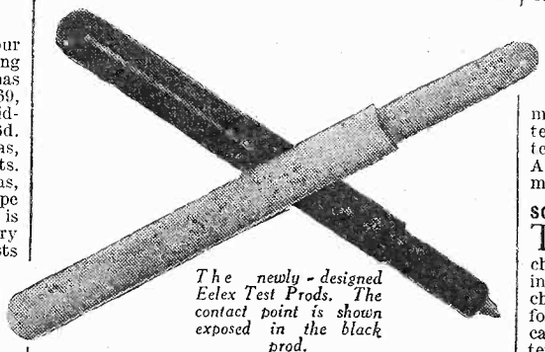
This is known as Model T.21A. and as will be seen it presents a handsome appearance. The finish of the complete casing is in gilt, and the disc which can be seen on one side is of bakelite. With the black terminals, this makes what is normally an uninteresting-looking component present quite a fresh appearance and should do much to attract the reader. The output of this particular model is 250 volts at 60 mA., 4 volts at 1 amp; and 4 volts at 4 amps. The input is designed for mains of 200 to 250 volts, and it is here that the component design displays real ingenuity. The centre terminal in the disc is intended for connection to one pole of the mains supply, whilst the terminal for the other pole is enclosed in a transparent envelope, together with holding-down screws, which is enclosed in the box containing the transformer. A small window is cut in the disc, and through this can be viewed a series of numbers, namely 200, 210, 220, 230, 240 and 250. The small hole above the window discloses a tapped hole when the window is directly over one of the above-mentioned numbers. To connect the instrument to the mains, therefore, the disc is rotated until the particular voltage of your mains is visible through the window, and then the loose terminal is screwed into the hole above it. The primary is thus adjusted for the mains with which it is employed. At 25s. this proves a most interesting component, and one which can thoroughly be recommended.

SIFAM METERS

A MOST comprehensive range of meters is manufactured by the Sifam Electrical Co., Ltd., and we wish to take this opportunity of drawing particular attention to one of these. In a recent article in these pages a handy multi-range meter was described. This was entitled "The Practical Wireless Multi-meter," and in it one of the Sifam range of meters was employed. This particular instrument is type E.70.M. and is of the moving coil type. It has a scale reading from 0 to 5 milliamps and has a D.C. resistance of approximately 50 ohms. No reference number was given in the article in question, and we should like readers to note also that the price of this particular instrument is 25s.

EELEX TESTING PRODS

ON page 1029 of the issue dated February 18th, Mr. Preston showed an illustration of some testing prods in the course of his article on "What is Wrong?" The prods which were illustrated were old-type Eelex products, and we have been informed by Messrs. J. J. Eastick & Sons, the manufacturers, that the particular type which was illustrated is now obsolete. The reason was that the grub screw, attached to the upper part of the handle, and which anchored the lead could come into contact with the hand, and where very high voltages were being tested, this could result in a nasty shock, or perhaps some more serious result. Accordingly, this type of handle was scrapped, and the type illustrated on this page adopted in its stead. These new prods, or testing handles, have a completely detachable front portion, into which a thoroughly sound electrical connection can be made. The actual wire is led down through the end of the prod, and consequently the bare wire can nowhere come into contact with the hand of the user. Another interesting feature of these prods is that the contact point is covered until wanted, when the front portion is drawn back for about a quarter of an inch, given a partial turn to the right or left, and remains locked with the contact point exposed to view. This enables the point to be left exposed for lengthy tests, or, owing to the spring mechanism behind this portion of the prod they may be used in the ordinary way by pressing the end of the prod against a terminal, etc., when the point projects and makes the requisite contact. These prods cost 2s. each.



The newly-designed Eelex Test Prods. The contact point is shown exposed in the black prod.

BULGIN VOLUME-CONTROL WITH SWITCH

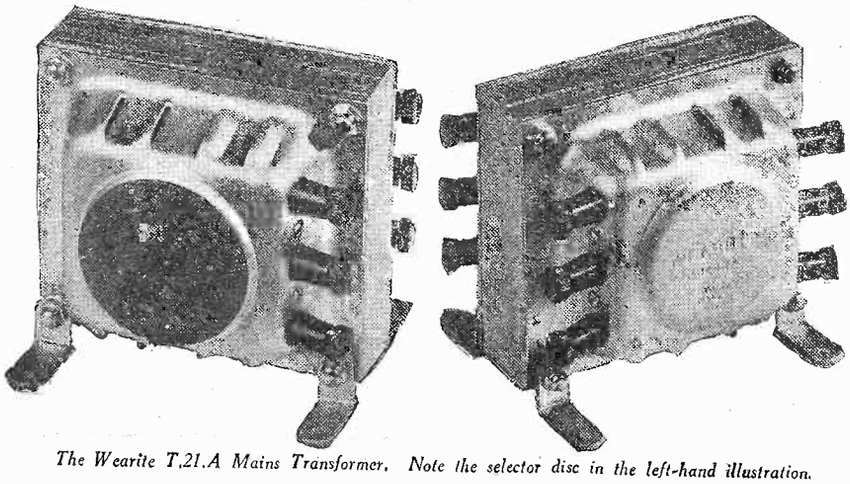
THERE are many parts of a receiver which often necessitate control of voltage and also connection or disconnection of the voltage. A typical instance is in the switching on of the S.G. potential applied to the H.F. side of a receiver. This is usually carried out by means of a potentiometer, and this must be disconnected from the H.T. supply when the receiver is not in use to prevent the constant drain on the supply. Extremely neat switches and controls are manufactured by Messrs. Bulgin, and these are totally enclosed. The appearance is much the same as an ordinary enclosed volume-control, with the addition of a small cam-shaped chamber at one end. Inside this a very efficient quick-make-and-break switch is incorporated, and this employs phosphor bronze and brass, so designed that the contact surfaces are self-cleaning. The spring loading ensures that the contact is made very rapidly and is also broken rapidly, which practically eliminates arcing. The switch is rated at 3 amps at 250 volts. The resistances are all rated at 3 watts and are obtainable in various values from 500 ohms to 100,000 ohms. The price varies from 5s. to 6s., which, of course, is extremely reasonable for a combined device of the high quality in which these are manufactured. The control is fitted with three terminals (potentiometer pattern) and two additional terminals are mounted on the base for the switch. A simple one-hole fixing device enables it to be readily mounted on the panel.

SOVEREIGN VARI-CHOKE

THERE are many circuit arrangements where it is often preferable to be able to adjust the H.F. choking effect, and there are, of course, several ways in which this can be carried out. The Sovereign Vari-choke is an interesting component which is designed for this specific purpose. It consists of a neat bakelite case containing a terminal on the side and two terminals on the top. Between these two latter terminals is a small knob similar to that on a pre-set condenser. The side terminal and the one on top immediately above it are the two ends of a very efficient H.F. choke, and therefore it may be used simply as a choke if so desired. Where the variable factor is required, the other terminal is called into use, and the small knob adjusted to give the requisite degree of choking effect. The component costs 3s. 6d., and will be found very useful to the keen experimenter.

