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# Practical Wireless

3D.

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THE PREDOMINANT WIRELESS WEEKLY

# Practical Wireless

EDITOR:
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# ROUND *the* WORLD *of* WIRELESS

### Another Musical Interval Signal

THE Polish station at Lwów, which you may hear broadcasting daily on 380 metres, just below Radio Toulouse, has adopted a few notes on a zither as an interval signal. Although most of the transmissions are relayed from Warsaw, at times you may pick up the local call *Hallo! Hallo! Polskie radjo Lwów*—the name of the city being pronounced *Lvoof*. When official communications are broadcast, in order to draw the special attention of listeners, they are preceded by the roll of a drum.

### Sidelights on a World Conference

ACCORDING to a Spanish "daily," over *three and a-half million* sheets of paper were used by the six hundred delegates to the International Radio Convention in the preparation and distribution of minutes, speeches, etc. Apparently more work was done than mere talking, and it is to be hoped that some good may arise out of the decisions taken.

### A Russian Usurper

LISTENERS to the Barcelona EAJ1 station may hear now and again a programme of Russian origin, as a Leningrad 10 kilowatt transmitter has made its appearance on 348.2 m. Although usually swamped by the Spaniard in the later hours of the evening, the Soviet transmission can be fairly clearly heard between 6.0 and 7.0 p.m. G.M.T.

### New French High-power Transmitter

THE French Posts and Telegraphs Administration has now passed the plans for the construction of a 60 kilowatt transmitter to be installed in the neighbourhood of Nice, on the Mediterranean Riviera. The station will be so designed that its energy can be increased at a future date to 120 kilowatts.

### Yale *versus* Cambridge

THE B.B.C. has staged an international debate between Yale and Cambridge University students; the subject is to be, *That the cancellation of War Debts and Reparations is Necessary for the recovery of World Trade.* The Cambridge representatives will speak from a studio at Broadcasting House and their Yale opponents from New York. The transmission is being carried out by trans-Atlantic telephone on short-waves, but listeners, of course, will hear both sides of the debate through the stations taking the National programme.

### A Question of Acoustics

IT is a curious fact that many architects when designing public buildings do not yet realize that acoustics may become as important a factor to the success of the enterprise as the actual planning of the building itself. Even to-day, after more than ten years of broadcasting, experienced experts can only point to the lounge of a seaside hotel or to a disused wharf on the bank of the Thames as providing satisfactory conditions for the transmission of music. Actual places of entertainment, built or reconstructed since the advent of broadcasting in the main, are notorious for an utter absence of any claim to acoustical perfection; and frequently present a serious problem to the engineers responsible for the relay of an outside broadcast. It is for this reason that sometimes, owing to unsuitability, a place of entertainment may cease to figure in the radio programmes.

### Listen to Berlin

ON February 11th, a further relay is to be carried out by the B.B.C. of a special variety performance in the Berlin Studio. It is entitled: *Funk-Karusse* (literally: *Radio Round-abouts*). The cast will include a number of well-known cabaret artists, including the screen star, Renate Muller, made known to the British public by the film *Sunshine Susie*.

### Budapest Programme on Short-Waves

SOME commercial receivers just fall short of tuning to 550 metres, the wavelength of the Budapest main programmes. On the other hand, as it frequently happens that dial readings down to 200 metres can be obtained, there is a possibility of hearing the Hungarian entertainments relayed by the new Péczs 4 kilowatt transmitter now temporarily working on 207.5 metres.



### New Features of Italian Broadcasts

FOR some few weeks all relayed performances from the Rome and Naples opera houses have solely been broadcast through Milan, Turin and other stations linked up in the North Italian group. On the other hand, those given at the Scala Theatre (Milan) or at Trieste, Genoa, Turin and Florence are only transmitted on the Rome and Naples wavelengths. The idea is a practical one inasmuch as by this means listeners are able to hear programmes which are *not* available to them in *their own* cities, and in addition the broadcasts do not, as they might otherwise do, affect the bookings of the local theatres.

### The B.B.C. Droitwich Station

TO replace Daventry National on the "long" waves the B.B.C. will erect a 100 kilowatt transmitter at Droitwich. The contract for the construction of this station has been given to the Marconi Wireless Telegraph Co., Ltd. New and exceptionally high-powered valves will be incorporated in this ultra-modern plant.

### Hear the Cuckoo Calling

IF your receiver will allow you to do so, turn the condensers to 574 metres, or some little distance above the Budapest dial reading when you should now clearly hear transmissions from Ljubljana (Jugo-slavia), which has recently boosted up its energy to about 7 kilowatts. Identification of the studio is an easy matter as between items you will pick up a reiterated cuckoo call.

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

**INTERESTING and TOPICAL PARAGRAPHS**

### Restricted Liberty in Japan

THE Japanese authorities have decreed that wireless receivers in that country are to be so constructed that they can only tune in to Japanese transmitters; moreover, listeners are not allowed to possess short-wave apparatus. This measure appears to have been taken to combat anti-Japanese propaganda broadcast by the new Nankin (China) high-power station and the Soviet broadcasters.

### Another World Broadcast

ON Passion Sunday, April 2nd, the Vatican will relay a religious ceremony from the Basilica of St. Peters, Rome, in celebration of the fiftieth anniversary of the Pope's first Mass, and also on the occasion of the opening of the Holy Year. Both the address from the Holy See and the Sacred Service will be broadcast on 19.84 m., but may also be relayed to the Italian stations, including the Rome short-wave transmitter.

### Radio Luxembourg ready to Function

ALTHOUGH no definite date has yet been fixed for the opening of this 200 kilowatt station, according to a French report, the studios are now completed, and the station will shortly be on the air with a regular daily schedule. Concert broadcasts have been assured by engagement of an orchestra numbering some thirty instrumentalists. So far, the wavelength to be adopted will be 1,191 metres.

### Radio *versus* Floods

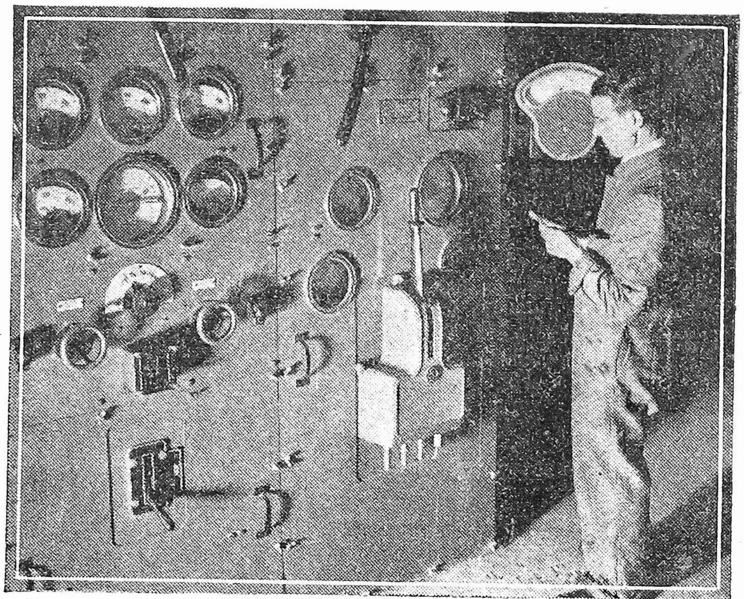
FLOODS in Russia, when the thaw sets in, cause considerable damage to outlying districts. In order to warn the inhabitants of lonely villages, threatened by the overflow of rivers, the Soviet authorities have installed some short-wave transmitters for rapid communication with the nearest cities. Warnings can thus be sent through the broadcast transmitters and assistance organised for coping with any local trouble.

### Lady or Woman Announcer

NOT only in Great Britain, but in many continental countries where a female undertakes this important post in a studio, no suitable word has yet been found to designate her. If a man is an announcer, what are we to call a woman who fulfils the same duties? The word *announceress* is used in the United States; in Germany, *Angsagerin*, and in France, where a man is termed *le speaker, speakerine* has been coined. Many of the broadcasting authorities of Europe would welcome suggestions.

### Teheran Calling

GERMANY has been carrying out a number of tests with distant countries during the past month or so, through Nauen and Zeesen, and I am now informed that we are shortly to hear a relay from Teheran (Persia). If the preliminary trial is successful the broadcast will be passed on to other German transmitters on the medium waveband and will thus be made available to the greater part of Europe. In March an interchange of programme is also to be made between Berlin and Buenos Aires, Rio de Janeiro, and possibly with Monte Video. Relays of New York programmes *via* Rocky Point and Beelitz, near Berlin are now a regular weekly feature with some of the German stations, and we are now promised, as a special treat, a programme from Tokio (Japan). With a short-wave receiver tuned to the Nauen or Zeesen wavelengths it is possible to pick up many of the tests necessary for these transmissions, and you will find them peculiarly interesting.



*Reading the meters on one of the main power intake cubicles in the headquarters of British broadcasting at the B.B.C.*

### Athlone Calling

TEST programmes from the new Irish Free State broadcasting station at Athlone, which is equipped with a Marconi 60-kilowatt transmitter, have been widely received abroad. Several reports of good reception have been received from Newfoundland, and the transmissions have also been reported as clearly heard in such distant countries as India, Iceland, and Greenland, in addition to practically throughout Europe. The wavelength of the Athlone station is 413 metres.

### Morocco on Short-Waves

IN view of its distance and also unfavourable position in the broadcast band, Radio Rabat is being poorly heard except in the southern districts of Great Britain. Listeners on short waves, however, may pick up these programmes on Sundays between 12.30 and 2.0 p.m. if they care to tune in to 23.39 metres or to 32.26 metres between 8.0 and 10.0 p.m. G.M.T. The call is: *Ici Radio Maroc à Rabat*, the interval signal consisting of the ticking metronome.

### Radio Agen Again!

ON January 8th, Radio Agen (France), which was destroyed by floods in March, 1930, resumed its daily broadcasts. Although the station only radiates with a power of barely 1 kilowatt its transmissions can be easily heard by listeners on the South coast of England. The wavelength temporarily adopted is 453 m. At present, the broadcasts are made twice daily, namely, between 12.30 and 1.30 p.m., and from 7.30–8.30 p.m. G.M.T. All announcements are made in French only.

### Alterations in the German Broadcasting System

DURING 1933 the German Reichspost will carry out a re-organization of the broadcasting network. The small Berlin relay will be closed down and possibly Kiel will also suspend its transmissions. The Hamburg circuit, fed by a main 60 kilowatt station, will include relays at Bremen, Flensburg, Hanover, Magdeburg and Stettin all working on one common wavelength. The second German net will include Frankfurt-am-Main, Freiburg-im-Breisgau, Cassel, and the new 2 kilowatt Treves station.

### Russia's Extra Wavelengths

FOLLOWING the Madrid Radio Conference, the Soviet authorities have decided that their transmitters may use the wavelengths comprised in the band 1,053–2,000 metres (285–150 kilocycles), and also from 714 to 882 metres (420–340 kilocycles). It will be noticed that the new Leningrad station is already monopolizing one of these channels—namely, 857.1 metres.

## SOLVE THIS!

### Problem No. 20.

Jackson had a simple battery two-valve set, fitted with one H.T. positive tapping, 120 volts at 15mA. The valves were ordinary two-volters. He bought a small mains unit having outputs of 120 volts at 20 mA. and 4 volts at 2 amps., and joined this up to his set. He rewired the filament circuits with twin flex, and joined the filaments in series to enable the necessary 4 volts to be applied. When the set was switched on, however, he was rewarded with a terrible hum and no signals were distinguishable. Why? Three books will be awarded for the first three correct solutions opened. Mark envelopes Problem No. 20, and send to the Editor, PRACTICAL WIRELESS, Geo. Newnes, Ltd., 8-11, Southampton Street, London, W.C.2, to reach us not later than February 6th.

### SOLUTION TO PROBLEM No. 19.

In connecting up the new batteries Jackson inserted the Grid Bias Plugs in the wrong end of the battery, and this naturally stopped signals.

The following three readers received books in connection with Problem No. 18:—

A. R. Griffith, 73, St. David's Hill, Exeter, Devon; J. Dixon, 1, Nettleham Road, Sunderland; G. F. Hill, 14, Park Avenue, Wakefield.

# A VARIABLE-MU H.F. UNIT

**Build This Neat Little Instrument to add Range and Selectivity to Your Set.**

By A. E. OAKLEY

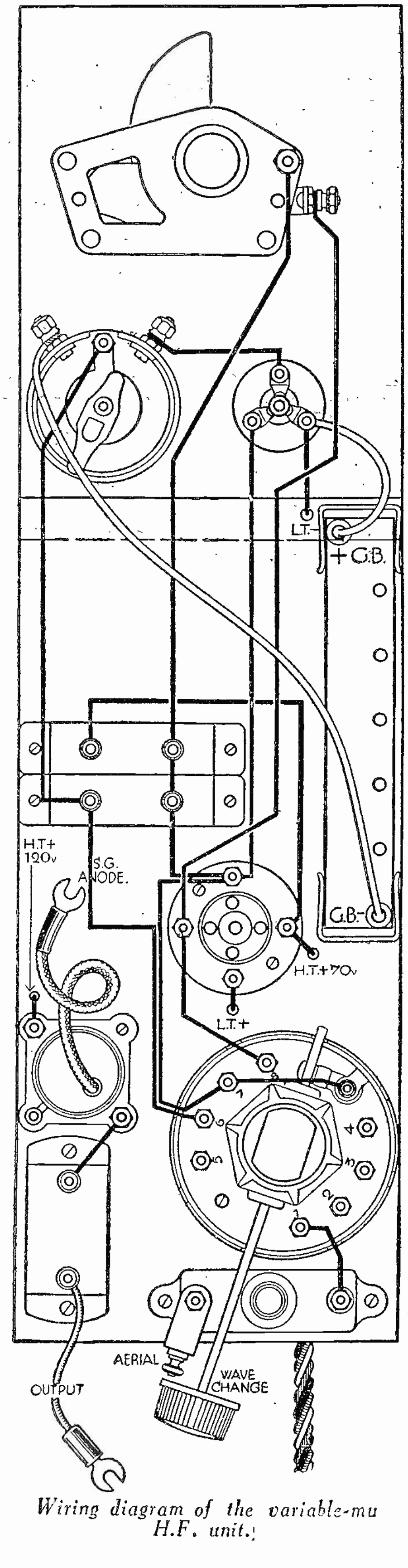
THERE are probably thousands of our readers who have perfectly good "detector 2 L.F." sets which they, for one reason or another, don't want to scrap. Possibly there is a feeling of sentiment for a good and faithful servant; or, perhaps, the cost of that wonderful set you are going to build is prohibitive at the moment. Well, here is a scheme for adding a modern high-frequency stage to your present set without altering it in any way. Of course, a few components must be bought, but the design here given is as simple and inexpensive as possible, in view of certain essential considerations. Further, the parts can nearly all be used in a modern set should you decide to construct one later.

### What It Will Do

Now let me tell you the exact purpose of this unit. It is a high-frequency amplifier, with aerial tuning complete in itself; which only requires connecting to a set to improve it greatly. It makes use of the variable-mu type of screened grid valve, and is intended to be used in conjunction with a set of the "det. L.F." type—whether a two- or three-valver does not matter. If with your present set you can just—but only just—get hold of one or two foreigners with reaction pushed to the utmost, then this unit will bring them in easily, and pick up others in addition. If your local station is more or less all over the dial, it will help you to keep it in its proper place.

In designing the unit two features have been regarded as of prime importance; first, compactness and simplicity; second, complete stability, not merely in the unit itself, but as to its effect on the set with which it is operated. The extremely small dimensions, and the neat lay-out shown in the drawings, will indicate that point number one has been achieved. Stability and freedom from interaction or radiation have been obtained by careful design and the use of screened components. The constructor of this amplifier may have perfect confidence that it will do its job; in other words, it will pick up signals which the detector valve alone would not deign to notice; it will pass on greatly amplified signals to the set and it will greatly improve selectivity. It will give you the joy of "reaching out," and the pleasure of a change of programme which the present set will not give.

Do not imagine, however, that the mere addition of an H.F. stage, however good in itself that stage may be, will make a more or less "dud" set into a first-rate and up-to-date one. It won't. Your set may be designed in such a way that there are undesirable magnetic or capacity couplings between its components. Operated as at present, possibly no ill-effect is noticed. But the extra energy which the H.F. valve will put into the present tuning coil detector valve, etc., may cause oscillation. The same fault is likely to reduce selectivity, and if the over-all selectivity of the combination is to be high, then each part of it should be as good as possible. Look at it this way. Your set could have a selectivity figure of merit we will call 10; but because of certain faults it only reaches 3. The new unit has an efficiency of 10, and the combined efficiency could, and should be, with a properly arranged L.F. receiver, 10×10=100. Unfortunately, however, it is only 10×3=30. The new unit will really "multiply the goodness" of the set with which it is used, both as to selectivity and range, so it is well worth while to take a little trouble to make it as good as possible. An article will appear in an early issue giving ideas for improving this type of set, which will help some of those who are constructing the unit here described.




*Wiring diagram of the variable-mu H.F. unit.*

### The Circuit

Starting at the aerial terminal, we have a pre-set condenser with a capacity of .0003 maximum. This helps selectivity by reducing the damping effect of the aerial, and gives you a control of the strength of incoming signals. The coil is screened, has an aperiodic aerial coil and tuned-grid coil. Both these windings are divided into medium and long-wave sections, the latter being short-circuited by a double switch in the base of the coil. The foot of the grid coil is connected to the slider of a potentiometer, which has a 9-volt grid-bias battery across its outer terminals. This potentiometer controls volume and selectivity by varying the bias on the working grid of the variable-mu valve. Turning the control knob to the right gives increased volume; to the left, greater selectivity. The tuning condenser has its earth end connected to the foot of grid coil through a 1 mfd. fixed condenser. The valve anode gets its current supply through an H.F. choke, which is also screened, and has, too, a screened pigtail for connection to the anode terminal. The output from the valve passes to a fixed condenser of .0002, from the other side of which leads a flex for connection to the aerial terminal on the main set. It will be noted that a 3-point on-off switch is necessary to take care of the switching of the grid-control battery and L.T. supply.

### Constructional Points

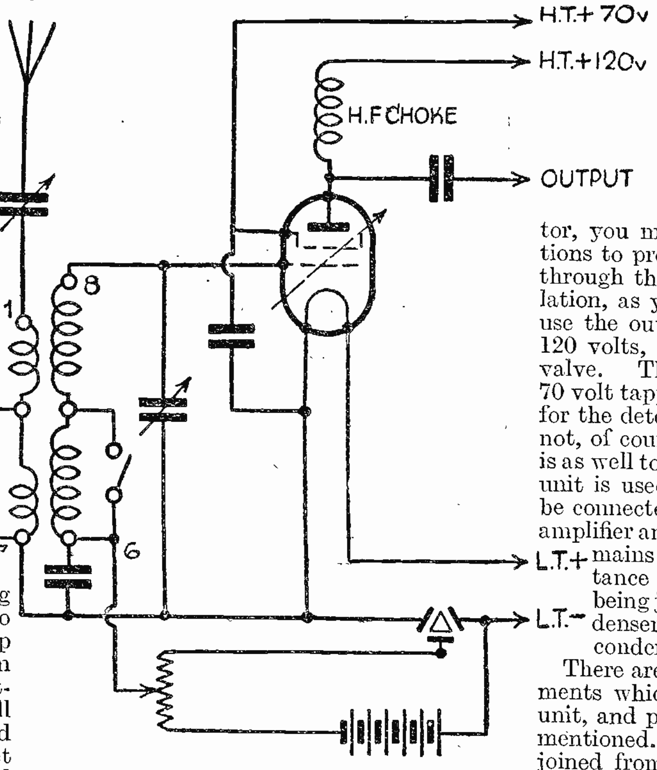
The panel is a piece of oak-faced plywood 4⅝in. by 6¾in. and about $\frac{3}{16}$in. thick. This could be of walnut or mahogany, stained to match the set with which it is used. The base is also of $\frac{3}{16}$in. ply, 4⅝in. by 10½in., screwed to two ⅜in. battens. No case is shown, as this will, no doubt, be made in a style to harmonize with the set. Short wiring and compactness are the prime features of the layout. The drawings show the exact position of each component and wire, and these should be adhered to. Terminal plates have been avoided, there being only one terminal for attachment of the aerial lead. This is carried on a short metal extension from the pre-set condenser. The various battery leads are taken through the base for the sake of tidiness. A metal or fibre clip holds the four flexes in place just behind the batten, which is notched for them to pass through. Red and black flex is used for the L.T. wires, with spade tags of similar colours fitted to the ends. The two H.T. leads from the screen-grid terminal of valve-holder and choke should be a different colour from the L.T. wires, and are fitted with orange and red wander plugs (the former for the screened grid). The lead from output condenser is a short piece of rubber-covered wire with a metal spade tag soldered to the end. This goes to the aerial terminal on main set, and is the only direct connection between unit and set. The earth connection is effectively made by the L.T. battery leads. If the wires are coloured and finished in the way described there will be little chance of making a wrong connection. On examining the valve, it will be noted that one of the filament pins has a label marked "E" against it. This must be on the earth side of the set, preferably negative. The coil screen must be earthed with a short piece of wire connected between terminal 7 and the holding screw of the spring which bears against the wave change switch spindle.

**LIST OF COMPONENTS**

- 1 Screened Coil with switch, Telsen No. 216.
- 1 Small Friction Disk Drive, Telsen No. W 257.
- 1 Wire wound Potentiometer, Watmel, 50,000 ohms.
- 1 Screened H.F. Choke with shielded pigtail, Wearite, H.F.P.A.
- 2 1.0 mfd. Condensers T.C.C.
- 1 0.0002 mfd. Condenser, Dubilier.
- 1 0.0005 mfd. Direct Drive Variable Condenser, Polar No. 3.
- 1 0.0003 (max.) Pre-set Condenser.
- 1 Three-point on-off Switch.
- 1 Four-pin Valve-holder.
- 1 220 V.S.G. Valve, Cossor (Metallised).
- 1 9-volt Grid Bias Battery.

### Operating the Unit

First check and examine the wiring point by point, to make sure there are no errors or omissions; also that all terminals are tight. Now, with switch "off," connect up, giving each tag or wander plug a flick on its terminal first to see there is no short. Don't forget to remove the aerial lead from your set and connect it to the unit, and the unit output lead to A on set. Switch on your set (not the unit) and tune in your local station, which you will hear, but probably at rather poor strength. Now switch on the unit, adjust its tuning condenser to the loudest position, and try the effect of the volume control, also varying the pre-set condenser. By this time you will have got the "feel" of the set and an idea of the relation of the two tuning condensers. Now you can begin to search for foreigners. Bring your reaction up to the edge of oscillation, and turn the two condensers in unison, but every few degrees move the aerial tuning condenser back a little and forward again to ensure that it has been in correct relationship with the inter-valve condenser (the one on main set). The upward movement of this latter should be steady and very slow, for it will now be much sharper than hitherto, and stations are easily passed over. If you get a station rather near the local, and the local is also heard too loudly, you will need to adjust the volume control, pre-set condenser, and reaction carefully, and can generally succeed in reducing the local so much that it is not heard if the wanted station is fairly loud. It is often better to tune in the station accurately with the volume control reduced, as this gives best selectivity, and when the station is perfectly tuned on both condensers the volume can be increased without the local coming in. Satisfactory H.T. voltages are usually 70 on the screened grid and 120 on the anode, but the valve may be worked up to as high as 150 volts with a corresponding increase in screen voltage. Don't forget that the unit coil must be switched for long and medium waves as well as your set. The switch spindle has a flat on it. When this flat is at top or bottom the switch contacts are open, for long waves; when exactly at either side, closed, you are on the medium wave-band. It will be noted that the coil has an additional winding intended for reaction. This is not used.




*The circuit of the H.F. unit.*

It should, perhaps, be pointed out that if the receiver which you are at present using employs a mains battery eliminator, you may have to adopt some precautions to prevent instability due to coupling through the unit. This may result in oscillation, as you will probably be tempted to use the output tapping, if that is rated at 120 volts, for both this unit and the L.F. valve. The same thing may occur if the 70 volt tapping on the unit is also employed for the detector valve. This instability will not, of course, be caused in all cases, but it is as well to be forewarned. Where a mains unit is used, therefore, a resistance should be connected between the H.T. leads of the amplifier and a higher voltage tapping on the mains unit; the junction of the resistance and the lead from the amplifier being joined to one side of a fixed condenser of the order of 1 mfd. The condenser is, of course, joined to earth.

There are quite a number of other experiments which can be carried out with this unit, and perhaps just one of these may be mentioned. The small condenser which is joined from the anode of the variable-mu valve to the receiver may be made variable,

### Continental Operatic Transmissions for England

According to a German paper during the months in which there is no operatic season in Great Britain, some performances from German theatres, including the Munich National Opera House, will be relayed to British listeners. Although definite dates have not yet been fixed, these transmissions will be carried out during February and March.

### Russia Builds the Latvian High-power Station

The 15 kilowatt transmitter which is being erected at Ajviekeste (Latvia) and destined to replace the smaller station now installed at Riga, has been constructed by Soviet State engineers with home-made material. It is the first time that Russians have built a station outside their own frontiers, and the experiment is being watched with interest. Although it is destined to operate the new station at the outset on its advertized power, it has been designed with a view to an increase in energy, when desired, to 50 kilowatts.

## HERE AND THERE

### Delayed Radio Echoes

An interesting discussion recently took place between Professor Stormer and Dr. van der Pol regarding the physical explanation of the particular phenomenon of delayed Radio echoes, a subject which has been studied by both these scientists. Professor Stormer's explanation of these echoes is based on this theory of the Aurora Borealis, and in this connection he assumes that radio signals travel far beyond the moon before being reflected to earth as an echo. On the other hand, Dr. van der Pol has shown theoretically that another explanation of these echoes is possible without having to assume that the signals travel so far. In Dr. van der Pol's theory the long times of transit can be accounted for by the low signal velocity that may occur, according to theory, in the electrified parts of the earth's atmosphere. Both the professors were of the opinion that a final explanation of these mysterious echoes can only be given after further experiments, the principal necessity being to take readings of these echoes in the course of further research. Professor Stormer gave a lecture on the Aurora Borealis, illustrated by a film and by photos showing the "Northern Lights" in great variety of forms. He spoke about photographic measurements of the altitudes of the Aurora Borealis, which appeared to occur in the atmosphere at a height of between 80 and 1,000 kilometres. Of particular importance are the Auroræ in sunlight, which show a different colour and are observed in the earth's shadow at altitudes twice as great as the regular Auroræ. He spoke about phenomena associated herewith, such as the solar corona, the cosmic ultra-rays and the above-mentioned radio echoes with long times of transit.

### Interesting Statistics

In January, 1933, the total number of licensed listeners in Germany reached 4,307,772, which, in view of a declared population of 64,776,000 souls, works out as 6.65 per cent. of the total inhabitants.

# IDEAL RECEPTION AND HOW TO OBTAIN IT

**This Article deals with Points on Obtaining Really Good Quality with Ample Volume, together with remarks on the Causes of Weak Reception**

By
GILBERT E. TWINING

ONLY a very short time ago it was the rule that quantity, or rather volume, could not be obtained except at the expense of quality. Improvements in the construction and design of valves and components, together with the introduction of the moving-coil speaker, and many other refinements have made greater volume with better quality possible. It has been realised that to obtain the very best results a receiver must be designed as one complete unit, that is to say every piece or component must be chosen and matched with care, and a knowledge of its particular operation and position in the set. This is one very good reason why, when undertaking to build a set, the components should always be those specified by the designer, also the layout and spacing must be studied and followed implicitly.

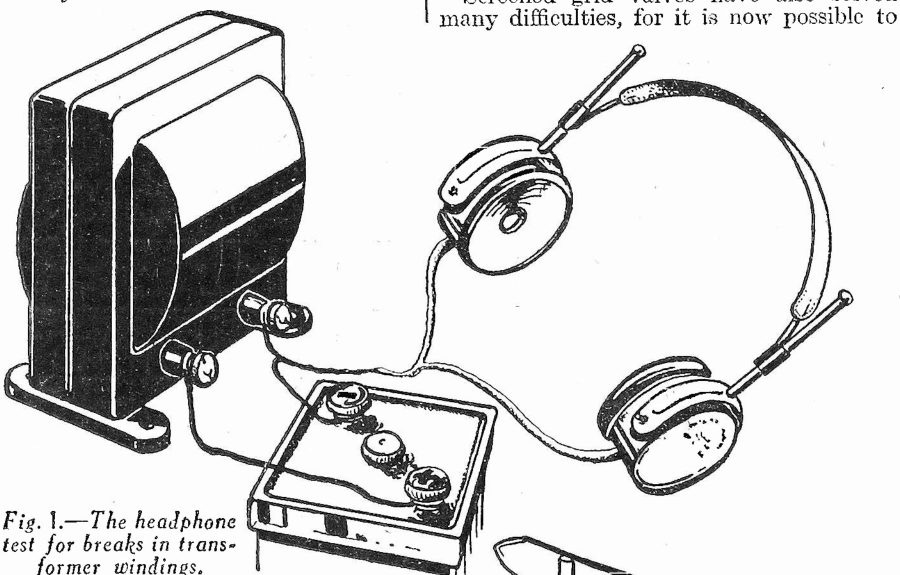


*Fig. 1.—The headphone test for breaks in transformer windings.*

### The Aerial and Earth

Naturally the aerial and earth play a very important part in the reproduction of the set, for no receiver can give good quality and volume if these are indifferent, for the simple reason that if the signal strength to the receiver is too weak, excessive reaction has to be resorted to, which tends to reproduce a noisy background.

Generally speaking, the flatter the tuning of a circuit the better the quality of the reproduction, but against this method is the very bad interference which is set up. This is one of the great difficulties concerning the present-day broadcasting system because, owing to the number of stations and the close proximity of the wavelengths, the ether is becoming very overcrowded, consequently when a station is tuned in, others are likely to be heard as a background, by reason of their being in partial resonance with the set, and this is the reason why it is so necessary at the present time to design receivers incorporating as much selectivity as possible. The band-pass method of coupling appears to have almost completely overcome these difficulties. It gives a very sharp cut-off, and does combine quality with selectivity.

Screened grid valves have also solved many difficulties, for it is now possible to thoroughly stabilise the high-frequency side of the set. Two screened grid stages can be used with perfect stability and enormous amplification. The recently-introduced multi-mu type of valve has a great advantage over the ordinary screened grid variety, for the reason that they will deal faithfully with weak or strong signals. The volume is controlled by varying the negative bias on the control grid; it will thus give a fine variation in amplification with the advantage of good quality at any volume.

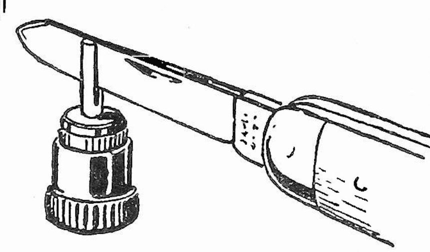


*Fig. 2.—Opening the pins of a wander plug with a pocket-knife to ensure good contact.*

### Causes of Weak Reception and Bad Quality

Partial short-circuiting of the aerial to earth may easily mean weak signals, and the points to investigate are perished lead-in tubes, broken insulators and dirty earthing switches, or even a partial break in the aerial wire itself caused by corrosion. The earth wire must be as short as possible and preferably of stout 7/22 stranded copper wire. It should be soldered to the earth tube or sunken plate, not just screwed down under a terminal. A convenient water-pipe makes a very good earth, provided a rigid attachment is made to it. The pipe should first be scraped clean, and the earth wire held in contact with an earth clip, afterwards wrapping with insulating tape for protection from the weather.

### High Tension

When an H.T. battery is running down and nearing the end of its life, the voltages on the valves are no longer correct, and consequently a loss of strength coupled with distortion is the result. Many users are tempted to carry on with the old battery after the voltage has dropped below its useful life. One way of testing the battery is to reduce the grid-bias voltage; if this gives slightly louder and clearer signals it proves that the H.T. current is too low and therefore the valve is over-biased. It must not be forgotten, however, when fitting a new H.T. battery to advance the grid-bias value to its original voltage. It should always be remembered that to gain the greatest efficiency from the valves they should be supplied with the maximum voltage stated by the makers. but also remember increased voltage, especially in the power stage, means more negative grid-bias and therefore a larger G.B. battery.

