Practical Wireless, July 29th, 1933.

SOME OLD CIRCUITS REVIVED

Practical Wireless

3D

Published every Wednesday by
GEORGE NEWNES LTD.
Vol. 2.——No. 45.
JULY 29th, 1933.
Registered at the G.P.O. as a Newspaper.

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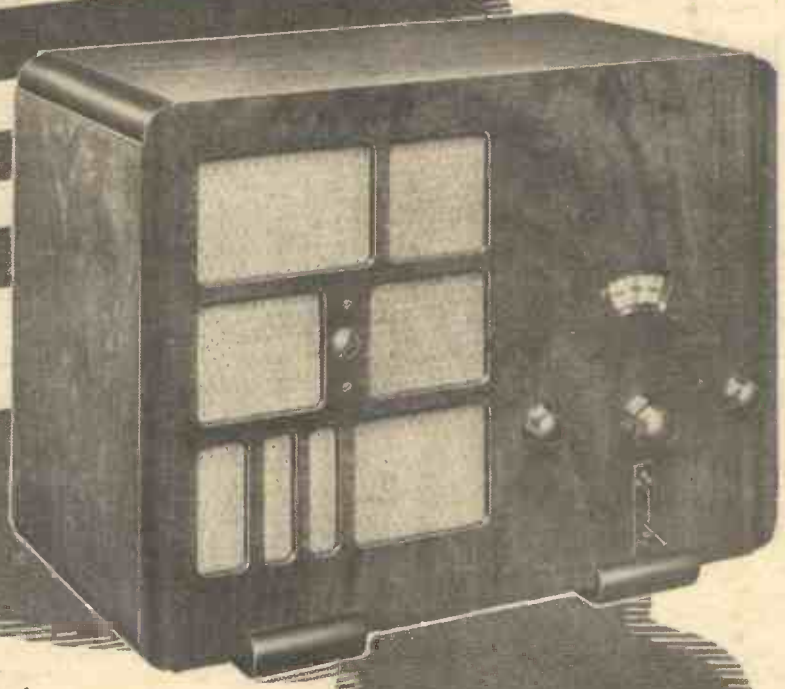

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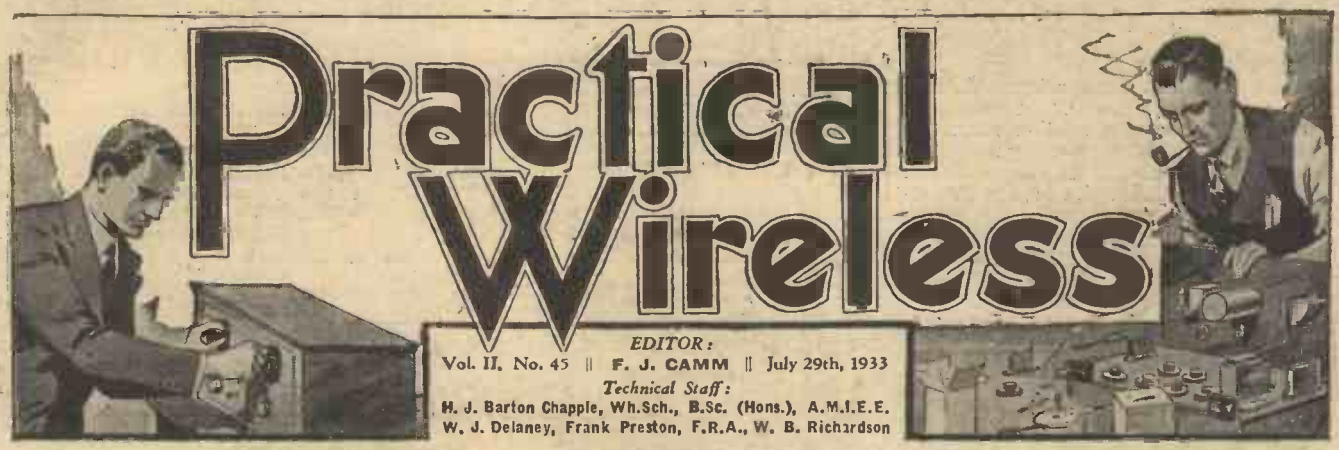


ROUND *the* WORLD *of* WIRELESS

Final Lucerne Wave-plan

FOLLOWING considerable discussion, a final European wave-plan has been evolved at Lucerne and it has been accepted by the majority of delegates. Holland, Hungary, Finland, Poland, Lithuania, Sweden and Greece, however, have not agreed to the allocation of wavelengths, but as no general change-over can take place before January, 1934, there is every hope that they may be induced to give their consent before the plan is brought into operation. So far, at the time of writing, Great Britain appears to have succeeded in securing almost everything she requires—we have lost no channels—and subject to some exchanged frequencies between home transmitters, the B.B.C. stations will work on the following wavelengths: Daventry National (1,500 m.); North Regional (449.1 m.); Midland Regional (391.1 m.); Scottish Regional (373.1 m.); London Regional (342.1 m.); West Regional (307.1 m.); North National (296.2 m.); Scottish National, Bournemouth and National Relays (285.7 m.); Belfast (267.4 m.); London and West National (261.1 m.); and Plymouth (203.5 m.). It will be seen from the above that, in general, the stations have been placed somewhat lower in the broadcast band, but the actual difference will cause no inconvenience to listeners when tuning their sets.

A Novel Use for Radio in America

I HAVE so got into the habit of telling you a bit of freak radio news from America, or elsewhere, week by week, that I feel I cannot disappoint you by failing to do so even though, to be candid, I am sometimes hard put to obtain something authentic to tell you from "over there." This week I offer you two items of interest, the first of which cannot be called "freak," by any means as it goes to show the vast progress that has been made in radio design during the last few years. This takes the form of a light-weight radiophone—that is the American name for it—for use in small light aircraft. This set is able to transmit and receive at will and enables the pilot, who is often working single-handed, to call up aerodromes and inquire landing conditions, and to receive weather reports and any other information he might require. It is no larger in size than an ordinary two-valver and weighs only 11lbs! The other item is somewhat more strange! It has been found that mosquitos are attracted by the loud humming noise that the female insects make while in flight, and a band of radio inventors have imitated this noise by means of loud-speakers and oscillating valves. The mosquitos roll up in thousands to be caught in a trap, and this time radio destroys lives instead of saving them. This method of fly-catching was hit upon quite by accident for it was found that mosquitos were being burnt by the thousand in an electric furnace that made a humming noise while working in an American works. This discovery led to the production of the radio catcher!

No Channel for the Private Stations.

THE effect of the decisions taken by the Lucerne Conference on privately owned transmitters has been specially disastrous, inasmuch as no channel has been officially provided for their use, and they will be left to the tender mercies of the French State authorities. As the wavelength of 312.8 m. has been reserved to a transmitter in the Paris region, it is expected that the *Poste Parisien* will be allowed to take it over. Whether Radio Toulouse will secure authority to operate on 335.2 m. or 222.6 m. is not yet known, but the latter channel is an international common wavelength for which the maximum power allowed is 30 kilowatts. It would also be shared with a large number of foreign stations. The fate of Nice-Juan-les-Pins, Radio Normandie (Fécamp), Radio Vitus (Paris), Radio L.L., as well as Béziers, Nîmes, Agen and Bordeaux-Sud-Ouest is still in the melting pot. January 15th, 1934, will witness a "general post" and a re-logging of European stations will prove to be a pastime for many long winter hours.

If Belgium Raises the Tax

THE rumours that the Government would shortly increase the broadcast listening licence from 60 to 100 francs has raised thousands of protests from all over the country. Most of the wireless associations which provide entertainment programmes to the two Brussels stations have decided to appeal jointly to the authorities on the grounds that such an increase in cost would strangle the radio industry in Belgium. Roughly speaking there are 400,000 wireless sets registered, representing about one and a half million listeners.

The Radio Tourist Special

AS an experiment the Belgian Railway Company has brought into operation this summer a special train, "radio-touristique," working a circular tour between Bruges, Liége, Spa, Ghent, etc. All first and second class carriages are equipped with four loud-speakers connected with a microphone and amplifying panel located in the guard's van. By this means, a running commentary is given to passengers on all historical and other places of interest met with during the trip. Tests are also being carried out with wireless receivers, gramophones and electrical pick-ups. If the scheme proves successful, some 200 trains will be similarly equipped as it is calculated that the cost of the installation in each instance could be completely covered in the course of one summer season.

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

Promenade Concerts 1933

A SUMMER in London is unthinkable without the "Proms." There is no need to announce that another season of them will be held this year, any more than the public has to be told that the conductor will be Sir Henry J. Wood, who, like the concerts themselves, reappears for the thirty-ninth consecutive year. A few particulars, however, may be of interest. The season is to last eight weeks, with the usual additional Saturday at the beginning. The opening concert has been fixed for August 12th, and the series will come to an end on October 7th. Needless to say, the B.B.C. Symphony Orchestra will play throughout. The programme scheme does not vary a great deal from that of previous years, but one or two features will be changed. There will be the usual generous allowance of British music, but instead of being substantially included in special "British Composer" nights, it will be fully distributed throughout suitable programmes.

Excerpts from Seaside Shows.

NO items are more welcome during the summer months than the regular relays of excerpts from the best seaside shows. One of the most popular of these is at the Beach Pavilion, Aberdeen, from which the inimitable Harry Gordon and his Company will broadcast to the Scottish Region on August 4th. While the majority of outside broadcasts to Scotland at this time of year come from the seaside, the microphone still remains faithful to the Edinburgh Theatre Royal, where the traditional spirit of Variety lives on as vigorous as ever. An excerpt from the show at this theatre will be relayed on Tuesday, August 1st, and should be a fitting tribute to the holiday season.

Royal Dockyard Draughtsmen's Choir.

THE Royal Dockyard Draughtsmen's Choir, conducted by George Bollard, will give a concert from the Plymouth studio on August 2nd. Marcel Kingdon (tenor) will sing, and Ernest Watkiss will play two groups of violin solos at this concert, which will be relayed to West Regional listeners.

Cycle Racing Broadcast

MOTOR cycle racing on grass is a sport that provides plenty of thrills, and listeners will be interested to hear that an eye-witness account of the Grass Track Motor Cycle Racing at the Maze Racecourse will be given from Belfast on August 5th. This event has been organised by the Lisburn Motor Cycle Club.