BECKER "KIT-SWITCH"

WHEN building up a mains receiver on the chassis pattern for insertion into a radio-gram cabinet, the leads from the mains to the mains transformer are usually omitted until the receiver has been inserted into the cabinet. The necessary On-Off switch is then attached to the side of the cabinet in some handy position, and the mains leads are then attached. This usually proves a troublesome procedure owing to the difficulty of getting at the small terminals which are usually attached to the normal mains On-Off switch. Furthermore, when the chassis has to be removed for alteration or some other purpose, the mains leads must first be disconnected, and the same trouble is required upon putting the chassis back. The Becker "Kit-Switch" overcomes this difficulty in a simple manner. In place of the normal small operating knob, the toggle is tapped. Into this screws an operating rod an inch long. The switch may therefore be mounted on a small metal bracket attached direct to the chassis, the wiring completed, and then when the chassis is slid into place, the operating knob may be screwed in from outside the cabinet. A neat bakelite escutcheon is provided for attachment to the cabinet side, and this is clearly engraved On and Off. This is a most useful accessory and will prove of inestimable benefit in the type of receiver above referred to. The price is 2s. 6d.



The Wearite T.21.A Mains Transformer. Note the selector disc in the left-hand illustration.

KEIR DAWSON, BRADFORD.

RADIO RAMBLINGS

JOTTINGS FROM MY NOTEBOOK

Improving S.G. Selectivity

I DO not think it is generally known that the selectivity of an S.G. receiver can often be improved fairly considerably by applying a small negative bias to the grid of the first valve. The object of the bias is to reduce the damping effect of the valve on the aerial tuning circuit. It is important that the voltage should be very low, because if it exceeds about .5 volt sensitivity is reduced and in consequence the volume on distant stations suffers.

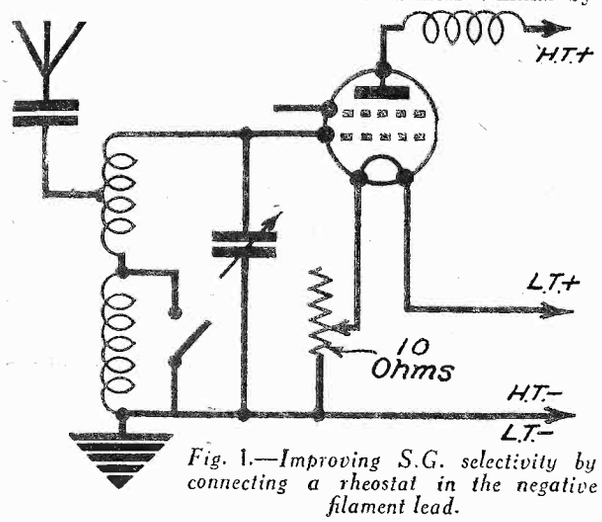


Fig. 1.—Improving S.G. selectivity by connecting a rheostat in the negative filament lead.

The lowest voltage that can be used in the normal way is .9 volt—that supplied by the smallest grid bias cells which are available—but a much lower voltage can be obtained "automatically" by connecting a rheostat in the negative filament lead, as shown in Fig. 1. The rheostat causes the filament to be made slightly positive in respect to the grid and this is, of course, equivalent to making the grid negative. As the resistance of the rheostat is increased the bias voltage rises, and *vice versa*. In addition to varying the grid bias the rheostat also reduces the filament current and so acts as a pre-detector volume control. By proper adjustment, however, it is usually an easy matter to find a setting at which selectivity is increased without any serious loss in volume. The idea is certainly worth a trial if you require to make tuning just a little sharper.

Automatic Tuning

WITH a receiver intended for family use it is very convenient to make it so that any of the more popular stations can be received by the mere process of putting a plug into a particular socket. This can easily be arranged in the case of a Det.-L.F. set as shown in Fig. 2, without affecting the normal tuning control in any way. It is seen that two or three (according to the number of alternative programmes required) pre-set condensers are connected by one of their terminals to one side of the variable condenser, whilst the other terminals are joined to sockets which may be mounted on the panel. A wander plug, connected to the earth terminal by means of a short length of flex, can be put into any of the sockets marked A, B, C and D; when it is in socket A the variable tuning condenser functions normally, but by transferring the plug to one of the other sockets a different pre-set condenser is brought into circuit. The method of "calibration" is to insert the plug into, say, socket B and tune in a station on the corresponding condenser; the process can then be repeated for the other condensers.

When an S.G. receiver is in use the same idea can be applied, but the modification is a little more involved. In this case two sets of pre-set condensers and a "double" plug are required. The latter can easily be made by attaching two wander plugs to a thin strip of fibre. All the necessary connections will be shown next week.

Long-wave Instability

IF you have done much experimenting with portable receivers you will know the oft-encountered difficulty of obtaining complete stability on long waves. The trouble is most noticeable when using an S.G. circuit with tuned-grid H.F. coupling, and only this week I have been asked three times for advice on this matter. In each instance I have first of all suggested that the H.F. choke in the anode circuit of the S.G. valve was probably at fault and twice this has proved to be the case. It has been pointed out in these pages before that a choke for this position must have a really high inductance and in consequence a component specially designed for the purpose must be used. There are two distinct kinds of H.F. chokes, one of which is intended for reaction purposes and the other for use with S.G. valves. The latter type will always work satisfactorily for reaction as well, but an ordinary reaction choke is almost invariably quite unsuitable for use with an S.G. valve; it has too small a number of turns and too high a self-capacity.

When a good and proper S.G. choke has been used, instability can often be cured by the simple expedient of de-coupling the screening grid of the S.G. valve by connecting a 1,000 ohm resistance in series with its high tension positive lead. If neither of the remedies suggested above proves effective it is a fairly clear sign that the set is badly designed or that insufficient screening has been used for the inter-valve tuning circuit.

Anode Volts

I WAS approached the other day by an enthusiast who was greatly distressed because his new power valve distorted horribly when given the grid bias voltage recommended by the makers. He explained that reproduction was all that was desired when the G.B. was cut down from 9 to 6 volts, but this did not pacify him. On making full inquiries I found that my friend was using a new 120-volt high tension battery and a well-known make of balanced-armature loud-speaker. Now here is the snag, the battery certainly gave a full 120 volts and the Instruction Sheet issued with the valve said that the correct G.B. voltage for 120 volts *on the anode* was 7.5. But he had entirely overlooked the fact that the loud-speaker windings, of about 2,000 ohms resistance, were connected between H.T. positive and the anode terminal of the valve holder. They were "absorbing" something like 25 volts, and thus the actual anode voltage was about 95 instead of 120. In consequence it was quite correct to employ the lower grid bias voltage, and only by doing so could the valve be made to function properly.

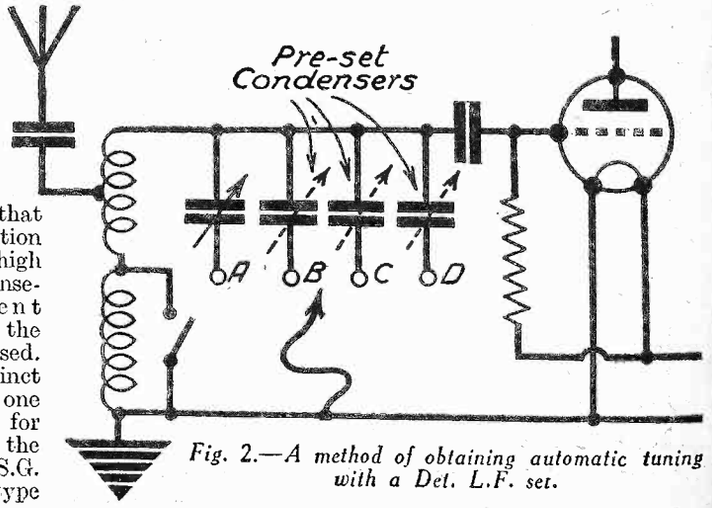


Fig. 2.—A method of obtaining automatic tuning with a Det. L.F. set.