### Chokes and Transformers

Sometimes intermittent and weak signals, coupled with distortion, can be traced to a break in the windings of a transformer or choke. A battery and headphones connected across the windings, as shown in Fig. 1 will, if the windings are O.K., indicate by clicks in the headphones when the circuit is made and broken.

If, after more than two years' service, the quality of reproduction falls, it may be taken that the valves have become poor in emission, and they should be replaced.

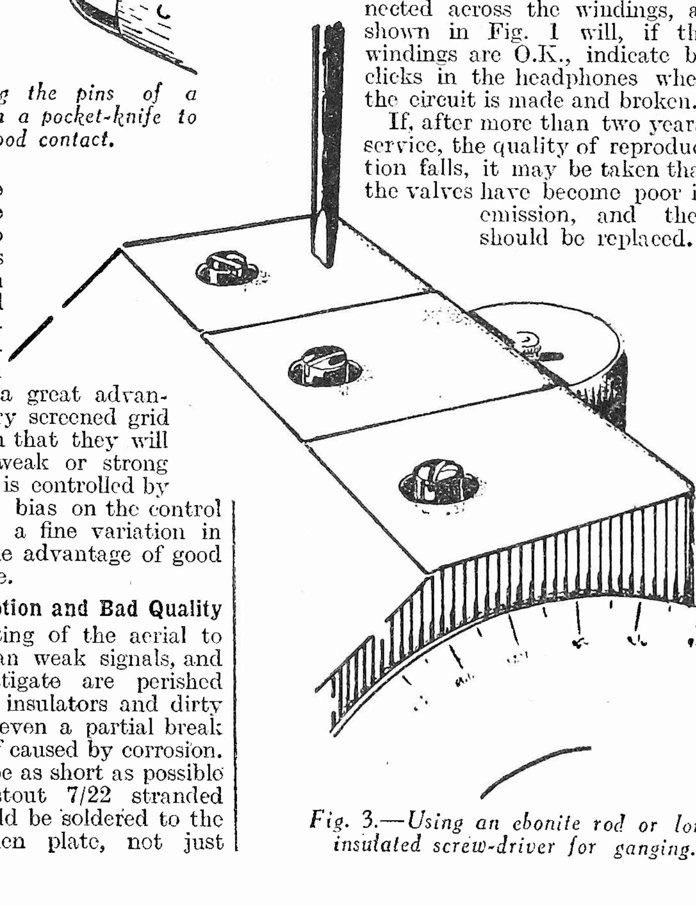
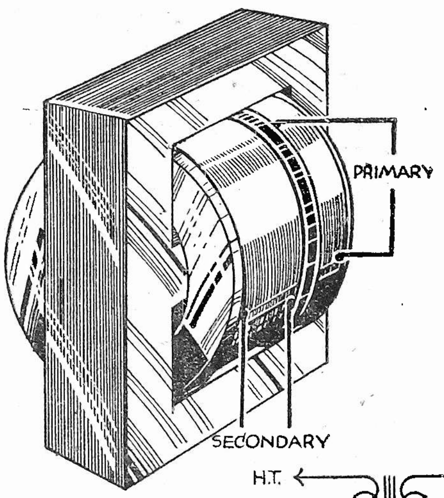


*Fig. 3.—Using an ebonite rod or long insulated screw-driver for ganging.*

# PUSH-PULL: QUIESCENT —

## An Explanation of the Working these Methods of Amplification.



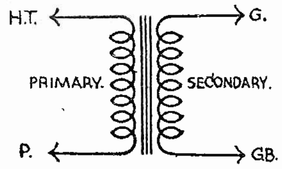




*Fig 1.—An ordinary L.F. transformer shown in pictorial and theoretical form.*

IT is necessary to remove any misconception that may exist in the minds of some amateurs concerning the date of origin of " Push-pull " amplification. It is not by any means new, but was covered by a patent application dated 1915. The modern design of valves has, however, only within recent years enabled full advantage to be taken of the invention, and it is for that reason that it has not been popular until fairly recently. The latest development, namely, Quiescent Push-pull, has again revived interest in this method of working two valves, and in response to many readers' requests for details on the subject, I have written this explanation, which covers the complete subject of the output stage. Unfortunately, it is essential that a graph or curve should be employed in order that the idea of the handling capabilities of a valve may be explained, but this will be found quite simple to understand, so that this article may be appreciated by the beginner or advanced experimenter.

### The Transformer

When a valve is employed in the last stage of a receiver, it is invariably fed from a low-frequency (L.F.) transformer, and the transformer consists of an iron core over which are wound two separate windings—a primary and a secondary. The primary consists of a small winding, and the secondary a larger winding, the ratio between these windings being expressed as the ratio of the transformer. That is to say, a 4 to 1 transformer has a secondary containing four times the number of turns in the primary. Fig. 1 illustrates this in pictorial form, and the small diagram shows the usual theoretical diagram for this arrangement. Now, when an *alternating* current is applied to the primary winding, a similar alternating current is generated in the secondary winding, and if this latter winding is larger than the primary there will be a voltage step-up, corresponding to the ratio between the turns. The signal which is present in the anode circuit of the valve preceding the output valve consists of an alternating current, and therefore the secondary winding will receive a greatly increased replica of this signal. When a single valve is employed for feeding the loud-speaker, the grid of the valve is joined to one end of the secondary winding, and the other end of this winding is joined to the filament, but in order that there shall be no distortion, a small battery known as the grid-bias battery is inserted between the secondary terminal marked G.B. and the filament. This arrangement is illustrated in Fig. 2, and the graph, Fig. 3, will explain the reason for the biasing battery. I shall not go into the question of why the curve is necessary or how it is prepared, but if you simply study this curve in conjunction with the following details you will get the idea quite clearly. The curve has a certain portion which is to all intents and purposes straight, and this extends in the diagram from B to C. At B it begins to flatten out and cross the zero (or 0) line, and at C it flattens out and runs along the bottom line. Now, the bottom line shows the volts which are applied to the grid, either from a battery or from the secondary of a transformer, and the right-hand line shows the current which flows from the anode circuit of the same valve, from which it is obvious that different values of grid volts will result in different values of anode current. (For instance, if 10 volts are applied to the grid, the anode current will be 1 mA. This is ascertained by taking the point of intersection of the vertical line above the grid volts reading and the curve.)

### Avoiding Distortion

Now, in order that there shall be no distortion in an L.F. valve, it is essential that the anode current shall reproduce faithfully the variations applied to the grid, and therefore we have to bias the valve to its mid-point. On the diagram the centre of the curve is marked with a dot lettered A, and this is exactly in the centre of the heavy portion of the curve. If a signal which has a maximum variation of 10 volts is applied to the grid, it can be seen that there is an equal distance on each side of A where the anode current variation is equal. If, however, a signal with a total variation of 16 volts were applied to this grid, there would be a swing of 8 volts on each side of the centre, and this would introduce distortion for this reason. On the left of the curve every 2 volts applied to the grid reduces the anode current by 1 mA. Therefore all notes or passages of music which were applied to the grid, but which did not exceed 10 volts variation receives equal treatment. When, however, an extra loud passage, or very low note which occupied the total grid swing of 16 volts, was received, the first part of the oscillation would vary 1 mA per 2 volts, but as soon as the first 5 volts swing were passed the succeeding 2 volts would only result in a very small difference in anode current. Obviously, this would result in a distorted form of signal, and the opposite half-cycle would result in a still more violent form of distortion, as it will be seen that 8 volts to the right of the point marked A would bring the working point past the zero line, and the grid would therefore become positive. In Fig. 4 the signal applied to the grid is shown in diagrammatic form below the graph, and the reproduction of this in the anode circuit is shown on the

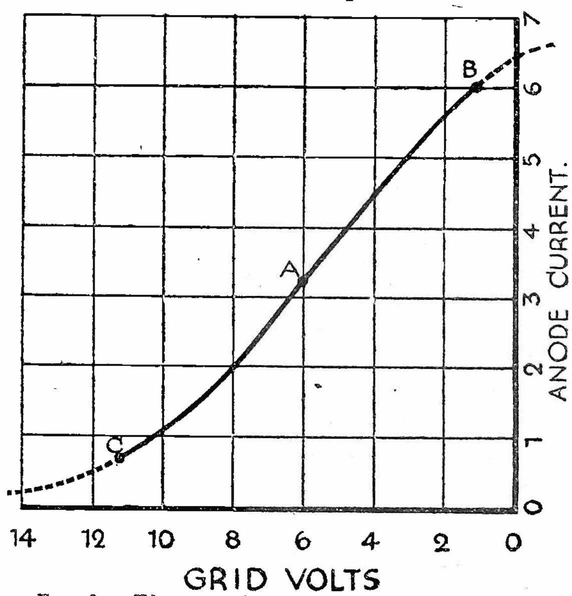



*Fig. 3.—The normal grid volts anode current curve of an L.F. valve.*

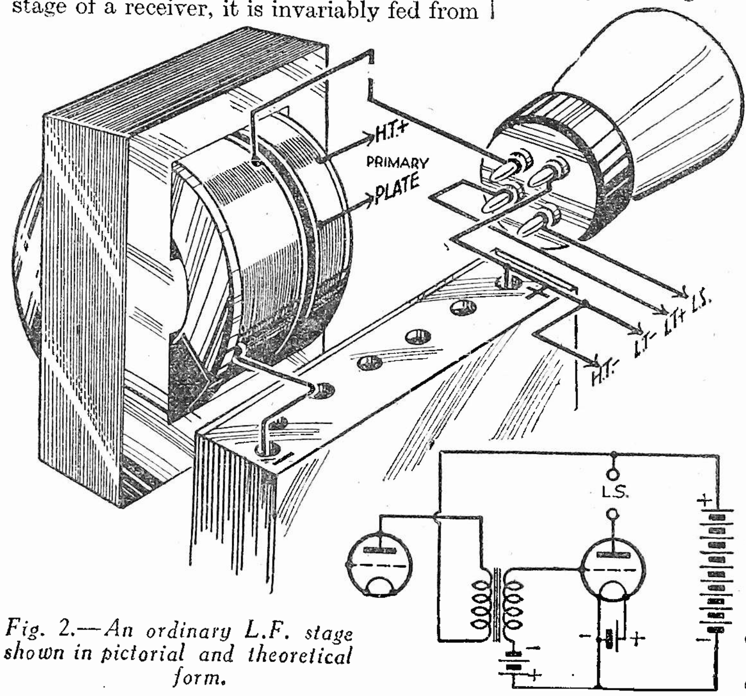



*Fig. 2.—An ordinary L.F. stage shown in pictorial and theoretical form.*

# —AND CLASS B AMPLIFICATION

## and the Differences Between

By W. J. DELANEY

right. This incidentally shows the amplification obtained, as the oscillations are much larger than shown below the graph, but are in every other respect an exact replica. That is to say, the largest variation is exactly four times the smallest in both cases. In Fig. 5, however, the signal applied to the grid is much too great, and, as will be seen, the anode circuit will only receive a badly mutilated copy of this signal.

### The Advantage of "Push-pull"

This introduces the first method of using "Push-pull." Where the signal applied to the last valve is too great to be handled faithfully, the usual remedy is to reduce the strength of the signal down to that which can be safely handled. If another

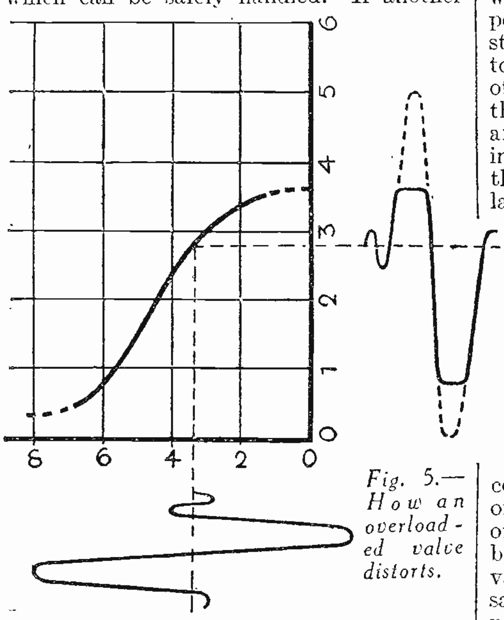



*Fig. 5.—How an overloaded valve distorts.*

valve is connected in parallel with the last valve, the signal applied is still too great, as the individual valves will still be receiving a swing much too large for them. If, however, we can divide the signal into two parts, and apply each part to a separate valve, we should be able to deal with this large signal. This leads us to "Push-pull." To divide the signal into two equal parts, a special transformer is used, and this is made up in the same way as an ordinary transformer with the exception that the secondary winding is duplicated, and the two windings are joined together in series. In other words a larger secondary is used, and it is centre-tapped. Fig. 6 shows the arrangement in pictorial and theoretical form. The ratio between the windings now exists between each half of the secondary and the primary, and as the centre of the secondary is joined to the filaments it is clear that each end of the secondary will be exactly 180 degrees out of phase, which means that they are exactly opposite. For instance, if at any one moment the voltage at one end is 6 volts positive, then the opposite end will be 6 volts negative. The connections of this transformer are shown in Fig. 7, from which it is quite clear that the two valves are working opposite to each other. The effect of this arrangement is now apparent, and it results in our being able to apply a larger signal to two valves in "push-pull" that we can apply to one valve of the same type.

### Combining the Two Halves

The signal present at each anode is, however, also 180 degrees out of phase, and in order that it may be utilised to operate the loud-speaker, a special transformer (or choke) is necessary to combine the two halves of the signal. This consists of a centre-tapped arrangement exactly similar to the input transformer, and the anodes are joined to the ends of the primary, with the centre tapping joined to H.T. positive. From what has been said, and a study of Figs. 3 and 4, it is clear that the total anode current is the mean or average, of the signal fluctuations, which means that one valve (as in Fig. 4) would use an anode current of roughly 3 mA, whilst two in push-pull would consume just double that. This is the principal reason for the lack of use of push-pull in battery-operated receivers. The drain on an H.T. battery is very large, and the arrangement would be too expensive to maintain, in spite of the doubled output.

### Quiescent Push-pull

Experiments have been carried out in the years since the invention of the Push-pull principle, and as a result of American endeavours, a system was evolved known as "Push-push." This consists of two valves arranged in the orthodox Push-pull manner, but instead of applying the normal value of grid bias for the valves being used, each valve receives nearly double the necessary voltage. This brings the working point to C (Fig. 3). Obviously, therefore, when a positive half-cycle is applied to the valve it will effect a corresponding variation in anode current, but the negative half-cycles will have no effect, as the current is already practically zero. Therefore, the two valves will work only on alternate half-cycles, which means to say that when one valve increases its anode current by 5 mA, the other valve remains quiescent, and does not reduce its anode current by 5 mA. This results in a great saving in anode current as the total current is directly relative to the strength of the received signal. (It will be noted that I have just used the word "quiescent" and this term is now used in place of the original "Push-push"). This arrangement therefore consists of an ordinary Push-pull circuit, with the difference that the grid bias applied to the valves is roughly double that normally required. If a milliammeter is inserted in the H.T. positive lead of two valves in Push-pull, the anode current will be seen to be double that of each valve, but in Quiescent Push-pull, the bias applied will result in the needle of the milliammeter dropping to zero, or nearly so. When, however, a signal is received, the needle will rise, and as the signals vary in strength, so will the needle of the meter vary. This will not indicate distortion, as is usual in the output circuit, but will give an indication of the manner in which the consumption of H.T. varies with the different items being received. For instance, where a quiet passage of music consisting of high notes is received, the current will be extremely small; but when a dance band is tuned in the current will be much higher.

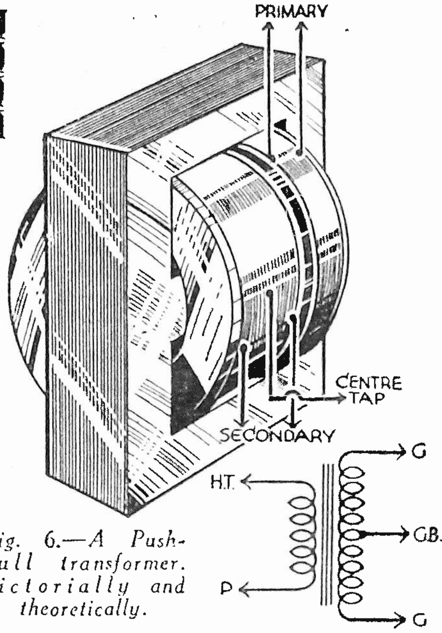



*Fig. 6.—A Push-pull transformer, pictorially and theoretically.*

### Actual Figures

Some actual figures obtained as the result of experiment may show the usefulness of this method of amplification. An Osram P.2 valve, with an H.T. voltage of 110, consumes normally 10 mA. The estimated power output is 100 milliwatts. Two P.2 valves in Push-pull would result in a consumption of 20 mA at 110 volts, with an estimated output of roughly 200 milliwatts. In Quiescent Push-pull, however, the same two valves would only

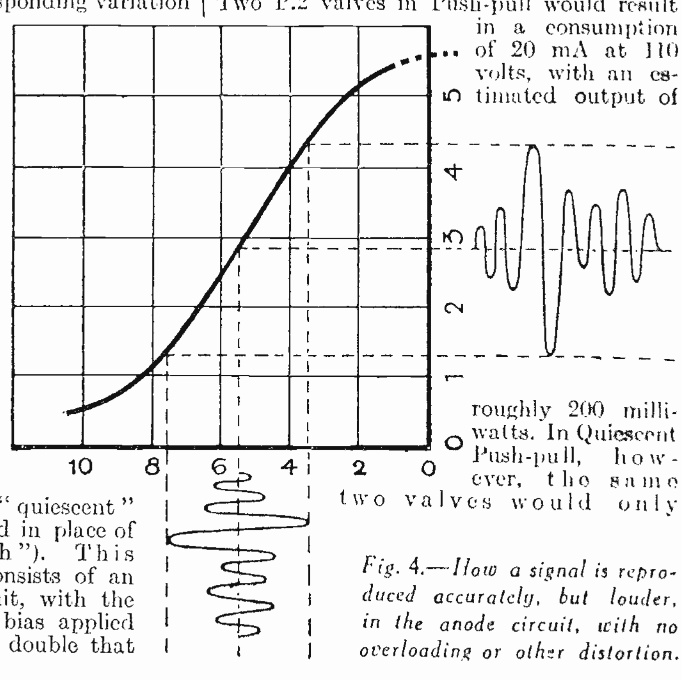



*Fig. 4.—How a signal is reproduced accurately, but louder, in the anode circuit, with no overloading or other distortion.*

consume a normal current of 3 mA, but would give an output of 300 to 350 milliwatts. The current mentioned, namely 3 mA, is of course, that registered during intervals in the programme, or when no signal is being received. It will increase in accordance with the above-mentioned particulars, but there is obviously a great saving, and a greatly increased output. The pentode valve lends itself admirably to this method of amplification, and the table below gives the figures obtained with a pentode in an ordinary output stage, and in Quiescent Push-pull. (This term is usually abbreviated to Q.P.P.).

| | H.T. | Current | Power output |
|---|---|---|---|
| Ordinary circuit | 110 volts | 10 mA | 190 milliwatts |
| Q.P.P. | 110 volts | 2.5mA | 450 milliwatts |

When it is possible to apply 150 volts to the output stage of these two pentodes in Q.P.P. it is possible to obtain an output of 1 watt with a consumption of only four and a-half milliamps, normal current.

### Special Transformers

It was mentioned previously that the use of valves in Push-pull enabled a signal to be applied to the valves which was nearly double that which could be applied to one similar valve. In Q.P.P., however, we can use a signal which is four times that required by one valve, and this enables a very much greater output to be obtained, as we may use more L.F. stages, as well as larger power valves. It was also stated previously that the anode circuits of the valves were coupled together by a centre-tapped choke (or transformer). In Push-pull, the two anode currents, being 180 degrees out-of-phase, cancel out, and there is therefore not so great a need for accurate matching of the anode circuit. In Q.P.P., however, the two valves work individually, and there is a much greater need for accurate matching. The inductance of each half of the output choke has therefore to be greater than with ordinary Push-pull output chokes, and consequently special components are being placed on the English market so that amateurs may take advantage of the great saving in this method of amplification. There are a number of other points which have to be guarded against, but experiments are still being carried out, and as soon as sufficient information has been obtained I shall give a constructional article in these pages of a receiver in which the principle is employed to the best advantage. The consumption of the receiver will be measured in its various forms, so that readers may obtain an accurate idea of the advantages and savings to be gained by the method, but there is still a lot of research to be carried out to avoid distortion, damage to the valves, and damage to the input transformer, due to accidental applications of the wrong voltage, or in the method of switching on and off.

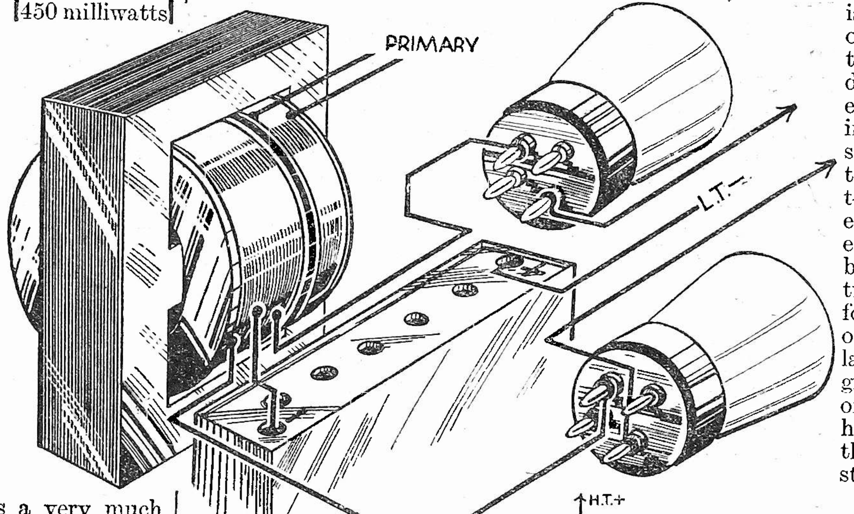
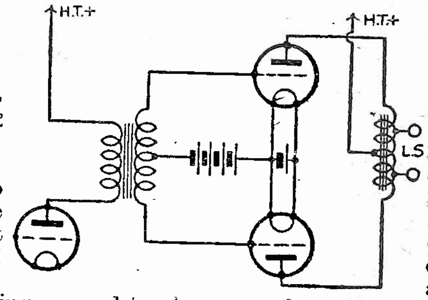



*Fig. 7.—The push-pull stage, showing how the two valves work "back-to-back."*




### Class "B" Amplification

A further development in this method of amplification is also receiving attention, and this has been called "Class B" amplification. With this method, the grid bias applied to the valves is so large that no current at all flows when no signal is being received, but when the signal is applied to the valve the positive half-cycles are so large that the grid runs over to the positive point and grid current flows. The effect of this is that the input transformer puts a terrific strain on the previous valve, and to avoid damage an ordinary transformer cannot be used. As power has to be supplied, obviously a step-down transformer must be used instead of a step-up transformer, and in America, where this method is being used in practice by one big firm, special power transformers with a step-down ratio of 2 to 1 are being employed, and the valve feeding this transformer is of a super power design similar to that used in small transmitters. This neutralises, to some extent, the saving of current effected by the output valves, but the undistorted output is tremendously increased, and for portable Public Address outfits and Talkie installations, there appears to be a great field for this method of amplification. The valves, however, appear to suffer at the moment, and I understand that the English valve manufacturers are experimenting with a view to producing special valves for the purposes. Our readers will naturally be given all information relating to this process as soon as details are available from the valve manufacturers and the component manufacturers.

## NEW Q.P.-P. COMPONENTS

THE following are details which are so far obtainable of the new components now on the market, and which are specially designed for Quiescent Push-pull amplification.

### Radio Instruments

Quiescent Push-pull Input Transformer. Primary D.C. resistance 900 ohms. The core is of high permeability nickel iron, ensuring a good bass response. The base of the transformer is fitted with a metal plate held to the bakelite casing by metal eyelets. A small kink in the centre of this plate presses against the metal core, and therefore a small soldering tag may be affixed to the screw when fixing this component down and the core earthed thereby. The Secondary has a total D.C. resistance of 9,500 ohms. The normal current which should be passed through the primary is 2 m.A., at which the Inductance is 16 henries. At 1 m.A. the inductance is 20 henries, and with no D.C. (when parallel-fed for instance) the inductance is of the order of 30 henries. The total ratio is 1/8, enabling a very good signal to be passed to the push-pull valves so as to obtain the full advantage of the principle.

Quiescent Push-Pull Output Choke. This has a total 'primary' D.C. resistance of only 400 ohms. The 'secondary' is tapped to provide two ratios, 1/1 or 2/1, but by varying the connections it is possible to obtain four ratios, namely, 1/1, 1.4/1, 2/1 and 2.8/1. The centre of the choke is connected to H.T. positive. The D.C. resistance of the Secondary at the 1.4/1 ratio is 310 ohms. and at the higher ratio it drops to 170 ohms. The Input Transformer costs 15s., plus 1s. 6d. royalty; and the Output Choke costs 12s. 6d.

### Varley Ltd.

Only one type of Input Transformer is made for this purpose by Varley Ltd., but for output purposes there are three separate types of component. The Input Transformer has the high ratio of 9 to 1, which enables the output stage to be fully loaded when using Q.P.P., and avoids all risk of the Detector valve, or penultimate L.F. valve from being overloaded before the output stage receives its full load. In spite of this high ratio, however, the Primary has been wound to provide a D.C. resistance of only 825 ohms with an inductance of 30 henries with no D.C. When included direct in the Anode circuit, the current passed may be as high as 4 m.A., at which the inductance only drops to 22 henries. At 2 m.A. the inductance is 27 henries. The secondary has a total resistance of 9,300 ohms. This component, inclusive of royalty, costs 17s. 6d.

For output purposes a combination of transformer and choke has been evolved, and the following are the details of the three components.

(1) DP37. Ratio 3/1 and 42/1. Primary D.C. resistance 460 ohms with an inductance of 13 henries for each half with D.C. current of 26 m.A. D.P38. Primary D.C. resistance of 400 ohms with inductance of 8 henries for each half with current of 26 m.A. Ratios 3/1 and 50/1. DP39. Ratios 3/1 and 75/1. Primary D.C. resistance of 400 ohms with inductance of 8 henries to each half with 26 m.A. The price of the DP37 is 18s. 6d., and the other two models cost 16s. 6d., all inclusive of royalty.

THE SECOND ARTICLE OF A SHORT SERIES

# ALL ABOUT YOUR RADIO BATTERIES

An Informative Article giving Details of Construction and Working Principles of Accumulators

By
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A.M.I.E.E.

THOSE readers who have followed the first article on primary batteries will find the knowledge acquired particularly useful in gaining information on secondary batteries, or accumulators. In fact, the knowledge thus obtained will reveal the similarity between the two types. Both batteries depend upon chemical action for setting up a potential between two elements of opposite polarity. Both types evolve hydrogen at the negative pole and oxygen at the positive pole, and in both cases the chemical action involves the combination of the two gases, and their eventual return to the liquid from whence they arose.

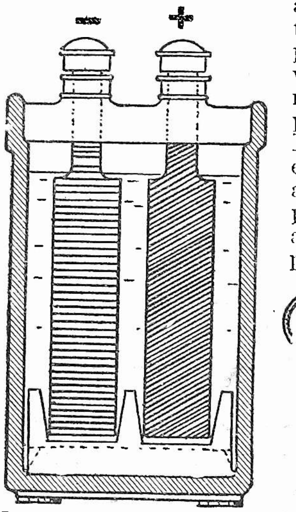

*Fig. 5.—A modern thick-plate accumulator.*

In practice the action of both types is very similar, the chief difference being that in an accumulator no zinc is consumed, neither is the electrolyte used up at the end of the discharge. One of the greatest drawbacks of the more powerful type of ordinary battery is the mess and inconvenience of emptying out the spent liquid, renewing the zinc and cleaning and reassembling the elements. Also, the cost of working is prohibitive except in the case of quite small outputs, as the zinc consumed costs several pence per pound, whereas coal, used in steam generation, comes out at several pounds per penny, to say nothing of water or even wind power.

But for all that, the primary battery is an actual generator of its own power, and does not require the assistance of a dynamo, as in the case of the accumulator. Readers who have the first article by them will do well to compare Fig. 1, therein shown, with Fig. 5 in the present article. The similarity will be found rather startling. Here we have a glass cell containing two elements, one negative and one positive, immersed in dilute sulphuric acid. So far the make-up is apparently identical, but in the present case the negative element is of finely-divided or "spongy" lead. The positive, however, reminds one rather forcibly of the Leclanche cell, as it depends for its action on a substance *rich in oxygen*.

### The Advantages of the Secondary Battery

We now come to the point where the secondary battery reveals its own special points and asserts its superiority over its humbler brother, the primary cell. In the first case there is no mess or bother over recharging, no replacement of spent elements or chemicals and—practically no loss on "standing by" within reasonable limits. All we have to do, when a recharge is necessary, is to pass a *direct* current, at the proper rate, into the battery, and in eight to twenty hours, according to type, the battery is charged up and as good as new. Let us see how these obvious advantages are brought about.

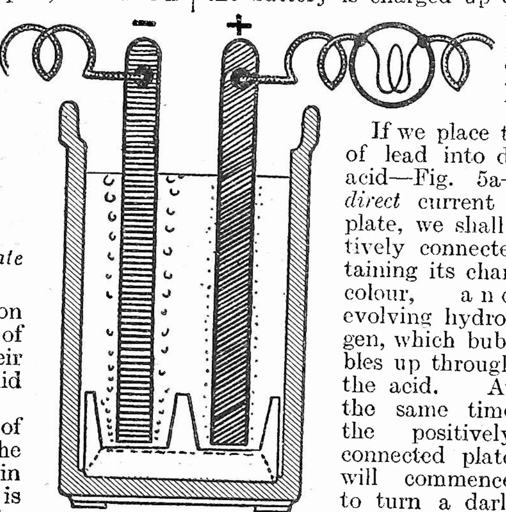

*Fig. 5 (a)—Two strips of lead in sulphuric acid.*

If we place two plain strips of lead into dilute sulphuric acid—Fig. 5a—and pass a *direct* current from plate to plate, we shall see the negatively connected plate maintaining its characteristic lead colour, and evolving hydrogen, which bubbles up through the acid. At the same time the positively connected plate will commence to turn a dark brown colour and evolve oxygen. We shall also observe that the hydrogen comes off at exactly *twice* the rate of the oxygen, proving the accuracy of the formula $H_2O$. This is a very important observation, as it provides an infallible indicator of polarity. The reader will do well to memorise this fact in the simple phrase "Negative bubbles are numerous." By doing so he will never experience the disaster of a "reversed" battery. If this process is continued for some hours we shall have "formed" the plates to some small extent, and have stored in them a limited amount of energy. This is really chemical energy, but will resolve itself into electrical energy if we connect the two plates by means of an electrical conductor. If we place a voltmeter in circuit, Fig. 6, it will register two volts instead of the average 1.5 volts afforded by the primary cell of the Leclanche type.

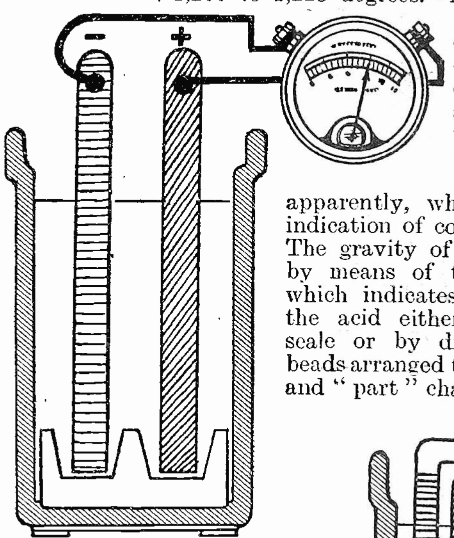

*Fig. 6.—Showing how to read the voltage of the accumulator.*

### Chemical Action in Forming the Plates

Very briefly the action is as follows: Sulphuric acid is a chemical compound of hydrogen, oxygen and sulphur, which is capable of being split up into its constituent elements by the passage of an electric current. This process is known as "electrolysis." We, therefore, have the hydrogen "reducing" the lead to a pure "spongy" form and the oxygen raising the positive element to a rich oxide of lead-peroxide. This so-called process of "forming" is greatly accelerated by casting the lead plates into "grids" and pasting them with suitable lead oxides.