"The Week in Scotland"

DURING August the regular series of talks on "The Week in Scotland," which, since its inception at the beginning of the year, has been given with great success by Mr. George Blake, will be taken over by Mr. J. W. Herries. Mr. Blake, who combines wide knowledge with an admirable microphone technique, has set a very high standard; but Mr. J. W. Herries, who is a journalist, and no stranger to the microphone, should be equally informative and entertaining. It will be interesting, incidentally, to compare the views of a representative of the West. Mr. Herries will give his first talk on August 5th.

INTERESTING and TOPICAL PARAGRAPHS

THE "ARTIFICIAL TRAIN" TEST

The H.M.V. way of testing. See paragraph on this page.

Dual Band Broadcast

A CONCERT which promises to provide varied entertainment will be broadcast from Belfast on August 12th. In it will be heard two bands, the Argyle Temperance Flute Band and the Sirocco Silver Band, and Samuel Adams (baritone), who is to sing a number of well-known songs.

Organ Recital from Broadcasting House

SIR W. G. ALCOCK will give a recital on the Broadcasting House organ on July 31st, and it will be relayed on the Regional wavelength. The programme consists of Overture in D minor (Handel-Ellingford), Larghetto in F sharp minor (Bach), Caprice (Guilmant) and Postlude in C (Alcock). On Fridays during August organ recitals will be given from the Concert Hall at noon by C. H. Trevor.

"This Radio Racket"

A CHARLES BREWER production will be a popular Midland feature on August 2nd. This is a broadcasting burlesque entitled *This Radio Racket*, the book and lyrics being by Godfrey M. Hayes and F. Keston Clarke, and the music by Jack Venables. Evelyn Over and Dorothy Summers, Peter Howard and Ernest Sefton are in the cast, and the instrumental music is by Ernest Parsons and his Revue Orchestra.

Military Tattoo Relay from Tidworth

ANOTHER important military tattoo will be heard by listeners to the National programme on August 5th, when a relay from Tidworth takes place. These tattoos are, of course, only suitable for broadcasting in sections, as listeners are at present unable to share with the audience on the spot in the visual glories of such displays. The sound portions of the Tidworth Tattoo therefore will be relayed between 9.25 and midnight, and the B.B.C. chorus, led by Joseph Lewis, with Ernest Butcher as soloist, will provide community singing from a studio during an interval.

SOLVE THIS!

Problem No. 45.

Swinburne built a simple three valver employing a variable-mu H.F. stage, S.G. Detector and Pentode output stage. A special plated chassis was made for him and he completed the wiring with great care. On switching on results were very disappointing, signals only just being audible. He tried various adjustments and made sundry small alterations in the wiring, and after ten minutes or so decided to try an alteration of the bias applied to the Pentode. When he held the grid battery to remove the negative plug he was surprised to find that the battery was quite hot. What was wrong? Three books will be awarded for the first three correct solutions opened. Address your solutions to The Editor, PRACTICAL WIRELESS, Geo. Newnes, Ltd., 8-11, Southampton Street, Strand, London, W.C.2. Mark your envelopes Problem No. 45, and post to reach here not later than July 31st.

SOLUTION TO PROBLEM No. 44.

The circuit which Samuels built up should have been mounted on a metal chassis, when the earth connection would automatically have been made to the condenser. As he used a wooden baseboard the earth connection was omitted. This accounted for the fact that the condenser did not tune.

The following three readers received books in connection with Problem No. 43.

Mr. Herbert Fairbanks, 14, Thirsk Grove, Blackpool; Mr. James McCartney, 23, Hayfield Road, Salford 6; Mr. G. Howes, 2, Rothesay Avenue, Richmond.

First Artificial Train for Radio Sets

WHAT is believed to be the first artificial train in the world has just had its inaugural run at Hayes (see photo above). It has no station, no porters, no passengers, and no smoke, but its speed is equivalent to 923 m.p.h. It has been designed by the technical engineers of the "His Master's Voice" research laboratories, and its sole freight is radio receivers and radio gramophones. One of the experts who was responsible for designing the "train," in explaining its use, said, "There are about 2,300 soldered connections linking together the 600 parts of an average receiver. In designing a new set it is essential to make sure that all these parts will withstand the jolts the instruments are bound to receive in transport. Consequently, we set to work to create an 'artificial train,' which comprises a movable platform that is rocked up and down through eccentric cams operated from a powerful electric motor. In order to test a new model H.M.V. radio receiver we strap it on to the platform—start the motor and it then receives 1,500 vibrations a minute."

The BEST L.F. COUPLING?

The Problem of Low Frequency Couplings is Not Always Understood by the Home Constructor. In this Article FRANK PRESTON, F.R.A., discusses the Pros and Cons of Every Type of L.F. Coupling.

THERE are so very many methods of coupling low frequency valves that the amateur is likely to experience a good deal of difficulty in deciding which is best for his own requirements. The question is not simplified by reading such bald, but oft-written, statements as "Resistance-Capacity Coupling gives most purity, but Transformer Coupling affords more amplification." Whilst this very general rule might be true in some slight measure there are so many factors to consider that it cannot be applied with impunity.

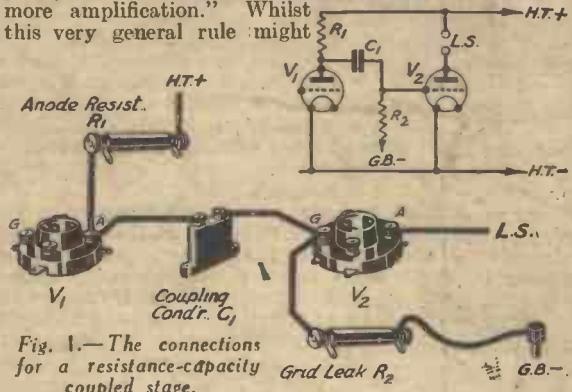


Fig. 1.—The connections for a resistance-capacity coupled stage.

Correct "Matching"

The whole question of L.F. couplings is bound up in the correct "matching" of one valve to another, and we cannot proceed to answer it without first considing certain conditions which must be fulfilled. The primary essential if we are to get the best out of any valve is that the impedance (or resistance to alternating currents) of the component connected in its anode circuit should bear a definite relationship to the impedance of the valve itself. For all practical purposes it can be taken that maximum efficiency is obtained by choosing a coupling component whose impedance is not less than twice that of the valve, or conversely, by choosing a valve which has an impedance equal to one-half that of the component to be connected in its anode circuit. An example will make this point quite clear. Suppose our valve is one of the "210 L.F." type, having an impedance of 10,000 ohms (the exact figure is always quoted on the makers' instruction sheet), the component—transformer, primary, resistance, choke, etc.—to be wired in its anode circuit should have a minimum impedance of 20,000 ohms if the full amplification of which the valve is capable is to be obtained.

If the rule just cited is kept clearly in mind the advantages and defects of the several L.F. coupling arrangements will more readily be appreciated.

Resistance-Capacity

Without any further deliberation let us examine the simplest method of feeding a low-frequency valve, that is, by means of a resistance-capacity circuit. The connections are shown both practically and theoretically in Fig. 1, from which it can be seen that a simple fixed resistance is connected between the anode of V.1—which might be either a detector or L.F. valve—and high tension positive. The grid of V.2 receives its signal voltages through a fixed condenser joined to the anode of V.1. Although it does not take any part in the transference of energy from V.1 to V.2, a grid-leak is joined between the grid of the latter valve and the G.B. battery to permit of the application of the correct bias voltage to V.2.

It is an easy matter to find the correct ohmic value for the anode resistance when the impedance of V.1 is known, but the question of deciding on the optimum capacity for the coupling condenser and the most suitable resistance for the grid-leak is not quite so simple. In practice, however, neither of these values is very critical, and they can both be determined with sufficient accuracy by rule-of-thumb methods. The capacity of the condenser is largely dependent upon the value of the anode resistance and should lie between .005 mfd. for a 100,000 ohm component and .01 mfd. for a 10,000 ohm one. The grid-leak should be from four to eight times as "big" as the anode resistance.

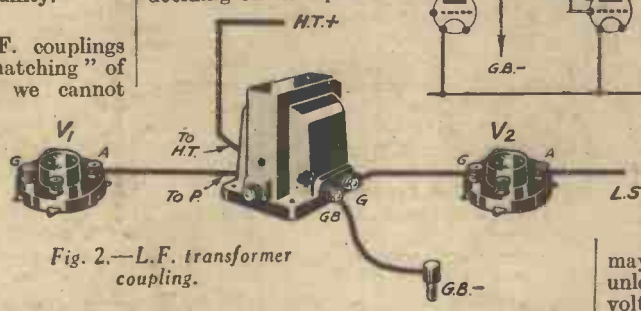


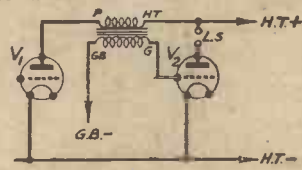
Fig. 2.—L.F. transformer coupling.

Use a Good Coupling Condenser

There is just one important point to remember in using R.C. coupling, which is that the coupling condenser must be a "mica" one of good quality, since it is subjected to very high signal voltages. A poor condenser will "break down" in very little time, and, besides silencing the receiver, will probably cause valve V.2 to be ruined by the application of a large positive grid-bias derived through the anode resistance.

Uniform Impedance

A resistance-capacity amplifier properly set up as explained will produce very fine results in the way of good quality reproduction. The main reason for this is to be found in the fact that the impedance of the anode resistance remains practically uniform at all audio frequencies. We shall see later that the impedance of other coupling devices is subject to wide variations. Resistance-capacity is not the only form of coupling that will give pure reproduction, though it is undoubtedly the cheapest.



Disadvantages of R.C.C.

But it has two notable defects. Firstly the coupling device does not, in itself, provide any amplification and thus the increase in volume obtained is only that produced by the valves. In the second place the anode resistance has the effect of cutting down the high tension voltage supplied to the valve V.1. This loss is not serious where the resistance is 50,000 ohms or less, but for higher values the valve may be prevented from working at its best unless the H.T. battery is of unduly high voltage.

Choke-Capacity

The latter difficulty can entirely be overcome by substituting a low-frequency choke for the anode resistance, because a choke has a comparatively low resistance

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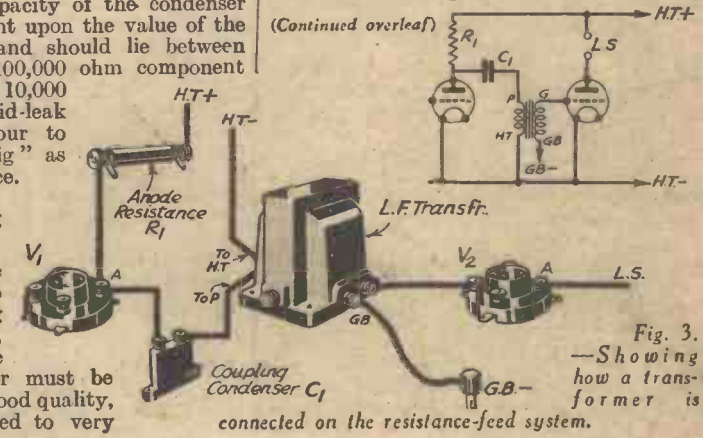

Fig. 3.—Showing how a transformer is connected on the resistance-feed system.