Condenser Voltages

YOU know that when making an eliminator or mains receiver the smoothing condensers should have a rated "working voltage" of at least twice that of the H.T. supply. The reason is, of course, that when the mains are first switched on the voltage rises to a "peak" value which is much greater than that normally maintained. This is because there is no "load" on the H.T. supply until the valve cathodes heat up.

Just recently I wished to carry out a few experiments with an all-mains set and found at the last moment that the only big condensers on hand were for 250 volts working, and the rectifier I was to use gave an output of 175 volts at 25 milliamps. Being pushed for time I used the condenser which I had, but so as to prevent a break-down, a 40,000 ohm resistance was connected between high tension positive and negative. The idea was that the resistance would impose a fair load on the circuit and thus keep the peak voltage down to reasonable limits; actually the latter was found to be just about 230 volts. There is one objection to it, namely, that the by-pass resistance absorbs a certain amount of current even when the set is working.

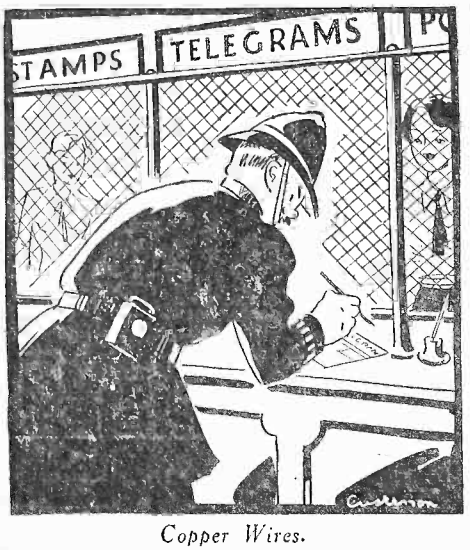
500 Kilowatts !

AS many readers can testify, the reception of American medium-wave stations is particularly easy this winter, and there is seldom any difficulty in bringing in one or two stations between 200 and 300 metres provided that one feels like sitting up until 1 or 2 a.m. If conditions are as good next year it looks as though we might even be subject to *interference* by American transmissions, for I hear that the 428.3 metre station, WLW, at Cincinnati, is shortly to increase its power to the phenomenal figure of 500 kilowatts. This should truly be the most powerful broadcasting station in the world.

Dark-Emitters

IN a recent note in these columns I referred to the possibilities of dark-emitter valves and now I hear that the Westinghouse Company has perfected a dry rectifier capable of working at radio frequencies. From this little piece of information it would certainly appear that we are getting a little nearer to the era of filament-less valves.

WIRELESS TERMS TRAVESTIED



Copper Wires.

Practical Letters from Readers.

The Editor does not necessarily agree with opinions expressed by his correspondents.

Inert Cells

SIR,—In the current issue of your paper, PRACTICAL WIRELESS, under the heading of "Inert Dry Batteries," page 1008, there appears to be some doubt in the mind of your writer as to whether or not Inert Cells are still available. We have pleasure in advising you that we do, and have for a considerable number of years, manufactured inert cells. The size which would apparently appear to meet the suggestion made by your writer would be our No. 65,106, the dimensions of which are 1½" by 1½" by 4½" high, the list price being 20s. per dozen.—THE EDISWAN ELECTRIC CO., LTD.

A Satisfied Reader

SIR,—With reference to the "Long Range Express" and my previous correspondence, I am pleased to say the fault respecting the reaction has now been rectified. It was corrected by following your suggestion of reversing leads 5 and 6 on the grid coil.

I thank you very much for the assistance you have given me and I wish PRACTICAL WIRELESS every success.—H. K. (Leytonstone).

Soldering Aluminium

SIR,—I noticed a query in your query section relating to Soldering Aluminium. Although the method suggested in the answer may work, it is a little difficult to get a clean result. I find the following answers, which I think could be used with success by most amateurs:

Flux:
80 per cent. stearic acid.
10 per cent. tin chloride.
10 per cent. zinc chloride (this could be made at a chemist's).

Solder:
80 per cent. tin.
20 per cent. zinc.

Bit nickel, if copper is used it will make the work dirty.—R. C. COLLINS (Sutton).

Misnomers

SIR,—The recent articles by "Cynic" in PRACTICAL WIRELESS have prompted me to inquire whether or not it is a practical suggestion that your paper should attempt to eliminate all the unsuitable terms connected with radio. Of what use is it to point out the misnomers if we are to keep on using them. Radio to-day being one of the largest and most prosperous of our industries, surely proves that the time has come to scrap all the unsuitable words which we apply to radio components, and also to describe correctly the use of the parts in the receiver. We still use "wavelengths in metres" and "frequency in kc/s." In my humble opinion it is quite possible to scrap "wavelengths in metres." Mild attempts to introduce the better system of "frequencies in kc/s" has been tried at intervals for many years, but, as you know, we are not at all nearer to the desired system. It would, I think, be very fitting for the newest, and also the leading, weekly radio paper to be the first in dropping the misnomers, and also a determined attack against the use of "wavelength in metres." I suggest that if lists of stations and their frequencies were printed, in all the wireless papers, B.B.C. included, leaving out the usual column of the stations wavelength, we could drop wavelengths in a very short time. The change over would have to be complete and quick, whatever method to introduce "frequency in kc/s" is tried. We have tried to get used to kilocycles gradually and haven't got anywhere with it.—S. CARTER (Lepton).

(*What do our Readers think? We are in agreement.—Ed.*)

CUT THIS OUT EACH WEEK.

DO YOU KNOW?

—THAT the cold valve is now an accomplished fact, and it makes automatic volume control extremely simple and cheap.

—THAT television goes from success to success, and if you have not "looked-in" for some time you should take an early opportunity of doing so in order to see what strides have been made.

—THAT a tone-corrector should not be added to a commercial receiver unless you are certain one is not already included in the circuit.

—THAT H.F. decoupling condenser for use on the long waves should be larger than those needed for short waves, and, therefore, a large value should always be chosen for dual-range sets.

—THAT a receiver designed for use on 50-cycle mains should not be used on mains with lower frequencies owing to the risk of accentuated hum.

—THAT a mains receiver intended for use on 25-cycle mains may be used on 50-cycle mains without much risk of trouble.

—THAT over-charging is as injurious to an accumulator as under-charging if it is persistently carried out.

—THAT a receiver intended for short waves and normal broadcasting wavelengths should be fitted with both short-wave and standard H.F. 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 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.

"Keep it Practical"

SIR,—I was only introduced to PRACTICAL WIRELESS a couple of weeks ago, but I'm a regular reader now. Please *don't* fill up space in your columns with bits of Broadcasting House gossip; keep them essentially practical and continue the articles you have hitherto provided; they seem to be good, to the point, and easily digested. With best wishes to you and your staff and hoping they will carry on the good work.—W. T. BARNSLEY (Morden).