These are usually litharge for the negative and red lead in the case of the positive plates. This gives the elements a good "start" and hastens, and therefore cheapens, the "forming" process, which is the most tedious operation in battery manufacture. This "forming" process is complete when the negative material has been reduced to pure "spongy" lead, and the positive material has been raised to a rich oxide of chocolate colour. When this has been brought about the cell will furnish a useful current, at a steady voltage for many hours, until its useful capacity has been discharged. During charging the "specific gravity" of the acid, i.e., its density compared with distilled water, will have risen from, say, 1,200 to 1,225 degrees. Also, as charging nears completion dense bubbles of oxygen and hydrogen will ascend through the acid until it turns milky and finally "boils," apparently, which is a visual indication of complete charging. The gravity of the acid is read by means of the hydrometer, which indicates the density of the acid either by a floating scale or by different coloured beads arranged to float at "full" and "part" charge, and sink at discharge. As the cell is discharged the gravity falls in proportion, also the voltage, which drops to 1.8 volts when the *useful*, and healthy, limit has been reached.

On a recharge these conditions are reversed.

(To be continued)

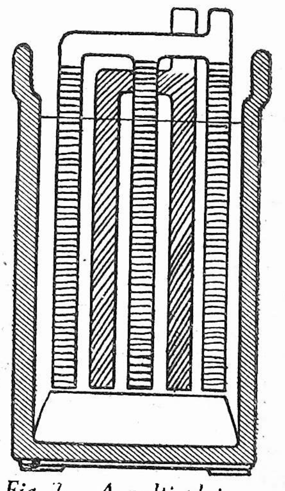

*Fig. 7.—A multi-plate accumulator, showing how the plates are joined up.*

# THE DEVELOPMENT OF THE TUNING COIL

## (PART 1)

By
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THE illustration indicated as Fig. 1 shows two coils, the one of a type commonly employed with a crystal receiver in the immediate pre-broadcasting days, and even for a considerable time after the British Broadcasting Service had been established, and which has been brought out of retirement for the purpose of photography, and the other, a modern-to-the-minute high-efficiency "canned" coil. It will be obvious at once that there is a great difference in both the dimensions and the general design of the two coils. Why these differences? In what ways are the new coils better than the old? What has led to these radical changes in design?

To appreciate the successive steps in the development of the modern tuning coil, it is necessary to bear in mind the fact that all coils are intended mainly for one purpose only—namely, to act as one element of a resonant circuit, that is to say, a circuit which, when the set is "tuned," will respond to the frequency of the wanted station, so that a large oscillating voltage is developed across the extremities of its winding. The tuned circuit may be employed to "feed" the grid of a high-frequency valve or a detector valve, as when it forms the aerial tuning element, or it may be used as the "load" in the anode circuit or following grid circuit of a high-frequency amplifier, as in the well-known tuned anode or choke-fed tuned grid circuits.

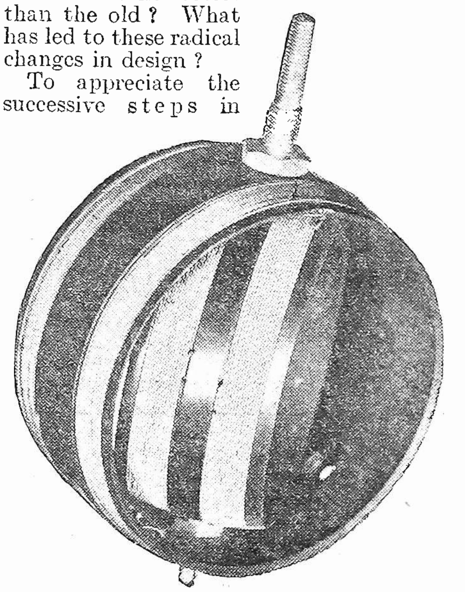

*Fig. 2.—An example of the once very popular variometer tuner.*

### Two Important Factors

Next it must be remembered that the wavelength to which such a circuit will respond depends upon two factors—the inductance of the circuit and its capacity. It follows, therefore, that a circuit can be tuned to various wavelengths by adjusting either the inductance or the capacity, or both. In order to avoid going into a technical explanation of inductance and capacity, we will take a simple analogy. Those readers who play the violin, or the ukulele, or any other stringed instrument, will know that the strings are tuned by altering their tension, that is to say, by screwing or unscrewing the pegs, and that the note given out is also altered by varying the effective length of the strings by means of the fingers. Obtaining different notes from a violin is roughly equivalent to tuning a receiver by altering the inductance of the tuning circuit, while tuning a violin by screwing up the strings corresponds more or less to radio tuning by varying the capacity.

In the modern tuning circuit, the element of inductance is provided by the coil, and practically all the capacity by a variable condenser. Every coil, however, possesses a certain measure of self-capacity, about which I shall have more to say later. Now in the pre-broadcasting and early broadcasting days, there were very few stations in operation, and very accurate and sharp tuning was not necessary. The coils employed, therefore, could be used without any additional fixed or variable condenser, the capacity of the circuit being provided by the self-capacity of the coil, and the tuning being effected by varying the inductance. This type of coil is indicated by the large one in Fig. 1. In other words, the early listener had what was equivalent to a one-string fiddle for a tuning circuit.

### Inductance Variation

Several methods were employed for varying the inductance. The coils themselves were of large diameter and considerable length, and a favourite way of adjusting their value was by providing tappings at intervals, taken down to radial switches. In one type, for example, a coil was divided into ten equal sections by a ten-stud switch, while one of the sections was further subdivided into ten parts by a second switch. A coarse adjustment of the inductance, or number of turns in circuit was made by rotating the first switch, and the final tuning was effected by means of the second switch.

In other coils, the insulation was scraped off along a straight line parallel to the axis of the coil, and a sliding contact or contacts running on a bar enabled any desired length of the coil to be tapped off (see Fig. 1). Coils of this type were arranged to tune over a wide band of wavelengths. Another form of variable inductance was the variometer, a partially dismantled example of which is shown in Fig. 2. In this component two coils were arranged one inside the other, the inner coil being swivelled so that its position relative to the fixed coil could be altered. When the two coils were parallel with their turns all in the same "sense," either all clockwise or all anti-clockwise, they had the effect of adding their inductances. As the inner coil was rotated, however, the combined inductance decreased until when the two coils were again lying parallel but in opposition, the combined inductance was equal to the difference of their respective inductances.

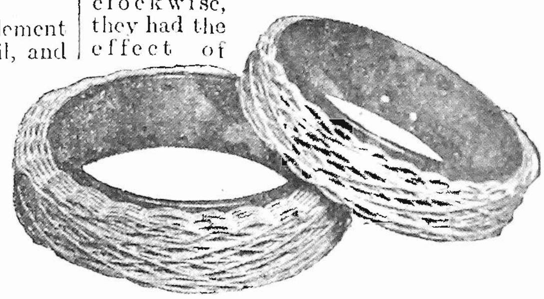

*Fig. 3.—Home-made "lattice" coils built up on spokes which were afterwards removed.*

### Serious Losses

With coils tuned in this way, and covering very wide wavebands, tuning was very "flat," that is to say, the inherent selectivity was very low. Moreover, coils which relied upon any form of tapping or sliding contacts for adjustment occasioned serious losses due to the inactive portion of the winding. As stations became multiplied in number the need for more accurate tuning was manifest,

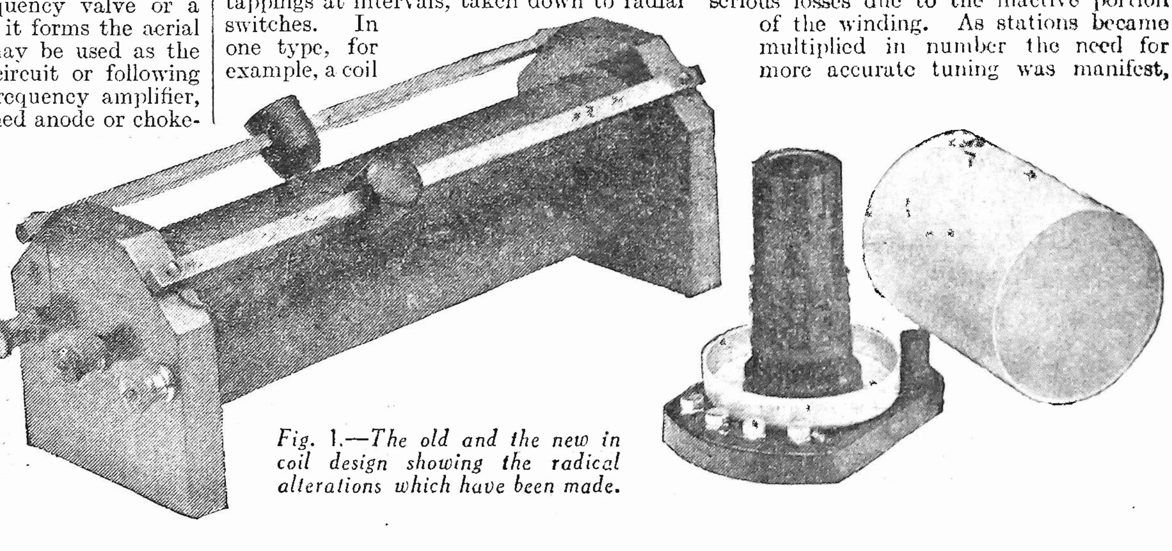

*Fig. 1.—The old and the new in coil design showing the radical alterations which have been made.*

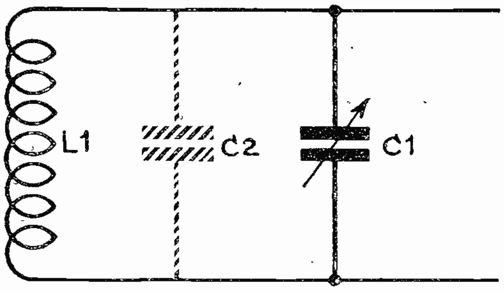


*Fig. 6.—The self-capacity of the coil shown in parallel with the coil and tuning condenser.*

and the use of coils having no provision for altering the inductance, but which could be tuned by a variable condenser, came into favour. The first efforts in this direction took the form of a tapped coil, giving a first rough approximation of tuning, with a variable condenser either in series or in parallel for accurate tuning.

Then, to avoid the losses occasioned by "end effect," a single coil without tappings was used, several coils of different inductance being provided to cover different wavebands. In those very early days manufactured coils were neither plentiful nor cheap, and most experimenters wound their own. Coils of some $2\frac{1}{2}$ to 3in. in diameter, and about an inch long, wound with several layers, were popular. They were mounted on a two-pin plug, and corresponding sockets were employed in the receiver to accommodate them. The self-capacity of these layer coils, however, was high and occasioned considerable losses, and the next few steps in development had to do with reducing these losses.

Various methods were devised, for instance, for spacing the turns and so avoiding self-capacity. So-called "basket" coils were woven around a spider-shaped former having an odd number of spokes, the spokes being afterwards removed and the coils secured by threads, see the coils illustrated in Fig. 3. Unfortunately, the higher efficiency of these coils was often cancelled out to a great extent by the practice of dipping the complete coil in paraffin wax, which substituted for the air spacing a dielectric which produced a high-capacity. The "high-water" mark of these special plug-in coils was achieved by the well-known "honeycomb" coil, which is still used to some extent to-day. Two examples of those made by the Igranic Co. are shown in Fig. 4. Although not so efficient as the best modern coils, they are, in the hands of those who know how to use them to advantage, quite satisfactory for a number of applications and, being obtainable in a wide range of inductances, can be used to good effect in receivers where the very utmost in efficiency is not required.

### How Self-capacity Arises

References have been made to the term "self-capacity," and in view of the fact that it is so often misunderstood, or its effects misconstrued, it is felt advisable to deal with the question a little more fully here before passing on to the next stage in our coil development. From previous articles in this journal readers will appreciate quite readily that if two or more metallic conductors are separated by some kind of insulator, and alternating voltages are applied to these conductors, then the configuration of conductor and insulator acts as a condenser, having a definite capacity which can be measured. In every coil, then, we have the elements of a condenser, the wire forming the coil acting as the conductor and the wire covering, coil support, or even the air acting as the insulator.

Naturally, the small condensers which are formed are complicated in their arrangement, but it will be appreciated that when an alternating voltage is applied across the ends of the coil a current will flow and a small voltage is set up between each small interturn condenser. The result of this is that a certain proportion of the current flows through this inherent capacity, and not through the wire of the coil in the correct manner. The interturn condensers really produce a *resultant effect*, equivalent to a condenser shunted across the ends of the coil, as indicated in Fig 5, and this is what we term the distributed or self-capacity of the coil.

In actual practice the capacity values obtained in this way are small when compared with the capacities of condensers normally used in the radio receiver. They can range from almost zero up to 30 or 40 mfd. (that is, .00003 mfd. or .00004 mfd.), and this will depend on the method of winding. Undoubtedly, the best coils (when space permits them to be used, and other effects, such as interaction, direct pick-up, and so on do not arise) are single layer solenoidal ones, especially when the turns are very slightly spaced.

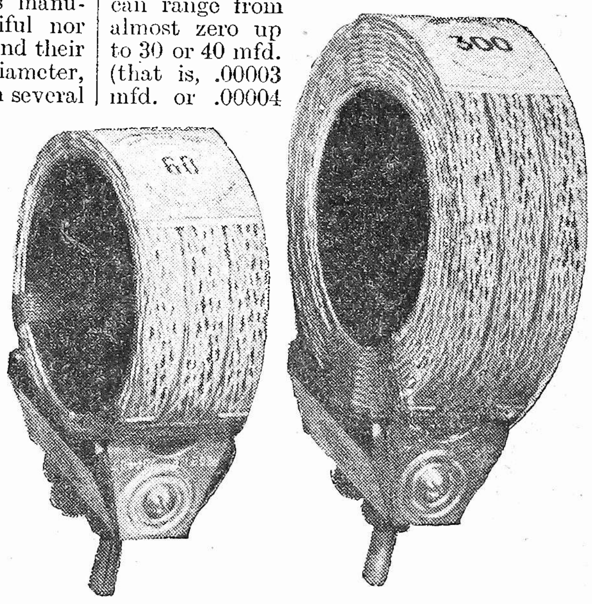


*Fig. 4.—Two good examples of the commercial version of honeycomb coils.*

### Self-capacity Effects

Comes now the question of what effects are produced by the presence of this self-capacity in any coil. I could deal with this side of the subject very exhaustively if mathematics was introduced, but, naturally, the reader does not want his mental balance upset by that procedure, so I will be content with stating a few facts which readers must accept without proof.

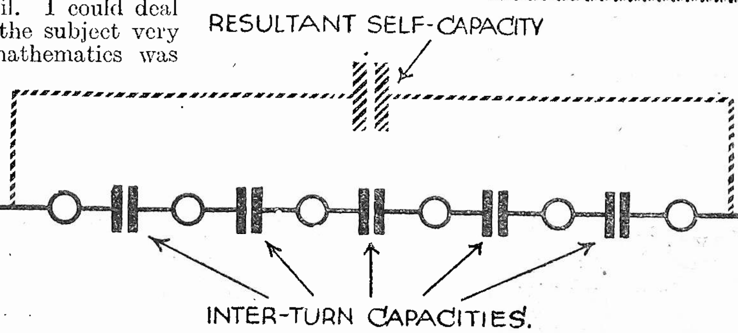


*Fig. 5.—The total distributed capacities of a coil*

First of all the inductance of the coil is increased slightly, this increase going up in proportion to the square of the frequency. It is interesting to note here, however, that since the inductance of a coil at low frequencies is more than that measured at high frequencies, the *effective* inductance at these high frequencies will probably differ but little from that at low frequencies. That is to say, the increase due to the presence of the self-capacity will counterbalance the decrease due to the high frequency effects, and, in consequence, there is little to worry about on this score.

Referring to Fig. 6, however, it will be seen at a glance that when we have our coil L1 tuned by a variable condenser C1, the self-capacity, shown dotted as C2, in effect increases the value of the capacity of the tuning condenser at any point in its range. As far as the maximum capacity value of the condenser is concerned (generally .0005 mfd.) the proportional increase is quite small, but when we come to the other end of the scale the minimum value of the condenser capacity is increased in a much larger proportion.

The outcome of this should be at once apparent, namely, a restriction of the tuning range for a given coil by reducing the ratio of the maximum capacity to the minimum capacity of the tuning condenser. How often have amateurs been at a loss to understand why they could not tune down to a certain wavelength—here is a very likely cause and a reason why it should be avoided if at all possible. There are one or two other effects to which I shall make reference, but these must be deferred to the next article in this short series.

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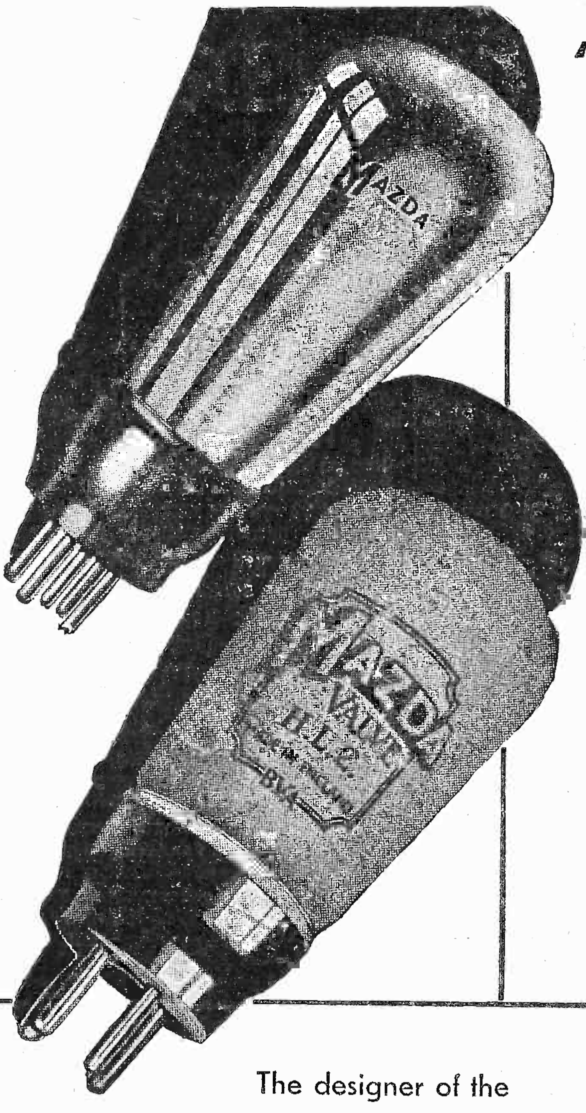
## MAZDA LEADS THE WAY IN 1933 WITH "QUIESCENT PUSH-PULL"



*—the new principle developed in the Mazda valve laboratories and used for the new "Wireless World Quiescent Push-Pull 2."*

The problem of economically providing a battery operated set with sufficient power to operate a moving coil speaker efficiently has hitherto proved a serious difficulty. The new principle of Quiescent Push-Pull, developed in the Mazda Valve Laboratories, has solved this problem as, by the use of two Mazda Pen 220A's, a power output of as much as 1.3 watts can be obtained with a total H.T. consumption of only 6 m/A at 120 volts.

The new principle is used to great advantage in this new "Wireless World" circuit, which has been designed to work with Mazda valves.

For full report on Quiescent Push-Pull see article by E. YEOMAN ROBINSON, CHIEF ENGINEER, THE MAZDA VALVE LABORATORIES, in "Wireless World" for January 6th, 1933.

The designer of the "WIRELESS WORLD" QUIESCENT PUSH-PULL 2 specifies **2 MAZDA PEN 220A's 17/6 ea.** and **1 MAZDA H.L.2 . . . 7/- ea.**

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V.185

# *PRACTICAL NOTES on—* LOW-FREQUENCY COUPLINGS

## Underlying Principles and Sound Advice on the Correct Use of the L.F. Transformer

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

MOST listeners will have noticed that in many modern receivers the low-frequency transformer is not connected in the conventional manner, that is to say, with the primary winding direct in the anode circuit of the previous valve, but that a resistance fed circuit is adopted. Although those who have made a study of radio theory are able at once to appreciate the reasons for and the advantages of this method of connection, a brief description of resistance feed and a simple explanation of the reasons for its adoption will form a fitting introduction to these notes.

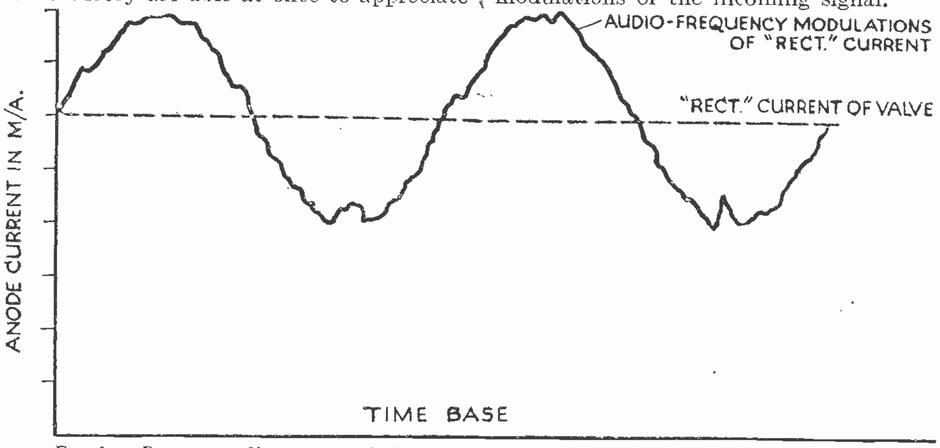



*Fig. 1.—Diagram illustrating difference between "rest" current and actual current passed by valve.*

To-day is the day of fairly powerful sets, employing at least one radio frequency amplifying stage. As a result, signal voltages of considerable magnitude are built up before being passed to the detector valve. The ordinary leaky grid detector, operated at a fairly low anode voltage, is unable to handle very strong signals without some risk of distortion due to what is termed double rectification. It is possible, however, by increasing considerably the anode voltage of the detector and at the same time modifying the values of the grid condenser and leak, to increase the signal capacity of the detector valve, thus reducing the risk of overloading, even when strong signals are being handled. This method of detection is called "power grid" detection and it is being adopted in both manufactured and constructional sets where really good quality output is desired.

### Saturation

There is, however, one disadvantage attaching to this system, namely that, at the higher value of anode voltage, the anode current becomes substantially increased, and usually reaches a value which causes "saturation" of the average type of low-frequency transformer. To realise the nature and effects of saturation it is necessary to know that the anode current of a detector valve can be considered as comprising two portions: a steady direct current equal to that which the valve would pass when the normal anode voltage was applied and no signal was being received, and an alternating current equal to the variations in current due to the audio-frequency modulations of the incoming signal.

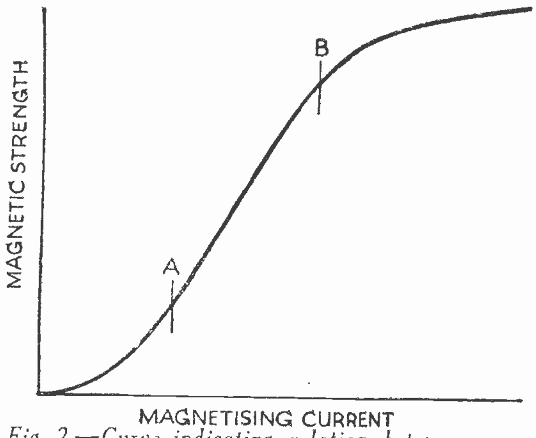



*Fig. 2.—Curve indicating relation between magnetizing current and magnetism induced in core of L.F. transformer.*

This is shown in Fig. 1, where the steady or "rest" current of the valve is indicated by a dotted line, while the actual value is shown by the thick line. If the whole of the anode current is passed through the primary winding of the transformer, the core will achieve a steady degree of magnetization due to the direct current component, and this magnetization will be modulated by the alternating component of the anode current. This would not matter in the slightest if the actual value of the magnetization at any moment was strictly proportional to the strength of the magnetizing current.

### Magnetizing Effects

Unfortunately, however, the iron of which the cores of transformers are made does not respond uniformly to the magnetizing current. The relation between magnetizing current (in this case the value of the anode current at any instant) and the magnetism induced in the core is indicated in the curve reproduced in Fig. 2. It will be seen that over a considerable range of current values, represented at A to B, the magnetism of the core is proportional to the magnetizing current, but that above B, popularly known as the "knee" of the curve, the magnetic strength does not increase so rapidly with increasing current. If, therefore, the steady or "rest" value of the anode current is approximately equal to B, the changes in magnetism will not be in strict proportion to the changes in anode current, but will be distorted as illustrated in Fig. 3, where the curve A.C. represents the variation of anode current and the curve MS represents the resultant changes in magnetic strength. Because the secondary voltage of the transformer, which is the signal applied to the grid of the following valve, follows faithfully the changes in magnetic strength, it follows that saturation of the iron core must result in distortion of the signal.

The device known as resistance feed avoids the risk of "iron circuit distortion" by filtering out the direct current component of the anode current. Fig. 4 is a simple diagram of the connections, and it will be seen that the main anode current passes through a high resistance R, while the audio-frequency voltage developed across this resistance is led to the transformer primary via the condenser C.

The correct values of resistance and condenser have been often explained in PRACTICAL WIRELESS, and it will suffice to remind readers that the resistance should be from two to five times the anode resistance of the valve, and the condenser of approximately one microfarad capacity. Further, the resistance must be capable of carrying the full anode current of the valve without overheating. Several interesting variations of the standard connections are available and the different alternatives have their specific uses in different circumstances.

### Connection Variations

For example, in the diagram Fig. 4, the step-up ratio of the transformer is equal to the "turns ratio." That is to say, if the

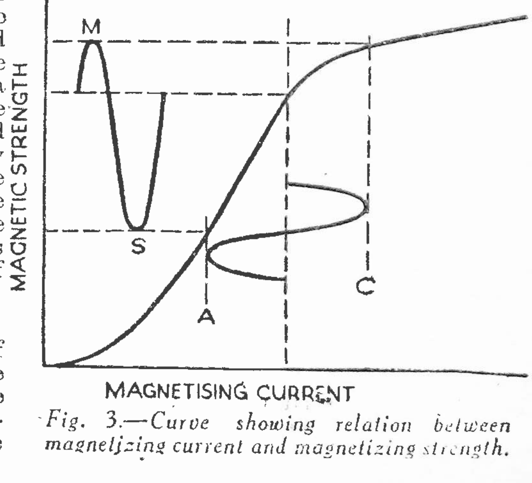



*Fig. 3.—Curve showing relation between magnetizing current and magnetizing strength.*

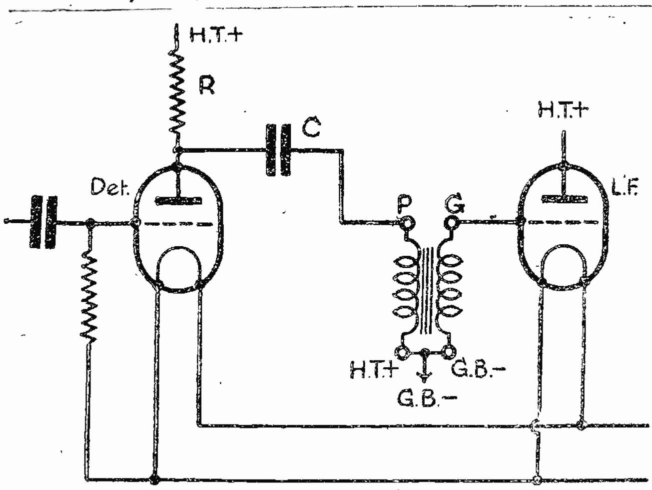



*Fig. 4.—Diagram illustrating step-up ratio of the L.F. transformer.*

transformer is a standard 4 to 1 component, having four times as many turns on the secondary winding as on the primary winding, the step-up in Fig. 4 will be 4 to 1.

It is possible, however, by varying the connections to the transformer, to obtain three other ratios. It is obvious that in Fig. 4 the incoming signal is applied only to the primary winding, between the terminals P. and H.T. + which is connected to earth via the terminal G.B.—, while the grid circuit of the following valve comprises simply the secondary winding, which has four times as many turns. But in Fig. 5 by a simple re-arrangement of the connections, the primary circuit still contains the same number of turns, while the grid circuit is composed of the primary and secondary windings in series, so that the effective ratio of the transformer is 5 to 1.

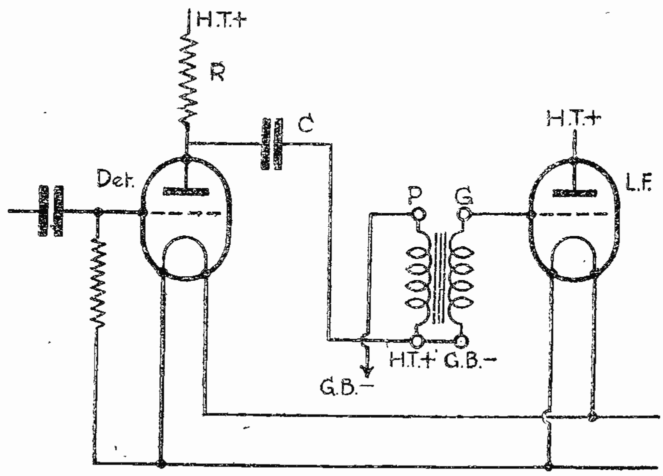



*Fig. 5.—Rearrangement of Fig 4 to give increased step-up ratio.*

A further variant in Fig. 6 is similar to Fig. 5, but the primary winding is reversed, so that the secondary or grid circuit consists of the primary and secondary windings in *opposition*. The step-up ratio in this case is one less than the turns ratio of the transformer, and in the case of a 4 to 1 transformer would be only 3 to 1.

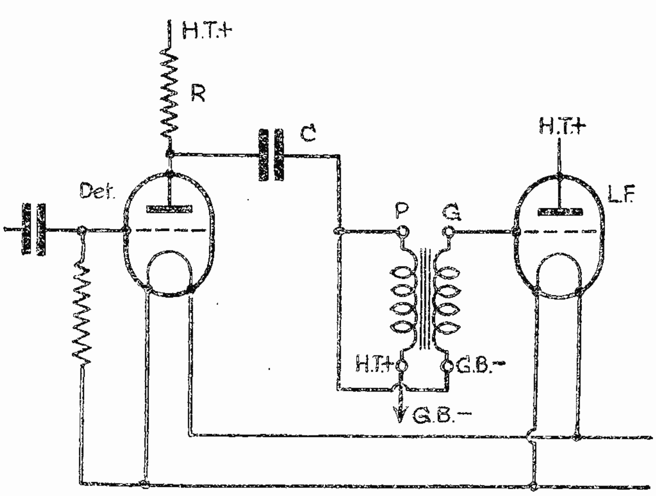



*Fig. 6.—Connections of L.F. transformer when using pentode output valve.*

### Becoming a Grid Choke

The last combination is illustrated in Fig. 7. Here the primary and secondary windings are again in series, but the connection from the coupling condenser is also taken direct to the grid of the following valve. A little study of this diagram reveals that the circuit is equivalent to ordinary resistance capacity coupling with a low frequency choke instead of a high resistance leak to complete the grid circuit. The transformer, therefore, simply acts as a grid choke, and has no step-up effect. Another way of looking at it is to consider this arrangement as a 1 to 1 transformer.

It may now be asked what uses can be made of these different arrangements. One can almost hear some reader saying: "Why bother to reduce the step-up effect of your transformer? Surely the most economical method is to use circuit No. 5 and obtain the biggest possible effective ratio."

But this is not necessarily so. In many cases it is true that the extra step-up is of considerable value. For example, it must be remembered that, in introducing the resistance feed method, the total amplification of the valve is to an extent limited. To quote one case, the maximum stage gain, apart from the transformer step-up, is equal to the amplification factor of the valve multiplied by the resistance R and divided by the sum of R and the anode resistance of the valve. If, therefore, the resistance R is only twice the valve resistance the gain (again not counting the transformer step-up) can only be two-thirds of the valve's amplification factor. The additional effective ratio obtained in Fig. 5 may, in this case, be of advantage. On the other hand, suppose you are employing a pentode in the output stage, you might conceivably find that with the highest ratio, or even the simple turns ratio of the transformer, you were overloading the output valve, and thus getting bad reproduction. It is then a simple matter to change the connections to those shown in Fig. 6 and thus reduce the overall amplification.