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to direct high-tension current, despite its high impedance to alternating or signal currents. To be more explicit: a well-known L.F. choke rated at 20 henries inductance has a D.C. resistance of only 250 ohms, whilst its impedance at 1,000 cycles (equivalent to the average female speaking voice) is over 100,000 ohms. Choke-capacity is thus better than R.C. in one respect, but it is somewhat worse in another. The impedance of any choke varies with the frequency of the alterating currents it has to carry—it becomes less at lower frequencies and more at higher ones. For instance, the impedance of the component referred to above is only about 6,000 ohms at 50 cycles, although it is nearly 600,000 ohms at 5,000 cycles. It will be appreciated from this explanation that a choke must have a sufficiently high impedance—twice that of the preceding valve—at the lowest frequency at which perfect reproduction is required. Unfortunately most manufacturers do not state the impedance of the chokes they supply, but, instead, give the inductance. It will therefore be helpful to know that the impedance at 256 cycles (middle "C" on the piano) can be found very approximately by multiplying the inductance in henries by 1,500. Moreover, in most cases it will be found that satisfactory results can be obtained over the whole musical scale by so choosing the choke that its impedance is correct at 256 cycles.

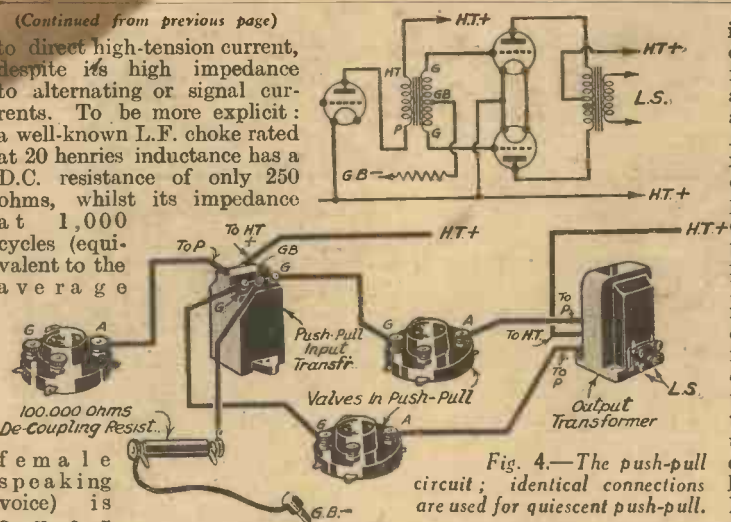

Fig. 4.—The push-pull circuit; identical connections are used for quiescent push-pull.

Theoretically, of course, choke-capacity coupling cannot possibly give uniform amplification to the full range of audio frequencies due to the choke's constantly varying impedance. In practice, however, it is found that so long as the choke has a sufficiently high impedance at about 256 cycles the difference in strength at various parts of the scale is not so much as can be detected by the ear.

There is yet another point to take into consideration, because a choke's inductance varies with the amount of direct current passing through it; as the current is increased the inductance becomes less. In making the above calculation, then, it is necessary to know what inductance the choke has when passing the anode current normally required by the preceding valve. All reputable manufacturers state the inductance both "without D.C." and "on load," so no difficulty arises here. It is important, however, to ensure that the choke is never called upon to carry more than its rated maximum current, because under such conditions its iron core would become magnetically "saturated," with a result that the choke could not respond to the L.F. current fluctuations. Serious distortion would inevitably follow.

L.F. Transformer Coupling

Although choke-capacity coupling obviates one defect associated with R.C.C. it still has the disadvantage of not providing any inter-valve amplification. As a matter of fact the only coupling component which does produce a voltage step-up is a transformer. For this reason more volume can be obtained from two valves coupled by a transformer than by the use of any other device. The latter benefit, however, is obtained only at the expense of quality; but whether the expense will be great or quite inappreciable depends entirely on how "good" the transformer is. If it is a big component with a massive core and a high inductance primary winding it will produce results quite as good as those to be obtained with choke coupling. If not—well, it just won't. The transformer must be chosen in exactly the same way as the choke with a view to its primary impedance and not, as many people wrongly imagine, by its step-up ratio. *A well-designed L.F. transformer of low ratio will give distinctly better results than a poor one having a high ratio.*

When more than a single L.F. stage is employed it is almost invariably better to use Resistance-Capacity or Choke-Capacity coupling for the first stage at any rate, since when two transformers are used there is always a danger of causing instability or overloading, due to the excessive amount of amplification produced. Two, or even more, transformers can be used together, but for good results great care is necessary in designing the receiver.

Resistance-Fed Transformer

Because of the disadvantages mentioned, it is more than probable that ordinary transformer coupling, as illustrated in Fig. 2, will gradually die a natural death. It is rapidly being replaced by a system which combines the R.C.C. and transformer methods, and which is illustrated in Fig. 3. The resistance R.1 and condenser C.1 are the same as the two similar components shown in Fig. 1, but a transformer is inserted between the coupling condenser and the grid of V.2. It will be seen that the anode resistance carries the direct H.T. current to the anode of V.1 and the transformer has therefore to deal with the alternating signal currents only. This component can thus be made quite small without there being any danger of its core becoming "saturated." The degree of amplification to be obtained is slightly greater than that provided by the transformer alone, and the quality of reproduction is equal to that given by the R.C.C. method of coupling.

Push-Pull

The next system of L.F. coupling I wish to mention is known as push-pull, and which has recently come into great prominence in two or three different forms. Connections for a P.-P. amplifier are shown in Fig. 4, from which it can be seen that two valves are used in the output stage. Their grids are fed from a special input transformer having a centre-tapped secondary, and an output transformer with centre-tapped primary is used to "collect" the amplified signal currents from the anodes of the two valves. It can be seen from Fig. 4 that both valves receive their grid bias through a common tapping, which is decoupled by means of a 100,000 ohm fixed resistance.

The principal advantage of push-pull is that a large undistorted output can be obtained even when the H.T. supply is of comparatively low voltage, and by using two small power valves in the last stage. This is because the two valves work together, each dealing alternately with the negative and positive half-cycles; one valve can thus be said to be "pushing" whilst the other is "pulling." In consequence, any distortion which might occur in one valve is cancelled out by the other.

Quiescent Push-Pull

The system just dealt with is that which has been in use for several years, but a newer "version" of it has only become popular during recent months. I refer to quiescent push-pull, or, by another name, "push-push." The new method differs from the old only in respect to the way in which it is used. The two valves are given a very heavy negative grid bias so that they normally pass only one or two milliamps of H.T. current. On the application of signal voltages, however, the valve which receives the positive half-cycle amplifies in a normal manner

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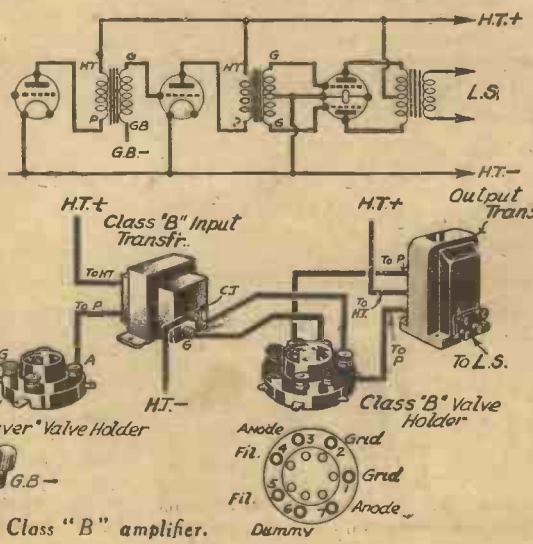
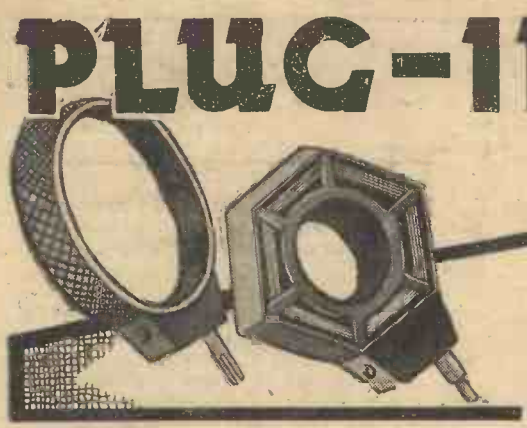
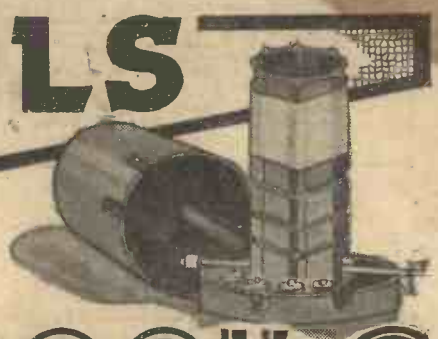


Fig. 5.—The arrangement of a Class "B" amplifier.

PLUG-IN COILS V DUAL COILS





By H. E. THOMPSON

In This Article the Author Discusses the Relative Merits of Both Types

THOSE who have followed Mr. Barton Chapple's articles on The Development of the Tuning Coil in Nos. 20 to 23 of PRACTICAL WIRELESS, will have observed that the dual coil of to-day is not an ephemeral cult of the moment, but a design evolved through many varying shapes from an ancestor remarkably like its present-day descendant. This family likeness is unfortunate in some respects, for it is primarily responsible for the idea that the reversion to type is also a reversion to inefficiency. The radio amateur who has not delved very deeply into the mathematics of his hobby may well be excused for comparing unfavourably the insignificant, and often rather shoddy-looking, wire-wound cylinder that he finds beneath his screening can with the intricate and artistic windings of a good commercial plug-in coil of some years ago. Whatever be the reason, there can be no doubt that there is a firmly-rooted belief amongst many amateurs that the plug-in coil possesses some inherent superiority—a belief that periodically finds expression in the correspondence columns of this journal, and that I have even heard avowed occasionally by dealers in wireless apparatus. Now that the series of articles on coil evolution has been completed, let us apply the theories of design explained therein to this question of coil types, in order that we may discover what justification exists for preferring one type to another, either on theoretical or practical grounds.