An Appreciation

SIR,—I wish to acknowledge receipt of my Encyclopædia, for which I thank you. I consider it to be very clear and concise and I should strongly advise all your new readers to take advantage of your renewed offer in PRACTICAL WIRELESS No. 21. I made up a dual range coil described in the Encyclopædia, and I admit I put it together hurriedly, but upon testing it in a det. 2 L.F. set I was amazed at the performance it gave, and I have since made another exactly similar. The Encyclopædia is an absolute mine of information. Thanking you again, and with best wishes for the future success of PRACTICAL WIRELESS.—ROBERT W. STEWART (West Hartlepool).

That Handy Gauge

SIR,—Although I am rather late about it, I feel I simply must write and congratulate you on publishing such an excellent wireless journal. You have done a great service to wireless amateurs. Your strongest point lies, I think, in your clear, large, and fascinating diagrams, which can be understood equally well by beginner and advanced enthusiast alike. I am very pleased with my Home Constructor's Handy Gauge, and, as I am a keen wireless "fan," I can see that it will be of great use to me in the future. Wishing you the best of luck, and hoping for the prolonged continuance of such an A1 weekly.—A. W. J. MASTERS (Midhurst).

Another Reader's Gratitude

SIR,—I wish to take this opportunity of thanking you for the Data Sheet Self Binder, which I have just received, and also for the Wireless Constructor's Encyclopædia, of which I am very grateful. I have only one fault to find with it, the information in it is so valuable that I am afraid it will soon be worn out with being so much in use.—F. KIRBY (Leeds).

(*Continued from page 1252*).

A Norwegian Reader's Appreciation and Suggestions

I am not very much in love with the over-praised single-dial receiver practice, having come to the conclusion, confirmed by several years' experience, that it always pays to have at least the oscillator tuning condenser as a separate unit. But even in view of this fact, if an ingenious scheme were launched by you rendering it possible to have a single-dial receiver that would not incorporate too many sacrifices, I might be interested in trying once more. I am also taking an interest in S.W. reception, and a description of a really fine and outstanding S.W. superhet. would be a very welcome affair. But here, again, a S.W. superhet. is wanted as a separate, specially built receiver, not a more or less unsuccessful combination of short, medium and long-wave receiver. A really satisfactory solution of such a combination is in my opinion a feature that is not workable in practice, conditions being fundamentally widely different. Before closing, permit me to emphasize the point that not only do I appreciate the course taken by you in paying particular attention to the small and middle-size receivers, but it should also be clearly understood that there are so many home constructors throughout the world who have accumulated quite a decent stock of different components, in many cases rather expensive parts, so that only for that reason descriptions also of large receivers are wanted.—B. HJELMSTAD (Oslo, Norway).

All-mains Receivers and Interference

SIR,—I am taking this opportunity, through the columns of your excellent paper, to remark upon a subject which I am sure will be of interest to your readers who possess all-mains commercial receivers. No doubt the electrical interference which emanates through a loud-speaker when an ordinary house-lighting switch is turned on or off is only too well known. I understand that as this is external to the set, manufacturers thereby disclaim all responsibility. In my opinion, the manufacturers should incorporate in the set some sort of filter device, choke, etc., which would entirely eliminate this insignificant but very annoying type of interference. As an owner of a well-known make of all-electric receiver, I consider it rather unfair on the part of manufacturers to expect a purchaser who has paid a high price for a set to go to outside sources for a cure of this household type of interference.—N. D. SCOTT (West Wickham).

(*Continued on page 1254.*)

(Continued from page 1253.)

"An Excellent Stimulant"

SIR,—Being a keen amateur experimenter of some years' experience, I was certainly delighted when I recently purchased my first copy of your paper—you may rest assured that it will not be the last! Upon perusal I find your paper brimful of practical articles—an excellent stimulant indeed! The articles are soundly practical and suitable for the veriest novice, and not like some so-called "practical articles" that could only come within the compass of an experienced amateur. You are to be congratulated on the production of such an excellent paper—value for money, too!—L. N. RICHARD (Liverpool).

Invaluable

SIR,—May I take this opportunity of thanking you for the safe receipt of the Encyclopædia? I must say I am more than delighted with it as it exceeds by far my expectations and your earlier description of it. In fact, it is invaluable. I have been a regular reader of PRACTICAL WIRELESS since No. 1, and up to the present it is my ideal radio weekly. Now for a suggestion! Why not issue, say every six months, a self-binder and complete index, to enable one to keep a permanent record of your invaluable paper and at the same time do away with the bugbear of laboriously searching through each issue for a particular article or item.—H. L. ENNIS (Bromley).

[*You will have already noted that we made an announcement regarding a binder and index in issues* 18, 19 *and* 21.]

RADIO CLUBS & SOCIETIES

HACKNEY RADIO AND PHYSICAL SOCIETY

An exceptionally well-attended meeting was held on Monday, February 13, at which Mr. L. E. Cole gave the first of a series of talks on "Fault Finding in Receivers." Unfortunately, we were not able to have a faulty set for the purpose of this lecture, but Mr. Cole very ably demonstrated likely faults by means of diagrams which even the most inexperienced members were able to follow with ease. Commencing at the H.F. end, Mr. Cole described many simple faults which often occur, and in each case demonstrated easy and quick methods of determining the fault. This subject is to be followed up by further talks and demonstrations, and in the series we hope to cover every fault likely to occur in battery and mains-driven sets. We had pleasure in giving a welcome to four visitors who evinced great interest in our meeting.—A. F. Rogerson, Hon. Secretary, 19, Sewdley Street, Clapton, E.5.

THE CATFORD AND DISTRICT RADIO AND TELEVISION SOCIETY

The members of the Catford and District Radio and Television Society were entertained recently by Mr. Hall. The lecturer first of all explained how short-wave reception had no appeal to the ordinary listening public in England, but in the Tropics it was in great demand. In fact, short-wave wireless was their only means of listening to the Mother Country. Next he explained the various short-wave adaptor systems, the Autodyne, Separate Oscillator, and the little-known American Intra Vario System. Mr. H. S. Ryland, the Chairman, opened the discussion by asking the speaker about the H.T. supply in the Tropics. The speaker admitted that this was a great difficulty, but even so, people out there are willing to go to any trouble to have their wireless. He quoted one instance of a man who hailed from the Congo who placed a standing order for a H.T. battery to be sent from England every fortnight at a cost of somewhere about 45s. per battery. Even where towns abroad had electric mains laid on their troubles were not ended, as the speaker mentioned one town he had heard of where the inhabitants were never sure whether they were on an A.C. or D.C. supply, as it was A.C. during the day and D.C. at night. Various other questions were asked, all of which were promptly answered by Mr. Hall. After the discussion he demonstrated a short-wave adaptor and many short-wave stations were heard, including Moscow, which came through at great strength giving a programme in English. Full particulars can be obtained from the Hon. Secretary, Mr. H. W. Floyd, 38, Como Road, Forest Hill, S.E.23.

A.-A. R. & T. S. CONCERTS FROM AMERICA

The Anglo-American Radio and Television Society and associated society, The International Radio Society, have pleasure in announcing that arrangements have been made with various American broadcasting (medium wave) stations for the broadcasting of special DX concerts dedicated to members of the A.-A. R. & T. S. and I.R.S. The societies would be extremely obliged if members, and others, hearing any of these broadcasts would communicate with Leslie W. Orton (Hon. President), at 11, Hawthorn Drive, Willowbank, Uxbridge, England, giving details of reception, fading, etc. Unfortunately, at the moment, the times at which these concerts will be broadcast are not at hand, but they will probably be "put over" between 3 and 6 a.m., G.M.T. May we remind readers that membership to the A.-A.R. and T.S. and I.R.S. is free? The aims of the societies are to promote goodwill and fellowship between nations and aid radio enthusiasts. A stamped-addressed envelope should be enclosed (except in forwarding reports of reception of special concerts, as above) when a reply is desired.