### Individual Study

In extreme cases, say, for instance, where you have two low-frequency stages, it may be of advantage to adopt the one to one arrangement, relying for amplification on the gain obtained by the resistance capacity network R and C.

In fact, each receiver must be considered entirely on its own merits. Due regard must be had to the strength of the signals received, to the number and efficiency of the other low-frequency amplifying stages, and last, but by no means least, to the "acceptance" or signal handling capacity of the following stages, especially the output stage. It is not for a moment suggested that complicated switching arrangements should be installed to enable rapid change-over to be made from one set of connections to another. It is definitely worth while, however, to experiment when building a set, in order to ascertain which arrangement suits best your particular valve combination and working conditions.

Further, it is useful to be able to alter the ratio in the event of changing the valve types, as from triode to pentode output. Another use to which the arrangement may be put is to increase the ratio during the summer months, when reception conditions, especially for the distant stations, are not so favourable as during the winter. If the "turns minus one" or simple turns ratio scheme is adopted as standard for winter reception, it may well be that the additional amplification provided by the "turns ratio plus one" arrangement may be a considerable advantage in the summer.

Many listeners, in addition to their "house" set for family use, like to keep an experimental receiver in commission. It would be a good plan to arrange such a receiver with flexible connections to the transformer so that the benefit of changing ratios can be obtained swiftly and without breaking and re-making soldered joints.

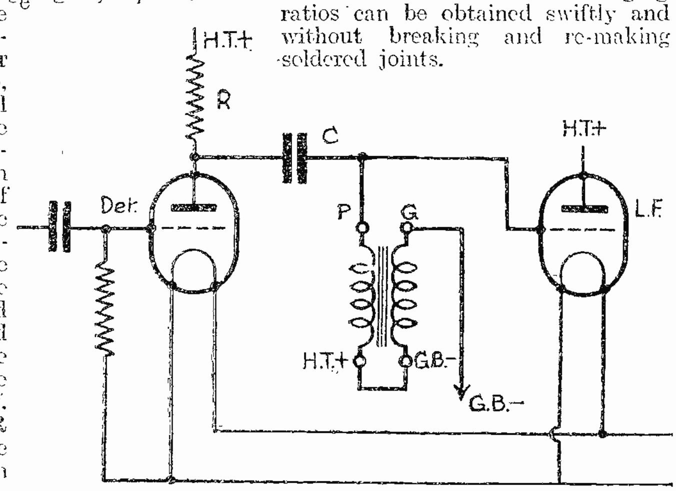
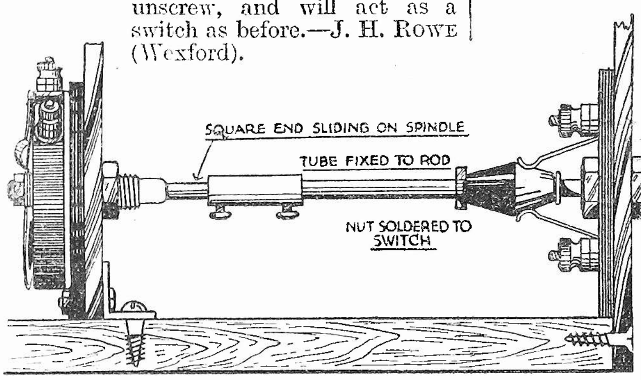



*Fig. 7.—Another arrangement of L.F. transformer.*

# THE HALF-GUINEA PAGE — Radio Wrinkles FROM READERS

## A Dual-control Device

HERE is a device which will be useful to those who wish to add a rheostat, volume control, etc., without an additional knob on the panel, when the set has a push-pull switch. Solder a 2B.A. or larger nut, to the metal bush on the end of the switch, as shown in the sketch, and to this screw a piece of brass rod tapped accordingly. The extra component is mounted conveniently back from the panel on a piece of ebonite, and its spindle is filed flat or square. A small piece of brass tube is soldered to the extension rod, and the remaining end is hammered square or flat to fit the component spindle and to slide freely on it, as shown. If the nut and switch knob are tightened properly the knob will operate the component and never unscrew, and will act as a switch as before.—J. H. ROWE (Wexford).




*A handy dual control device.*

## Switching in the Extra Valve

HERE is a simple method of using some old coil plugs to plug the speaker to the extra valve, and at the same time to connect the L.T. to the said valve. The push-pull switching arrangement on the panel is not interfered with, and still functions on whatever number of valves is used. First obtain a piece of ebonite of the same thickness as the plugs. Mark out and drill four holes. Into these holes push tightly two pins and two sockets (obtained from two broken plugs) as shown in Fig. 2. To the right hand side only of this double socket affix two pieces of thin brass to the ebonite by two 6 B.A. screws and nuts or

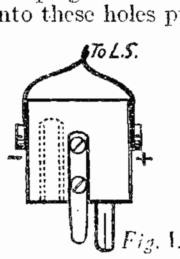



*Fig. 1.*

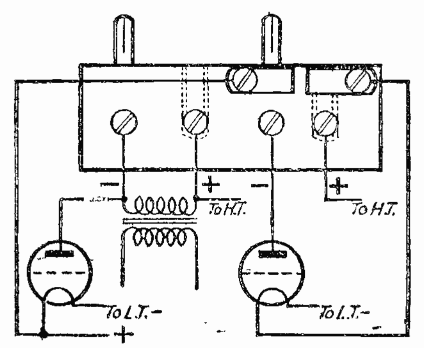


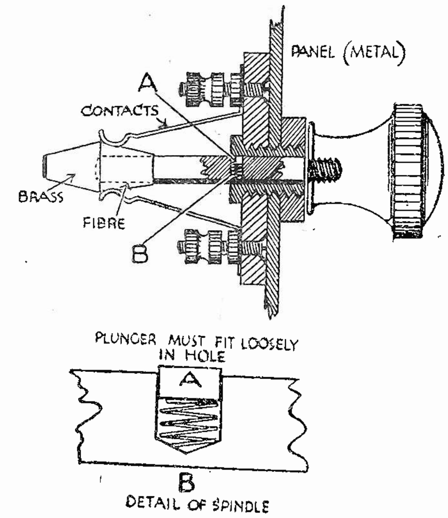

*Fig. 2.—A simple plug-in switch arrangement.*

> ### THAT DODGE OF YOURS!
>
> Every reader of "PRACTICAL WIRELESS" must have originated some little dodge which would interest other readers. Why not pass it on to us? 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."

terminals. To another plug affix by two 6 B.A. screws and nuts a small piece of brass (Fig. 1) to make contact with the two pieces of brass on the double socket. The wiring arrangement is clearly shown in the sketch, which also helps to make the idea clear. It will be seen that when the L.S. plug is in the left-hand socket the L.T. supply to the other socket is broken, and when the L.S. plug is in the right-hand socket the L.T. is connected and the extra valve is functioning.—C. T. EVERARD (Chelmsford).

## A Panel Switch Improvement

THE accompanying sketch shows an arrangement which I have adopted to make positive contact between the spindle and the bush of a switch mounted on a metal panel. As is common with many switches of this type, after a short time the spindle wears loose and results in uncertain contact, which invites trouble. All that is necessary to do to convert a switch of this type is to drill a small hole, say ⅛in. diameter, diametrically in the spindle, midway between the end of the fibre bush and the knob. Next cut a piece about 3-32in. thick from a piece of ⅛in. diameter brass rod. This forms the plunger, which must fit loosely in the hole in the spindle. To complete the arrangement all that is required is a small spring, ⅛in. outside diameter and about ⅛in. long, which fits at the back of the plunger. The spring is put in the hole and the plunger on top. The plunger is then held down flush with the spindle whilst the bush is slipped over. Of course the stroke of the spindle must not exceed twice the length of the bush, or the plunger is apt to fly out. The spindle, plunger, and bush can be assembled first and then fitted in the other part after, if the contacts are slackened off and moved to one side. The



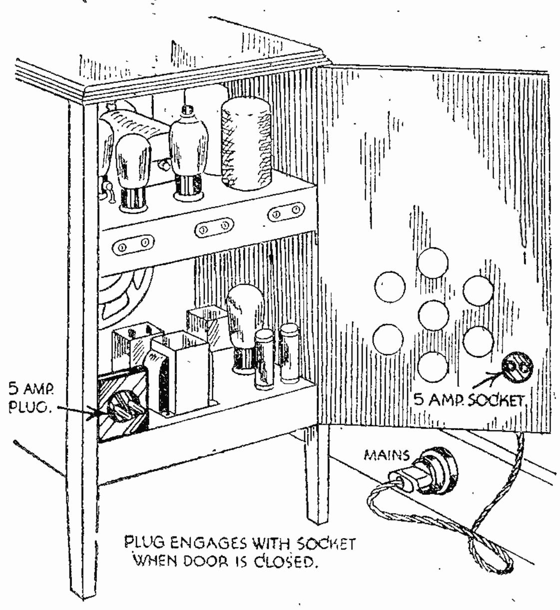

*Improving contact in a switch spindle.*

above is a typical example, and the sizes may be altered to suit different types of switches. This method provides an easy solution to faulty switches.—G. HUMPHREYS (Birmingham).

## Automatic Safety Switch

THE accompanying illustration shows a simple automatic switching arrangement for an all-electric receiver. Mounted inside the cabinet, at the rear, is a two-pin plug to which the connections from the mains unit are taken. A corresponding socket is screwed to the door of the cabinet in such a position that when the door is closed the socket engages with the pins, so completing the circuit. When the door is opened the circuit is automatically broken, and the arrangement makes a useful safety switch, particularly for persons unacquainted with mains apparatus.—E. HUGHES (Hendon).

(*Continued on page 941.*)




*An automatic switch for an all-electric receiver.*

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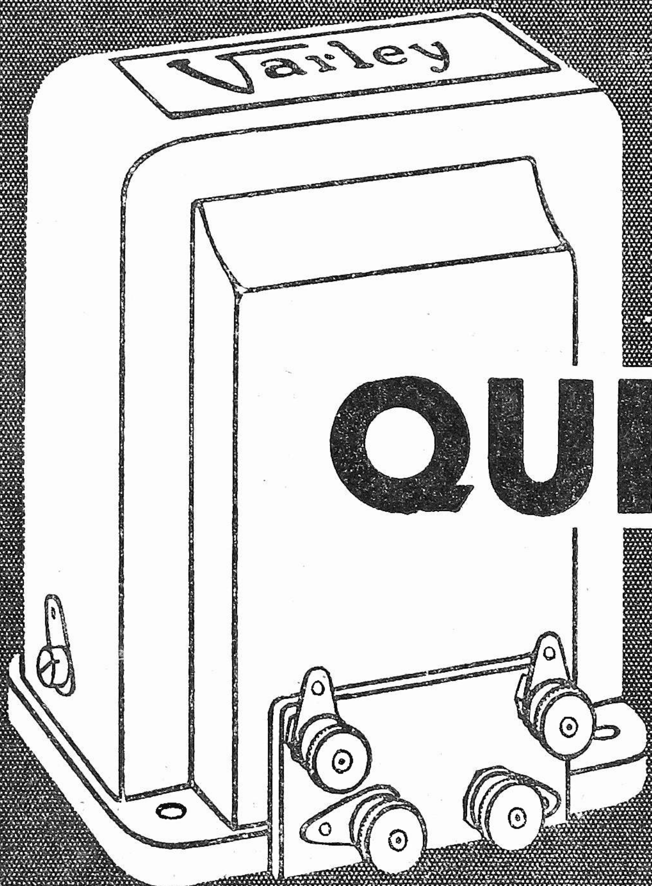


● **DP36.** QUIESCENT PUSH-PULL INPUT TRANSFORMER

| | |
|---|---|
| Ratio | 9/1 |
| Primary D.C. Resistance | 825 ohms. |
| Total Sec. D.C. Resistance | 9300 ohms. |
| Prim. Inductance | 30 henries with no D.C. |
| | 27 " " 2 M.A. |
| | 22 " " 4 M.A. |

PRICE, *including Royalty* ........ **17/6**

# QUIESCENT

● **DP37.** QUIESCENT PUSH-PULL OUTPUT TRANSCHOKE

| | |
|---|---|
| Ratios | 3/1 and 42/1 |
| Primary D.C. Resistance | 460 ohms. |
| Sec. D.C. Resistance (3/1) | 130 ohms. |
| Sec. D.C. Resistance (42/1) | ·8 ohms. |
| Primary Inductance | (each half) |

13 henries with D.C. current of 26 M.A.

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● **DP38.** QUIESCENT PUSH-PULL OUTPUT TRANSCHOKE

| | |
|---|---|
| Ratios | 3/1 and 50/1 |
| Primary D.C. Resistance | 400 ohms. |
| Sec. D.C. Resistance (3/1) | 130 ohms. |
| Sec. D.C. Resistance (50/1) | ·9 ohms. |
| Primary Inductance | (each half) |

8 henries with D.C. current of 26 M.A.

PRICE, *including Royalty* ........ **16/6**

● **DP39.** QUIESCENT PUSH-PULL OUTPUT TRANSCHOKE

| | |
|---|---|
| Ratios | 3/1 and 75/1 |
| Primary D.C. Resistance | 400 ohms. |
| Sec. D.C. Resistance (3/1) | 130 ohms. |
| Sec. D.C. Resistance (75/1) | ·64 ohms. |
| Primary Inductance | (each half) |

8 henries with D.C. current of 26 M.A.

PRICE, *including Royalty* ........ **16/6**

# Varley

**READY NOW**

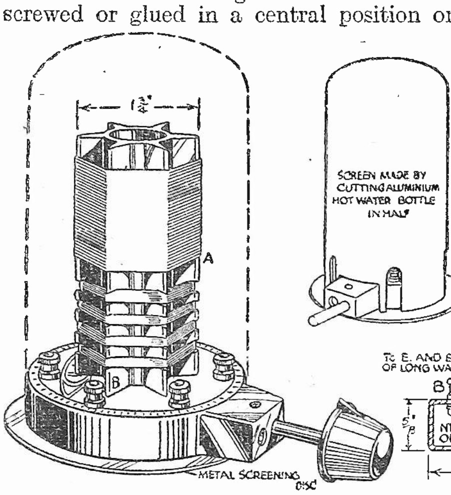
Proprs.: OLIVER PELL CONTROL LTD.

*Advertisement of Oliver Pell Control Ltd., Kingsway House, 103, Kingsway, London, W.C.2. Telephone: Holborn 5303.*

(*Continued from page 939.*)

### Coil Mountings from Old Plug-in Coil Cases

THE ebonite cases of old plug-in coils make very good mountings for home-made S.G. coils, such as were published in No. 3 of PRACTICAL WIRELESS. The old case is first emptied of its coils, then a ½in. hole is bored in the centre of one side. The tuning coil is then either screwed or glued in a central position on

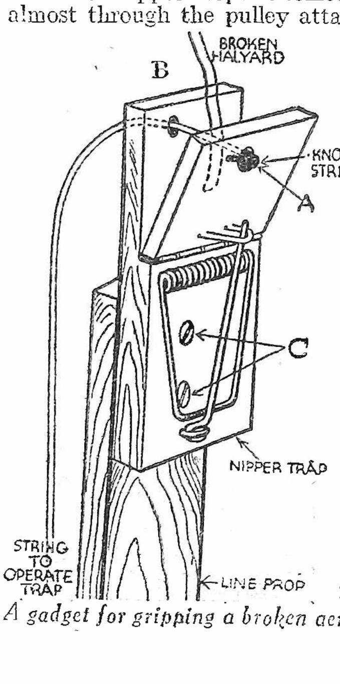



*A plug-in coil case used for a coil mount.*

top of the ebonite case, as shown in the accompanying sketch. Any number of terminals can be fixed around the coil, the wires being passed through the ½in. hole and secured underneath the terminals. The terminals A and B are placed in a line at right angles to the old pin holder. A piece of sprung metal is fastened on, but it must not quite touch terminal B. A brass rod is passed through the pin holder to a position immediately beneath the spring clip. A small piece of metal is fixed to this end, so that when the knob on the other end is turned it will force the clip up to B and short the long-wave winding. These mountings and coils can be ganged by boring a hole opposite the pin hole and then passing a long rod through to another coil mounting. A cheap and efficient shield can be made of an aluminium hot-water bottle, which is cut to the size required.—B. CLARKE.

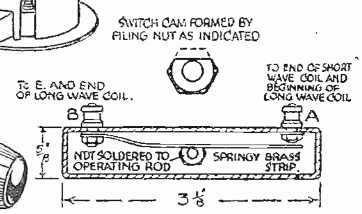
### When the Aerial Breaks

WHEN the aerial breaks, the halyard or support rope is sometimes pulled almost through the pulley attached to the pole or other fixture, so that it is impossible to get hold of the loose end without having to climb or lower the pole. I have found the following gadget work most successfully in dealing with this problem. Procure a mouse or rat trap of



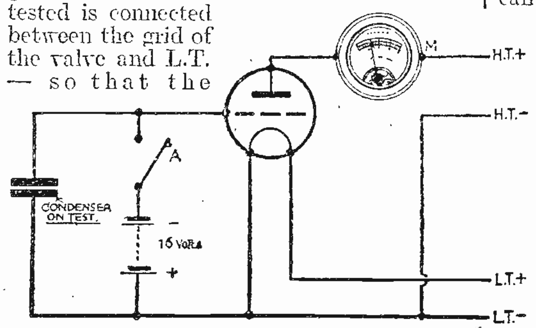

*A gadget for gripping a broken aerial halyard.*

the "nipper" pattern and, having drilled a small hole A through the flapper portion, and another hole B through the base, fix the trap by means of two screws C at the extreme end to a clothes-line prop or other suitable pole. Note that about half the trap should overhang the end of the pole. A long length of string is then passed through the hole B and secured by means of a knot on the upper side of hole A. The trap is now set in the ordinary way, and the prop raised and manœuvred until the loose cable or rope protruding from the pulley comes between the jaws of the trap. The long string which is attached to A is then pulled and the rope secured so that it can be hauled safely down again. —S. C. TOYE (Erdington).



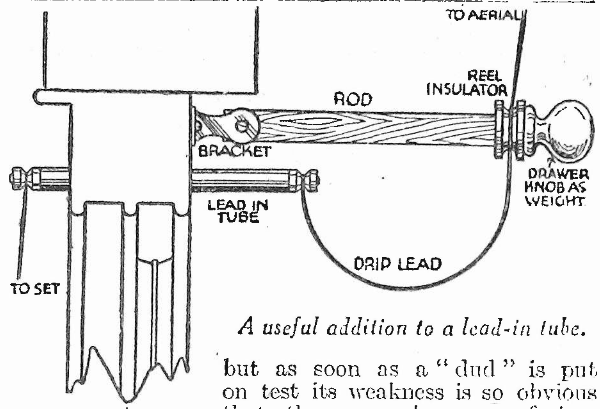

### Testing Fixed Condensers

I HAVE found the following to be a thoroughly reliable and economical way of testing fixed condensers of .5 mfd. or larger capacity. The circuit consists of any triode type battery valve arranged with about 90 volts H.T. across plate and filament, preferably from a dry battery. Grid bias is applied by means of a 16-volt G.B. battery across grid and filament. The condenser to be tested is connected between the grid of the valve and L.T. — so that the




*A method of testing fixed condensers.*

G.B. battery will charge it. A switch (A) is arranged so that the G.B. battery may be cut out of the circuit, and a milliameter (M) is included in one of the H.T. leads. Now with switch A closed, a grid bias of 16 volts is applied and H.T. consumption is as shown by the milliammeter to be very small. If the fixed condenser is a good one there is a voltage across its plates very nearly as high as that of the G.B. battery, and as no current is needed to apply G.B., any drop in voltage will be due to the condenser itself leaking. To show how quickly this voltage will drop, open switch A. This cuts out the G.B. battery and bias is now applied by the condenser. If the condenser is a good one of, say, 4 mfd. capacity, there should be no appreciable rise in anode current for at least fifteen minutes. The lower values show a quicker rise, but as soon as a "dud" is put on test its weakness is so obvious that there can be no confusion. —D. C. GREEN (Clevedon).



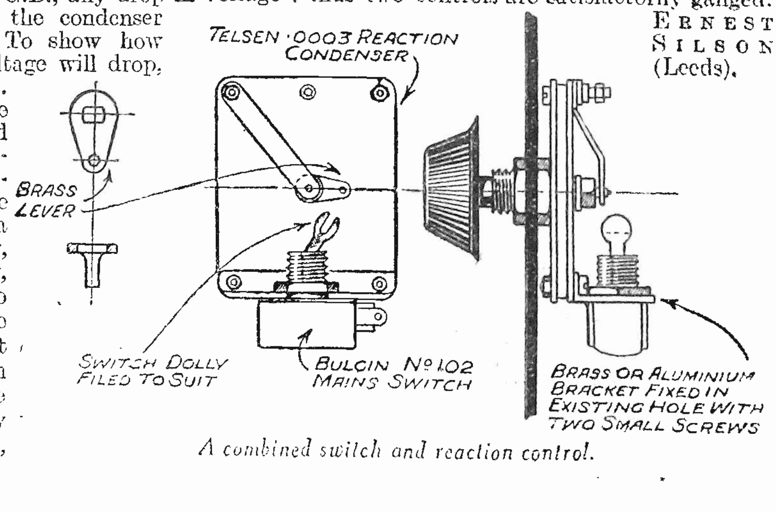

*A useful addition to a lead-in tube.*

### A Lead-in Fitment

AN aerial lead-in refinement which has the advantage of compensating for the slackening and tightening of aerial ropes due to weather variations is of great value to keep the down lead taut and prevent swaying where it is near to the house wall. A rod of wood about ½in. diameter and about 15in. long is hinged to a bracket fixed to the window frame just over the lead-in tube. A reel insulator is fixed on the outer end of the rod together with a small weight of any suitable kind (a china door knob is actually used). The down lead is wired to the insulator and then direct to the lead-in tube, with only a little slack to provide a "drip" loop. The hinge can be made with two window-blind brackets and a 4B.A. long screw fixed through the rod. The arrangement is adjusted to be just free to move up and down, and thus makes allowance for the shrinkage of the ropes during wet weather. The weight should be adjusted to keep the down lead taut.—A. H. STAPLES (Hendon).

### Combined Switch and Reaction Control

THE accompanying sketch shows a useful gadget I have made for my two-valve all-electric receiver. It consists of a reaction condenser combined with a mains switch, thus making the set easier to control by the inexperienced members of the family. A "Telsen" .0003 mfd. reaction condenser (*not* differential) was obtained and to it is fixed a brass bracket by means of small bolts through the existing eyeletted holes. This bracket has a hole cut in it for the Bulgin or similar mains switch. The switch dolly is filed out as shown, and a small brass or steel lever is made and fitted to the main shaft of the condenser. This engages with the cut dolly at minimum capacity, and thus two controls are satisfactorily ganged. ERNEST SILSON (Leeds).




*A combined switch and reaction control.*


*Mr. W. B. Richardson leaving in a Tiger Moth with a Fury Four for test.*

# MORE ABOUT THE WHICH WILL MAK

# The Fu

**EVERY READER WHO MAKES THE FURY FOUR WILL BE ADVISED FREE OF CHARGE UNTIL THE SET FUNCTIONS IN THE MANNER CLAIMED.**

By
**F. J. CAMM**

*who will give complete constructional details next week, together with independent test reports.*

THE publication of the preliminary announcements concerning my new receiver, the "Fury Four," in our issues for January 21st and 28th has produced an enormous amount of interest, not only among the readers of this paper but also among the trade and the Press generally. I have received a welter of correspondence from eager readers asking for advance details of its construction, whether it will be suitable for A.C. operation, whether it is stable and so on. I cannot, of course, send advance details through the post, but full constructional details, together with a full-size wiring diagram showing above-baseboard and sub-baseboard wiring will be given in next week's issue. As I explained earlier, I have been to an enormous amount of trouble to make the "Fury Four" worthy of the paper. I have checked and double checked component values, tested it on a variety of aerials and demonstrated it to many wireless experts and members of the radio trade. I have received also one or two letters from inspired sources, to which I have not for obvious reasons replied, for I cannot divulge information which keeps us ahead of our competitors.

The "Fury Four" has my personal guarantee that it does what I claim for it, and I would repeat, every reader of this paper may obtain my advice FREE OF CHARGE until the receiver functions in the same manner as mine. It has been tested in swamp areas, and I shall place before you evidence in support of my claims, together with the reports of experts to whom I have loaned receivers.

### The Controls

Last week I explained the circuit diagram in detail and I feel that I ought now briefly to run over the controls. The knob on the extreme left is the main tuning knob and that on the extreme right the secondary tuner. A remarkable feature of the "Fury Four" is the manner in which these two scales remain in step at both ends of the scale. For example, at the lower end of the scale London National comes in with both dials set to 18; London Regional with both dials set to 50; Midland Regional with both dials at 60; and North Regional with both set to 80. You will note from the calibration chart given next week that the double gang and the single condenser remain in step with remarkable precision, thus avoiding the confusing operation of having to set one dial to one number and the second one to another. The central and upper knob is the wave-change

*The finis*

**FREE FULL-SIZE 1/- FURY FOUR WILL BE**

*A rear view of the Fury Four from which the compact lay-out may be seen.*

*The arrangement of the components a*

# 1933 WONDER SET
# E RADIO HISTORY

## ay Four

**The Multi-Station RECEIVER WITH THE DESIGNER'S GUARANTEE OF SATISFACTION.**

**SEE THE PERSONAL GUARANTEE GIVEN LAST WEEK!**

hed receiver with the W.B. speaker ready for use.


*Mr. W. J. Delaney, about to enter a Tiger Moth with another Fury Four for test purposes.*

switch, and immediately beneath it the on-off switch. The left-hand lower knob is the potentiometer for adjusting the voltages applied to the screening grids, and the right lower knob is the reaction condenser. A valuable use can be made of these two latter controls when interference or jamming occurs by reducing the voltage applied to the screening grid and building up signal strength by means of the reaction condenser.

Coupled with the other outstanding features of the "Fury Four" this system of control makes for great selectivity, and enables the operator to have complete control over the stability, signal strength, and quality of reproduction of the "Fury Four"; and speaking of quality of reproduction, all of the experts to whom the "Fury Four" has been demonstrated are unanimous in pronouncing it faultless. As an example of its station-getting properties I append a list of stations clearly received without jamming or overlap at Hendon on Friday, January 20th, on a poor indoor aerial. No effort was made to provide a complete list of the stations received, the following merely being selected from my calibration chart and the dials set to the positions I had previously ascertained.

All of the undermentioned stations were tuned in and verified within an hour. This, of course, is not a complete list of the stations received on the "Fury Four." A full list of stations received will be given next week.

LONG WAVES.
HUIZEN.
LAHTI.
RADIO-PARIS.
KONIGS WUSTER-HAUSEN.
DAVENTRY NATIONAL.
EIFFEL TOWER.
WARSAW.
MOTALA.
MOSCOW.
KALUNDBORG.
OSLO.

MEDIUM WAVES.
BUDAPEST.
MUNICH.
VIENNA.
BRUSSELS No. 1.
PRAGUE.
NORTH REGIONAL.
LANGENBERG.
BEROMUNSTER.
ROME.
KATOWICE.
SOTTENS.
MIDLAND REGIONAL.
LEIPZIG.
RADIO TOULOUSE.
LWOW.
SCOTTISH REGIONAL.
ALGIERS.
STUTTGART.
LONDON REGIONAL.
STRASBOURG.
BRNO.
BRUSSELS No. 2.
MILAN.
POSTE PARISIEN.
BRESLAU.
GOTEBORG.
PTT.
NORTH NATIONAL.
HILVERSUM.
SCOTTISH NATIONAL.
BRATISLAVA.
HEILSBERG.
TURIN.
MORAVSKA-OSTRAVA.
LONDON NATIONAL.
FRANKFURT-AM-MAIN.
HORBY.
FÉCAMP.

Only occasionally was it found necessary to make slight adjustments to the pre-set aerial condenser, in order to find the best setting for the particular aerial which was used. As a matter of fact, the "Fury Four"

**BLUEPRINT OF THE**
**GIVEN NEXT WEEK!**

d the wiring beneath the baseboard.

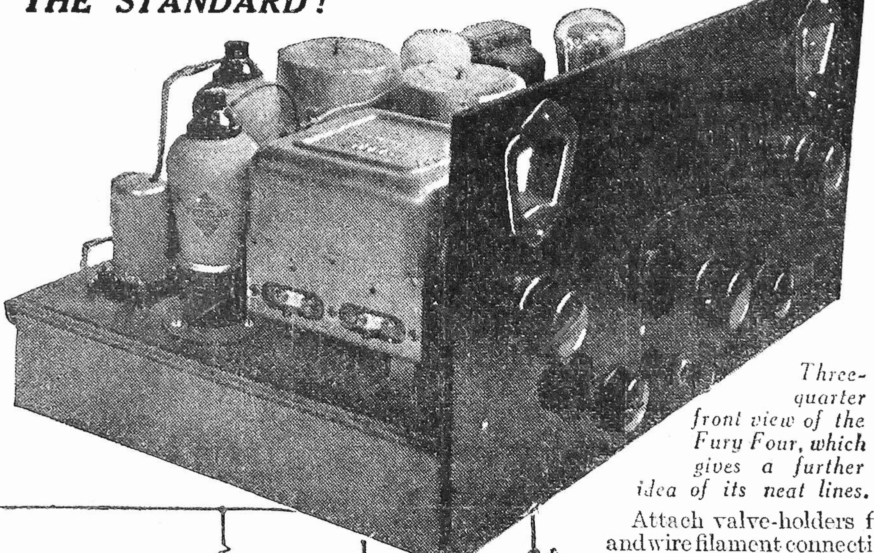
*Another view of the Fury Four which will assist you in wiring.*

is a prolific station getter, and instead of having to twiddle seven or eight knobs, with their impossible permutations, you have in the "Fury Four" a receiver which even a beginner can operate, make, and afford. Over one hundred stations have been logged in a single evening on the "Fury Four," and it is with enthusiasm and confidence that I enjoin readers of this paper to make up my "Fury Four."

**They may do so in the certainty that it will do all that I claim for it, and so confident am I of this that I guarantee to give them my personal advice until it functions in the manner claimed.**

You should not make any receiver until you have first investigated the capabilities of the "Fury Four," the complete construction of which, with blue print, will be dealt with next week. I will just add in passing, that I shall also produce an A.C. version of it. In order to enable those who wish to proceed with the construction I append an assembly order.

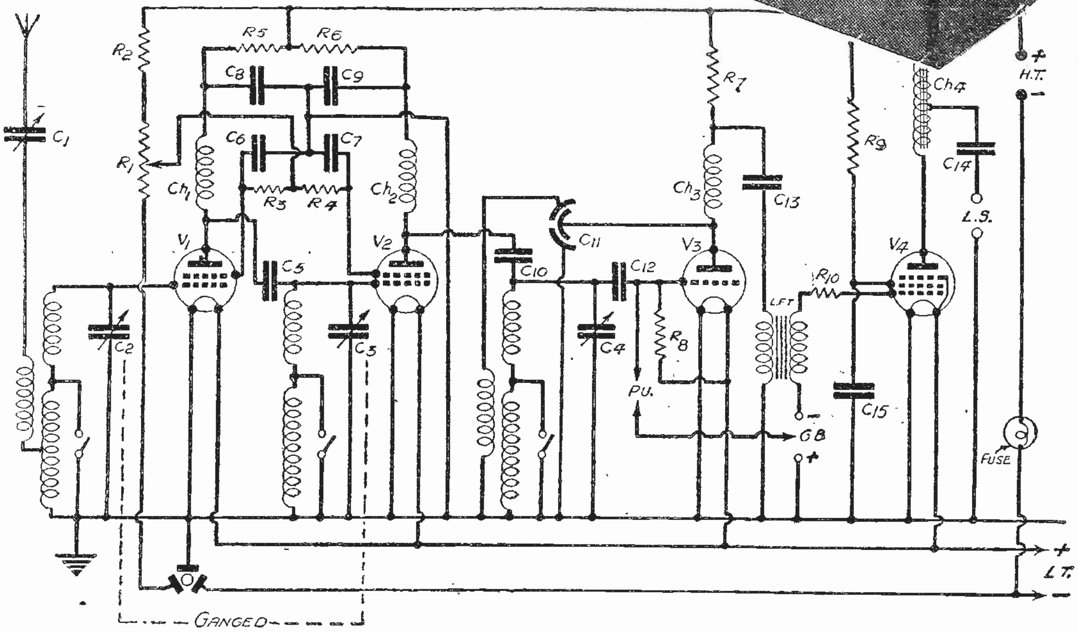
## *THE SET WHICH SETS THE STANDARD!*



*Three-quarter front view of the Fury Four, which gives a further idea of its neat lines.*

Attach valve-holders first, and wire filament connections. Use bare wire for Negative filament leads to facilitate earthing of other leads. Mount condensers, terminal blocks and fuse on underside of baseboard, and wire as much as possible on this side of baseboard. Attach resistances where no lead goes above board.