A Question of Efficiency

One cannot be dogmatic about such components as valves or transformers, since their functions are varied, and a change in design may not only revolutionise their efficiency but even add to their functions. A coil, however, has one function only, and its maximum theoretical efficiency, although not attainable in practice, is within the sphere of calculation. There was a time when a designer was able to set the pulses of amateur constructors throbbing by his claims for a variometer of vast dimensions wound with something like a small bale of fencing wire, but those happy days of ignorance are no more. No coil, whatever its shape, or composition, can serve, or is required to serve, more than one desirable purpose, *i.e.*, to develop as large an oscillating voltage as possible across its windings, in tune with the frequency of the required transmitter. The main factors which militate against efficiency in any coil are three in number—self-capacity, dielectric absorption, and resistance. It is assumed that readers are familiar with recent articles on the meaning of self-capacity and dielectric losses, but in order to make a better comparison between a single winding and a layer winding, it may be desirable to enlarge a little on one aspect of resistance.

Ordinary direct current flowing through a wire is evenly distributed throughout the whole section of the wire, but alternating current, which, of course, travels backwards and forwards in any given length of wire, tends to keep to the periphery. At the very high frequencies used in wireless this tendency is greatly emphasised, and the current not only flows on the skin of the wire, but also packs itself largely into one portion of the skin—the inside of the turns forming the coil. This phenomenon is caused by the fact that the currents in the wire produce a magnetic field inside the wire itself, and, as the magnetic field of the coil as a whole accentuates the effect, it follows that the greater and more bunched the magnetic field of the coil, the greater will be the unwanted ohmic resistance present.

Dielectric Absorption

Consideration will now make it obvious that, since all the self-capacity in a solenoid coil is in the form of a minimum of little condensers in series, its self-capacity must be less than that of a layer coil, where the condenser-effects are necessarily more numerous. Similarly, the dielectric absorption of the plug-in type must be less controllable, and from what has been said above about coil resistance, it is plain that the concentration of the windings in the multiple-layer system results in increased coil resistance. Again, it is not possible in any plug-in coil of normal type to obtain the big separation necessary between turns with large differences of H.F. potential. Generally, then, from a purely theoretical point of view, the solenoid coil scores over the plug-in coil as an efficient coil form.

At this point, the plug-in enthusiast may point out that the original coils were solenoids, and that they were abandoned for plug-in types. This, of course, is true, but quite apart from the fact that many of the factors which determine the efficiency of a coil were imperfectly understood at that time, the amateur of to-day often fails to realise that the principles of circuit design in those days called for a handy compact form of coil that could readily be changed for one of another value. The coil must always be considered in relation to the efficiency of the other components in a wireless set. There is no inherent merit either in a fixed coil with one or more windings, or in a combination of plug-in coils with corresponding constants, *apart from their suitability to the form of circuit in which they are employed.* For instance, when swinging coil reaction was common practice, it would have been cumbersome and ineffective to have utilised solenoid coils in the anode and reaction circuits. It would be equally ridiculous to-day to employ a movable plug-in coil in a modern design where the stability of the set is often calculated to such fine margins that the failure to utilise metallic sheathing on a small lead may set up oscillation.

Modern Requirements

A few years ago, the set designer worked to approximations and wide margins, because the efficiency of the average valve and tuning condenser was a variable quantity. It was advantageous, therefore, to be able to ring the changes on coils to compensate for deficiencies in other respects. A greater use, too, was made of plain coil coupling, particularly in inter-valve links and in neutrodyne schemes, and as components were very approximately matched, it was convenient to use a form of coil that was quickly adaptable to variations of coupling. These were really the only considerations that made the plug-in coil so universally popular. To-day, when multiple circuits are a necessity, it is essential that coils should be mathematically exact in their constants, that all windings, including reaction, should be meticulously proportioned, and that screening should be possible without loss of efficiency. From a manufacturing point of view, the solenoid coil lends itself more readily to the attainment of these ends at a reasonable price, and when all the windings are incorporated on one fixed former, the amateur is relieved of the possibility of setting up undesirable interaction effects through the use of separate coils.

It has to be understood that this discussion refers to apparatus constructed for the broadcast band. Practical considerations outside the broadcast band, where selectivity is not a vital question, may indicate a preference for other forms, but that is a matter with which the amateur is not concerned. Hypercritical amateurs may possibly be inclined to point out that the 6-pin coil was a plug-in coil, but it was a solenoid limited in its adaptability, and I have understood the term "plug-in" in this article to refer solely to the non-solenoidal type usually implied by that description.

A Unique Short-Wave Adaptor

By LESLIE W. ORTON

THE majority of short-wave adaptors comprise a detector stage (capable of operating upon short waves) which replaces the detector stage of the broadcast receiver when plugged into the detector socket. With receivers employing a powerful audio frequency stage this method is hard to beat. It is when we come to small two and three-valve receivers that we desire something different.

If it is possible to add an L.F. stage to the receiver it will be found that results are as good as could be desired. On the other hand, it is not always possible to add an L.F. stage to every broadcast set. If an L.F. stage is employed in the adaptor a number of new components are required, and it was with a view of constructing an adaptor capable of amplifying as well as detecting that resulted in my constructing the "Extramp," which is short for extra amplification.

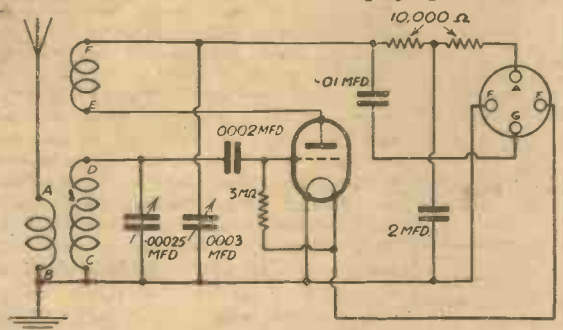


Fig. 1.—Circuit diagram of the adaptor for use with a battery set.

Small Extra Cost

This is a unique adaptor which employs the detector stage of the broadcast receiver as an L.F. amplifier, resulting in extra amplification at little more cost than if the usual type of adaptor were constructed. A perusal of Fig. 1 will show how this is done. It will also show that the construction is simplicity itself.

Before starting upon the constructional details there are one or two points which should be remembered. In the original model an aluminium panel was employed to overcome hand-capacity effects. Although an advantage, this luxury is not essential, and therefore the wiring diagram (Fig. 3) shows the receiver with an insulated panel. If a metal panel were employed the panel could be used to take the place of various wires.

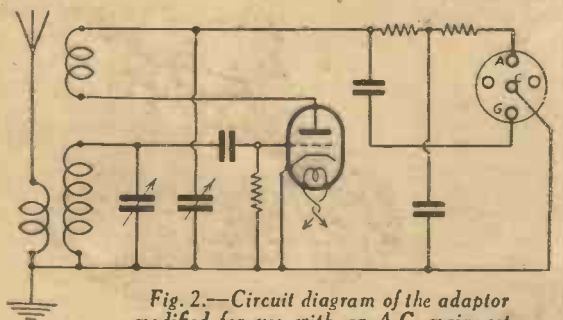


Fig. 2.—Circuit diagram of the adaptor modified for use with an A.C. mains set.

Now place all the components in their proper positions, as shown in diagram, and fasten down. Do not economise in screws, but fix every component firmly to the baseboard. If one screw is employed where two are intended there will be a possibility of the component moving when knocked, resulting in a loose contact, which is just the thing to create rushing and crackling noises.

If the wires are soldered, care should be taken to observe that the resultant joints are clean and firm. Failure to do so may result in more crackles—which, when amplified, will create a terrific amount of noise.

Adaptor Plug and Coils.

Having placed the components and wired the receiver, we have now to consider the adaptor plug and coils. The former must be of such construction as to enable a valve to be plugged into it when it is plugged into the detector socket of the broadcast set. There are quite a number of plugs (constructed for pick-up work) which are ideal for this purpose. Care should be taken not to twist the wires which travel from the receiver to the plug tightly, as interaction may result. If loosely wound no trouble will be experienced. The coils employed in the original set were home-made six-pin affairs. These are readily constructed, and they are cheaper than commercial coils.

Although the constructor may feel tempted to employ a clip to short a larger coil down so as to enable it to receive upon more than one waveband, I do not recommend this procedure if the receiver is to be operated much below 19 metres. Far better to construct a coil for each waveband.

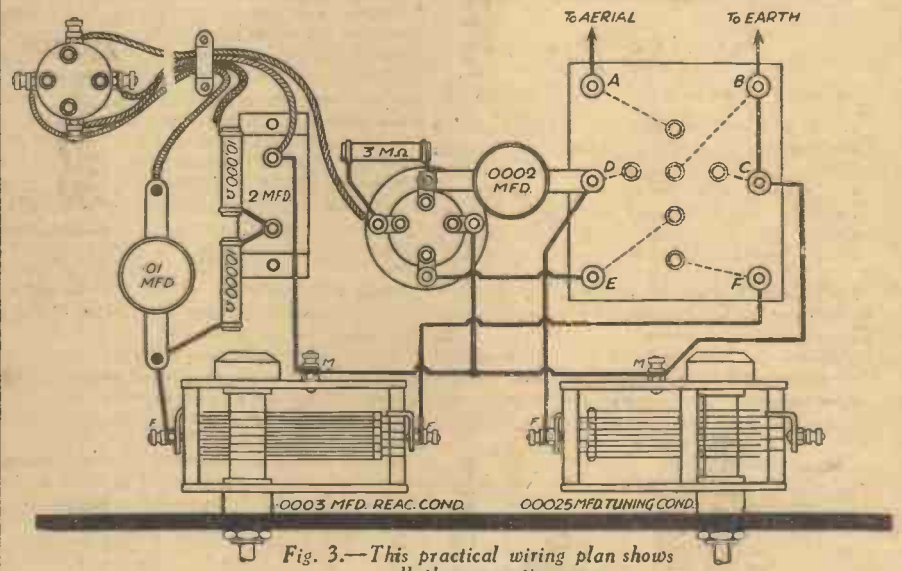


Fig. 3.—This practical wiring plan shows all the connections.

Testing the Adaptor.