WEST HARTLEPOOL S.W. CLUB

A start has been made to form a Radio S.W. Club in West Hartlepool. A meeting will be arranged as soon as a sufficient number of members can be got together, and any readers interested in the above club are invited to call or write to Mr. R. W. Stewart, 9, Kilwick St., West Hartlepool.

THE SOUTHALL RADIO SOCIETY

The meeting of the above club held on Tuesday, February 28th, was addressed by Mr. A. Stephens, the subject being set design. He dealt with the theory underlying the design of sets, and pointed out the snags likely to be met with by any constructor who launched into making sets to his own design. Mr. Stephens dealt with the various forms of coupling on both the low and high frequency sides, output circuits and superhets.

GOLDERS GREEN AND HENDON RADIO SOCIETY

At a recent meeting of the society Mr. F. E Henderson, A.M.I.E.E., gave a very interesting talk on the variable mu valve, during which the many difficulties in its manufacture were described The great advantage of the valve was its excellent possibilities for pre-detection volume control without upsetting ganging; rectification was not introduced with the consequent trouble of cross modulation and modulation hum. The use of graded potentiometers was most desirable. Some useful literature was distributed in which were to be found recommended circuits for reducing high voltages to the requisite potential.—H. A. Scarlett, President.

KETTERING RADIO AND PHYSICAL SOCIETY

The above society, formed less than a year ago, now boasts a membership of over 150. Meetings are held each Monday in the Smoke Room, Victoria Picture House Café, Kettering. An excellent lecture is arranged for every week, usually with ambitious demonstrations.

A complete 5-metre transmitter, sufficiently small to be held in one hand, and a 5-metre receiver, complete with aerial and batteries, were exhibited. At a recent meeting of the society a lecture on Radio Communication on Ultra-Short Waves, was given by Mr. H. R. Bourne, B.Sc., of Rugby (G2KB). The various advantages of ultra-short waves were discussed, including their consistency, freedom from fading effects and insusceptibility to interference from electrical machines, motor-car ignition systems and atmospherics. The uses of these low wavelength transmissions were described and various types of receivers explained for the reception of signals of the order of five metres. Details of Mr. Bourne's experimental work with portable transmitters in and around Rugby terminated a highly instructive lecture.

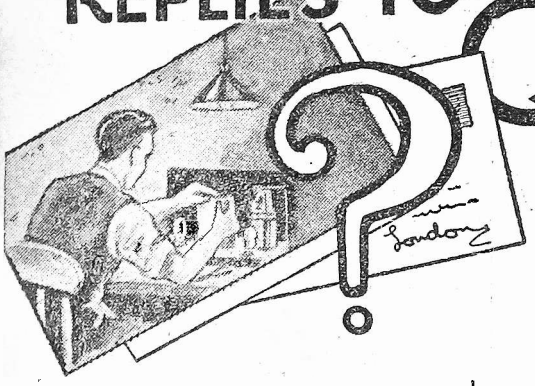
Hon. Secs: Mr. R. J. Parkhurst (G5YF), 9, Shakespeare Road, Kettering, and Mr. Thomas H. Hall (BRS1018), 59, Tresham Street, Kettering.

SLADE RADIO

The tenth of the society's "Junk Sales" was held at the meeting last week. A considerable amount of surplus apparatus was satisfactorily dealt with during the evening, and as usual the disposal of some of the lots provided considerable amusement. The opportunity was taken by Mr. Hornby to describe a new type of set on the market which has recently been installed in the cars of some very notable personages. Details were given of the special precautions which had been taken to eliminate possible pick-up from magneto, distributor, etc., also of the aerial and earth systems. Anyone interested in wireless is invited to write to the Hon Sec., 110, Hillaries Road, Gravelly Hill, Birmingham, who will be pleased to forward particulars of the society, also acopy of the advance programme.

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.

ELECTROSTATIC LOUD-SPEAKER

"I have read in your paper, and also from catalogues, etc., that the electrostatic type of loud-speaker has many interesting features. From what I can see of this it consists simply of a large condenser. I appreciate that it is two plates separated by a dielectric, and the two plates are joined to the output terminals of the wireless receiver. My query is this—can I make one of these speakers at home? I should be glad of your advice, and if it is possible, could you give me the requisite data, please?"—(Y. S. F., Bognor.)

We are afraid that the home-construction of this particular type of receiver is a little bit too difficult. There are certain other features which you do not mention which will make it extremely difficult to build up a worth-while electrostatic loud-speaker, and if you must have one of this type, then our advice is to buy it. You can, of course, build up at home a balanced armature, or even a moving-coil speaker, provided you can obtain a suitable unit to operate it.

GANGED VOLUME CONTROLS

"My receiver employs ordinary H.F. valves of the S.G. type. To reduce the volume of the signal which is received I have an ordinary potentiometer across the H.T. supply. For increasing the volume of distant stations and other purposes I use a small reaction condenser. It occurs to me that I could gang these two controls together so as to reduce the number of knobs which I have to twiddle, but there may be some reason against this. I should appreciate your assistance in solving my problem which amounts to this—how can I reduce the number of controls?"—(S. G., Edinburgh.)

The easiest solution is to remove the reaction condenser. In place of this use a small semi-fixed condenser, and adjust this so that the receiver just bursts into oscillation. Now in the H.T. lead to this valve (the detector) insert a high-resistance, the actual value of which must be determined by experiment. These two resistances, that is, the one which you insert in the detector anode lead, and the S.G. potentiometer should be of the same make, and you will find that the majority of such components are readily adaptable to ganging. The position of the moving elements must be chosen so that the reaction is increased as the H.T. on the screening grids is reduced. This provides a most efficient method of controlling volume and selectivity by means of one control.

THE "FURY FOUR"

"I am going to make up the 'Fury Four,' but I already possess a small mains unit which delivers H.T. at 150 volts 30 mA. and L.T. at 4 volts, 4 amps. I should like to use this with the "Fury Four," but should first like to know whether it is suitable?"—(W. C. F., Bath.)

There are two points to your query, W. C. F. If you intend to build the battery version of the "Fury Four," you cannot, of course, employ the L.T. section of your mains unit. On the other hand, if you intend to build the A.C. version of this receiver, then the H.T. supply is nowhere near large enough. You must therefore either build the battery version and use accumulators for supplying the low-tension current, or build the Mains version, and obtain a fresh eliminator to supply the requisite 200 volts. The mains valves operated with 150 volts at 30 mA. will be very inefficient, and therefore the cheapest method is to build the battery receiver and use the H.T. side of the mains unit only.

HOME-MADE CABINET

"I have recently built up, at a fair amount of trouble, a small radio-gram. cabinet, and have fitted my old receiver inside this. The set, which previously gave splendid results, now seems to have gone all to pieces. First of all, the valves give off a terrible ringing noise. Secondly, the speaking sounds like a big drum, and you can hardly understand what is being said when the news is coming through. What have I done to cause all this? I am only a newcomer to wireless, and I am afraid I have upset things in some way, but I don't know how."—(J. G., Upminster.)