Turn over, attach H.F. chokes, L.F. transformer and pent. choke. Continue wires where possible. Attach coils, continue wiring. Attach variable condensers, complete wiring. Drill panel—mount switch, potentiometer and reaction condenser, and attach panel. Complete wiring.




**CIRCUIT DIAGRAM OF THE FURY FOUR.**

*C1, C5, C10—.0003 mfd. C2, C3, C4—.0005 mfd C6, C7, C8, C9—.1 mfd. C11—.0003 Differential. C12—.0002 mfd. C13, C14, C15—1 mfd. R1—50,000 ohm. Potentiometer. R2, R7—30,000 ohms. R3, R4, R5, R6—1,000 ohms. R8—2 megohms. R9—5,000 ohms. R10—100,000 ohms. Ch1—Screened S.G. Choke. Ch2—Unscreened S.G. Choke. Ch3—Screened Standard H.F. Choke. V1., V2—Metallised 220 S.G. (Cossor). V3—Metallised 210 H.F. (Cossor). V4—220 PT (Cossor).*

**Assembly Order for the "Fury Four"**

Drill holes for valve-holders and small holes for leads. Mark centre line, on which switch rod of coils should be positioned. Lay all components in positions they are to occupy, and with awl mark screw points.

**FREE NEXT WEEK!**

**A FULL-SIZE BLUE PRINT**

**(POINT-TO-POINT WIRING)**

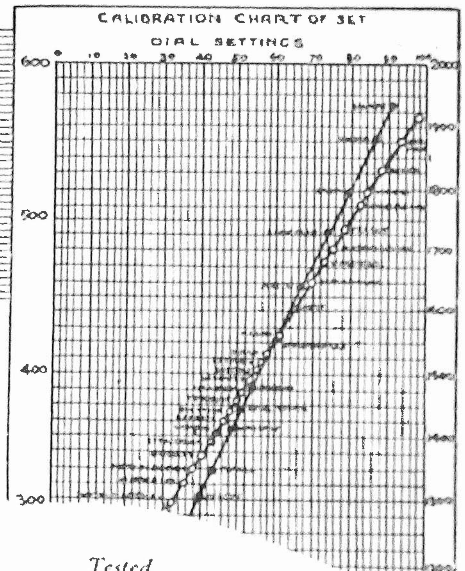
**Size 18½ ins. x 28½ ins. OF THE FURY FOUR THE BEST RECEIVER OF ALL**

## LIST OF COMPONENTS FOR THE FURY FOUR

One Three-gang LISSEN Coil Assembly (L.N.5162).
One LOTUS Two-gang Condenser with Disc Drive.
One LOTUS .0005 mfd. single Condenser with Disc Drive.
One SOVEREIGN Compression Type Condenser, Type J.
One WEARITE S.G. Choke, Type H.F.P.A.
One BULGIN S.G. Choke, Type H.F.4.
One PETO-SCOTT Screened H.F. Choke.
One L.F. Transformer, Ratio 3 to 1.
One TELSEN Pentode Output Choke, Type W.72.
Three DUBILIER 1 mfd. Fixed Condensers, Type BB.
Two DUBILIER .0003 mfd. Fixed Condensers, Type 665.
One DUBILIER .0002 mfd. Fixed Condenser, Type 665.
Two DUBILIER .1+.1 C mfd. Fixed Condensers, Type BE 31.
Four CLIX Chassis Mounting Valve-holders, Three 4-pin and one 5-pin.
Four 1,000 ohm ERIE Resistors, 1 Watt Type.
Two 30,000 ohm ERIE Resistors, 1 Watt Type.
One 100,000 ohm ERIE Resistor, 1 Watt Type.
One 5,000 ohm ERIE Resistor, 1 Watt Type.
One LISSEN 2 meg. Grid Leak with Wire Ends.
Three BELLING-LEE Terminal Blocks.
One BELLING-LEE 4-way Battery Cord.
Six BELLING-LEE Terminals, marked Aerial, Earth, Pick-up, Pick-up, L.S. and L.S. (Type B).
One BULGIN Fuse-holder, Type F.5 with Fuse.
One LEWCOS 50,000 ohm Potentiometer.
One TELSEN .0003 mfd. Differential Reaction Condenser, Type W.185.
One WEARITE Three Point Switch, Type GWC.
One Ebonite Panel, 16in. by 8in.—BECOL.
Three CLIX Wander Plugs, GB+ GB 1 and GB 2.
Two COSSOR Valves, Type 220 S.G. (Metallised).
One COSSOR Valve, Type 210 H.F. (Metallised).
One COSSOR Valve, Type 220 PT.
One EDISWAN 2-volt Accumulator.
One EDISWAN 9-volt Grid Bias Battery.
One EDISWAN 120-volt Super Capacity H.T. Battery.
One W.B. Loud Speaker, Type P.M.4.
One CARRINGTON Fury Four Cabinet.
Two coils of GLAZITE Connecting Wire.
Sundry Screws, soldering tags, etc.

# Receivers and their Records

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



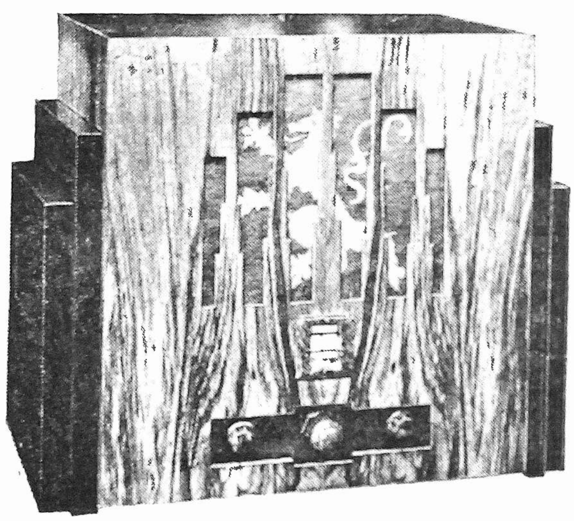

Tested by JACE

## CLIMAX BALANCED BANDPASS THREE FOR A.C. MAINS.

If a radio dealer's catalogue is perused, the reader will find that in the matter of mains-operated three-valve receivers offered to him there is a wide choice, and, inasmuch as most of them include a screen-grid H.F. stage, a detector, and a pentode output, he may find considerable difficulty in making a definite selection. It is, however, in what may appear to be minor details, but which in effect are all-important factors in the actual performance of the instrument, that they differ from one another. A designer, limited by the number of valves in the circuit and, in particular, the price at which the set can be sold, is compelled, in the matter of sensitivity, selectivity, and quality of reproduction to effect a compromise. In the matter of the first factor, in view of the greatly improved components at his disposal, he is able to secure the results desired, and the question of selectivity largely depends on the number of tuned circuits which he may be permitted to incorporate in the receiver. As regards quality, the problem offers fewer difficulties. If efficiency is shown in the layout of the components, and great attention paid to small but important details, he may, with care, achieve results with a three-valver which will compare favourably with the performance of a much more elaborate and expensive receiver. The *Climax A.C. Model Bandpass Three* is a good example of what can be done when these conditions *are* fulfilled.

The receiver is designed for A.C. mains only, and, as you may see from the illustration, it is housed in a solid walnut cabinet with plain black side pieces recessed for practical hand-grips; the left-hand one contains an aerial volume-control condenser. The front of the cabinet is more of a utilitarian than decorative design, but it is simple and effective, the speaker grille bearing the well-known *Climax Lion rampant*. Immediately below it we find in a recessed metal escutcheon an illuminated and calibrated condenser scale printed in black for the waveband 200-550 metres, and in red for the channels above 800 metres. In addition, the main broadcasting stations are given at their respective dial readings, and are clearly seen through small rectangular openings allotted to that purpose. The three knobs, comprising the tuner, the combined wave-change, radio-gramophone, and "on" and "off" switch, and the volume control, have been placed in a line in such a position that they can be handled comfortably with the operator's wrists resting on the table carrying the receiver. For fine tuning this will be found to be exceptionally convenient. The terminal strip at the back of the instrument is particularly simple and offers no "puzzle" to the uninitiated. There are the usual sockets for aerial and earth, gramophone pick-up, and, if desired, an external loud-speaker. One outstanding feature which calls for special mention is the mains protection arrangement adopted. The set cannot be opened until the mains have been disconnected from the receiver, as the plug itself is fixed in the chassis. Such a method prevents any possibility of shock or "short circuit" which might cause trouble.

Although, in every instance, makers supply instructions on the operation of their receiver, and diagrams showing how these should be set up and operated, the booklet delivered is apt to be mislaid. In order that this loss should not be materially felt, in this case the makers have very cleverly printed the most important of these instructions on a large ivorine tablet affixed to the back metal panel. The circuit consists of a screen-grid H.F. stage (Mazda metallized A.C./S.G.) with mixed coupled bandpass input filter coupled to a power grid detector valve (metallized A.C./H.L.) by an improved method of tuned anode circuit, comprising capacity-controlled reaction in the approved manner, followed by a parallel-fed transformer to the output pentode (Mazda/A.C. pen.), which in turn is transformer-coupled to the moving-coil loud-speaker. Effective smoothing is carried out by speaker field and large-capacity condensers. The undistorted output is roughly 2 watts. The H.T. supply is obtained from the A.C. mains by means of a transformer and a double-wave rectifying valve (Mazda UU120/350), the consumption of current being slightly over 72 watts. The construction of the receiver is robust; the metal chassis bears on its surface the valves, and totally screened tuning coils, the balance of the components being housed in the substage.



*The Climax Balanced Bandpass Three for A.C. mains.*

On test the *Climax Bandpass Three* put up an excellent performance. With the mains aerial (a wire interwoven with the power lead and plugged into the aerial socket) full loud-speaker reception was obtained not only of the two London programmes, but also of some of the more powerful Continental broadcasts. Under these conditions actual sensitivity suffered little and, if anything, the selectivity on the medium waves was enhanced. For the reception of transmissions on the longer waves an outside aerial is called for if any volume is desired, but Daventry National and Radio-Paris provided good signals. For "locals" alone, strength was even too great, and recourse had to be made to the aerial input control on the side of the receiver. Using an external aerial and earth, excellent results for a three-valver were secured. Selectivity and sensitivity were remarkably good, and the separation of stations was greatly simplified by a judicious handling of the aerial input and reaction controls. A decrease of the former and increase of the latter proved the value of bandpass tuning. The reception of a broadcast from Muhlacker whilst London Regional is on the air is a severe test, but this was made possible if the aerial input was reduced to a minimum and full use made of reaction. A certain amount of interference was still caused by the local broadcast, but the foreign transmission was clearly readable. At a greater distance from the local, such an inconvenience would not arise. The action of the reaction control is very gradual; when applied to medium waves it must be used sparingly. More latitude exists when stations are to be tuned in on the longer channels, as it may almost be taken to its maximum point before bringing on oscillation. The dials have been fairly accurately calibrated, and the readings show little variation with any alteration in aerial capacity, i.e., whether the set is used with mains or external aerial, or when the aerial input control is brought into action.

# ARE YOU STILL USING PLUG-IN COILS?

## Some Suggestions for Owners of Old Types of Sets

By H. E. THOMPSON

A STUDY of the various articles on modernising old receivers that have appeared in wireless periodicals during the last few years might almost lead one to the conclusion that the writers are either not too familiar with conditions prevailing in many households, or that they do not consider any wireless set more than three years old worth the trouble of rejuvenating. For instance, nowadays, one will look in vain for advice on improving the performance of old sets built in the years when plug-in coils and externally-neutralised H.F. valves were found in every circuit; yet anyone who travels about will soon discover that many of these obsolete models are still in regular use, for the simple reason that their owners, forced to economize in every direction, have quite properly looked upon a modern receiver as an unjustifiable extravagance. Some users, misunderstanding a statement frequently made in the radio press to the effect that improvements in radio reception are mainly due to the increased efficiency of modern valves, have blindly and hopefully taken the obvious step of replacing an odd valve or so by a modern type possessing, naturally, completely altered characteristics, and have been so disgusted with the results that they have resigned themselves to hearing the desired station through a background of its neighbours, and to the accompaniment of sundry mysterious whistles and whisperings that daily grow more insistent.

Bearing in mind the vital fact that the user of one of these old-type sets will not be prepared to spend much more than his own time on improving his lot, I have been making a number of practical experiments with "junk" apparatus, in order to discover what can be done very simply and very cheaply to meet modern conditions, and the circuit shown in Fig. 1 represents the most satisfactory all-round solution of the problem. Before dealing with the why and wherefore of this circuit, however, I should like to define the extent to which, in my opinion, an old-type set can be improved by the *average man*, without wholesale rebuilding, and without spending money that would be laid out more economically on the purchase of a complete new kit. It is convenient to express these limitations in the form of three prohibitions, based on what I have seen attempted, and the average results therefrom.

### What Not to Do

(1) *Don't replace the old 3-electrode valve in the H.F. socket by a modern S.G. Valve.*

This substitution frequently necessitates a complete redistribution of the wiring and components, in order to secure stability, and the new signal produced is enhanced to such a degree that the faults of the old output system are so disproportionately accentuated as to be unbearable on the speaker.

(2) *Don't attempt to get 1933 quality by odd replacements.*

Quality is not a question of a special component alone, but is a matter of design from stem to stern.

(3) *Don't buy a Band-pass Unit (or other equivalent costly tuning device).*

If you can really afford to do this, go the whole hog, and get a complete new kit. Botching of this type never pays in the long run.

Having decided what ought not to be attempted, it only remains to find out what can be aimed at, and I think that, if an obsolete set can be made to pick up, clear of interference, any station within its capacity, and to reproduce that station with the volume and quality for which the set was originally designed, the user should be satisfied.

It is obviously impossible to deal piecemeal with every type of wireless set still in use, so I shall assume that the old set contains a stage of H.F. amplification, followed by a detector and at least one L.F. stage, that stability is obtained through the use of a neutralising condenser, that both aerial and anode tuning is accomplished by plug-in coils and variable condensers, and that reaction is supplied through the medium of a plug-in coil—a general specification that should cover most of the obsolete sets worth the trouble of improving.

### Increasing Selectivity

Now, users of these old sets will have discovered long since that the setting of the aerial condenser is much less critical than that of the anode-tuning condenser, the latter being really the "master mind," as it were. Yet, almost every cheap specific for increasing selectivity is concerned with the aerial-tuning circuit. In old sets one needs every possible bit of energy on the grid of the H.F. valve in order to build a good fat signal, and it has always been my experience that devices operating in front of the grid of the first wave are only effective when the signal received is so strong that much of it can be dissipated with advantage. It will be obvious, then, that if the anode tuning, already fairly sensitive, can be made really critical, one need not arrange the aerial circuit to give selectivity at the expense of volume. Indeed, some of the old aerial coil arrangements, that looked admirable on paper, bandied the incoming signal about to such an extent that it died away altogether in the more remote districts, so the simpler the aerial end can be kept, the better will be the ultimate result on the ancient receiver.

Fig. 1 represents the necessary compromise, and to those who see a number of ways in which it could be improved I would say that I have drawn the simplest possible effective circuit, involving probably the purchase of only two very cheap new parts, and utilizing, with the minimum of alteration, only such components as already exist in most obsolete sets, or can be obtained at "scrap" prices. Whilst the circuit diagram is self-explanatory to anyone capable of making a successful alteration, a few notes may be helpful.

### Adding the Additional Components

The lead-in is taken to earth through (a), a pre-set condenser, .0003 max., and (b) a coil coupled to the centre-tapped grid coil. These coils are plug-in types, mounted in one of the old two-way coil-holders, and whilst, normally, they are very close-coupled, a shade of movement is necessary for extreme selectivity in certain cases. The anode and reaction coils are also of the plug-in brand, coupled in a two-way holder, but when mounting these room must be left for the full swing of the reaction coil, since I have found that, on some old sets, oscillation occurs at the bottom of the medium waveband, even with the reaction condenser at minimum, and a movement of the reaction coil itself is required to restore stability. Where possible, the aerial coils should be mounted on the outside of the cabinet, and the others inside the set, but if all of them must be mounted close to each other, they should be arranged to swing in opposed planes—*i.e.*, horizontally and vertically. Reaction is controlled primarily by the small reaction condenser (preferably .0003 mfds.), but the amount of reaction effect available is governed by the swing of the reaction

(*Continued on page 961.*)

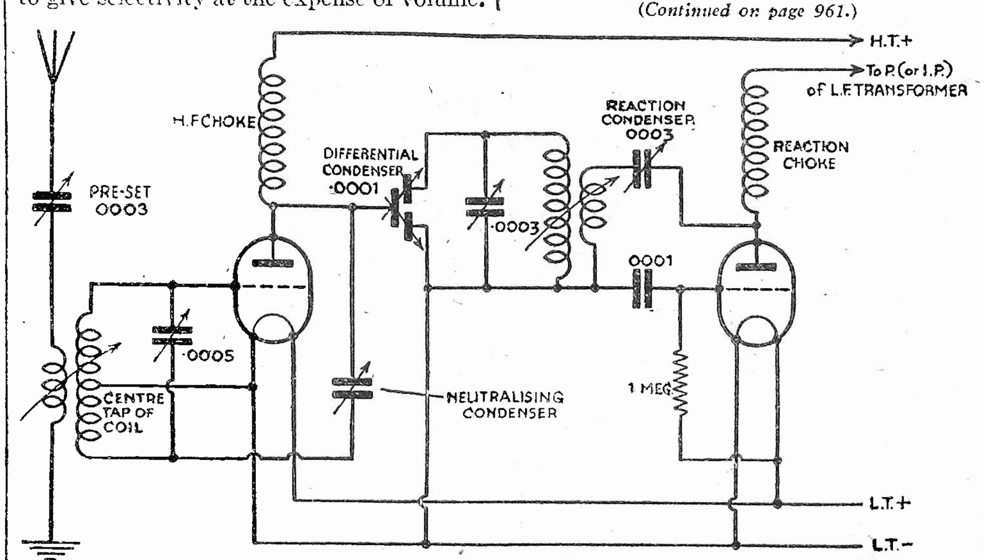



*Fig. 1.—How Plug-in coils may be used in an H.F. and detector circuit.*

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|---|---|---|---|
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| Oldham Type 0.50 L.T. Accumulators .. | 0 | 9 | 0 |
| Siemens 9 Volt G.B. Battery .. .. | 0 | 1 | 0 |
| Block L.T. Accumulators 80 amp/hrs. .. | 0 | 11 | 0 |
| Oldham 120 Volt Wet H.T. Accumulators, or 12 monthly payments of 7/6 .. .. | 4 | 1 | 0 |
| Atlas A.C. 244 H.T. Eliminators .. .. | 2 | 19 | 6 |
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| | £ | s. | d |
|---|---|---|---|
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| Epoch Twentieth Century permanent magnet moving coil speaker with Input Transformer .. .. | 1 | 15 | 0 |
| Bluespot 99PM permanent magnet moving coil speaker with Input Transformer .. .. | 2 | 19 | 6 |
| W.B. PM2 Permanent Magnet Moving Coil Speaker with Input Transformer, or 12 monthly payments of 8/- | 4 | 5 | 0 |
| R & A Victor Permanent Magnet Moving Coil Speaker with Input Transformer, or 10 monthly payments of 8/- | 3 | 10 | 0 |
| R & A Challenger Permanent Magnet Moving Coil Speaker, with Input Transformer .. | 1 | 15 | 0 |
| Bowyer Lowe AED Mark III Pickup .. | 1 | 10 | 0 |
| Volume Control .. | 0 | 3 | 0 |
| Collaro Double Spring Gramo Motor Automatic Stop .. .. | 1 | 13 | 0 |
| Collaro A.C. Induction Gramo Motor .. | 2 | 10 | 0 |
| Collaro Complete A.C. Gramo playing Unit with Induction Motor Pickup and Volume Control. Or 12 monthly payments of 7/6 .. | 4 | 0 | 0 |
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|---|---|---|---|
| Two Matched Celestion PPM Soundex Speakers. Mounted on New Type double packed non-resonant baffle-board. This arrangement eliminates booming, chattering, and directional effects and gives wonderfully life-like reproductions. Suitable for any battery or mains driven receiver. Or 10 monthly payments of 8/6 .. | 3 | 17 | 6 |

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| | £ | s. | d |
|---|---|---|---|
| 1 Lissen Three-gang Coil Unit type LN5162 .. .. .. | 1 | 6 | 0 |
| 1 Erie 2-megohm Grid Leak with wire-ends .. .. | 0 | 1 | 0 |
| 1 J.B. Unitune two-gang screened condenser .0005 mfd., with disc drive .. | 0 | 18 | 6 |
| 1 J.B. Nugang Single screened condenser with disc drive .. | 0 | 9 | 6 |
| 1 Ready-Radio .0003-mfd. Differential Reaction Condenser | 0 | 3 | 0 |
| 1 Varley Pentode Nichoke .. | 0 | 12 | 6 |
| 1 Erie 100,000 ohms resistance | 0 | 1 | 0 |
| 2 Erie 30,000 ohm resistances | 0 | 2 | 0 |
| 1 Erie 5,000 ohms resistance .. | 0 | 1 | 0 |
| 4 Erie 1,000 ohms resistance .. | 0 | 4 | 0 |
| 1 Set of 8 Erie Resistor coupling links .. .. .. | 0 | 1 | 0 |
| 1 pair Panel Brackets .. .. | 0 | 0 | 6 |
| 1 Ready Radio fuse holder and fuse .. .. .. .. | 0 | 1 | 0 |
| 1 Wearite screened H.F. Choke Type HFPA .. .. .. | 0 | 4 | 0 |
| 1 Ready Radio 3-pt. switch .. | 0 | 1 | 6 |
| 1 Ready Radio S.G. H.F. Choke | 0 | 5 | 6 |
| 1 Kinva standard screened H.F. Choke .. .. .. | 0 | 2 | 9 |
| 2 Dubilier .1-mfd. C.T. Condenser type B.E.31 .. | 0 | 6 | 0 |
| 3 Dubilier 1-mfd. Condenser type B.S. .. .. .. | 0 | 6 | 0 |
| 2 Dubilier .0003-mfd. Condensers type 665 .. .. | 0 | 1 | 0 |
| 1 Dubilier .0002-mfd. Condenser type 665 .. .. | 0 | 0 | 6 |
| 1 Lewcos 50,000 ohm Potentiometer .. .. .. | 0 | 3 | 0 |
| 1 Sovereign .0003-mfd. Preset condenser .. .. .. | 0 | 1 | 3 |
| 1 Ready Radio 3-1 ratio L.F. Transformer .. .. .. | 0 | 8 | 6 |
| 2 Belling Lee Wander plugs G.B.+, G.B.— .. .. | 0 | 0 | 4 |
| 3 Clix sub-baseboard valve holders 4-pin .. .. .. | 0 | 2 | 0 |
| 1 Clix sub-baseboard valve holder, 5-pin .. .. .. | 0 | 0 | 9 |
| 1 Belling Lee 4-way Battery Cord .. .. .. .. | 0 | 1 | 9 |
| 3 Belling Lee terminal mounts | 0 | 1 | 6 |
| 6 Belling Lee terminals A.E.P.U., L.S.+, L.S.— .. | 0 | 1 | 0 |
| 1 Permcol Panel 16" x 8" drilled to specification .. | 0 | 5 | 6 |
| 1 Drilled and foil covered baseboard 16" x 10" x 3/8", and 2 side Strips 10" x 2" .. | 0 | 4 | 0 |
| 1 Direct Radio "159" "Fury Four" Cabinet in Walnut .. | 1 | 1 | 0 |
| 4 Valves to specification .. | 2 | 17 | 6 |
| Connecting Wire, Screws, Flex, etc. .. .. .. .. | 0 | 0 | 8 |
| | £10 | 17 | 9 |

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|---|---|---|---|
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| Varley D.P.37 Quiescent Pushpull Output Transchoke .. .. | 0 | 18 | 6 |
| Varley D.P.38 Quiescent Pushpull Output Transchoke .. .. | 0 | 16 | 6 |
| Varley D.P.39 Quiescent Pushpull Output Transchoke .. .. | 0 | 16 | 6 |
| R.I. Type Q Quiescent Pushpull Input Transformer .. .. | 0 | 16 | 6 |
| R.I. Type Q Quiescent Pushpull Output Choke .. .. | 0 | 12 | 6 |
| Sound Sales Quiescent Pushpull Input Transformer. | 0 | 15 | 0 |
| 2 Matched Mazda Pen 220A Pentode Valves for Quiescent Pushpull stage .. .. | 1 | 15 | 0 |
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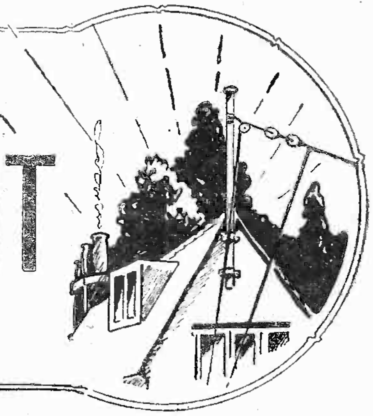
Practical Wireless, Feb. 4.

# The BEGINNER'S SUPPLEMENT



*Conducted by*
F. J. CAMM

## THE BEGINNER'S A B C OF WIRELESS TERMS (Contd.)

**Choke**

A COMPONENT the function of which is to offer an easy path to direct currents but a difficult one to alternating currents. Chokes used in radio are of two distinct types, those used as a barrier against *high-frequency*, or very rapidly alternating currents, and those which offer a high impedance to *low-frequency* currents. A high-frequency choke is composed of a single coil of fine wire. This consists of a large number of turns wound round a bobbin in much the same way as a small tuning coil. As low self-capacity is a necessary feature the coil is often wound in sections as in the inset (Fig. 1).

The H.F. type of choke is no use for preventing the passage of *low-frequency* currents. It has not sufficient *inductance*. A low-frequency choke, therefore, has more turns of wire and is wound on a bobbin with an iron core. The iron core usually consists of thin sheets or laminations. These are stamped out in the shapes shown in Fig. 2, and when fitted together they not only form an iron centre to the bobbin itself, but pass right round the outside as well. This is what is called a *closed core*, and its presence greatly increases the *inductance* of the choke.

Fig. 3 shows a typical L.F. choke in a moulded bakelite case. The similarity between this and an L.F. transformer is very marked. However, a transformer has two windings, whereas a choke has only one.

**Choke Capacity Coupling**

A method of coupling one valve in a receiver to the next one following by means of a choke and a condenser. The choke is included in the output (anode) circuit of the first valve, and the anode is connected to the input (grid) of the next valve by means of a condenser. If the first of the two valves to be coupled is a high-frequency amplifier, then the choke must be a high-frequency one, but if it is the detector or one of the low-frequency valves, then a low-frequency (L.F.) choke is used. Choke-capacity coupling usually gives very clear reproduction. It does not give a step-up between each stage, as with transformer-coupling, but has an advantage over resistance-capacity coupling in that it does not appreciably diminish the high-tension voltage.

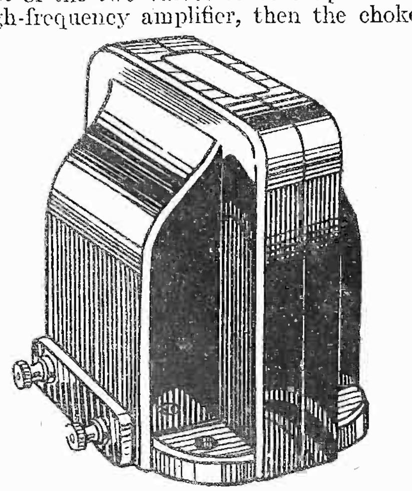


*Fig. 3.—An L.F. choke in a moulded bakelite case.*

**Choke Control**

A term used to denote a certain type of transmitter which employs a large iron-cored choke for "controlling" the oscillations.

**Circuit**

The wiring arrangement used to connect any electrical apparatus. The term is also used in a general sense to indicate the whole plan or lay-out of a wireless receiver or transmitter.

**Circuit Breaker**

A device for quickly severing an electrical circuit. The term is usually confined to automatic switches and similar apparatus which come into operation under abnormal conditions, such as when too heavy a current is flowing in a circuit or when a reversal of current takes place. Automatic circuit-breakers are also called automatic *cut-outs*. A fuse may be classified as a circuit breaker, since the fuse wire melts and thus breaks the circuit as soon as the current exceeds a pre-determined amount. Both a fuse and a cut-out are shown in Fig. 4.

**Circuit Diagram**

A theoretical representation of a circuit. In radio circuit diagrams certain conventional symbols are used to indicate the various components, and these are joined by lines representing the connecting wires. A typical circuit diagram is given in Fig. 5. The names of the various parts are indicated against their symbols.

**Circuit Tester**

General term for various devices used to test the continuity of a circuit or its insulation. One of the simplest forms

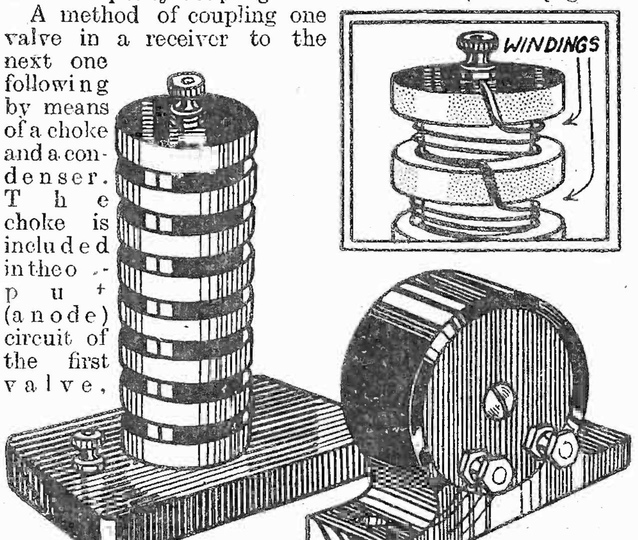



*Fig. 1.—Two types of H.F. choke and (inset) how the wire is wound in sections.*

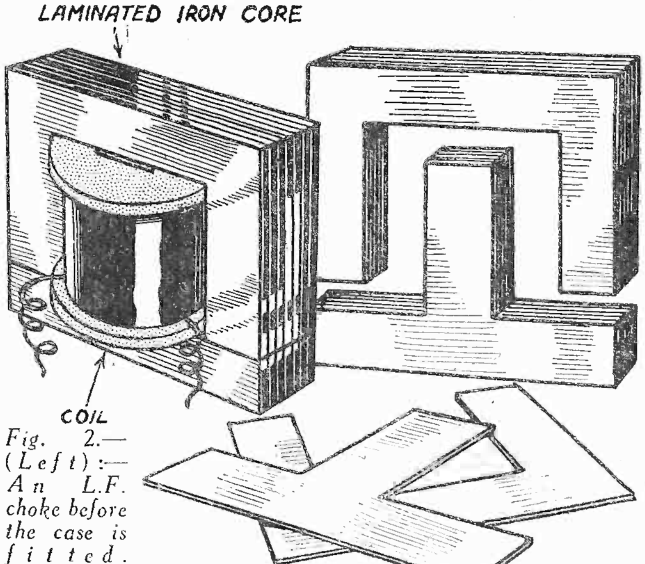



*Fig. 2.—(Left):—An L.F. choke before the case is fitted. (Right and foreground):—How the iron core is made up with two of the separate laminations.*

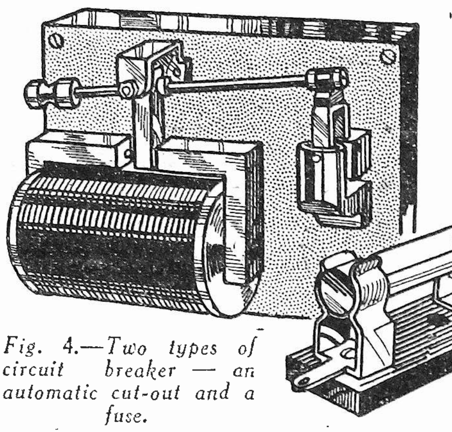


*Fig. 4.—Two types of circuit breaker — an automatic cut-out and a fuse.*

consists of a flash-lamp bulb and a battery. The bulb is joined to one pole of the battery and leads are taken from the other pole and from the bulb as in Fig. 6. The two leads are connected to the circuit to be tested. If there is a breakage somewhere in the circuit the lamp will not light, but if it is complete the lamp will glow.