Having constructed the adaptor, we may now test it. To do so we should insert the plug into the detector socket of the broadcast receiver, insert the valve in the adaptor, and place a H.F. or R.C.C. valve in the adaptor socket (which is plugged into the receiver). You will be surprised at the volume obtainable. With my model I found reception far better than with any other class of adaptor I have employed. During the evening RW59 and REN, Moscow, DJC, DJD and other German stations, GSA, Daventry, HVJ and 2RO, Italy, OXY, Copenhagen, and many other European stations provided excellent loud-speaker results. W2XAD and W8XK provide loud-speaker reception upon most evenings. ZSJ and 7LO have also been heard at good strength.

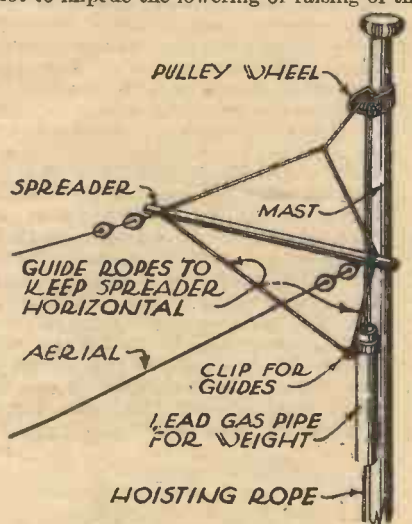
To realize the full capabilities of the adaptor it is necessary to tune in between 4 and 6 a.m. Employing my adaptor with a two-valve receiver I can log W3XAU, 8XK, 8XAL, and many other American stations at good loud-speaker strength upon almost any morning I wish to search. Mexican and Colombian broadcasting have also been heard, from stations XEW and HCK.

Although the receiver is shown as a battery model in Fig. 1, it is easy to arrange the receiver to work with a mains set. The correct connections for the adaptor in this case are shown in Fig. 2.

READERS' WRINKLES
The HALF-GUINEA Page

Keeping Twin Aerials Horizontal

THE accompanying sketch illustrates a simple and inexpensive device that I employ to steady my twin aerial and prevent any liability to swing. A piece of lead piping, encircling the guy rope, so as not to impede the lowering or raising of the

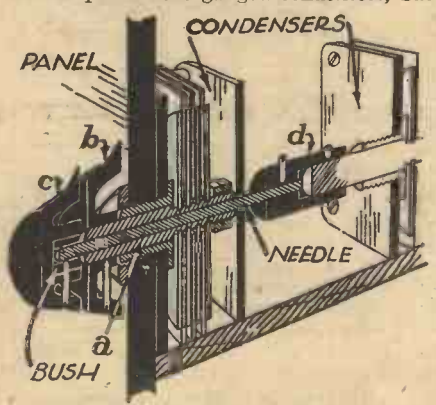


A device for keeping twin aerials horizontal.

aerial, acts as a weight. It holds itself in position upon the guy rope, and its two guides prevent the spreaders from swinging or rotating and, also when hoisted in position, it does not put any undue tension upon either the aerial or the guy ropes.—WM. S. HARRISON (Aintree).

Semi-Gang Device for Portables

IN home-made portables where space is of paramount importance, even at the expense of range and quality, it is useful to tune with solid dielectric condensers. It is helpful to use ganged condensers, but



Ganging dielectric condensers.

these are not easily obtained in very small sizes. This arrangement gives many of the advantages of ganging, but also gives separate adjustment.

The spindle (*a*) of the first condenser is drilled to fit a steel knitting needle. Any watchmaker will do this, but it is preferable if a lathe is available, to turn a new spindle, drilling it first and mounting it between centres, thus ensuring absolute truth. The knob (*b*), which is larger than (*c*) has its end filed flat. The outside end of the needle drive is fitted with a bush, as shown, and through this a hole is drilled, while in the knob (*c*), to accommodate a set screw, and a tap is run in. The threads thus started are finished by taking it out of the knob and tapping again. It is drilled right through to facilitate this. A longer set screw is then used and a flat filed or ground on the needle to prevent slip.

The end (*d*) holding the second condenser is made from a piece of ⅜in. brass rod, first drilled to fit the needle, then enlarged half-way to fit the condenser spindle. As before, set screw holes are drilled right through to help in tapping. It is advisable not to make the second condenser mounting too rigid. If the inside spindle is made quite free and smeared with oil, the condensers may be operated quite independently or, by holding both knobs, as ganged condensers.—J. H. ROWE (Dublin).

THAT DODGE OF YOURS!

Every reader of "PRACTICAL WIRELESS" must have originated some little dodge which would interest other readers. Why not pass it on to us? We pay £1-10-0 for the best wrinkle submitted, and for every other item published on this page we will pay half-a-guinea. Turn that idea of yours to account by sending it in to us addressed to the Editor, "PRACTICAL WIRELESS." George Newnes, Ltd., 8-11, Southampton Street, Strand, W.C.2. Put your name and address on every item. Please note that every notion sent in must be *original*. Mark envelopes "Radio Wrinkles." Do NOT enclose Queries with your Wrinkle.

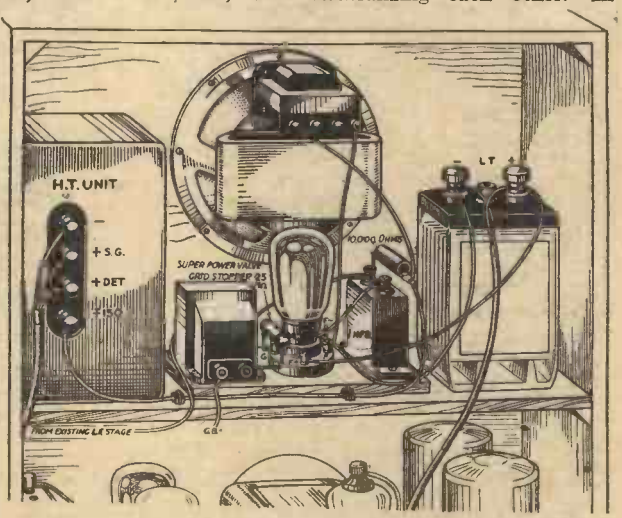
A Temporary Stage for your Wireless Set

THE accompanying sketch shows how I have brought my S.G. three receiver up to its original winter strength by the addition of an extra stage temporarily connected, and mounted on the battery shelf inside the cabinet. It will be noted that I have taken the precaution to decouple the new stage, and that a H.F. stopping resistance is included in the grid of the output valve. The original output valve (super-power) is now in the extra valve-holder, and an ordinary L.F. valve used to replace it.

This little unit, which functions very well, will, no doubt, be of interest to other readers.—F. JACKSON (Holywood, N. Ireland).

Improving a Moving-coil Speaker

HERE is a dodge which will be found useful for old type moving-coil speakers which are not fitted with hum neutralizing coils. All that is necessary is a small amount of cotton or enamel-covered copper wire of any gauge between about 20 to 30 s.w.g., this depending of course upon the room available for the winding; the thickest where possible is best, owing to its lower resistance. This coil is wound on top of, and insulated from, the field coil. And as it consists of comparatively few turns it is best to slot these through the magnet yoke instead of dismantling the speaker. The number of turns to wind are the same as on the speech coil. These turns are connected in series with the speech coil, and to do this break one connection from the secondary of the output transformer, and connect each end to the coil just wound. Try this coil connected both ways round, as it functions best when the two voltages are in opposition, thus neutralizing each other. In



Showing how the temporary stage is fitted to the set.

practice I have found this method very effective and well worth trying.—ERNEST SILSON (Leeds).

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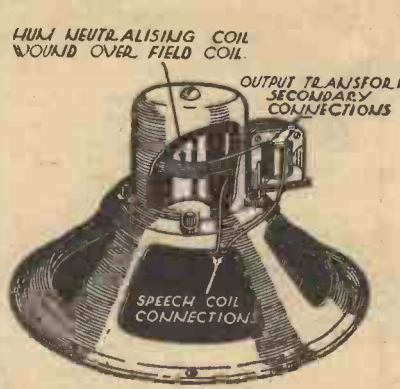
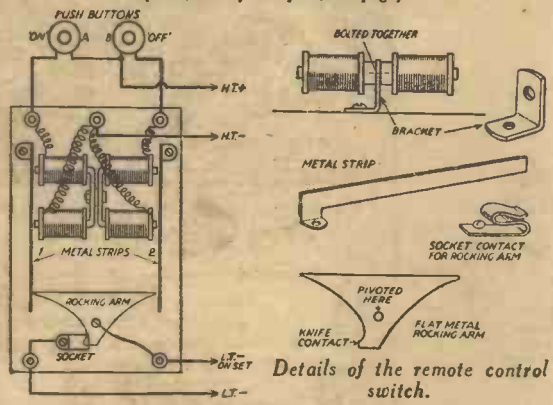


Improving a moving-coil speaker.

RADIO WRINKLES

(Continued from previous page)



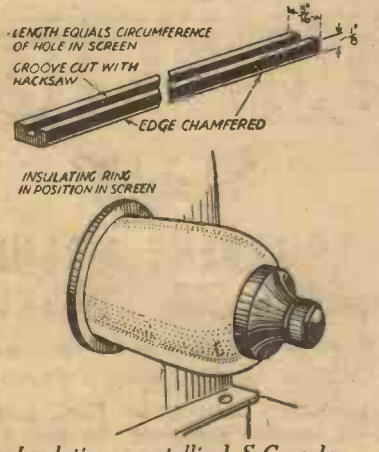
Details of the remote control switch.

Simple Remote Control Switch

THIS remote control switching device, which makes use of old 'phone bobbins, may be of interest to other readers. The parts required are as follows: one block of wood (3½in. by 2½in. by ½in.); two sets of bobbins; one rocking arm; two sheet iron strips (2⅜in. by ⅜in.); one socket and two push buttons. These parts, details of which are given above, are mounted on the baseboard in the positions shown above. In operation, the pushing of button A causes strip 1 to move inwards, pushing the contact tip of the rocking arm into the socket, and thus breaking the L.T. circuit. The voltage required can be obtained from the H.T. on the set, 100 volts giving the strip a good kick which enables the rocking arm to make a good contact. There is no continuous discharge while the control is in action. The switch on the receiver can be used in the ordinary way, providing the rocking arm is in the socket. When the control is to be used, the switch must be on all the time.—H. J. ORCHARD (Clapton).

Insulating a Metallised S.G. Valve

THE following dodge will be found useful in cases where a metallised screen-grid valve has to pass through a metal screen, which must not come in contact with the metallised coating. The hole in my screen being 1¾in. diam. I obtained a strip of ebonite ⅜in. wide and ⅛in. thick and of a length sufficient to go round the circumference of the hole in the screen. Along the centre of this strip, with a hacksaw, I cut a slot ⅛in. deep, and rounded off one corner, as shown below. After placing the strip in boiling water it was bent to a circular shape and pressed round the hole in the screen, the edge of which fits neatly in the central slot. The diagram shows this ring in position.—F. BISSEKER (Blackburn).