Your trouble is no doubt due to the fact that you have built the cabinet too small, and probably have, in addition, used very thin wood. The result of this is that the volume of sound produced by your speaker causes a large amount of cabinet resonance, and the soundwaves echoing inside the cabinet are impinging on the valves, giving rise to the ringing. Your best remedy is, of course, to build another more substantial cabinet. As this will probably be a too expensive remedy, try the following dodges. Cover each valve bulb with lumps of putty, plasticine, etc., over which is wrapped a large duster or other rag. The idea is to prevent the glass from vibrating. Secondly, screw large pieces of wood—any odd shapes and pieces will do—at different parts of the cabinet sides (inside, of course). This is to break up the wooden sides into irregular shaped pieces which will damp-out the vibrations. A final scheme would be to line the cabinet corners with kapok or similar material to stop echo.

DATA SHEET No. 26.

HANDY FORMULÆ.

Cut this out each week and paste it in a Notebook.

Frequency— $\frac{10^6}{2\pi\sqrt{LC}}$ cycles.

Where L is inductance in microhenries.
C is capacity in microfarads.

Wavelength—λ $1,885\sqrt{LC}$

Where λ is in metres,
L is inductance in microhenries,
C is capacity in microfarads.

FITTING A FUSE

"My receiver is rather old, and on no fewer than four occasions I have burnt out valves through the H.T. lead coming off the terminals at the back. I feel that I must fit some safeguard, but as I am only a beginner in wireless, I do not know what to fit. Could you enlighten me, please?"—(R. F., Cardiff.)

You will probably find that inside your receiver, behind the terminal strip, the two terminals marked H.T.— and L.T.— are joined together with a wire. This wire must be cut away. Now obtain a small baseboard fuse-holder, and attach one terminal of this to H.T.— terminal, and the other terminal to the L.T.— terminal. The lead which goes on to the F terminals on the valve-holders should come from the L.T.— terminal, and not from the H.T.— terminal. If you do not have two terminals on your set, but the H.T.— and L.T.— leads are both joined outside the set, you must do the same thing, namely, join the fuse between H.T.— and L.T.—, with the lead to the set coming from the L.T.— side.

METAL RECTIFIER

"I have just obtained from a friend a Metal Rectifier to make up a new H.T. eliminator. This has three terminals marked plus, minus and A.C. I am not sure how to connect this, but I am told it gives an output of 200 volts. What transformer must I get, and how is it joined to the three terminals. I believe a transformer only has two output terminals."—(R. H., Dulwich).

The rectifier may be joined up in one of two ways. For half-wave rectification a transformer giving an output of 250 volts at 45 mA. will be required, and for full-wave rectification on what is known as a voltage doubler circuit, a transformer with a secondary of 135 volts at 90 mA. will be needed. For the latter case, one secondary transformer terminal is joined to the terminal marked A.C., and the remaining secondary terminal is joined to the junction of two 4 mfd. condensers. The free terminals of the two condensers are then joined to the plus and minus terminals of the rectifier. These two terminals also furnish the D.C. output of the eliminator. For half-wave rectification, one secondary terminal is joined to terminal A.C., and the remaining secondary terminal is taken to one side of a 4 mfd. condenser and becomes H.T.— (D.C.). The plus terminal on the rectifier is joined to the other side of this condenser and is H.T. plus (D.C.). In both cases a smoothing choke will, of course, be needed.

RESISTANCE RATINGS

"I notice that a good many of the solid type of resistances which are now on the market are called '1 watt type.' How does one ascertain what wattage is required of a resistance? And how is the wattage of the resistance obtained?"—(S. F., Peterborough).

As has been explained many times in our pages, the passage of a current through a resistance results in a voltage drop. The value of this voltage is obtained by multiplying the resistance (in ohms) by the current (expressed as a decimal part of an amp.). Or, put in another way, the resistance in ohms is multiplied by the current in milliamps, and the answer divided by 1,000. This will give the volts dropped through the resistance. If now this voltage is multiplied by the current in milliamps, and the answer divided by 1,000, the answer will give you the watts dissipated by the resistance.

ALTERING A BAND PASS TUNER

"My set is a commercial make, and it is fitted with a band pass circuit. After reading several items in your paper I have come to the conclusion that the values of the couplings in this band pass arrangement could be modified to suit my particular district. I should be glad to know how to work out the best value, and the best make of parts to get for the purpose."—(K. A. R., Barmouth).

We do not advise you under any circumstances to attempt to interfere with a commercially-made receiver. Whilst it is quite likely that only a simple band pass arrangement is employed, and that it is possible to improve upon it, there is always the risk that there is some peculiarity in the particular receiver which depends for its correct functioning upon the resistance, or condenser, or some other part in the tuner. The alteration of this may, therefore, completely ruin the performance of the receiver. It may even result in actual damage. An instance may be given of a band pass adapted circuit in which the resistance employed is one of a series which carries the total anode current of the set, and which serves as a biasing resistance for the S.G. valve. A change in the value would vary the bias on the valve which might result in instability, and might even result in preventing the valve from functioning.

FREE ADVICE BUREAU

COUPON

This coupon is available until March 25th, 1933, and must be attached to all letters containing queries.

PRACTICAL WIRELESS 18/3/33.

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.

CELESTION SPEAKERS

WE have just received a handy loose-leaf folder from the Celestion people containing operating instructions and technical data concerning their various types of speakers. The instructions given should be particularly useful to possessors of these well-known instruments for enabling them to get the best results. Additional technical data concerning transformers and power handling capacity are also included for amateurs who wish to design their own amplifiers. A copy of any particular leaflet can be obtained from Celestion Ltd., London Road, Kingston-on-Thames.

T.C.C. CONDENSERS.

FIXED condensers of various types and for all purposes are shown in the latest folder issued by Telegraph Condenser Co., Ltd., Wales Farm Road, North Acton, W.3. Small mica condensers with capacities of from .00005 to .25 mfd.; high voltage electrolytic and paper condensers; smoothing condensers; and a special line of sub-divided block condensers are included in the folder, together with useful tables giving the dimensions, capacities, and prices of each component.

FORMO PRODUCTS

THE new range of components shown in the latest Formo list should appeal to all discerning constructors. Amongst the components listed are dual-range aerial and band-pass coils, L.F. transformers, multicouplers, and dual and triple gang condensers. The ganged condensers can also be obtained mounted on a common base plate with either two or three matched ganged coils with coupled switches. In the triple gang condenser each assembly is provided with an ordinary trimmer. The list also includes a range of Formo "Hymeg" fixed condensers of various capacities up to 1 mfd.

"ATLAS" MAINS UNITS

IN the latest folder issued by H. Clarke and Co., of George Street, Patricroft, Manchester, a comprehensive range of "Atlas" mains units is listed. Some are combined H.T. units and L.T. chargers, while a new A.C. model is also provided with grid-bias tappings. Other models are designed for delivering H.T. only, and one D.C. unit is provided with an ingenious switching arrangement which ensures the full voltage being delivered even when different amounts of current are being taken from the unit. It is for working on 200-250-volt mains, and the output is 15 to 25 milliamps. Other "Atlas" components included in the folder are an L.F. transformer designed for parallel-feed circuits, a new permanent magnet loud-speaker, short-wave coils, and a pentode choke.