**Close Coupling**

When an electric current passes through a coil it creates a magnetic field around the coil, that is to say, there are lines of magnetic force radiating from the coil. Now if this coil is brought near to another coil so that a large number of the lines of force pass through the second coil it is said to be "closely coupled" to it. If the current in the first coil is oscillating it will induce a current in the other coil, and if the other coil also has an oscillating or fluctuating current passing through it it will in turn affect the first coil. This property of *induction*, as it is called, is made great use of in wireless, and tuning coils are often placed close together in order that they should induce currents in one another. Sometimes, however, very strong inter-action is not required, and then they are spaced farther apart and are then said to be *loose coupled*. Fig. 7 shows two practical examples of close coupling. On the left two plug-in coils are mounted as close together as possible so as to obtain the maximum coupling. On the right two coils are shown wound on one former with the same object in view.

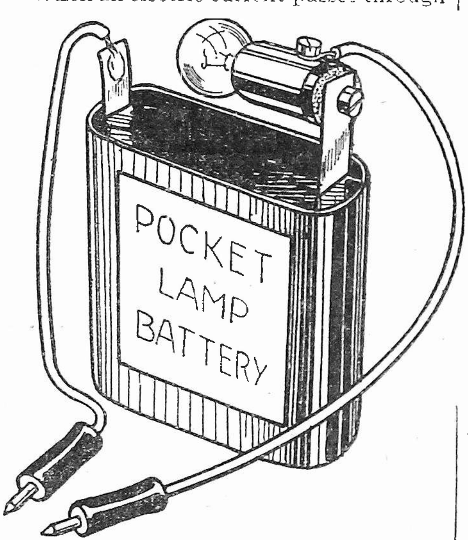



*Fig. 6.—A simple home-made circuit tester.*

**Closed Core Transformer**

A transformer in which the iron core goes completely round the coil windings, thus forming a continuous magnetic path. Such a transformer is usually built on the same lines as the choke illustrated in Fig. 2. The iron core is to all intents and purposes "closed," the only break being at the joints between the two halves. The advantage of a closed core over an open core or none at all is that it concentrates the magnetic field and so makes the transformer more efficient. See also "*Transformer*," "*Mains Transformer*," and "*L.F. Transformer*."

**Coherer**

An early form of wireless detector. The best known type consisted of a glass tube filled with metal filings. These occupied the space between two metal plugs, one in each end of the tube. The plugs or contacts were connected by wires to a battery and some form of recording device. It was found that normally the filings offered a high resistance to the flow of current, owing to the imperfect contact. If, however, a wireless wave struck the tube the filings "cohered" together and made comparatively good contact and so passed current to work the recording apparatus. Once the filings had adhered together it was found that a slight mechanical shock was necessary in order to restore them to their original non-conducting state. To overcome this difficulty various devices, such as buzzers, were employed to continuously tap the tube. Later several types of self-restoring coherer were invented. Some of these employed a globule of mercury between iron electrodes.

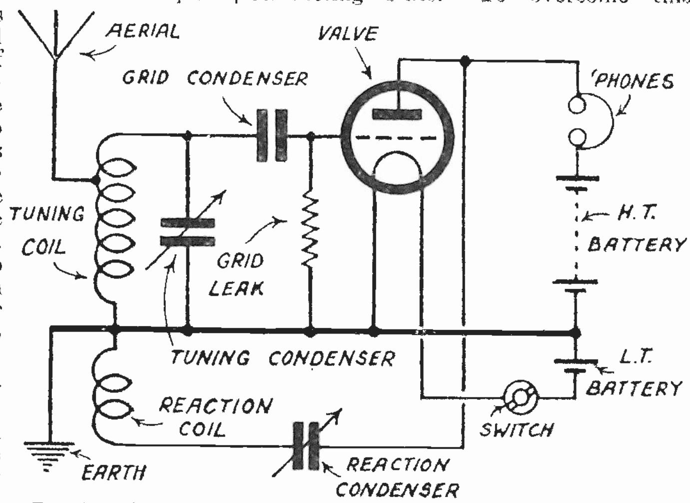



*Fig. 5.—A typical circuit diagram. All the symbols are marked to show to what they refer.*

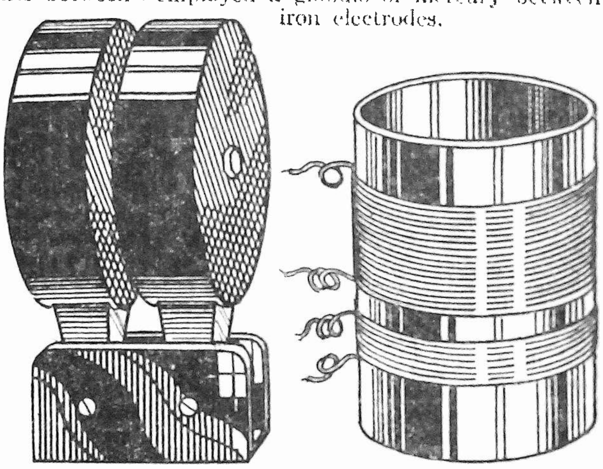


*Fig. 7.—Two examples of close coupling. In one case two plug-in coils are mounted side by side and in the other two coils are wound close together on the same former.*

## TRACING FAULTS WITH A PICK-UP

When a fault develops in a fairly complicated valve set with several L.F. stages, a gramophone pick-up often forms a useful aid in tracking down the cause of the trouble. If the leads from the pick-up are connected to a suitable adapter, of the type made to plug into valveholders, the pick-up can be connected into the grid circuit of the detector, and each of the L.F. valves in turn. By simply playing a record with the set switched on, and noting the strength and quality of the reproduction, it is usually an easy matter to locate the fault, or at any rate to narrow down the area in which it is likely to be. If in testing an H.F. det. and 2 L.F. circuit, for instance, one finds that the reproduction is perfectly normal with the pick-up in the grid circuit of the detector valve, the fault probably lies in the H.F. part of the circuit. If, however, it is necessary to connect the pick-up to the intermediate L.F. stage before any results can be obtained, the detector is probably faulty. Similarly, if the pick-up has to be connected to the power valve before the record can be heard, the fault probably lies in the intermediate L.F. stage. If no results can be obtained at all with the pick-up connected to any of the valves, the fault is either one affecting the whole set (as, for instance, a break in the H.T. negative lead), or else it is confined to the output stage. By narrowing down the field of search in this way, a great deal of time and trouble is saved.—Norman Hurst.

# THE DESIGN AND CONSTRUCTION OF SIMPLE PORTABLE SETS

This Article gives you some Useful Information on a Popular Subject

*(Concluded from page 878, January 28th, 1933, issue)*

By FRANK PRESTON, F.R.A.

WHEN using a circuit like those of Figs. 1 and 2 a double-pole, double-throw rotary switch can be made to serve the function of battery switch and frame aerial wave-change switch by connecting it as shown in Fig. 8. With the knob in the central position the set is switched off, but by turning it in a clockwise direction the batteries are connected and long-wave reception is obtained. When the knob is turned anti-clockwise the set is ready for medium-wave reception. The switch can most conveniently be mounted on the panel in such a position that it is symmetrical with the wave-change switch operating on the tuned grid coil.

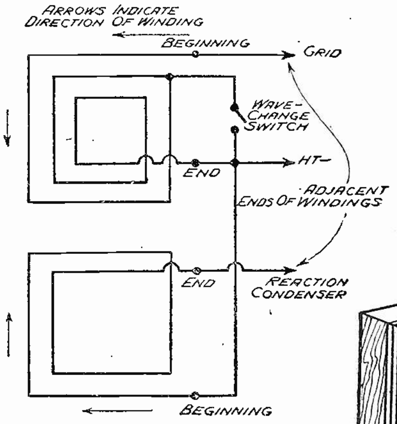



*Fig. 10.—The method of winding the frame aerial.*

When using the circuit of Fig. 3 it is better to mount the three-point wavechange switch on the loud-speaker fret and to use an entirely separate one for making battery connections. The 200 ohm resistance in the reaction circuit should be mounted as near as possible to the anode terminal of the detector valve, where it will function in the most satisfactory manner. It is hardly necessary to add that all wires going to the frame aerial should be as short and direct as possible.

### Screen the Speaker

When the loud-speaker unit is mounted inside the frame aerial it is always possible for both the speaker and its connecting wires to "pick-up" a small amount of H.F. energy from the frame windings. When this occurs, instability is the inevitable result and in consequence a most objectionable hum is emitted by the speaker. The difficulty can most easily be prevented by using a length of Lewcos twin-shielded wire for the connection between the set and speaker. This material consists of two rubber-covered wires passing through a tube of braided aluminium wire. The latter forms a screen, of course, and must be connected to H.T. negative at the "set" end; the other end of the screen should be connected to one of the screws in the metal body of the speaker unit. Connections from the screening braid are easily made by twisting the bared end of a length of 24 gauge cotton-covered wire round it and applying a spot of solder.

The frame aerial will be accommodated inside the lid, and a suitable form of construction for the wooden support for this is illustrated in Fig. 12.

The main frame is in the form of four sides of a shallow rectangular box, and four notched pieces of wood are glued one on each corner so that the windings can be held more securely in position. The medium-wave winding consists of side by side turns placed in the longest notch, whilst the long-wave portion is pile wound in the three smaller ones. This form of construction reduces capacity to a low figure and at the same time allows a fairly large area of wire to be exposed to the oncoming waves. The aerial is almost equally efficient on medium and long waves, since the exposed area of the medium-wave windings is as great as possible, whilst that of the long-wave winding is small in comparison. When a reaction winding is employed it will be put on top of the other windings, about two turns being wound over the medium-wave winding and three (one in each notch) over the long-wave one. More details in regard to frame aerial windings will be given later.

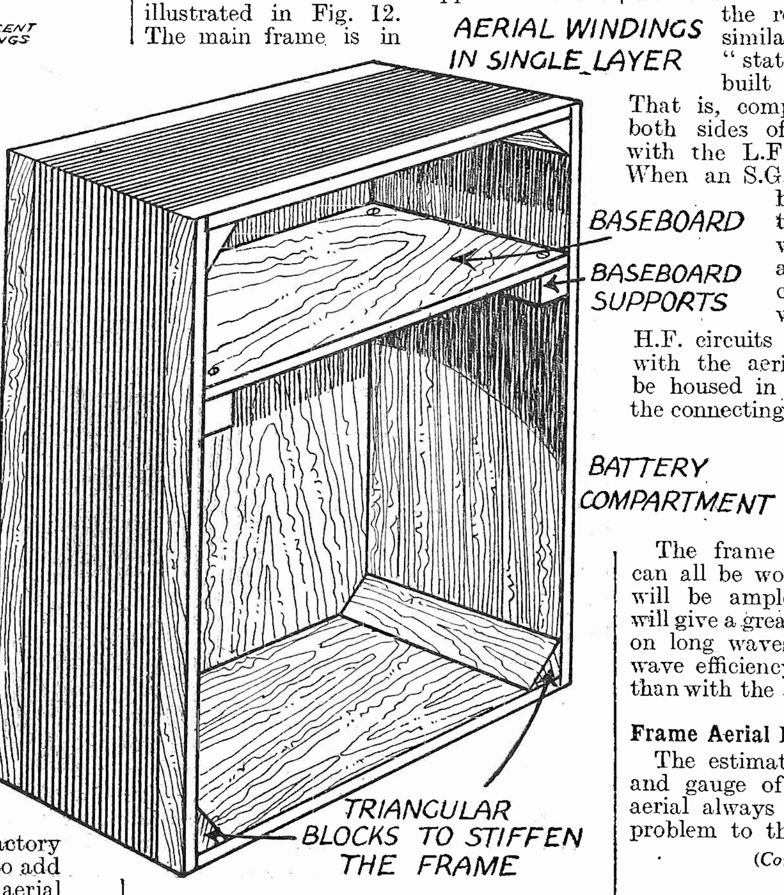



*Fig. 12.—How to build up the frame as a case to accommodate the set.*

### In Cabinet Form

When the set is being made in cabinet form a normal type of baseboard will be used, and this will be fitted into the aerial frame as shown in Fig. 12. The layout of the receiver components will be similar to that employed in a "stationary" set of the type built on a wooden chassis. That is, components will be mounted on both sides of the baseboard, preferably with the L.F. circuits on the underside. When an S.G. stage is being used it might be an advantage to screen the baseboard by covering it with metal foil. But, in addition to this, screened components should be used wherever possible in the H.F. circuits so as to obviate interaction with the aerial windings. Batteries will be housed in the bottom of the case, so the connecting wires can drop straight down from the set. The loud-speaker and its connecting leads must be screened exactly the same as in the suitcase model.

The frame aerial windings in this case can all be wound side by side since there will be ample space. This arrangement will give a greater area of wire when working on long waves, and in consequence long-wave efficiency will be somewhat higher than with the arrangement shown in Fig. 3.

### Frame Aerial Details

The estimation of the number of turns and gauge of wire required for a frame aerial always seems to present a difficult problem to the constructor. There is no

(Continued on page 952.)

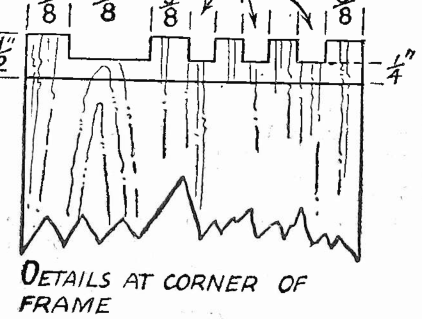



*Fig. 11.—The recesses to accommodate the windings.*

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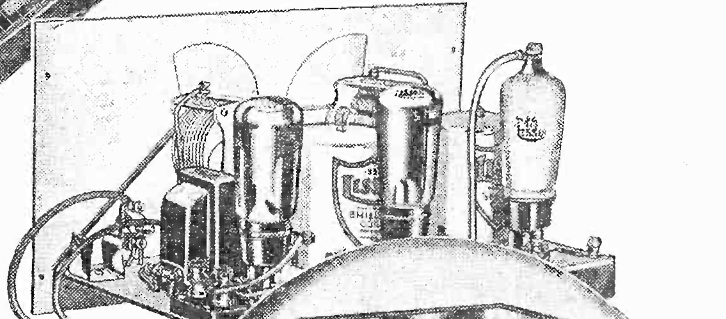

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## THE DESIGN AND CONSTRUCTION OF SIMPLE PORTABLE SETS.

*(Continued from page 950.)*

reason why it should, for, although the calculation is a little involved, there is a "rule of thumb" method which can be followed with every success. This rule is to the effect that the length of wire for the medium-wave winding should be approximately 75 feet and for the long-wave one 225 feet; this assumes that the two windings are joined in series for long-wave reception. As an example, it can be seen that the correct number of turns for the aerial shown in Fig. 9 would be approximately 18 for the medium-wave winding and 54 for the long-wave one.

The best size for a reaction winding is best determined by experiment, but, as a guide, it can be stated that two turns for medium waves and three for long waves will be found just about right. There is no need to short-circuit the "long-wave" portion when using a circuit such as that of Fig. 2, but it is most desirable that this should be done in the case of the circuit of Fig. 3. The reaction turns should go in the opposite direction to those forming the tuned winding when connected as shown in the sketch of Fig. 9, but they may be put on in the same direction if the connections to them are reversed.

Generally speaking, it is best to use fairly stout, such as 22 gauge, double cotton-covered wire for the medium-wave winding, but all the others may be of practically any gauge: 26 or 28 will be convenient in the majority of cases. If a little greater efficiency is desired, the medium-wave winding can be made in special stranded frame aerial wire such as Lewcos 9/40, which is sold in 100yd. reels. This material consists of nine strands of 40 gauge wire, each of which is enamel insulated, and the whole is silk covered. In using wire of this kind care must be taken that every strand is scraped bare of insulation at the end, and that they all make proper contact with the connecting lead; if this is not done, efficiency will be no greater than if a single wire were used. To ensure perfect contact it is best to twist the bared ends together and apply a little solder. The stranded wire is not much better than a single one for the long-wave winding, but it can be used for this purpose where space permits.

When it is desired to employ external aerial and earth wires the aerial may be connected to the grid of the first valve through a .0001 mfd. pre-set condenser and the earth lead to high tension negative. This is the simplest, but not the best. method because it causes a very decided loss in selectivity. A much better way is to join the leads to a small winding loosely coupled to the main frame windings. The extra winding will be put on top of the others, placing one turn over the medium-wave and three over the long-wave portions. Signal strength would be greater if more turns were used, but selectivity would suffer in consequence, and so the extra turns would not be worth while in most cases. Practically any gauge of wire will serve for the aerial winding, and results will be just about the same whether it consists of, say, 20 or 30 gauge. Optimum signal strength will be obtained when the aerial is joined to one particular end of the winding, so it should be connected to each in turn to find which is better.

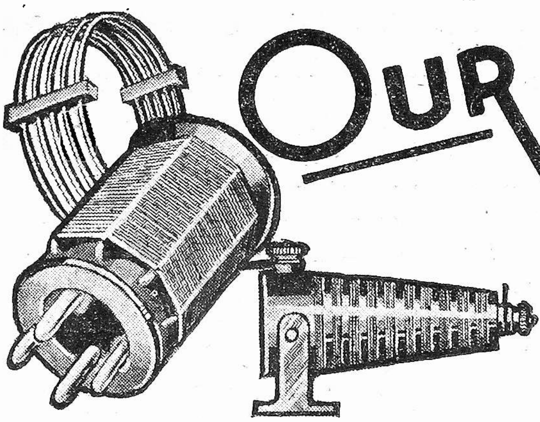
There are two or three different ways of making connection to the frame aerial, the simplest being to solder the necessary connecting leads to the ends of the windings. This is quite satisfactory when the set is built into an upright cabinet because the leads can easily be attached to the receiver, but it is awkward in the case of a suitcase type of instrument where the components are less accessible. It is therefore generally better to take the ends of the windings to terminals or sockets attached to the speaker fret or winding frame. The connectors (whether terminals or sockets) must of course be fitted with insulating bushes or else be mounted on an ebonite strip.

### Ganging Two-tuned Circuits

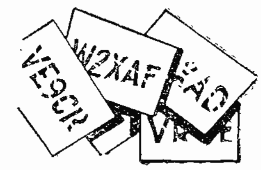
It was mentioned earlier on that the two tuned circuits of a receiver such as that represented by Fig. 1 could be matched and so tuned by a gang condenser, if desired. The matching is certainly not a very simple matter, because we are dealing with two coils (we can consider the frame aerial as a coil for this purpose) having entirely different characteristics. Instead of using a two-gang condenser of normal pattern, we must have one in which the two sets of vanes can be moved either separately or both together. Condensers with which such adjustment is possible are made by three or four firms and are of two different types. In one type a pair of drum dials are mounted side by side, each dial operating one section of the condenser. In another type only a single dial of the normal type is used, but there are two control knobs mounted concentrically. The larger knob rotates the dial and one set of vanes, whilst the small knob is operative on the other set of vanes.

With either kind of instrument the method of matching is the same. A station is tuned in at a low dial setting and brought to maximum strength by careful adjustment of the two condensers. If the condenser operating on the frame aerial has to be set to a higher capacity than the other, the aerial winding must be made a little larger, and *vice versa*. Needless to say, the correction of the winding must be accurate to a fraction of a turn. The same adjustment must be carried out on each waveband, alterations being made to the appropriate winding.

Even though the adjustment might be made quite accurately, it is doubtful whether it will "hold" over the whole tuning range, due to the fact that the self-capacity of the aerial and of the tuned grid coil will most probably be entirely different. When the relative settings of the two condensers vary a good deal at different parts of the dial some other compensating device will be necessary. This can best take the form of a "padding" condenser wired in series with one or other of the tuning condensers. The padding condenser will be a fixed non-inductive one of from .002 mfd. to .01 mfd., and should be connected in series with that condenser which requires the lower setting towards the top of the tuning range. It is impossible to give any specific details regarding the padding condenser, for it will be different with every set; the only way is to experiment with different values after finding with which condenser it must be used. In most cases it will be required for the aerial tuning condenser, and after it is inserted it is probable that another slight alteration to the size of the aerial windings will be required. After some experiment it should be possible to choose a value at which the settings of the two condensers remain sensibly the same over the whole of both tuning ranges. They can then be operated simultaneously.



# OUR SHORT-WAVE SECTION




## A SIMPLE SHORT-WAVE ADAPTOR

By A. Vaughan

MANY listeners would frequently like to tune down to short waves, but can neither afford a separate receiver nor a short-wave adaptor. The method about to be described of tuning down to short waves on a broadcast receiver is especially intended for this type of listener, being extremely simple and cheap, but nevertheless, quite efficient.

Fig. 1 is a typical broadcast receiver circuit, and possibly the bulk of the sets at present in use are of this type, with perhaps certain modifications. To convert this to a short-wave receiver, all the apparatus necessary is shown in Fig. 2.

An ebonite or paxolin former, 1in. diameter, has two coils wound on it. The larger-spaced coil being for tuning, and the smaller, unspaced coil for reaction. The number of turns required depends on the wavelength it is desired to receive, and by consulting the accompanying table, they can be determined.

| Approx. Waverange in Metres | Tuning Coil | | | Reaction Coil | |
|---|---|---|---|---|---|
| | No. of turns | Gauge of Wire | Length of winding A-B | No. of turns | Gauge of Wire |
| 15-30 | 6 | 20 swg | ⅝in. | 3 | 30 swg. |
| 25-50 | 12 | 20 " | 1⅛in. | 5 | 30 " |
| 45-80 | 24 | 20 " | 1⅞in. | 8 | 30 " |

Having made up the coil required, it is connected to the receiver at the points indicated—*i.e.*, A to A, B to B, C to C, and D to D; when it will be seen that the short-wave coils are in parallel with the medium-wave anode tuning and reaction coils respectively. The method of actual connection will depend entirely on the construction of the receiver, but many coils have terminals fitted, so in these cases it will not be difficult. The size of wire recommended, and the small weight, will make a self-supporting coil of sufficiently rigid construction. In many cases it will be found that to make the necessary connections, and for space consideration, the screening can will have to be removed from the anode tuning coil, but as the grid coil of the first valve is untuned when working on short waves, it will not cause self oscillation or instability.

### Method of Operation

To operate the receiver on short waves, variable condenser K must be set at minimum, for coil L is to function as an H.F. choke, and therefore, must have as little capacity in parallel with it as possible. Then adjust the reaction condenser until the set is just oscillating, and search very slowly for the well-known heterodyne of a station with condenser $K^2$.

It is very important when searching for stations to have the receiver not oscillating too strongly, or many stations will be completely missed. Points to remember particularly are that the tuning condenser $K^2$ and its slow-motion device were designed for medium waves, so the condenser should be rotated very slowly. Also, the condenser should only be used up to the centre of its scale, and this use of only part of the capacity is taken into account in the table, when the maximum value will be about .0002 mF. In some receivers a fixed condenser is connected from the detector anode to earth (shown dotted in Fig. 1), and it will probably be found necessary to disconnect this in order to obtain sufficient reaction to make the receiver oscillate.

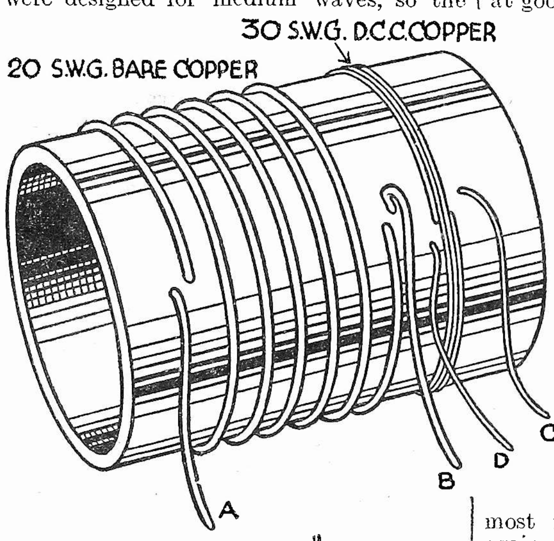



*Fig. 2.—The short-wave coil mentioned in this article*

With this circuit, in one evening the writer received stations in Java, Japan, Italy, and North and South America, all at good strength on 'phones, many of them at good loud-speaker strength.

As mentioned above, it is most important to carefully control the reaction condenser. When the receiver is oscillating too much, the station will be passed owing to the heterodyned carrier oscillating above audibility. This means that instead of hearing a whistle as you approach the tuning point of a station, nothing will be heard until dead in tune, and then just the slightest " Plop " will be heard if you are listening intently. If, however, the reaction control is not coupled so tightly, a faint rushing will be heard as you get near to the tuning point, this will increase in intensity and then develop into a whistle. As the control is advanced still further the whistle will decrease in pitch and suddenly cease. Almost immediately, it will rise in pitch again as the control is turned still further, but the hollow, or silent point, is the spot where the actual signal should be received, and upon getting this point the reaction control should again be adjusted, and the tuning dial and reaction control then adjusted in unison. The feel of the controls will soon be appreciated.

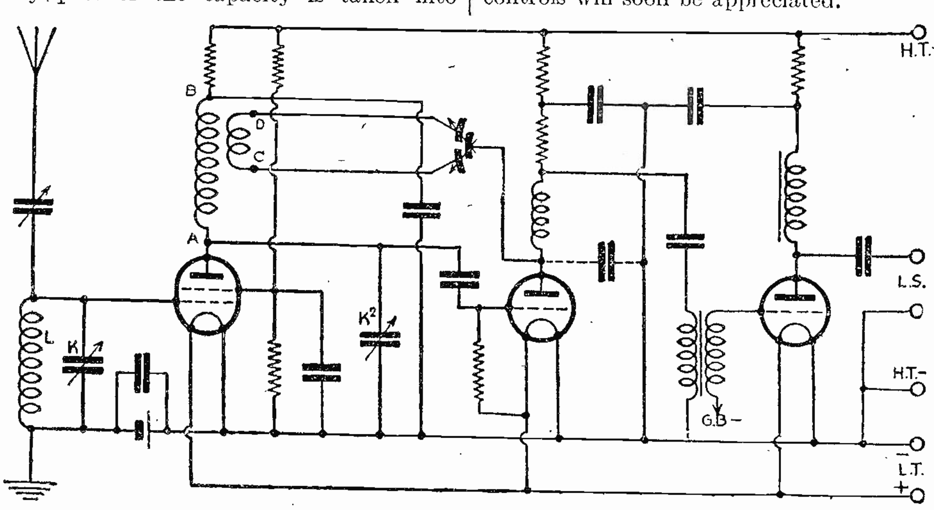



*Fig. 1.—A typical broadcast receiver circuit.*

TECHNICAL TOPICS

# A CHAT ABOUT AUDIO FREQUENCY

## How Musical Notes are Built Up

By H. BEAT HEAVYCHURCH

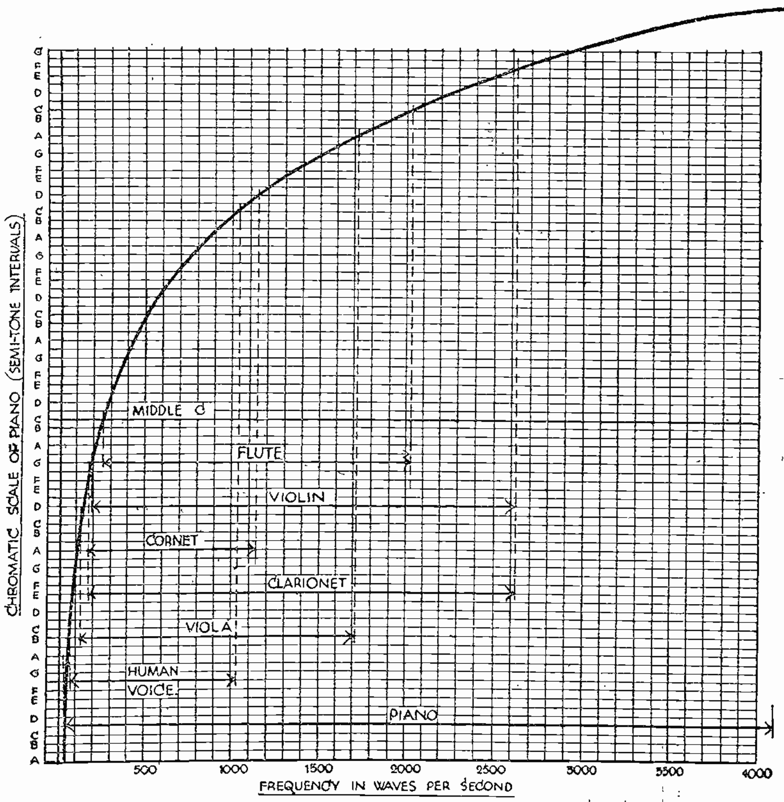
IN two recent articles I dealt at some length with the question of frequencies generally, and explained that the alternating currents and voltages met with in radio practice could be divided roughly in two groups—those, like the radio frequencies, which cannot affect the human ear, and a range of lower frequencies which corresponds to sounds. I discussed the subdivision of radio frequencies rather fully, and now I want to give you what I think will be regarded as interesting information with regard to the sound frequencies.

As sound is at once the raw material of which programmes are made, and the finished article turned out of your loud-speaker, it is of the utmost importance that those who design, build, or operate a radio receiver should have more than a nodding acquaintance with the properties of sound waves and sound-frequency currents. For this reason, I cannot do better than start with a brief explanation of how sounds are produced and transmitted, following this with a more intimate study of sound waves from a frequency point of view. We shall then be in a position to examine more closely the properties of electric currents which vibrate at audio frequency, and in this way be in a position to understand the why and the wherefore of certain circuit components which find a place in the audio-frequency side of radio equipment.

### What is Sound?

To begin with, then, what we call "sound" is the effect upon our ears of certain vibrations which take place in the air. The sensation of hearing is known to all of us—except those who are deaf—and needs no description. Actually, the sound waves are not *motions* of air, but merely rapid variations in air pressure or, as scientists would say, rhythmic alternations of compression and rarefaction. Most sounds, and all musical sounds, as opposed to mere noises, are produced by the vibration of some material substance or instrument. The vibration of the strings of a violin or the membrane forming the head of a drum are familiar examples. When the string or drumhead vibrates, it first compresses and then releases the pressure on a layer of air immediately surrounding it. This layer of air then jostles the neighbouring air particles, and so the changes of pressure are passed on from one layer of air to the next, in the form of a pressure wave.

In the case of pipe instruments, like the flute or organ, and in all wind instruments, the sound is originated by causing a column of air within the pipe or instrument to vibrate. This is effected by blowing across the end of the tube, or by forcing air into the tube, or by admitting air in rapid puffs by blowing against a tongue of thin metal or other material termed a reed. At the same time, the quality of the sound, or what musicians term its characteristic tone or coloration, is determined by the form and material of the instrument.




*This graph illustrates the frequency response of different instruments, etc.*

### Important Properties

There are three important properties or distinguishing features of all sounds, namely, their degree of loudness; their "pitch," that is to say, their degree of shrillness; and their characteristic tone. Loudness, or amplitude, does not concern us for the present. It depends primarily upon the amount of energy liberated by the vibration and the distance between the instrument and the hearer. The pitch of a sound, however, is a matter about which we have much to say. If you have a piano at home, strike a note at the centre of the keyboard and then, immediately afterwards, another note situated at some little distance to the right of the first one. You will perceive immediately that the second note is much shriller than the first and you will say that it has a higher pitch. Similarly, a note right down on the left-hand end of the piano will be of deeper pitch.