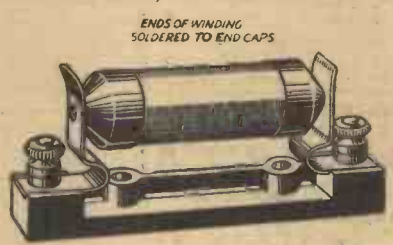


Insulating a metallised S.G. valve.

New Panels for Old

IT often happens after being in use for some time that the highly polished marbled bakelite panels and fittings so popular just now become scratched or marked, and thus lose their original brilliant appearance. As these sundry scratches or markings spoil the look of the front of the set and thus mar its general appearance, the following method of restoring a panel, which is very successful, can be used to advantage. A really good panel, slightly damaged, can often be picked up at a considerable reduction in price.

Take a piece of sand-paper, grade "000" or "00," a piece that has been used before preferred, or failing this, rub the sand-paper on a piece of hard wood to wear it down a little, and rub gently, using a circular motion, along the marks to be removed. The marks or scratches are usually only on the surface, and in a short time the part so treated will have a dull even appearance. Now take a buff stick (if you don't possess one, you can make one by tacking or glueing a strip of soft leather on to a piece of hard flat wood) and work over the whole surface of the panel, again with a light circular movement, and in a short time you will find that all the marks have disappeared leaving a nice even surface. It only remains now to apply a few drops of good liquid furniture cream, polish briskly with a soft cloth, and the panel will look as good as new. If the panel is at all warped just warm it and leave between two flat boards under a slight pressure for a short time when it will return to its normal state.—W. ASPINALL (Manchester).



How to make novel short-wave chokes.

Novel Short-wave Chokes

MANY constructors have on hand one or two of the old heavy duty cartridge type wire-wound resistances from which excellent short-wave H.F. chokes can be made. First de-cap one end and take out the resistance element, replace cap and place cartridge in holder. Using 36 or 40 s.w.g. enamelled wire, solder the start, to one end cap, and turning the cartridge by hand, fill up space between caps and solder end to other cap. The chokes made this way are easily changed although not as good as the commercial variety.—S. G. ROSSON (Levenshulme).

Use for Old Aerial Wire

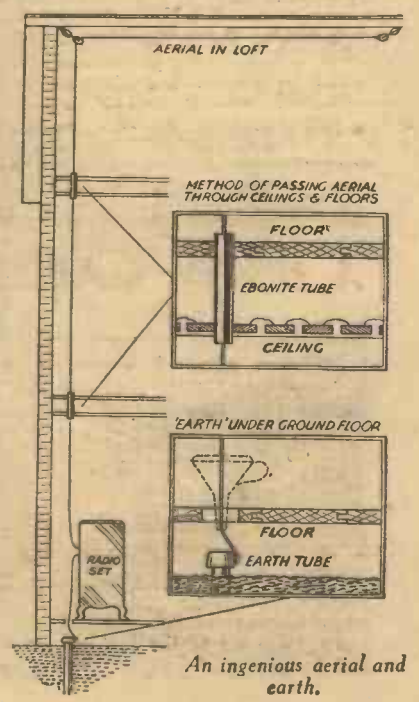
PLAIN copper wire aerials that have been in use three or four years are usually taken down and replaced in order to obtain better efficiency. The aerials, however, need not be thrown away as quite a good earth can be made from them. Rub the wire with emery-cloth to brighten it, and then obtain an old broom handle and cut off about four feet. To one end of the wood fix one end of the aerial with a staple, and wind the wire along the shaft in the same manner as winding a coil. Stop within about two inches of the end of the shaft and fix the wire with a staple if required, a terminal can be fitted to shaft and the end of the aerial connected to it.—H. H. ASH (Lincoln).

A use for old aerial wire.

An Aerial and Earth System

MANY listeners suffer a good deal of losses in their sets due to long earth and aerial leads. If a system is erected the same as shown in the accompanying sketch the losses will be reduced to a minimum. I have used the method for two years and have found that it gives better results than an ordinary outdoor system. The aerial is erected in the loft in the usual way and the lead-in is taken through the bedroom ceiling and then through the ceiling of the room which houses the set. At the point where the aerial passes through the ceilings an ebonite rod is slotted over the wire and pushed up flush to the ceiling; this of course insulates the wire and stops leakage. At the same time it makes a neat hole, and is therefore not unsightly.

As regards the earth, part of a floor board behind the set was removed and the earth rod buried as shown in the sketch. In the board taken up a hole was bored so that when the board was replaced the hole was practically over the earth tube.—S. DRY (Hull).



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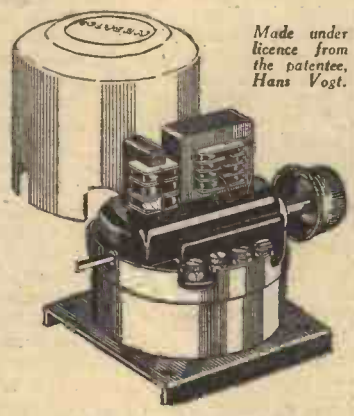

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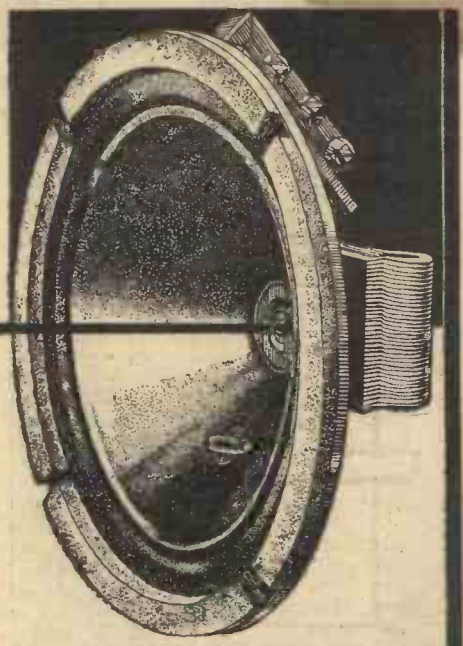

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USING SELENIUM CELLS

(Concluded from page 591, July 22nd issue)

By J. R. FENNESSY and H. WELTON

The Electrolytic Cell

WHILE on the construction of cells, a few words on the electrolytic cell would not be out of place. This cel, although light-sensitive, contains no selenium, and since one is easily made,

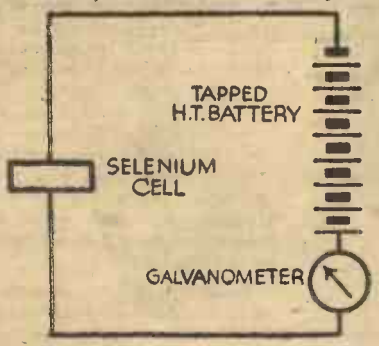

Fig. 5.—A simple selenium cell circuit.

it is worth while having one handy both on account of its interesting action and for comparison with the selenium operated types. Cut two 2in. squares of copper foil, place these face to face, and slip a rubber band over them. Now separate their two inner surfaces by inserting two split match sticks, and solder a wire to a corner of each foil square. Prepare a 1 per cent. solution of copper sulphate (about 4½ grains of the salt in each ounce of water), place sufficient of this in a glass jar to cover the foil cell, which is supported in an upright position therein. The now-completed cell should be placed in a dark place and allowed to remain undisturbed for a week, during which period a coating of oxide will have formed on the plates. One side of the jar should now be masked, the other half being left open to the light source, which must be allowed to operate on one foil only.

An assembly of elements for an electrolytic cell was shown last week.

Operating Selenium Cells

A simple circuit is shown in Fig. 5. It consists of a battery (a radio H.T. battery with tappings), a selenium cell, and a galvanometer arranged in series. The cell is placed first in darkness and then exposed to light. The galvo needle will be deflected immediately light strikes the cell. When the beam is broken, as, for instance, when a person passes between the light source and the cell, the galvo needle will fall back to a zero value. In this way it is possible to detect the approach of anyone.

A more ambitious and useful circuit is shown in Fig. 6. Here a relay has been substituted for the galvanometer in the first circuit. The purpose of this is evident for it enables a local circuit to be brought into action when light affects r, alternatively, ceases to affect the sensitive cell. It is not within the scope of this article to describe the construction of a sensitive relay; moreover, really good relays of the moving-coil type (essential for our purpose) are to be purchased very reasonably from dealers in government surplus, so that it is scarcely worth while attempting to make such an important and delicate component in the home workshop. To return, however, to a further inspection of the circuit given in Fig. 6. It will be observed that the local circuit closed by operation of the relay contains an electric bell. It follows that the ringing of a bell is but one of the applications of the circuit; we can, for instance, place the relay in series with lighting mains and a lamp, or a local battery and a lamp, or again we may substitute for the latter an electric motor. There are alternative connections to the relay which make it possible to wire the circuit so that the contacts are closed when the cell is in darkness, and opened as light strikes it, or vice versa.

Thus, at the fall of dusk our lights may be automatically switched on, or a burglar alarm sounded the moment an intruder casts his shadow on the cell. We may, using the circuit in Fig. 5, test the comparative efficiency of illuminants by taking readings of the galvanometer deflections due to these, the distance between cell and light source remaining constant during the experiments.

One of the most interesting branches of light ray experiment occurs in connection with the infra red or "black" rays. These rays lie beyond the red end of the spectrum, and their frequency of oscillation is so low that they are invisible to the human eye. That a selenium cell can "see" them, however, you can prove by performing the following experiment. Arrange your apparatus as in Fig. 6, turn out all lights so that the room is in complete darkness, and then project a strong beam of light from a torch on to the selenium cell. The relay is connected to operate the bell when the cell is in darkness, so that the effect of the beam is to keep the bell silent. If you break the beam by walking through it or by placing some opaque object in its path to the cell the bell will ring. Now to demonstrate the infra-red effect. Place in front of the lamp a thin sheet of ebonite—a thick piece is of little value as it passes less light and necessitates either increasing the size of the lamp or bringing it nearer the cell. No light should be now visible in the room, yet we find that the bell still rings when we switch off our hidden light, or walk through the invisible beam, for the selenium cell can "see" the black rays, although our eye ignores them. It is in this way that many burglar alarms are set up and operated.