THE HOUSE OF COSSOR

FROM the Cossor people comes a neat folder which tells briefly the history of the firm of A. C. Cossor, Ltd., from pre-war days to the present time. The folder, which is well printed in three languages, includes several half-tone illustrations of various processes in the manufacture of Cossor valves and components.

Another interesting leaflet we have just received from this firm is of special interest to overseas readers, and gives particulars of the new Cossor short-wave receivers for A. C. mains, and battery operation. Both models are based on a special development of the autodyne circuit giving one-knob control and enabling a low intermediate frequency to be used with consequent high amplification. The all-electric receiver is a six-valve super-het, housed in a handsome cabinet of modern design and embodies a mains-energised moving-coil speaker. The battery model is a 4-valver, and is fitted with a permanent magnet moving-coil speaker. The wavelength ranges of the receivers are 13.5 to 550 metres, and 13.5 to 500 metres respectively. These receivers are specially designed for overseas use and are not for sale in this country.

Replies to Broadcast Queries.

SUPERHET (Bala) (*a*) San Sebastian (EAJ8) on 456 m.; (*b*) Apparently a test by Radio Strasbourg (345.2 m.). BEGINNER (Sudbury): Heston Airport (833 m.); Air Ministry weather report broadcast by Automobile Association. 808 WH (Forest Gate): (1) WJSV Alexandria (Va.) on 205.4 m.; (2) Possibly WSAI, Cincinnati (Ohio) (225.4 m.); (3) WNAC, Boston (Mass.) on 243.8 m.; (4) WHAM, Rochester (N.Y.) 260.1 m.; (5) WOAI, San Antonio (Tex.) on 252 m.; (6) WTAM, Cleveland (Ohio) on 280.2 m.; (7) WTIC, Hartford (Conn.) 282.8 m; (8) KDKA, East Pittsburgh (Pa.) on 305.9 m.; (9) WENR, Chicago (Ill.) (344.6 m.); (10) WGY, Schenectady (N.Y.) 379.5 m.; (11) Possibly WBBM, Chicago (Ill.) on 389.4 m.; (12) WJZ, Boundbrook N.Y.) 394.5 m.; (13) KPO, San Francisco (Cal.) on 440.9 m.; (14) WPG, Atlantic City (N.J.) on 272.6 m. OPTIMIST (Sheffield): (1) R.A.F. Air Planes; ground station to aircraft; (2) Apparently U.S.A. experimental transmitter if call sign correct, WIID, H. Thomas, 69, Wellesley Avenue, North Providence, Rhode Island. W4LU, W. B. Taylor, AARS, 510, Brady Point Road, Signal Mountain (Tenn); WIXU, cannot trace: WIABY, H. E. Powers, 151, Pond Street, Leominster (Mass.). W1XAL, 70, Brookline Avenue, Boston (Mass.). S. T. 400 (Bacup): Apparently aerodrome station, testing on 1,236 m. (242.9 kc/s). SEARCHER (Cheshire): (1) G6MM, for the name and address of this transmitter please write to Radio Society of Great Britain, 53, Victoria Street, London, S.W.1; G6MX, Manchester Wireless Society, 2, Parkside Road, Princess Road, Manchester; G5BK, W. Brown, 52, Winstonian Road, Cheltenham, Gloucestershire. S. W. F. (Cirencester): (1) WEA, Rocky Point (N.Y.) on 28.28 m.; (2) WIY, Rocky Point (N.Y.) on 21.65 m. NIP (Romsey): (1) WCAU. Philadelphia (Pa.) on 256.3 m; (2) WABC, New York, (348.6m.) C.B.S.; KDKA, East Pittsburgh (305.9 m.). N.B.C.; WBZ, Boston (302.8 m.), N.B.C.; WTIC, Hartford (Conn.) on 282.8 m. (N.B.C.) —are all well heard. L. E. BARNES (Templecombe): Radio Toulouse, 60 kW. testing. PEN (Surrey): Regret, cannot trace.

RECEIVERS AND THEIR RECORDS

(*Continued from page 1233.*)

plug to the mains system, and an outside aerial of not more than 40ft. in length to one of the appropriate Fahnstock terminal clips, the earth being taken to the remaining one.

The chief quality of a superheterodyne receiver is that of selectivity, and in this respect the "Philco 8-Valve Model 247E" was of outstanding merit. The scale is clearly marked, and tuning is greatly facilitated by the fact that as the condenser is revolved so a thin strip of light is thrown on to the dial, thus showing the exact fraction of a degree at which the station is heard at its best. Sensitivity, as might have been expected with this circuit, was excellent, and broadcasts were easily received throughout the wave-range, irrespective of their distance.

In view of its great selectivity, no difficulty was experienced in separating any two neighbouring stations working with a 9 kilocycle separation. On the longer wave-range, most of the broadcasting stations were tuned in at full loud-speaker strength.

ADVERTISEMENT INDEX

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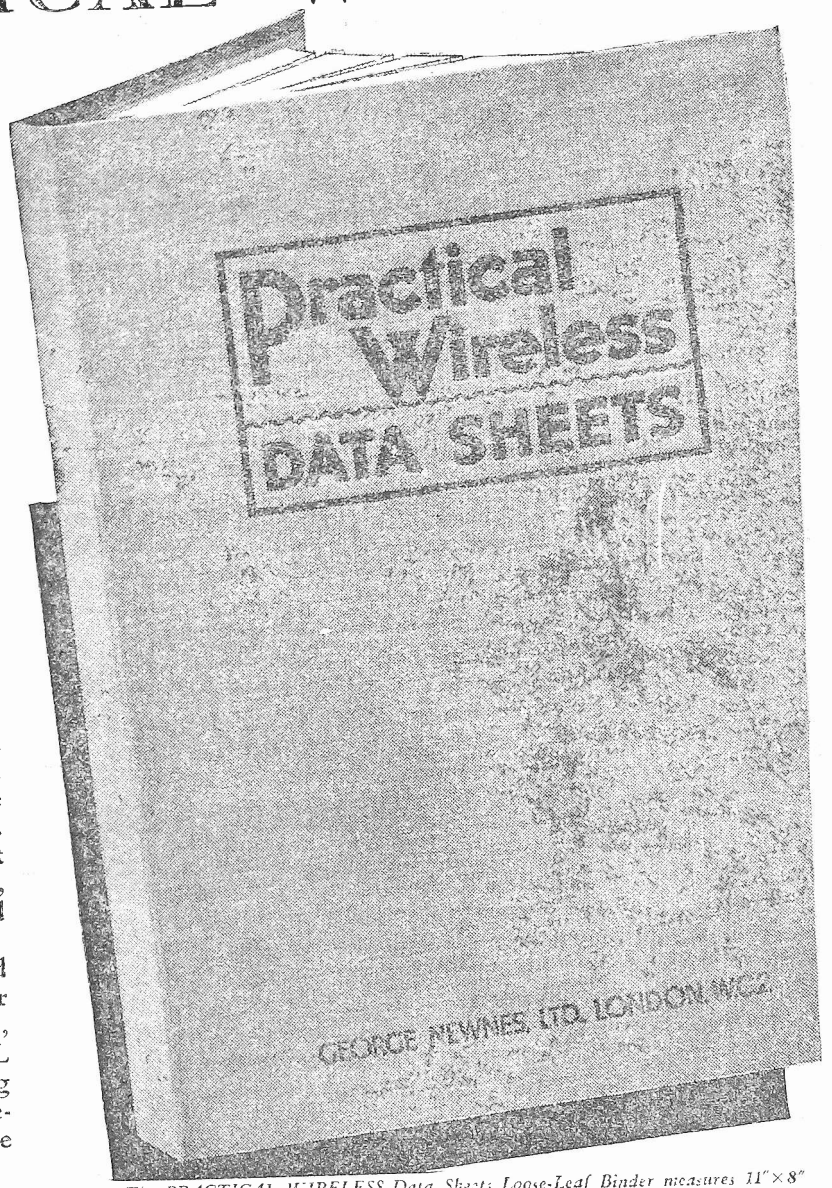