The pitch of a note is decided solely by the frequency of the vibrations producing it. Thus, for example, the middle C of a piano is the result of a string or wire vibrating at a frequency of 256 per second. The range of frequencies corresponding to actual sounds is restricted. About 30 vibrations per second represents the lowest pitch which can be heard by the average human ear, and the upper limit is in the neighbourhood of 30,000 for human beings, although there is considerable evidence that some animals and insects can hear sounds of much higher pitch. For ordinary musical purposes, however, a range of 30 to 6,000 vibrations per second covers all that is really necessary and all of which can be handled under modern broadcasting conditions. A receiver which is reasonably selective and gives a good response over this range of frequencies can be considered very satisfactory indeed.

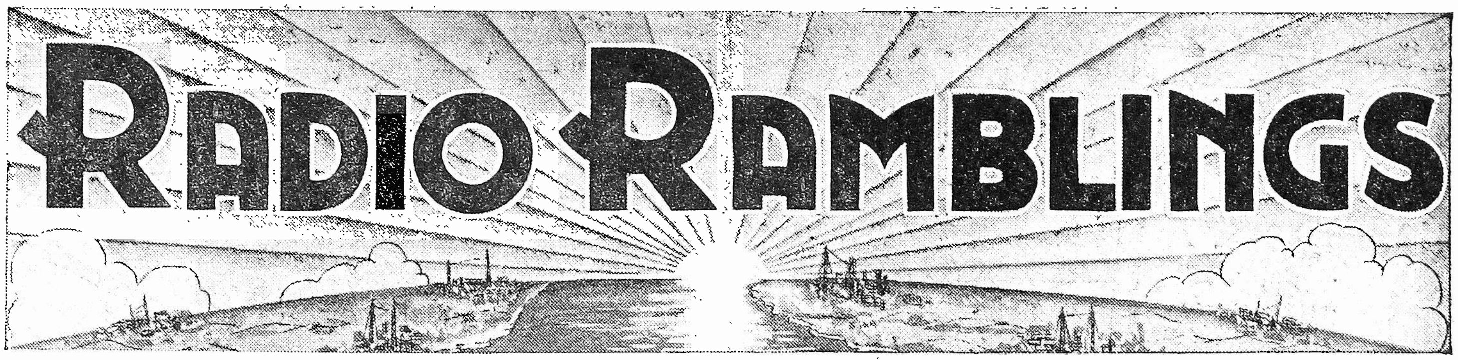
### Octaves

If you examine a piano you will notice that the keys are arranged in a definite order or pattern, and repeat themselves at regular intervals. For example, you will find that every eighth white note occupies the same position relative to the black notes. Now strike a note—say middle C—and then the next note above it occupying a similar position. Not only will the second note be of higher pitch, but it will have a certain similarity of sound. It is what is called one octave higher. The octave is divided into twelve intervals called semi-tones. Each note in the octave is exactly one octave above or below the corresponding note in the adjacent octave.

Now it is interesting to learn that in order to produce a note one octave higher than another note, all that is necessary is to double the frequency, while to produce a note one octave lower, the frequency must be halved. Thus, the frequency of middle C being 256, the frequencies of the C above it, and the C above that again are 512 and 1024, that is, twice and four times the frequency.

Technically, the frequency of a given note is termed its "fundamental" frequency. A frequency twice as great is called the "second harmonic," three times as great, the "third harmonic," and so on. Thus, a note and its successive octaves comprise the fundamental frequency and its second, fourth, eighth, sixteenth harmonics, and so on. The other harmonics—third, fifth, sixth, seventh, etc.—form other notes which are not octaves of the fundamental. Thus, the third harmonic of middle C is the G of the next octave, and the sixth harmonic the G above that. Some of the higher *odd* harmonics represent tones which sound rather unpleasant when heard with the fundamental.

*(To be concluded next week.)*




**JOTTINGS FROM MY NOTEBOOK**
By "DETECTOR"

### The Cathode Ray Oscillograph

DURING the Exhibition arranged by the Physical Society several interesting lectures on scientific subjects were given. At one of them a Mr. Watson Watt dealt with further developments of the cathode ray oscillograph and demonstrations were given. The oscillograph used was made by Messrs. A. C. Cossor, Ltd., and Mr. Watt explained how, by its use, it was possible to see the origin of many of the atmospherics that made our listening uncomfortable during the summer months particularly. A film was shown which gave a single minute of the thunderstorm history of Europe, and the places of origin of individual atmospherics were indicated by a series of bright flashes on a dark map of Europe. During a half minute of recording the film showed lightning flashes in mid-Atlantic, the North Sea, Denmark, Germany, Hungary, and the Balkans and France, all of which had contributed to the stream of atmospherics affecting Great Britain. The flashes appearing at different places on the map were fascinating to watch, but you can judge for yourselves the influence they must have had on reception.

### Mount Everest Expedition

SOON the Mount Everest expedition will be well in the news, and, no doubt, radio will play a large part in maintaining communication with the party as far as possible. I see that the firm "Ever Ready" are supplying a special equipment of Morse signalling lamps so that the climbers will be able to converse with each other at a distance. The hand torches used have all their metal parts covered with rubber so as not to be cold for the hands, and a special switch is fitted so that a continuous light or a Morse intermittent light can be used. In the butt end of the torches is a fitment for holding two spare bulbs. The climbers will also wear an Ever Ready button-hole lamp, the current for which will be derived from a dry battery carried in a small leather case.

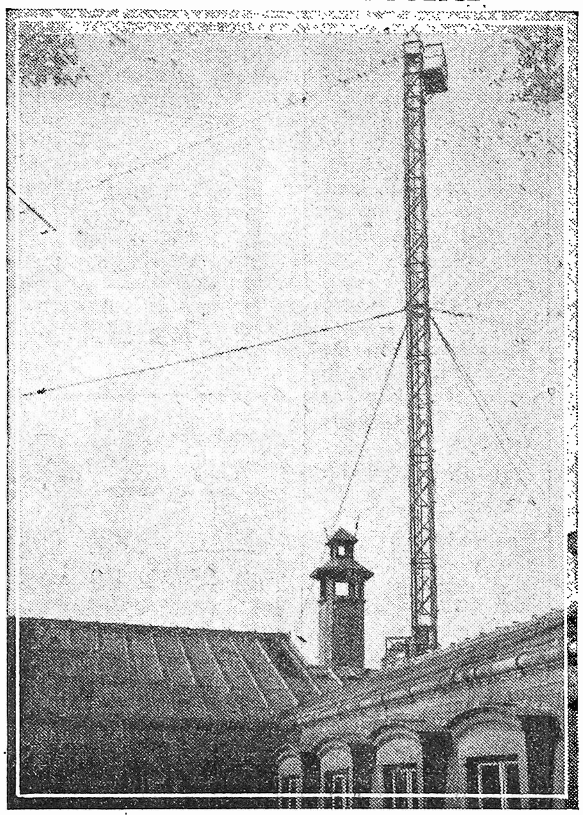
### Remarkable Response to S.W. Amateur's S O S

HERE is a little radio story that you may like to hear which also possesses the virtue of being absolutely true. A professional cinematograph cameraman was engaged in Alaska in procuring "shots" of the local scenery, and during his rest periods he amused himself in his little shack with a portable transmitter and receiver that he had made up, his hobby being radio. During his tour of the ether he made contact with an amateur in New Zealand, and for over an hour they exchanged pleasantries, in the course of which they described to each other their respective situations. The amateur in Alaska was speaking when the New Zealand listener heard a sigh, and the transmitter suddenly went dead in the middle of a sentence. After trying without success to get any further signals from the Alaskan amateur, the New Zealand man, 5,000 miles away, thought something was wrong and started sending out a series of S O S's. After a while a wealthy amateur in the U.S.A. made contact with him and listened to a description of the matter, and in turn sent out signals over the American continent. Strangely enough another amateur in Alaska was working and picked up the message, and succeeded in getting the details of the approximate position of the cameraman's hut. Taking a friend with him he started out on a search and some time later he found the shack with the amateur inside lying unconscious across his transmitter. It appears that an oil stove that was not burning correctly had emitted fumes that had gassed the cameraman, and after some minutes of artificial respiration he came round, none the worse for his experience. When he had completely recovered he and his new found friend got in touch with the American amateur, and the one in New Zealand and sent out thanks and exchanged congratulations. I know the story sounds almost too good to be true but it is so, and is another instance of very many where a life has been saved through radio.

### Loud-speakers on French Motor Lorries

I SEE that a law has been passed in France that after January 1st of next year all heavy motor lorries will have to be fitted with a loud-speaker and amplifier inside the cab connected to some kind of microphone arrangement outside. This is because of the numerous complaints received by the police from private motorists that lorry-drivers inside the modern closed cabs are unable to hear the horns of other vehicles wishing to pass. Those of you who have heard the incessant din kept up by motorists' performances on their horns and hooters in France, will imagine that none other than a deaf mute would confess to inability to hear the sound of a vehicle's approach, but still, there it is!

**WIRELESS AND THE POLICE**



*Aerial mast of the wireless station at the Sûreté Générale, Paris, the headquarters of the French Police.*

### Pick-Up Tone Control

YOU have read in these pages some excellent articles on tone control either by means of adjustments carried out in the set itself or at the loud-speaker terminals, but I do not believe I have seen reference to the dodge of putting a fixed condenser across the terminals of a pick-up that has a tendency to accentuate the upper frequencies at the expense of the bass. A pick-up of this sort as a rule is a bad offender as regards needle scratch because of its inherent preference for emphasising sounds of high pitch, and the tone can usually be much improved by the addition of a shunt condenser. Too big a value of this condenser will cause the signals to become "woolly," and it should not have a bigger value than .001, unless the peculiarities of the pick-up demand it without loss of quality.

### Booklet on Radio Power Units

A HANDY little booklet has just been published at 6d. post free from the Telegraph Condenser Co., Ltd., North Acton, W.3, which deals with the construction of Radio Power Units for sets of all sizes. The units described therein all utilize Westinghouse metal rectifiers where the power supply is A.C., but a description of a D.C. unit is included for listeners on this supply.

# CHOOSING AND USING

In this Article FRANK PRESTON, F.R.A., Deals with the the Point of View of the User. *(Continued*

### Dual-compensated Speakers

Another kind of reproducer which is becoming justly popular is that consisting of a matched pair of moving-coil speakers so adjusted that, between them, they give practically uniform response to the whole harmonic range from about 32 to 9,000 cycles. There are two schools of thought in connection with the method of attaining a "balance" of tone, and each is represented by different speakers now on the market. One method is to design one speaker especially for the high, and another for the low, notes. This consists, basically, of using a small rigid cone for the "high-note" speaker and a larger cone of softer material for the "low-note" one. This system is not entirely satisfactory, because for its correct functioning it entails the use of filters so designed that they pass on to each speaker only the higher or lower frequencies.

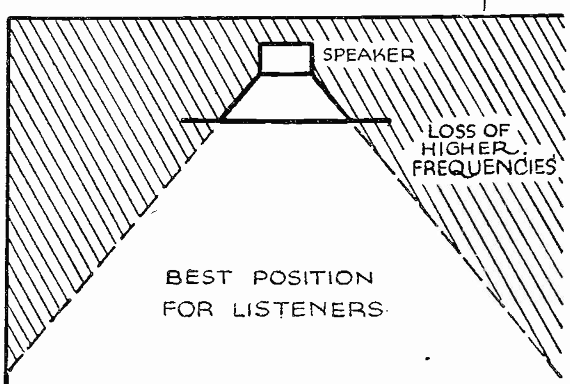



*Fig. 9.—Illustrating an effect of putting the speaker at one end of a room.*

A different method, and one which is more easy of application, is to employ two speakers each of which can respond to the whole frequency range, but which are so chosen that one gives additional response at those frequencies at which the other is less sensitive. To explain the matter in terms of response curves one might say that one speaker shows a "peak" at the point where the other has a "trough." Perhaps this explanation will be more readily understood by considering the hypothetical curves of Figure 7: that marked "A" represents the response of one speaker, that marked "B" the response of the other, and the straight line marked "C" shows the overall response of the two working together.

Dual-compensated speakers probably represent the last word in "quality" reproduction as judged by contemporary standards, but, quite naturally, they are more expensive than those consisting of a single instrument. They are obtainable in various power-handling capacities for different kinds of sets, but it would be both futile and wasteful to use a speaker of this kind on a small low-powered set, which could not do justice to it. On the other hand, it would be eminently suitable for a powerful high-class set, where its use would be more than justified. The dual speaker will, of course, handle about twice the signal energy of a single one, and so on a basis of power-handling capacity it will not prove very much more expensive.

### The Electrostatic Speaker

There is still another type of speaker which we have not yet considered. I refer to that which operates on the principle of a condenser, and is referred to as electrostatic. This speaker has no iron core, winding, or moving armature, but consists of two metallic plates separated by a layer of insulation. As alternating (audio-frequency) currents are applied across the metal electrodes the latter vibrate in a manner not unlike that of the diaphragm of a more conventional speaker.

The electrostatic speaker is not by any means sensitive, but gives extraordinary brilliance to stringed instruments, and to high notes generally. It is more or less free from definite resonance peaks, but does not respond at all well to low notes. Used by itself, it is therefore only really satisfactory when high-note reproduction is the principal requirement, or when the set itself gives emphasis to the low notes; for instance, when a very selective single circuit tuner is employed. But it can be used with every satisfaction in conjunction with an inductor or moving coil which is definitely partial to the lower frequencies. When used in the latter manner the electrostatic speaker forms one unit of a rather different kind of dual-compensated reproducer.

### Judging Speaker Reproduction

It is hoped that after reading the foregoing remarks you will have been able to decide which type of speaker is most likely to suit your own individual requirements, so you should now be in a position to try out a few examples of that type. The point which remains to be considered is how, and by what standards, you shall judge the speakers you hear. Again, I cannot lay down any special rules because the choice should depend more on your own ear than upon any advice I could offer. I would just remind you, however, that true comparisons cannot possibly be made unless each speaker is properly matched to the output valve. This matter was dealt with in a previous article entitled: "The Loud-speaker and the Output Stage," and published on page 332 of PRACTICAL WIRELESS No. 7.

I need scarcely add, when the speaker is to be used on a powerful set it must be capable of carrying the full output of signal energy without overloading. The power-handling capacity of the speaker should be no less than the "maximum undistorted output" of the last valve; the figures for this are given by the valve manufacturers in terms of watts, or milliwatts (thousandths of watts). As an example, it might be mentioned that the "maximum undistorted output" of the

# YOUR LOUD-SPEAKER

Various Types of Loud-speakers and Examines Them from
*from page 849, January 21st, 1933, issue)*

Cossor MXP is 2,000 milliwatts, and thus a speaker to follow this valve should be capable of handling no less than 2 watts. When dealing with small power valves the power output is only in the region of 200 milliwatts, which is not beyond the capacity of the smallest of speakers, and so no special care need be taken in respect to the speaker's power-handling capacity. It is always difficult to "remember" sounds, so the speakers should be connected as shown in Fig. 8 in order that the change-over from one to another can quickly be effected by transferring the wire marked "2." The first requirement is that the speaker shall be chosen to please *you*, but if two or three give very similar results so far as your ear can detect, it is wise to apply a few more specific tests to find which speaker actually gives best response to all frequencies. Now, this is a little difficult unless there is some standard by which to judge. If the speaker were to be used mostly with a pick-up and amplifier excellent comparisons could be made by running through one of those very convenient frequency records made by H.M.V. and Columbia. The idea is to select that speaker which gives most uniform response (as judged by the volume) to the greatest band of frequencies. At first sight it might appear that the same test would be of equal application to a speaker for use on any set, but this is not so because the pick-up has characteristics of its own which are probably quite different to those of the H.F. amplifying and tuning circuits.

A similar kind of test could be made on the radio side *if* the B.B.C. were to send out a regular frequency transmission, as I dare to hope they will in the future. Failing this, the best we can do is to listen to different types of programme material and make comparisons on each. In this respect the following kinds of broadcast matter will usually provide a good indication of a speaker's performance: (1) string orchestra, for high notes and harmonics; (2) organ, for low and pedal notes; (3) speech, for the middle register; (4) dance band for all frequencies, and especially the low ones treated by the drums; (5) military band for "brilliance" and "attack."

### "Attack"

But it is not sufficient to judge a speaker by its frequency response alone. There is another important point in respect to the way with which the speaker deals with sudden "bursts" of sound, referred to by musicians as "attack." I might be excused for explaining in general terms the meaning of "attack" as applied to the reproduction of music. As the name rather suggests, "attack" refers to the precision with which a note is struck (generally the first of a phrase), either by a soloist, band, or choir. Some speakers do not give precision to the note, but instead, reproduce a somewhat "blurred" sound which is very objectionable to the trained ear.

### Frequency Doubling

Another item which must be considered is whether the bass notes reproduced by the speaker are "real." This sounds rather Irish, perhaps, but it is a fact that many speakers which appear to give good response to very low notes, such as the pedal notes of an organ, do not in reality produce the actual sounds, but harmonics of them. Generally, the harmonics have twice the frequency of the originals, so that a 50-cycle note is actually reproduced by the speaker as a 100-cycle one. It is not always easy to detect this fault, but as it generally accompanies another one, bass resonance, it can often be traced through the latter. When bass resonance is present we get the effect of a "boom-boom-boom" when listening to a dance band or a musical composition in which there is a fair amount of bass. It can also be recognized by the fact that a certain low note always comes out a good deal louder than all the others. Although I have tried to suggest a few simple tests which can be applied even by the tyro in musical matters, I would recommend that, if possible, the non-musical reader should conduct them in the presence of a musical friend, who will be able to detect minor faults which might otherwise escape notice.

### The Best Position for the Speaker

And now we can consider how our speaker should be used if we are to get the best out of it. As explained before, the very first consideration is that it should be correctly matched to the output valve. Having attended to this matter, we should make certain that, if only a unit is bought, it is mounted on a suitable baffle board. As the question of baffles has been fully explained in previous numbers of PRACTICAL WIRELESS, I will not enter into it again here. Instead, I shall deal more with the best position for the speaker to occupy in the room.

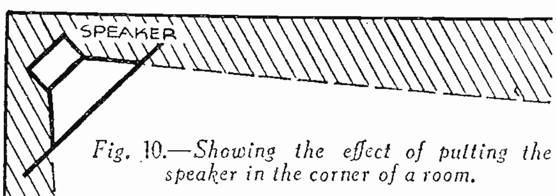
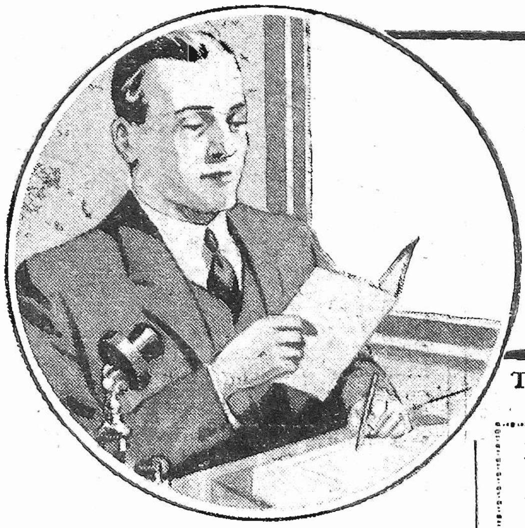



*Fig. 10.—Showing the effect of putting the speaker in the corner of a room.*

Here, again, I cannot give definite rules, but must perforce limit myself to suggestions and explanations. I can say most definitely, though, that it is always well worth while to try the speaker in various parts of the room and at different heights from the floor.

In the days of the horn speaker, we often found that most pleasing reproduction could be obtained by turning the speaker so that the open mouth of the horn was pointing into a corner. This has the effect of reducing the intensity of high notes reaching our ears, and thus rather compensated for the high-note emphasis nearly always given by the speaker itself. It is seldom desirable to put a cone type of speaker in a similar position.

*(To be continued)*



# Practical Letters from Readers.

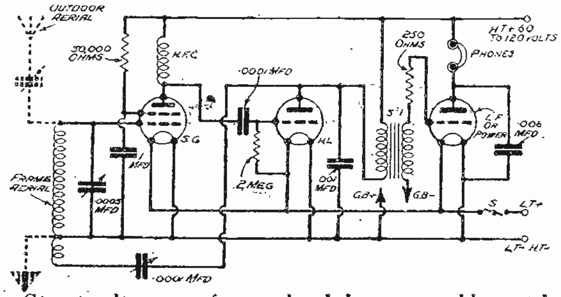
The Editor does not necessarily agree with opinions expressed by his correspondents

**INDEX TO "PRACTICAL WIRELESS"**
**In response to the request of many readers for an index and binding case, we have pleasure in announcing that we shall issue a semi-annual index and binding case for a nominal sum. The first volume will be completed with No. 26 issue dated March 18th, 1933. A further announcement will be made later.**

### From a Reader in New Zealand

SIR,—I have much pleasure in congratulating you on PRACTICAL WIRELESS, the first four numbers of which I have thoroughly enjoyed; the layout and illustrations, especially the latter, are splendid.

In our country we have 4 "A" class stations: 1YA, 2YA, 3YA, 4YA between 300 and 450 metres ranging in power from ½ to 2 Kw., and about twenty lesser "B" class stations for the smaller towns on the 200-300 metre band. Practically everybody has an all-electric radio, 230 v. A.C. 50 cycle model. Super-het. or T. R. F. between 5 and 8 valves, all of American origin, with an increasing number of N.Z. and Australian receivers now being sold. The licence costs 30s., and there are approximately 80,000 licensed listeners. These sets can pick up on speaker strength all "Aussie" stations—1,300 miles away—and plenty of European and American broadcasters. Los Angeles (K.F.I) being regularly received on 680 Kc/s., and even the London Regional has been verified as heard here. With best wishes for PRACTICAL WIRELESS.—EDWARD C. WATKINS (Christchurch, New Zealand).



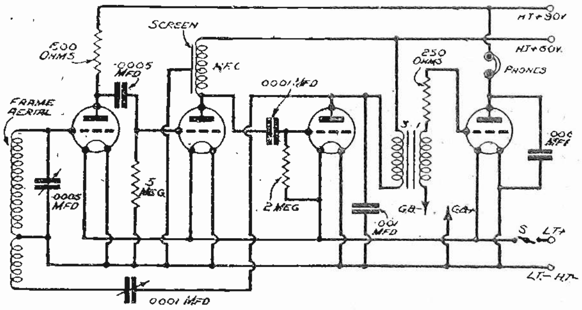

*Circuit diagram for a headphone portable, with single dial tuning.*

### Inductance and Capacity of H. F. Choke

SIR,—Replying to various inquiries on the subject, the inductance of the H.F. Choke described in PRACTICAL WIRELESS, No. 17, can be taken as being approximately 250,000 micro-henries, and the self-capacity 2.5 micro-microfarads. It will thus be seen that the choke is suitable for use in either the anode circuit of the detector valve or for tuned-grid coupling between S.G. and detector valves.—F. PRESTON (Carleton).

### Circuit Diagrams for Portable Sets

SIR,—Noticing a request from one of your readers (Mr. Hitchcock, of Harrow) for a circuit which I know a lot of people want, I enclose two useful circuit-diagrams. If any reader desires actual sizes and further particulars I shall be pleased to supply them with your kind permission. —C. L. Collins (Walmer).




*A 4-valve aperiodic coupled circuit for a headphone portable.*

### Constructional Article on 6-v Super-het Wanted

SIR,—I have taken PRACTICAL WIRELESS from its birth, and think it a good paper, but I have not yet seen an article on the construction of an A.C. Super-het set. I am sure there are many fellow readers like myself who are thinking the same thing. Where I live reception is bad, and if I saw a six-valve A.C. Super-het (that is with rect-valve) in a paper like yours I would make it straight away. Mind you, it must be as cheap as possible for we have no money to throw away these days. I hope you will do your best.—A. HOLBROOK (Rhyl).

**CUT THIS OUT EACH WEEK**

# DO YOU KNOW?

—THAT the average range of audibility in human beings is from 30 to 30,000 cycles.
—THAT the wavelength of a transmitting station is often kept constant, or controlled, by a crystal.
—THAT the metallic covering of metallised valves is not composed of aluminium, but zinc.
—THAT the anode wattage of an output valve is not the same as the undistorted wattage output.
—THAT a mica condenser may be used in place of a normal non-inductive condenser.
—THAT the earth connection should be of low resistance, and therefore heavy gauge wire should be used in addition to a buried plate.
—THAT a potentiometer with a value from 25,000 to 50,000 ohms may be joined across the aerial coil, with aerial to the arm, to act as a volume control.
—THAT selectivity in a detector circuit may be improved by tapping the grid-leak and condenser about one-third of the way down the coil, instead of connecting it at the top of the coil.

**NOTICE.**

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

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

### Wireless Constructor's Encyclopædia : More Congratulations from Readers

SIR,—I was very pleased to receive my "Wireless Encyclopædia," and felt I must write and thank you for it, and add my congratulations to the many others on your splendid paper. I should like to say that before taking PRACTICAL WIRELESS I knew nothing about the subject, but now I am thinking of making a small two-valve set. Also, I entirely agree with Mr. Sutcliffe *re* the entertainment articles, which, in my opinion, only fill up valuable space and are not at all "practical."—N. R. LEGER (Gosport),

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SIR,—I thank you for the Constructor's Encyclopædia. From my perusals of PRACTICAL WIRELESS, I thought the Encyclopædia would be good, but it is even better than I expected, and I am sure that it will prove invaluable to keen amateurs. It is the book I have been awaiting for the past twelve years. Wishing PRACTICAL WIRELESS every success.—LEONARD D. LONSDALE (St. Annes-on-Sea).

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SIR,—May I congratulate you in producing yet another fine publication in The Wireless Constructor's Encyclopædia, which I have just received. In my opinion, it is almost impossible to print a better book on the subject. I have been a regular reader of PRACTICAL WIRELESS since the first number, and am likely to remain so.—H. J. SAKER (Dartford).

## Practical Letters.

*(Continued from page 960.)*

SIR,—I beg to acknowledge with thanks the "Wireless Encyclopædia" sent me. It is, in my opinion, a very fine book, and must prove most instructive and interesting to any wireless amateur.—T. HARPER (Bristol).

SIR,—I have taken your paper since the first number and I am the proud possessor of the Encyclopædia which you have presented to those of your readers who availed themselves of your generous offer. I have numerous books on wireless, from sixpenny pamphlets to others up to 7s. 6d., and now I have in one book all the vital information contained in them and, in addition, information which is up to date, and at little cost. I thank you for your excellent paper and the very useful volume you have sent me.—W. J. WINSKILL (Co. Durham).

SIR,—Many thanks for my copy of the "Constructors' Encyclopædia"; it certainly is what its name implies and worthy of a prominent place on any bench. I am now awaiting my binder, also next week's PRACTICAL WIRELESS. I might add that my newsagent has had a standing order since the very beginning and Wednesday mornings are eagerly awaited. Again thanking you, and wishing PRACTICAL WIRELESS every success.—J. SHAW (Southampton).

## Are You Still Using Plug-in Coils?

*(Continued from page 946.)*

coil. This is a very useful feature in these old sets, where the use of reaction brings about a state of sensitivity akin to that of a sore tooth. The introduction of a small differential condenser (.0001) in the anode circuit is a new feature in the old layout, and it is in fact the essence of the set. It is to be considered as an additional tuning device, and critical tuning is achieved by this component, in conjunction with the anode-tuning condenser. The more the pointer of the differential condenser is turned towards the earth side, the greater the selectivity. In practice, only about three-quarters of the possible movement will be available without too great a loss of strength, but much of the loss can be brought back by reaction. Every movement of the differential condenser requires a slight readjustment of the anode-tuning condenser. The pre-set condenser in the aerial circuit will usually be nearly at maximum (fully screwed down), as reducing its value quickly reduces volume, and the extent to which volume can be regained by reaction will determine the degree to which it can be employed successfully.

If you must purchase an H.F. choke buy one of the Binocular type, but try any old H.F. choke you can get your hands on first of all, and if the results are promising, the binocular type may be substituted later. Neutralizing is, of course, carried out in the normal manner.

Here are approximate coil values, using aerial condenser .0005 and anode condenser .0003:—

| | *Aerial Coil* | *Grid Coil Centre-tapped.* | *Anode Coil.* | *Reaction.* |
|---|---|---|---|---|
| Under 400 metres | 35 | 60 | 50 | 75 |
| 400-600 metres | 50 | 75 | 75 | 100 |
| Long Wave | 150 | 250 | 250 | 150 |

Since old sets vary so much in their possibilities, one cannot say much about the results to be expected, but I see no

*(Continued at foot of next column)*

# RADIO CLUBS & SOCIETIES

### TONE CONTROL

Dr. Hughes (Multitone Electric Co.) gave a lantern lecture on the principles of tone control at a recent meeting of the Southall Radio Society. He discussed the various methods of sound reproduction, and illustrated how the "Multitone" transformer had been designed to make good low-frequency attenuation, which is all too prevalent at present in the average receiver. Dr. Hughes also covered the variable conditions which were met with in radio reception, and how irregularities in reproduction were obviated by the "Multitone" Coupling.

Hon Secretary: H. Rayner, 114, North Road, Southall.

### WOODFORD AND DISTRICT RADIO SOCIETY

Mr. Gwinn, of the Telephone Condenser Co., Ltd., gave a most interesting lecture to one of London's oldest radio societies (Leytonstone, Woodford, Wanstead, and District) at 20, High Street, Wanstead, on Thursday, January 19th. The lecturer very clearly showed that considerable improvements have resulted in the last few years in fixed condenser design. The dielectric had been improved, and the inductance effect considerably reduced. It was said that there had been lack of co-operation between condenser-makers and users. A lantern was provided by the club.

The Woodford Society has now been in existence well over ten years, and, considering the growth of population locally, ought to have at least three times its present membership. An extremely instructive syllabus has been arranged to the end of the present season. The Hon. Secretary is Mr. H. O. Crisp, 2, Ramsay Road, Forest Gate, London, E.7.

### BRADFORD SHORT-WAVE CLUB

On Wednesday, January 18th, a very interesting talk was given by Mr. Fennessy (G5ZI) on ultra-short-wave working, using a wavelength of about 60 centimetres. Another feature of the gathering was a morse writer, by means of which the members of the club were able to "see" their morse, as recorded on a tape, and to tell their faults at a glance.

These meetings are not of the usual lecture type, but are merely a gathering of short-wave fans, who discuss things relative to short-wave working. There is no membership fee, and anyone who is interested in this fascinating branch of radio is given a welcome. I might add that the club has its own receiver, which was constructed entirely by the members. Meetings are held every Wednesday night, at 7 p.m., in the Godwin Commercial Hotel, Godwin Street, Bradford. The usual programme is as follows: 7-8—Morse practice. 8-9—Any business that there may be, or the demonstration of a receiver, etc., and 9-10.30—A general talk. All correspondence should be addressed to the Secretary, Mr. G. E. Gaunt, 172, St. Leonard's Road, Girlington, Bradford.

### A RADIO LEAGUE OF NATIONS

The Anglo-American Radio and Television Society and the associated society, The International Radio Society, wish to express their thanks to PRACTICAL WIRELESS for the publication of a note regarding the societies which resulted in many new members being enrolled. For the benefit of readers who may not have observed the first announcement, here are the details of the societies in brief: They aim to promote goodwill and fellowship between nations and aid radio enthusiasts. No charge is made for membership. Anyone desiring to join has merely to send his, or her, name and address to 11, Hawthorn Drive, Willowbank, Uxbridge, England. If a reply is desired a stamped-addressed envelope should be enclosed. A bulletin, *Radio*, is issued freely to members who send a stamped envelope for it. No. 2 is just out, and it includes a list of North American stations which have been heard, and are being received, in Great Britain. A list of the Empire stations, short-wave broadcasters, etc., are also contained.

*(Continued from previous column.)*

reason why any obsolete set altered on the above lines, provided it has good L.F. amplification (good, in a volume sense), should not equal the performance of an old museum-piece, similarly altered, in my possession. This ancient four-valver gives at least fifty stations clear of interference on the speaker, and in N. Wales, where North Regional is a very powerful signal, the old set has no difficulty in bringing in either Prague or Langenberg quite clear of the North Regional station.