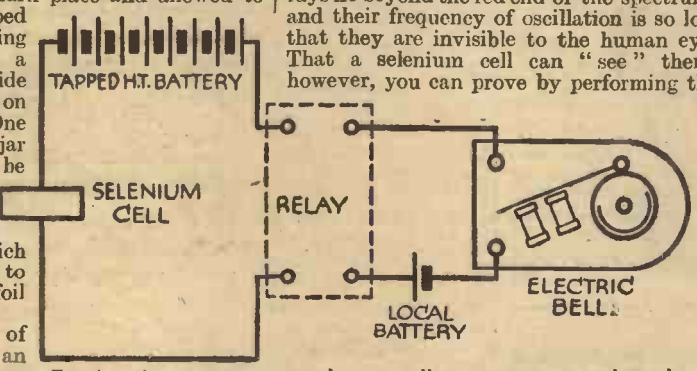

Fig. 6.—A circuit using a selenium cell in conjunction with a relay.

Hearing an Electric Light

If your home-made cell has any frequency response at all (depending on the manner in which you have made it), it will enable you to hear the frequency of the lighting mains if alternating. The connections are as shown in Fig. 5 with this exception—a pair of headphones are substituted for the galvanometer. On allowing the cell to "see" an A.C. fed electric light a hum corresponding to the frequency of the mains will be heard in the 'phones.

It would be impossible to describe here the multitude of further experiments for the amateur or the countless possible applications of the light-sensitive cell, nor do we consider it necessary. An interest and enthusiasm will endow the worker with far more knowledge than any amount of written matter.

At the commencement of this article mention was made of a disadvantage of selenium prohibiting its wider application. In conclusion we will briefly consider this. Referring to the circuits and uses indicated in this article, it is evident that the effect of the cell has been to create a definite make and break in some local circuit. The value of any variation in current under the influence of an inconstant light source has been neglected. In practice it is found that attempts to make a current passed by a selenium cell vary immediately and faithfully in direct proportion to changes in soulight rce intensity, have failed. In other words, the response to a change from dark to light and vice versa in a selenium cell is not immediate; there is a very considerable time lag which can in many instances be measured in seconds. Hence, the photo-electric cell is used in talking picture work and all undertakings employing modulated continuous systems. Such cells are possibly a little less sensitive than the selenium variety, but their response to delicate light variations is marked, immediate, and there is a total lack of inertia.

In spite of the fact that many experimenters long ago discarded selenium in favour of the photo-electric cell, it is interesting to note that quite recently a selenium cell of unique design—the Radiovisor Bridge, has been marketed. In this product the makers appear to have overcome the undesirable features present in the normal type of cell.

FOURTH ARTICLE

CHANGING FASHIONS IN SET DESIGN

A Brief Survey of the Development of Wireless Receivers from the Inception of British Broadcasting to the Present Day

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

WE now come to a period which I consider to be perhaps the most important in the history of wireless-receiver development — namely the years 1928 and 1929. You will remember that the screen-grid valve had been introduced during the previous season. Sensitivity and selectivity had reached a standard adequate for the broadcasting conditions of the time; good loud-speakers of the balanced armature type were on the market and rapidly gaining in popularity, while A.C. mains valves were available.

The one weak spot in set design was the output stage. A super-power valve was necessary for good volume and good quality, and because a super-power valve needed a fairly large grid input voltage, two low-frequency stages were required in most sets.

In 1928, however, the first British pentodes were introduced—five-electrode valves having high amplification factors and capable of giving big output. They solved the low-frequency problem because they gave ample power for operating average loud-speakers of the day at good volume, for a grid input such as could be supplied direct from the detector valve.

Family Receivers

Gradually, therefore, the standard good-class receiver for family use developed on what was called the "S.G.P." specification, namely one screen-grid high-frequency stage, a detector valve, and a pentode output valve. The screen-grid valve gave a good choice of stations; two tuned circuits, frequently ganged, provided very fair selectivity; and the pentode output valve gave adequate volume by the use of a single low-frequency stage. Not only so, but the pentode effected important economies in initial cost and working expenses. Results hitherto only possible with a four-valve set were now obtained with three valves—one valve, one holder, and one intervalve coupling were thus saved, and at the same time both low-tension and high-tension consumption were reduced, while a certain amount of space was also saved inside the set, which had some effect upon the appearance of the receiver and the cost of the cabinet.

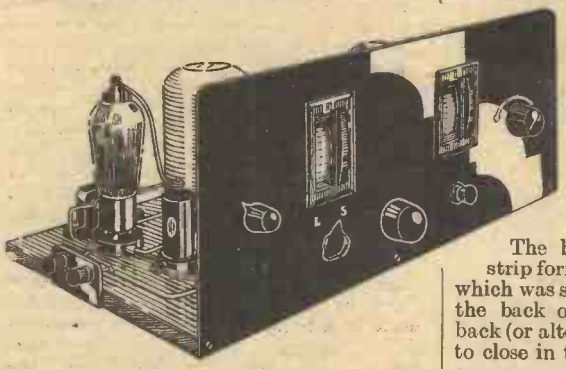

Fig. 1.—A receiver in which the contents of the panel are limited to the operating controls — tuning condensers, wave-change switch, filament switch, and volume control.

Up to this time, technical considerations had always come first in the design of receiving apparatus, and far too little attention had been paid to the external design of the set. Such developments in appearance as had occurred were all on the lines of facilitating construction and improving the accessibility of the internal arrangements, and the normal construction at this time was a flat baseboard with a vertical ebonite panel. One improvement which had been made was to limit the contents of the panel to the operating controls—tuning condensers, wave-change switch, filament switch, and volume control. Filament resistances, if used, were of the pre-set type and mounted on the baseboard. Terminals for aerial, earth, output, and H.T. and L.T. supplies were invariably mounted on a terminal strip at the back of the receiver.

The baseboard, panel, and terminal strip formed one complete technical unit, which was slipped into a simple cabinet from the back or front, while a flap or sliding back (or alternately solid back) was provided to close in the set, and sometimes a hinged cover was also provided.

Differing Layouts

Now, however, further improvements in layout and in appearance began to be seen in the best receivers. The need of careful screening in the high-frequency part of the apparatus led to the adoption of metal panels which not only formed part of the screening itself but also served as a common earth return for all leads which had to be connected to earth. For some time still the rectangular panel was the usual shape, but gradually it became possible to concentrate the few controls and knobs within a very small panel space. To avoid what some regarded as the unsightliness of a wide expanse of empty panel, that portion not containing controls was masked by a portion of the cabinet work, thus greatly improving the general appearance of the set.

The next stage came with the introduction of complete ranges of individually-shielded components—coil assemblies, tuning condensers and the like, all arranged for base-board mounting. Each variable component carried its own individual controls, so that the need for an actual panel disappeared. For example, a set of ganged coils had its built-in wave-change switch; reaction condensers were mounted on small metal brackets which could be bolted to the main tuning condenser frame, and so on. The best practice of the time, therefore, was to mount all the components on the base-board, which was of wood and covered by a thin sheet of metal. The controls protruded over the front edge of the baseboard, and the cabinet was designed with a closed front with holes through which the control spindles projected when the baseboard was pushed home in the cabinet.

From this it was but a short step to the all-metal chassis design which we now know so well—main components mounted on the top of an inverted metal tray, smaller components accommodated beneath, and the whole slipped into a handsome cabinet, or into a compartment of a radiogram. Here again it is customary to keep all the controls as close together as possible, so that the technical features of the set interfere as little as possible with the external design of the cabinetwork.

This form of design is particularly satisfactory when applied to receivers incorporating built-in loud-speakers. The whole of the technical equipment can be withdrawn from the cabinet for adjustment and repair, and the set itself presents a most pleasing appearance, can be designed to harmonize with any style of furnishing or decoration, and is now welcomed by the housewife instead of being spurned—or tolerated at the best, as was so often the case with the inartistic and even ugly apparatus of earlier seasons.

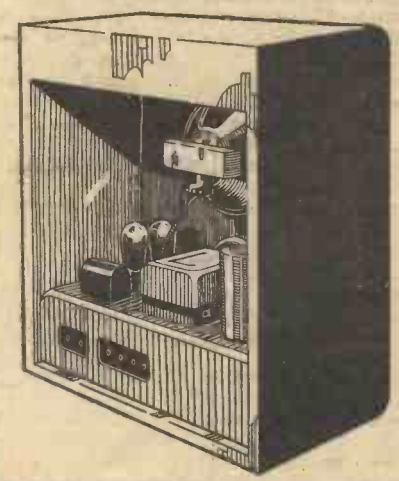

Fig. 2.—The all-metal chassis design which is common practice in modern receivers.

H.F. Valve Changes

But while external appearance was receiving all this overdue attention, technical matters were not being overlooked.

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Radio engineers were not yet entirely satisfied with high-frequency amplification. The screened-grid valve was extremely sensitive and normal circuits employing the valve were reasonably selective. But with the growing power of broadcasting stations it was found that high-sensitivity screened-grid valves were liable to be overloaded when local or powerful programmes were tuned in. Early in 1931, or thereabouts, a solution to the difficulty was forthcoming in the production of variable mu valves. These special screened-grid valves are extremely sensitive when operated at low or zero grid bias, but by applying increasing bias the effective amplification decreases, and at the same time the acceptance of the valve, that is to say its signal handling capacity, increases. It will be clear, therefore, that a valve of this type is almost an ideal radio frequency amplifier for use under modern broadcasting conditions. When receiving weak or distant stations the valve can be adjusted to its most sensitive condition by reducing the negative bias to zero or to such low value as is necessary to avoid grid current. Then, when it is required to turn to the local programme, grid bias can be increased by means of a potentiometer, thus avoiding distortion, and maintaining volume at a reasonable level. Moreover, the adjustable bias can be employed at all times as a handy volume control.

Up to a few months ago the variable mu valve, which was available in both battery-operated and mains types, represented the high-water mark of radio development, so far as valve and circuit design was concerned. Then, however, came new developments which, although not *fully* exploited at the moment, bid fair to have a profound effect upon set design during the coming season.

On the Output Side

The first problem to be tackled was the output stage of battery sets. Up to that time battery set owners had been forced to realize that the generous output necessary for operating a powerful moving-coil loud-speaker could not be theirs so long as they relied upon dry batteries for high-tension supply. No commercial type of high-tension battery available at a price within the reach of the average listener could supply sufficient power for really big outputs. The plums of radio, so far as volume and quality were concerned, were reserved for the fortunate owners of all-mains sets.

Suddenly, about six months ago, radio engineers revived a form of push-pull amplification known as Quiescent Push-pull, in which, by over-biasing two standard valves, and using them in such a way that each valve amplified only alternate half-waves of the input, the standing losses in the output stage were greatly decreased. By this device, the output of a battery set could be practically doubled without increasing materially the high-tension consumption.