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THE FOLLOWING DATA SHEETS HAVE ALREADY BEEN ISSUED:

Data Sheet No. 1—Accumulator Charging	Dec. 17th, 1932
Data Sheet No. 2—Coils & Coil Winding	Dec. 24th, 1932
Data Sheet No. 3—Resistances	Dec. 31st, 1932
Data Sheet No. 4—Mains Transformers	Jan. 7th, 1933
Data Sheet No. 5—Wire and Wire Gauges	Jan. 14th, 1933
Data Sheet No. 6—Chokes, H.F. & L.F.	Jan. 21st, 1933
Data Sheet No. 7—Condensers	Jan. 28th, 1933
Data Sheet No. 8—Battery Eliminators	Feb. 4th, 1933
Data Sheet No. 9—Screws & Screw Threads	Feb. 18th, 1933
Data Sheet No. 10—Battery-Operated Valves	Feb. 25th, 1933
Data Sheet No. 11—Mains Valves	Mar. 4th, 1933
Data Sheet No. 12—Handy Formulae	Mar. 11th, 1933

Those new readers who are desirous of completing their files of these Data Sheets may have those already issued for 2d. each from the address given above.

P. W. Gift Stamp No. 25
See page 1215.

Printed by NEWNES & PEARSON PRINTING CO., LTD., Exmoor Street, Ladbroke Grove, W.10, and published by GEORGE NEWNES, LTD., 8-11, Southampton Street, Strand, W.C.2. Sole Agents for Australia and New Zealand: GORDON & GOTCH LTD. South Africa: CENTRAL NEWS AGENCY, LTD. *Practical Wireless* can be sent to any part of the world, post free, for 17/4 per annum; six months, 8/8. Registered at the General Post Office for Transmission by Canadian Magazine Post.

Presented with PRACTICAL WIRELESS, dated March 18th, 1933.

"PRACTICAL WIRELESS" DATA SHEET No. 13

TERMINALS, FUSES, ETC.

TERMINAL SIZES

Terminal shanks are practically all 4 B.A. The older form of slotted shank supplied by Belling-Lee is 2 B.A. These sizes are clearance dimensions.

TERMINAL TYPES

Terminals are obtainable in many sizes and patterns, but the markings set out below are those which are standardised by the majority of terminal manufacturers. The Belling-Lee terminals are manufactured in four sizes, Types B, M, R and Q. Types B. R and Q have ebonite heads, whilst Type R is of metal. Types B and M also have non-rotatable heads so that the name is always easily read.

Eelex terminals are manufactured with non-rotatable indicating heads, and with socket centres so that plugs may be inserted. In addition, the Treble Duty terminal has removable indicating plates which are held in place on the head. The shank is slotted to accommodate connecting wires.

The Eelex Treble Duty Plug.

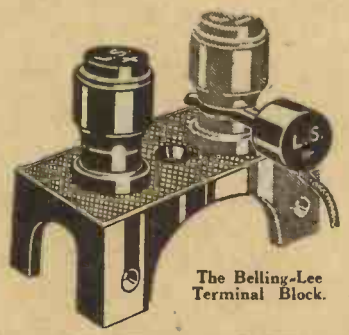
STANDARD TERMINAL INDICATIONS

Aerial	Aerial 1	Aerial 2
Aerial 3	Earth	Pick-up
L.S.+	L.S. –	Phones+
Phones –	L.T.+	L.T. –
H.T.+	H.T.+1	H.T.+2
H.T.+3	H.T.+4	H.T. –
Grid+	Grid –	Grid –1
Grid –2	Grid –3	Screen
Input+	Input –	Output+
Output –	+	–
Mains+	Mains –	A.C. Mains
L.T.A.C.		

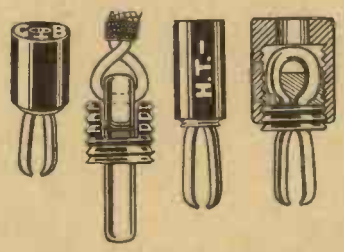
And in addition, plain red or black.

TERMINAL BLOCKS

Terminals are usually attached to a strip of ebonite fixed to the rear of a baseboard, but to simplify this method of construction, special terminal mounting blocks are manufactured by Belling-Lee, Ward & Goldstone, Telsen, etc. The Belling-Lee accommodates two terminals of any type, whilst the Ward & Goldstone accommodates only one terminal. The Telsen is complete with two terminals, one red and one black.



The Belling-Lee Terminal Block.



Various Types of Wander Plugs.

TERMINAL MOUNTING STRIPS

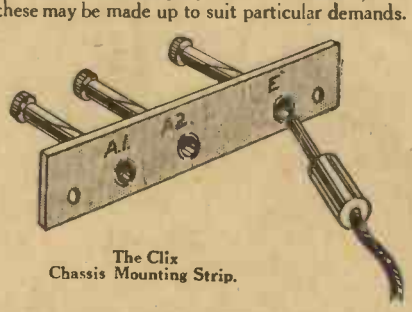
In place of the customary terminal block or strip, special paxolin strips are obtainable from Clix, in which resilient sockets are fixed. These are appropriately engraved and accommodate the solid type of plug. This is an improvement on the terminal with screw top, as it enables rapid connection to be made. Messrs. Bulgin also manufacture a small ebonite terminal block with two terminals fitted.

FUSES

H.T. – is invariably joined to L.T. –, and it is advisable always to make this connection by means of a fuse. The leads to the valve-holders are then taken from the L.T. – side of the fuse-holder. Fuse-holders are manufactured by Telsen and Bulgin and accommodate small lamp fuses of the flashlamp bulb type. They are obtainable in various ratings and the choice should be made in the following manner. Add together the total filament current consumption of each individual valve, and choose a fuse which will blow at a value slightly lower than this total. Microfuses are also obtainable, and these consist of a thin gold film and not a lamp type. They are also obtainable in various ratings. (Note: .2 amp. is 200 milliamps.)

BATTERY CORDS

To obviate the necessity of joining battery leads to terminals, special multi-way battery cords are obtainable. Those manufactured by Messrs. Belling-Lee are fitted with two spades for connecting to the accumulator, whilst the remaining cords are provided with wander plugs. These may be obtained in lengths of 30 in. or 54 in. and are made up in 5-way, 6-way, 7-way, 8-way, 9-way and 10-way cables. The leads are intended for G.B. and H.T. tappings, but obviously the plugs may be altered to suit individual requirements. Messrs. Bulgin, Ward & Goldstone and Harbro also manufacture multi-way battery cords similar in type to those above mentioned. Messrs. Bulgin do not supply spades or plugs with their cords so that these may be made up to suit particular demands.



The Clix Chassis Mounting Strip.