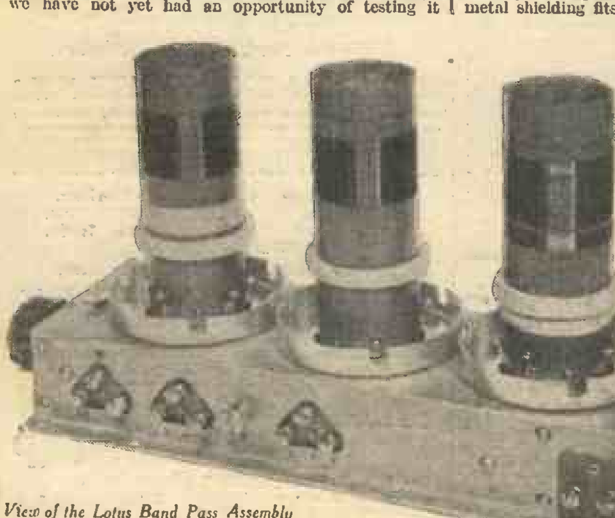

# What we Found..

### QUIESCENT COMPONENTS

THE introduction of the Quiescent Push Pull system has brought forth a demand for components more suited for this type of amplification than the usual Push-Pull system, and one of the first firms to produce these special components is R.I. The Input Transformer has a core of nickel iron, and is consequently of small dimensions. The total inductance of the primary, with no D.C., is 30 henries, which drops to 16 henries at 2 mA. The D.C. resistance is 900 ohms., and the total ratio 1/8. For Output purposes a special Choke is employed instead of the customary Transformer, and this has a Primary resistance of 400 ohms, with an inductance of 70 henries to each half at 50 volts, 50 cycles. The choke is tapped to provide four ratios, 1/1, 1.4/1, 2/1 and 2.8/1. The Input Transformer costs 15s., and the Output Choke, 12s. 6d., and they are components giving the same high standard of performance that is obtained with all R. I. products.

### NEW LOTUS BAND PASS ASSEMBLY

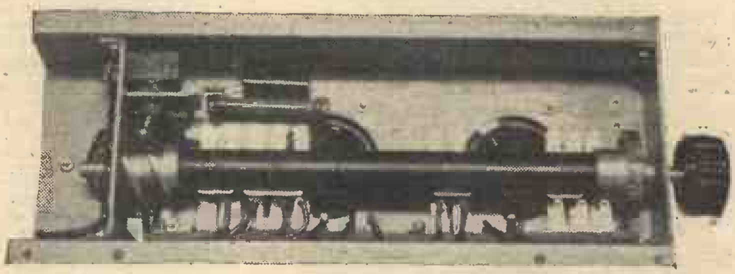
A NEW type of Band Pass Coil assembly is shortly to be marketed by Lotus Radio, and is illustrated on this page. As will be seen this consists of the two Input Band Pass Coils, together with an intermediate Grid coil suitable for inclusion in the detector Grid Circuit. This is provided with a Reaction winding. The metal base for these coils will be seen to be exceptionally high, and the reason for this is apparent from the upper photograph. The usual troubles which arise due to switching troubles have been overcome in these coils, and instead of simply short-circuiting the long wave winding when receiving the medium waves, special values of inductance are chosen for each band. In addition, the Aerial coil is also carefully varied, and the flexible fingers which enable these changes to be carried out may be seen below the coil base. An ebonite rod is fitted with a number of brass contacts, and these short the various contacts when the rod is rotated. A further novel addition to this operating rod is the provision of a substantial case cam at the extreme end. This operates an ordinary Mains type Q.M.B. on-off switch, and this is connected to a separate insulated plate fitted with two terminals. The leads to these terminals from the switch are twisted so that the Unit may be used with a Mains receiver or a battery receiver, to switch the set on as well as operate the wave-change mechanism. This is a really sound engineering job and although we have not yet had an opportunity of testing it thoroughly, it would appear to be a really first-class component. We understand that the price has not yet been fixed, but that it will shortly be placed on the market at a reasonable figure.



*View of the Lotus Band Pass Assembly showing the connecting terminals, and at the end the filament terminals on the insulated plate.*

### SCREENED WIRING KIT

IT has been repeatedly pointed out that hum in a mains receiver may often be cured by screening certain leads, and several readers have written to us asking how one can screen a lead. The ingenious Screened Wiring Kit manufactured by Remax Radio is the very thing for temporary or permanent screening. It consists of a small transparent envelope containing three feet of metallic braiding inside which is a similar length of insulated tubing. It is therefore possible to cut off any required length of the complete tubing and braiding and thread ordinary glazite or similar wire through it for shielding purposes. To provide a sound earth connection to the braiding twelve combination clips and earthing tags are included in a separate small envelope and these are clamped round the metallic covering and connection to earth made by means of a length of the flexible connecting wire, of which 3ft. is also enclosed. It is therefore possible to carry out the screening of any wires in an existing set without purchasing anything other than this small envelope, which costs 1s. The value of this to the experimenter will, of course, be fully appreciated.



*Under view of the new Lotus Band Pass Assembly, showing the switch operating mechanism.*

### SCREENED AERIAL LEAD-IN

THE down lead of an aerial is often the cause of considerable interference being picked up from tramways, etc., and the problem of reducing this interference is not easily overcome. Messrs. Ward and Goldstone have now produced an ingenious flexible air-spaced flexible lead which removes the trouble in a very simple manner. This consists of a number of short bakelite tubes having one end domed and provided with a central hole. The diameter of these tubes is roughly three-quarters of an inch. A heavy flexible metal shielding fits tightly over these bakelite shells, and through the shells ordinary rubber-covered lead-in wire is threaded. By having these shells at frequent intervals through the metal screening tube the lead-in wire is held centrally disposed in the tube and this may be earthed. The assembly is made up in various lengths from 10 ft. to 60ft., and the price varies from 12s. 6d. to 63s. Brackets are provided to hold the tubing away from the wall of the house, and a special cowl is fitted to the upper end to protect the joint from the weather, and a metal fitting relieves the strain from the connection. Although rather expensive, this will be found invaluable in districts where interference is exceptionally severe.

### IGRANIC PENTODE TAPPED CHOKE

IT is practically impossible to connect the windings of any type of loud-speaker direct in the anode circuit of a pentode valve, owing to the high impedance of this particular type of valve. Whilst it is true that the majority of moving-coil loud-speakers of to-day have a transformer incorporated, with a special tapping for pentode valves, there are still many loud-speakers, both in use and on sale, which have no provision for use with a pentode. It is therefore necessary to use a separate pentode transformer or output choke, and the special Igranic component under review will be found extremely valuable for this purpose. Four terminals are provided, giving step-down ratios from 1 to 1 up to 8 to 1. This enables speakers of, from roughly 800 to 30,000 ohms to be used with the same valve. A condenser of 1 or 2 mfds. is required in conjunction with this choke, which is of small dimensions and is enclosed in a neat moulded bakelite case with clearly marked terminals and soldering tags. The price is 10s. 6d.

### NEGROLAC PLATE AERIAL

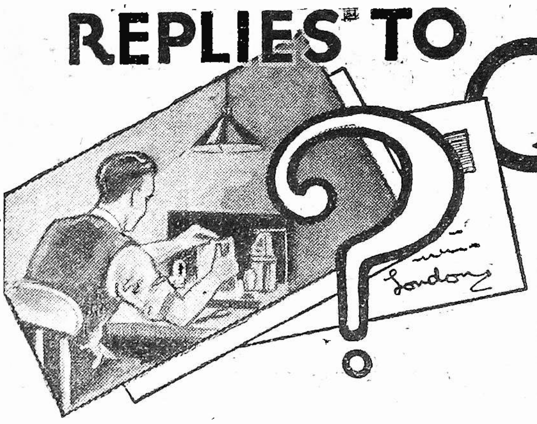
FLAT dwellers, and many other residents in large towns, often find extreme difficulty in erecting an efficient aerial, as restriction of garden space prevents the long wire, and very often the surrounding buildings are so high that it is not possible to erect a pole sufficiently tall to avoid the screening effect of these buildings. Messrs. Ward and Goldstone offer a ready and efficient solution to this problem in the Negrolac Plate Aerial. This consists of a perforated metal plate of substantial dimensions fitted to stout wooden cross-bars. Attached to the centre is a 50ft. length of multi-strand down-lead. The plate is intended to be attached to the highest part of the house, such as the chimney stack, and the down-lead carried to the receiver in the usual way, stand-off insulators being employed to keep the lead away from the walls. It is claimed that this type of aerial substantially improves reception by providing greater selectivity; removes fading caused by a swaying aerial, and reduces the total cost of an efficient aerial system. The price of the aerial, complete with the 50ft. down-lead, is 21s., and it must be remembered that no accessories are required.

### RICH & BUNDY L.F. CHOKES

WHEN constructing a mains unit, it is essential to know all the details concerning the choke employed for smoothing. In other parts of a receiver it is also essential that certain factors concerning the choke are known if the circuit is to be operated in the most efficient manner. Messrs. Rich & Bundy, the well-known makers of mains apparatus, give absolutely all particulars relating to their apparatus, and if a point is made of asking for it at the time of purchase, a characteristic curve of the inductance plotted against the D.C. load will be provided free of charge with any choke or transformer. All chokes are made with an "air-gap" and are, therefore, of the constant inductance type. These chokes and transformers are tested with a minimum high voltage pressure of 1,000 volts R.M.S. (or double the working voltage—whichever is the greater), and a severe standard is set for the insulation resistance. As an example of the ranges manufactured by this firm may be mentioned the small choke. Model E. 104, weighing 3½lb., with a D.C. resistance of 250 ohms and an inductance at 50 mA of 25 henries. This choke costs £1 5s. At the other end of the scale is a mains transformer, weighing 30lbs., with secondaries of 2,000 volts (centre-tapped); 4 volts 4 amps.; 4 volts 1 amp.; 4 volts 2 amps., and 10 volts 2 amps. This transformer costs £8 10s. 0d. Between these limits there is a most comprehensive range of transformers for all purposes, and smoothing chokes.

**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.

### PIANO LOUD-SPEAKER

**"I have found in my junk box a really fine loud-speaker unit of the older type, and I should like to use this in making up a loud-speaker. In looking round for some sort of diaphragm I thought of the sounding board of the piano. This should possess good musical qualities, and should make a good diaphragm. Before fixing the unit to it, I should like to know whether it will spoil the effect to screw the unit on to it, and perhaps you can suggest a better method. It seems to me that this would form a very good, inconspicuous loud-speaker, and should be worth trying out." (E. W., Hampstead.)**

The idea you mention is quite old, and, in fact, a commercial speaker was once on the market on similar lines. A small bracket should be screwed to the sounding board, so that the unit may be mounted up with the tip of the reed in contact with the surface of the board. If the Unit does not employ a reed, you should try and convert it to the reed type, and the attachment of the bracket will not noticeably affect the results.

### PERMANENT MAGNET LOUD-SPEAKERS

**"Whilst I was at school I was taught that iron and steel did not retain magnetism indefinitely, but that the property of magnetism was gradually lost. I should be glad, therefore, if you would tell me whether the term 'permanent magnet' loud-speaker is a commercial catch, or whether there has been some new property discovered which enables certain metals to indefinitely retain this valuable property of magnetism."—(R. J., Carlisle.)**

The term is, of course, not quite true, although to all intents and purposes, the speaker is permanent. The majority of firms who manufacture this type of loud-speaker are prepared to guarantee their product for at least five years, and naturally, by that time they will be out of date, so that the loss of its magnetism will not be of serious consequences to you.

### SELECTIVITY

**"I have an ordinary, rather old-fashioned three-valve set, employing a detector valve, followed by two low-frequency stages. The aerial tuning arrangement consists of a centre-tapped plug-in coil, which, as you are no doubt aware, is a rather flatly-tuned arrangement. I do not want to install any new tuning arrangements, but should like to know what I can perhaps do to the arrangement as it stands to enable me to tune-in some distant stations."—(R. F., Brompton Road.)**

Unless you are prepared to fit new tuning coils, you will have to juggle with the present controls in order to get a degree of selectivity. The following explanation should help you to understand the idea. Suppose you wish to receive a station which, at present, is badly jammed by a nearby local. Tune in the required station ignoring all interference, and so find the maximum position for the tuning dial. Now very carefully increase the reaction control, at the same time making any slight compensation necessary on the main tuning dial. In other words, keep the left-hand on the main-tuning dial, and keep the station in tune all the time, whilst with the right hand the reaction is increased. You will find that this will sharpen the tuning, and by careful adjustment you may succeed in getting the station completely free of interference. In any case, the interference will be greatly reduced in strength.

### INDOOR AERIAL

**"I have just been presented with a receiver by relatives, and must confess that I know absolutely nothing of wireless. I have never had a set before, and, therefore, have not interested myself in it. However, on getting this set, I decided that to operate it intelligently I should know a little about it, and, therefore, took in 'Practical Wireless,' from No. 15. My difficulty, before using this receiver, is what is the best type of aerial to fit up. Living in a flat, I am forced to adopt some form of indoor arrangement, and I wonder if you could give me some details concerning the best way to arrange such an aerial."—(R. S., Hampstead.)**

A complete article on Practical Indoor Aerials appeared in our No. 2, dated October 1st last. You may obtain a copy of this from our Back Issue Department, Exeter Street, Strand, W.C.2. Numerous different types of indoor aerial were described, and you will, no doubt, find some arrangement which will be suitable to you.

## DATA SHEET No. 20

Cut this out each week and paste it in a notebook

*FRAME AERIAL WINDINGS*

For normal waves (200 to 600 metres) use 22 d.c.c. wire, and space the turns to occupy approximately 10 turns to the inch. The frame should be square.

| Length of Side of Frame | No. of Turns |
|---|---|
| 12ins. | 18 |
| 18ins. | 12 |
| 24ins. | 9 |
| 36ins. | 6 |
| 48ins. | 5 |

### MAINS HUM

**"I have finished constructing a three valve mains-operated receiver, but the hum is rather too loud for my liking. I have used a standard method of mains construction, with a good heavy duty smoothing choke, and 4 mfd. condensers. How can I find what is causing the hum, and cure it when traced? Perhaps you could state which is the most likely place in the circuit for hum to be caused."—(S. L. K., York.)**

There are a number of different points where hum can be introduced, and without more explicit information it is rather hard to help you. However, the detector valve circuit is the most important, and you should see if this is sufficiently smoothed. An additional choke and smoothing condensers may be inserted in the positive H.T. lead to this valve with advantage. Vary the position of all transformers, and iron cored chokes; vary the position of the loud-speaker; use shielded leads for reaction leads and pick-up leads if such are fitted; screen the eliminator in an iron box connected to earth; and finally make quite certain that the eliminator delivers sufficient current for the receiver.

### GRAMOPHONE PICK-UP

**"I have been able to obtain quite cheaply a well-known make of gramophone pick-up. I understand, however, that there is a correct and an incorrect manner of mounting this so that the needle goes round in the correct fashion. How does one arrive at this? Is there a rule which has to be adopted, or do the makes vary? I naturally wish to get the best from this component, and, therefore, should appreciate your guidance."—(C. B., Kenton.)**

There is certainly a correct position for the pick-up, and the makers always supply a mounting template. If, however, you have been unable to get hold of this, you must mount the pick-up so that the angle with the recording groove is always (or nearly always) constant. Lay a straight-edge from the centre point of the record, so that the edge also touches the needle point. Then fix the rear of the tone-arm so that at no matter what part of the record you place the pick-up, the front of the casing is parallel with the straight-edge. It may be found impossible to get this correct at every point, but you should endeavour to reduce the variation to the very minimum, and the most important parts of the record are at the commencement and the end. The centre part of the recording will not matter quite so much.

### PANEL LIGHT

**"Several receivers which I have seen lately have been fitted with a small light on the panel, and when I asked one of my friends what this light was for I was told that it helped to bring the stations in. I have been since told, however, that I was being deceived. Can you tell me which is true? Does the light do anything to help in getting stations or not?"—(J. L. O., Carlisle.)**

We are afraid your friend was pulling your leg. The addition of a panel light has no effect upon the performance of the set, unless, of course, the current taken by the lamp is exceptionally high. The real use of the lamp is to facilitate tuning, and it might have been in this respect that your friend meant it helped in getting foreigners. Where the receiver employs an ivorine tuning disc, or is situated in a dark corner of the room, a lamp is a valuable asset, and by using a special low consumption bulb, and wiring this across the filament terminals of one of the valves, it gives an indication that the set is switched on, and makes clear the markings on the tuning scale.

### AUTOMATIC GRID BIAS

**"I have only just been introduced to your valuable paper, and am now in process of seeking your assistance on a matter which I wish to introduce to my set. It is automatic biasing for the low-frequency valves. Have you published any information on this method of avoiding a grid battery? I realise that it is rather too much, perhaps, to give me all details in a letter, but I should like to know when to expect an article on the subject in your pages, if one has not already been written."—(A. C., West Wickham.)**

A very complete article on the subject of Grid Bias was given in the December 24th issue of PRACTICAL WIRELESS. This may be obtained from the Back Number Department, Exeter Street, Strand, W.C.2.

### SELECTIVITY PROBLEM

**"I have a Screened Grid 4 with Frame Aerial enclosed, and it is a battery set. We have had electric put in the house, so I bought an Eliminator for D.C. Mains. Now I get North National and North Regional Stations all over the wave-band. Could you tell me what is wrong, if anything?"—(A. G.—No address).**

It would appear most likely, as you do not state whether the receiver worked satisfactorily before, that the Mains unit is causing your trouble. This is probably due to the Mains wiring acting as an aerial and picking up your local stations direct, and feeding these signals into your receiver from the coupling between the aerial input and the Unit, or direct through the wiring. Screen the Mains Unit, and make certain that the aerial side of the receiver is well separated from the Mains side. Also try special Mains H.F. Chokes in the input leads to the Eliminator, and try the effect of removing your frame aerial away from all walls, in case you are picking up the signals from mains wiring, by induction with the frame.

FREE ADVICE BUREAU

**COUPON**

This coupon is available until Feb. 11th, 1933, and must be attached to all letters containing queries.

PRACTICAL WIRELESS 4/2/33

# 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.*

### GRAHAM FARISH COMPONENTS

A COMPLETE range of the latest components made by Graham Farish, Ltd., is given in a booklet we have just received from this firm. A new potentiometer volume control, the "Megite," has an element of fine nickel-chrome wire embedded in bakelite. The action is through a slipper plate, giving a smooth, silent operation. Among the other components listed are a new H.F. choke, grid leaks, "Ohmite" resistances, fixed and variable condensers, valve-holders, and "Filt," the new percolative earth. The address is Masons Hill, Bromley, Kent.

### "GOLTONE" RADIO REQUISITES

GOLTONE components are too well known to require any introduction to constructors who will welcome a new and comprehensive 48-page catalogue which has just been issued by Ward and Goldstone, Ltd., Frederick Road, Pendleton, Manchester. A useful range of dual-range coils, H.F. chokes, fixed condensers, radio meters of various types, dry batteries, switches, and aerial and earth fittings are listed. Particularly useful to the constructor is the section devoted to instrument wires of all gauges, aerial and connecting wires, and battery and loud-speaker cords. Particulars are also given of a new screened aerial down-lead wire, recently introduced by Ward and Goldstone, who also specialise in a very compact and efficient charger for L.T. and H.T. accumulators, for use with D.C. mains.

### CLIX FOR GOOD CONTACT

CONSTRUCTORS desirous of having perfect contact in the wiring connections of their sets would do well to obtain a copy of the latest folder issued by Lectro Linx, Ltd. A useful range of the popular Clix fittings is listed, including various types of terminals, spade connectors, helically slotted plugs, and resilent sockets. Particulars are also given of the Clix chassis mounting valve holders for either soldered or screw connections.

### W.B. LOUD-SPEAKERS

IN the latest folder issued by Whiteley Electrical Radio Co., Ltd., particulars are given of their well-known permanent magnet moving-coil speakers, including a new model with cobalt steel magnets which sells at the remarkably low figure of 35s. Readers interested in moving-coil speakers should make a point of getting a copy of this folder.

### T.C.C. PRODUCTS

THE T.C.C. people have produced a booklet on the design and construction of power units which has a most useful gadget on the last page, which takes the form of a calculator showing how many ohms are wanted to drop almost any number of volts with any number of milliamps that may be passing. It costs sixpence, but it is well worth it.

## Broadcast Query Corner

1. Write *legibly*, in ink. Give your full name and address.

2. State type of receiver used, and whether transmission was heard on headphones or on loud-speaker.

3. State approximate wavelength or frequency to which receiver was tuned, or, alternatively, state *between* which two stations (of which you have the condenser readings) the transmission was picked up.

4. Give date and time when broadcast was heard. Do not forget to add whether *a.m.* or *p.m.*

5. Give details of programme received, and, if you can, some indication regarding the language, if heard.

6. State whether and what call was given and/or kind of interval signal (metronome, musical box, bells, etc.) between items.

7. To facilitate publication of replies, append a *nom-de-plume* to your inquiry.

All inquiries should be addressed to *The Editor*, PRACTICAL WIRELESS, 8-11, *Southampton Street, Strand, London, W.C.2*, and the envelope marked *Broadcast Query Service*, in top left-hand corner. Stamped addressed envelope should *not* be enclosed, as replies cannot be sent by post, but will be published in due course in each issue of PRACTICAL WIRELESS.

## Replies to Broadcast Queries

INQUISITIVE (Hanwell): (1) W. Wicks, 11, Rigby Cottages, Dawley, Hayes, Middlesex; (3) Alan Smith, 12, Ferres Avenue, West Drayton, Middlesex; (5) M. Griffon, 87, The Crossways, Heston, Hounslow, Middlesex. Nos. 2 and 4 regret cannot trace in list; you might write direct to Radio Society of Great Britain, 53, Victoria Street, London, S.W.1. BRS 1,038 (Herne Bay): Moscow (T.U.) on 50 m. W. H. ANDERSON (Portobello): (1) KDKA, East Pittsburgh (Pa.), National Broadcasting Company's programme (304.9 m.); WCAU, Philadelphia (Pa.), Columbia Broadcasting System (256.3 m.). RIGHTY (Long Eaton): WTIC, Hartford (Conn.) on 282.8 m. NOVICE (Billingham): Rabat (Radio Maroc) on 416.4 m. N. WHITAKER (Bradford): W8XK, Saxonburg (19.72 m.) relaying KDKA.





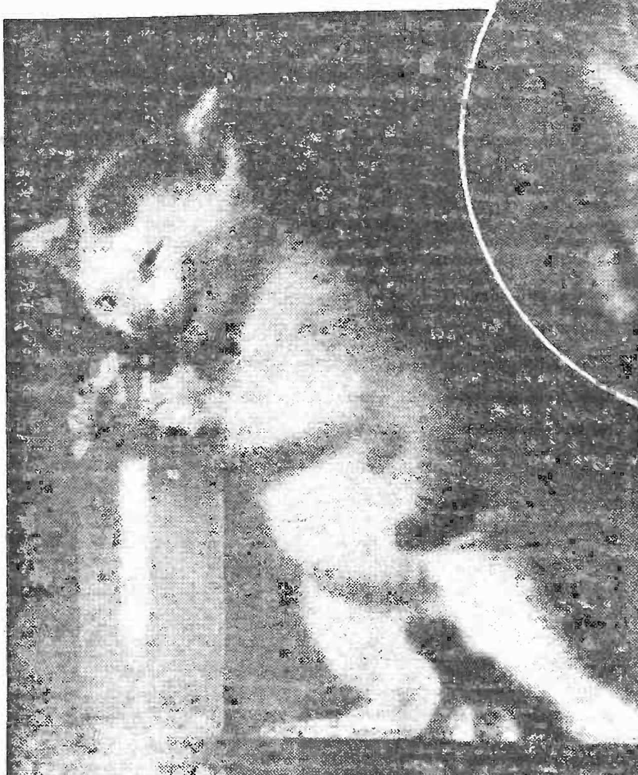


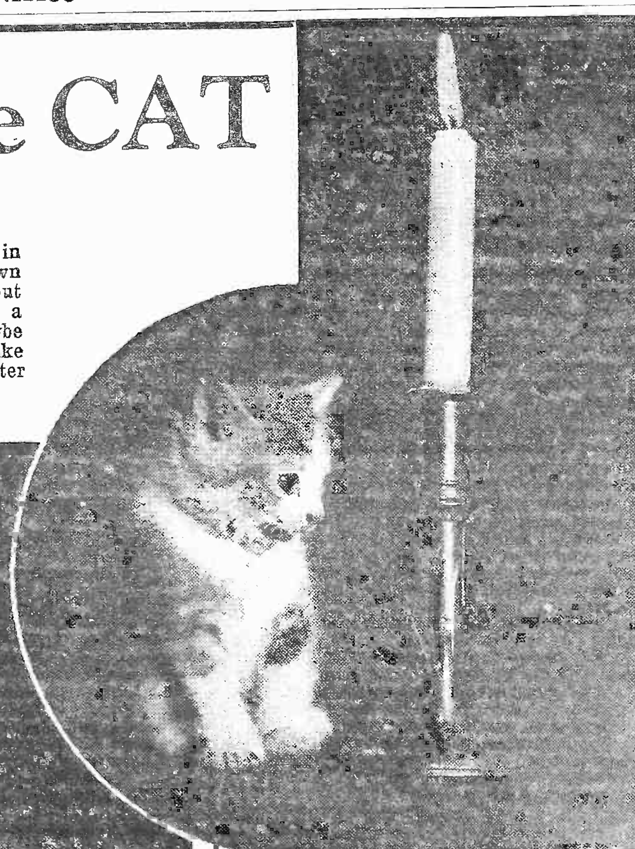
# ADVERTISEMENT INDEX

# The CINÉ and the CAT

by S. U. LLOYD

EVANGELINE, as you see, is something of a comedienne and quite at home in front of the camera. How you could make similar pictures of your own pets is explained in the February number of **HOME MOVIES**. As is pointed out in this article: "A very interesting little series can be made showing a favourite kitten from its youngest days up to mature "cathood"—maybe followed by a series showing her own kittens. It is indeed far easier to take ciné films of young animals than still pictures, as with a still camera the shutter is rarely pressed at the right time!"





*With a movie camera you can make your four-footed friends immortal. Animals—particularly young animals—are perfect ciné subjects.*

ALSO in the February number will be found many articles and pictures of equal interest to ciné enthusiasts and to those who have not yet taken up this wonderful hobby. There is, for instance, a fascinating account of the way in which an amateur has made films of Bird Life, which will appeal to every nature-lover, as well as another of the filming of Evangeline, whom you see here and who appears to be a born star—most cats are comedians at heart. Other features tell you how to splice "nine-and-a-half" film, how to make your own aluminium screen and so forth, while Adrian Brunel explains "Tracking Shots."

# HOME MOVIES

## SIXPENCE

**SEND POSTCARD TODAY FOR SPECIMEN COPY!**

*"Home Movies" is obtainable at all Newsagents, Bookstalls and Dealers, or post free 7½d. (Subscription rates: Inland and Abroad 7/6 per annum; Canada, 7/- per annum), from George Newnes, Ltd., 8-11, Southampton Street, Strand, London, W.C.2.*

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Presented with PRACTICAL WIRELESS, dated February 4th, 1933.

# "PRACTICAL WIRELESS" DATA SHEET No. 8

## BATTERY ELIMINATORS

### THE FUNCTION OF AN ELIMINATOR.

The purpose of a battery eliminator is to provide the working voltages of a receiver from the electric lighting mains. As these voltages must be Direct Current, a process of rectification is essential when using alternating current mains. With both types of mains a smoothing circuit must be employed to smooth out the ripples. The exception to these statements is the supply for the heaters of Indirectly Heated A.C. valves where ordinary A.C. at 4 volts is employed.

### METAL RECTIFICATION.

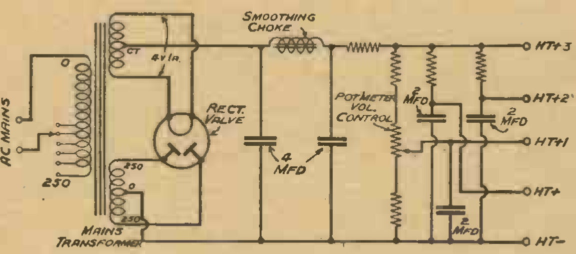
Metal rectifiers may be employed instead of valves for rectification purposes, and these may be joined up to provide half-wave rectification or full-wave rectification. For half-wave rectification the metal rectifier is joined in series with the positive lead from the transformer secondary to the choke. For full-wave rectification two half-wave rectifiers are joined in series, the ends being H.T. + and H.T. –. One end of the secondary of the transformer is joined to the junction of the two rectifiers, and the other end of the secondary is joined to the centre of two 4-mfd. condensers which are joined across H.T.+ and H.T. –. This method is known as the "Voltage doubling" principle.

### RESISTANCE VALUES FOR VOLTAGE DROPPING.

The value of resistances required to dispose of surplus voltages may easily be ascertained by an application (Continued opposite.)

### REMOVING HUM.

Sometimes when using a battery eliminator loud hum is noticed when the receiver is tuned to a powerful station. This is known as "modulation hum" and may be remedied by the following means: Two condensers with a capacity of .1 mfd. are joined together, and the junction point is taken to earth. The remaining two terminals are then connected to the two A.C. mains input leads. Another method employed with full-wave rectifying valves, is to join the two condensers across the two anodes of the valve, and to earth the junction.




### A.C. BATTERY ELIMINATOR.

The above diagram shows a typical A.C. mains battery eliminator, and illustrates the method of inserting voltage dropping resistances in conjunction with by-pass condensers. The tapping marked H.T. 1 is provided with an adjustable voltage by means of a potentiometer across the total output of the unit. In addition to the secondary windings shown on the mains transformer, separate secondaries may be provided to deliver 4 volts at 1 or more amps. for supplying the heaters of indirectly heated valves.

| Voltage to be dropped. | Current flowing. | Resistance required. |
|---|---|---|
| 10 volts | 1 | 10,000 ohms. |
| 20 ,, | 2 | 10,000 ,, |
| 30 ,, | 5 | 6,000 ,, |
| 40 ,, | 8 | 5,000 ,, |
| 50 ,, | 5 | 10,000 ,, |
| 100 ,, | 5 | 20,000 ,, |
| 150 ,, | 10 | 15,000 ,, |
| 200 ,, | 5 | 40,000 ,, |

It will be seen from this table that the values are definitely relative, and that the current (in milliamps) divided into the volts gives the resistance in thousands of ohms.

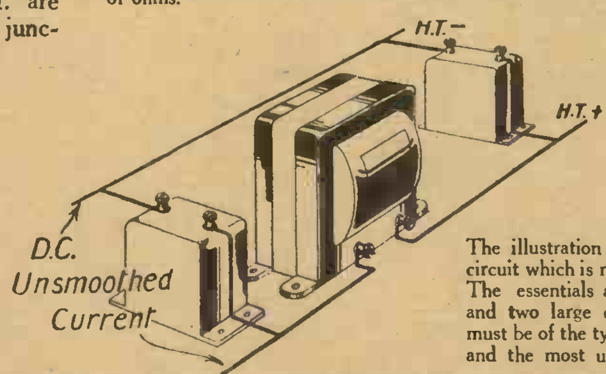
### AUTOMATIC EXCITATION OF FIELD WINDING.

Where a moving-coil loudspeaker with a mains field is employed this may be used in place of the smoothing choke of an eliminator. It should be of the type designed to work from D.C. supplies and taking a current of 20 to 40 milliamps. In view of the voltage drop which would be occasioned by this method, the output from the rectifier should be correspondingly larger than is required at the H.T. end of the eliminator.

(Continued from 1st column.)
of Ohms Law. The resistance required (in Ohms) is obtained by dividing the number of volts to be disposed of, by the current flowing in amps. (One milliamp is .001 of an amp.). The table given on the left shows some common values of resistance, and other values may be obtained by adjustment of the table, or by employing the above formula.

### AUTOMATIC GRID BIAS.

Automatic grid bias may be provided from the eliminator, by inserting in the H.T. negative lead a suitable voltage dropping resistance. The total anode current from the receiver passes through this resistance, and results in a voltage drop worked out by the method given on this sheet. This resistance may be tapped to provide various values of bias for a number of valves.




The illustration to the left shows the smoothing circuit which is required in every type of eliminator. The essentials are a high inductance L.F. choke and two large capacity fixed condensers. These must be of the type made to withstand high voltages, and the most useful value is 4 mfds.