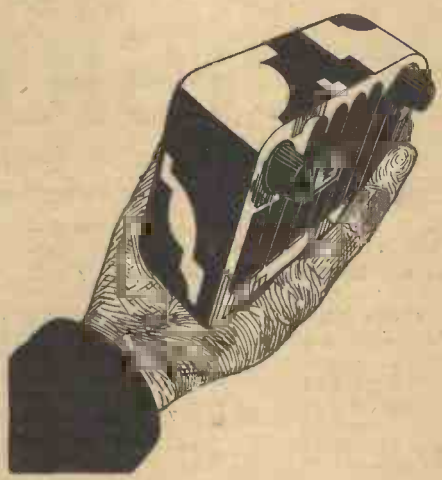


Fig. 3.—Will the multi-valve sets of the future be like this?

Following hot on the heels of Q.P.-P. came a further development, Class "B" amplification, in which double valves are employed, without grid bias, the two halves operating again in push-pull. In Class "B" the anode current, when no signals are received, is very small indeed. Each half of the valve is operative only during that portion of each signal wave when the grid is positive, and the value of the anode current depends entirely upon the value of the signal applied to the grid.

One disadvantage of Class "B" is that grid current flows all the time the valve is operative. Listeners have always learned that grid current was synonymous with distortion, but in Class "B" the ill effects are counteracted by actually supplying power to the grid circuit by means of a "driver" valve forming a previous low-frequency amplifying stage.

Class "B" amplification is having this effect upon modern receiver design, it is making available in battery sets maximum undistorted outputs up to some 2 watts—comparable with that of a good mains set. From the point of view of external appearance it is making little difference, but it will mean bigger volume and better reproduction, and a still more general use of the large moving-coil loud-speakers which are really essential for perfect quality.

Now just a brief forecast of future developments. So far I have carefully avoided reference to any features which have not yet come into general use in constructional sets. But there are many important developments which have long passed the experimental stage, and should appear in practical form at an early date. Of these, the general application of special combination valves such as double-diode-triodes and diode-tetrodes will further improve detection and facilitate automatic methods of volume control. Then again, it must not be forgotten that we have at our disposal already the "Westector" to replace the ordinary detector valve. New types of high-frequency amplifiers will shortly be adopted—valves designed on the lines of screened-grid valves but having a third grid between the screen and anode, and connected to the cathode, thus forming high-frequency pentodes. Great increases in stage gain will be possible with these valves.

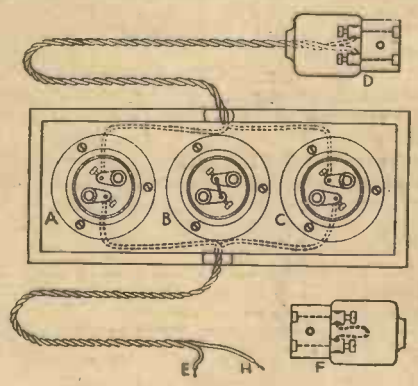
Another development, originated in America, but certain to be introduced on a large scale in this country, is the "super midget," a tiny self-contained receiver scarcely larger than a cigar-box and almost as inconspicuous as an ordinary telephone. Will these baby sets ultimately displace the relatively huge pieces of radio furniture which at present represent the best British practice? Time alone will show.

A TRIPLE-PURPOSE TESTER

THIS novel form of combined test set and circuit tester will be found indispensible to the wireless enthusiast and electrician alike for testing continuity of circuits, or coils, or finding short circuits, and for showing whether any circuit up to 500 volts is "alive" or "dead"; *e.g.*, mains supply, transformers, high tension, etc. Formerly, electricians have carried two and sometimes three different sets to do the jobs done by this one set, and the cost of this simple tester is negligible.

A, B and C are batten type lamp-holders mounted on a piece of wood—a rectangular switch block makes an excellent baseboard. The adaptor D is connected to a length of twin flex and one end of each wire is connected to one point of the outside lamp-holders A and C respectively, as shown. The ends of another piece of twin flex are connected to the two other points of these lampholders, while the middle holder B, is short-circuited. The other adaptor F is short-circuited by a small piece of fuse wire. Bare the ends of the flex (E and H) for about ½in.

To test for continuity of circuit, plug adaptor D into any light socket in the house and put lamps into holders A and C. Now touch the ends E and H on the ends of the circuit to be tested, and if this circuit is complete, the lamps will light. On a high resistance circuit put one lamp in one of the outside holders, say, A, and the adaptor F in the other holder C.



A handy triple-purpose tester.

When testing a circuit which has one side connected to earth, it is essential that two lamps be used, and both must light to be sure that the circuit is complete.

Now to test if a circuit is "alive" or "dead," plug adaptor D into the middle lampholder B, and if the voltage expected is not greater than 250 volts put one lamp in one of the outside holders and the adaptor F in the other, and touch the ends E and H to the two points being tested. If the circuit is "alive" the lamp will light. For voltages above 250 put a lamp in each of the holders A and C. If, when only one lamp is being used in the tester the lamp should go faulty and short-circuit itself, the fuse wire in adaptor F will go and no damage will be done. This adaptor can be kept in holder B when not in use.—JOHN DURIE (Wigan).

OLD CIRCUITS REVIVED

Notes Regarding a Number of Circuits Which Have Been Popular During the Past Few Years and Are Still of Interest to the Experimenter.

UP to five or six years ago the wireless amateur and experimenter used to think of his hobby in terms of "circuits," and whenever members of the "fraternity" met, such names as "Colpitts," "Hartley," "Meisner," "Armstrong," "Flewelling," and many others could frequently be heard. Many of those

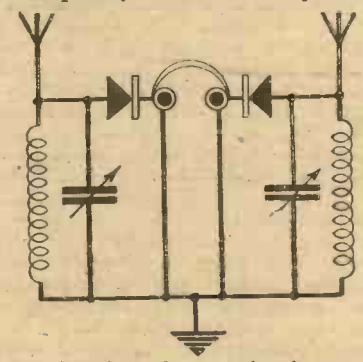


Fig. 1.—A simple circuit for obtaining increased volume from a crystal set.

readers, whose interest in wireless goes back over the past ten years, will recall most of these names, but to those who have only recently taken up the hobby the names will probably have no significance whatever. With the idea of refreshing the memories of "old hands," and of giving the younger generation a little food for thought, it is proposed to give brief particulars of some of the circuits that have been popular at various times during the past ten years or so. It would be quite impossible to mention all the circuits, so reference will only be made to those which were in the nature of "supers" or "stunts"; most of the others were merely embryos from which the circuits in use at the present time have been developed.

"Special" Crystal Circuits

Before passing on to the more elaborate arrangements it will be interesting to look at one or two modifications of the simple crystal set. In the earlier days, when components were particularly expensive, the crystal was as much as most of the more or less impecunious experimenters could afford, and for that reason it came in for a considerable amount of experimentation with a view to bringing its efficiency up to the highest possible level. One apparently simple way of increasing the signal strength from a crystal set was by the use of a dual arrangement, like that shown by Fig. 1. Two complete receivers were used in conjunction with two aerials and a single earth, but instead of operating a pair of 'phones, each one had to drive only a single earpiece. Theoretically, this system should provide twice as much volume as the more conventional one; in practice, however there were a number of "snags," such as getting the two halves of the set into exact balance, matching the crystals, and finding a position for the aerials so that they did not tend to shield each other. In consequence of these difficulties, the final result was not always better, or even as good as that obtained with a standard type of set. For the keen experimenter this circuit can still provide ample scope and is very interesting.

Full-Wave Detection

Another attempt to double the power of a crystal set was by the use of full-wave rectification, the circuit employed being somewhat like that represented by

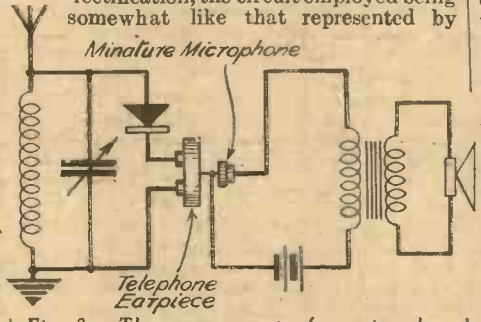


Fig. 3.—The arrangement of a microphone amplifier for operating a loud-speaker from a crystal set.

Fig. 2. Here again two crystals were made use of, but they were actually in series, with the 'phones connected between them. It can be seen that the principle of this arrangement is identical with that of a full-wave rectifier of the types at present used in A.C. eliminators. Although I can claim to have obtained quite satisfactory results with this circuit, there is no doubt that it is decidedly tricky and demands the use of almost identical crystal detectors, and of an accurately centre-tapped secondary tuning coil. Incidentally, the latter is most easily obtained by the use of the old-fashioned slider or by taking a number of tappings and finding the one most suitable.

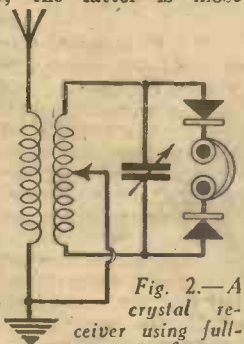


Fig. 2.—A crystal receiver using full-wave rectification.

Loud-Speaker Crystal Sets

In the earlier days of broadcasting numerous attempts were made to operate a loud-speaker from a crystal set without the use of costly valve amplifiers. The simplest of these, and one which met with some measure of success, was to attach a small microphone to an ordinary telephone earpiece and to connect this to a speaker through a high-ratio transformer; the general idea of the circuit connections can be gathered from Fig. 3. The idea appears to be perfectly simple and straightforward, but it was found very difficult to produce the extremely small and light-weight (as they must be) miniature microphones for the purpose. Consequently, in most cases, a considerable amount of experimental work was necessary before anything like satisfactory results could be obtained.

Reflex Circuits.

Immediately following the crystal "era," and by which time components were cheaper and more easily obtainable, numerous circuits were evolved in which a crystal detector was used in conjunction with valve amplifiers. In some cases the valves acted purely as low-frequency or high-frequency amplifiers, but in others a single valve was made to amplify at both low and high frequencies. Circuits using the latter arrangements became to be known as "reflex," since the signal first passed through the valve and was amplified at high frequency; next it was rectified by the crystal, and then *passed back* to the valve, which then magnified the low-frequency impulses. A simple and one-time popular reflex circuit is represented by Fig. 4, from which it can be seen that the valve is coupled to the crystal on the tuned-anode system, and the output from the crystal is fed back to the valve through a low-frequency transformer, across the secondary of which is connected a fixed condenser to

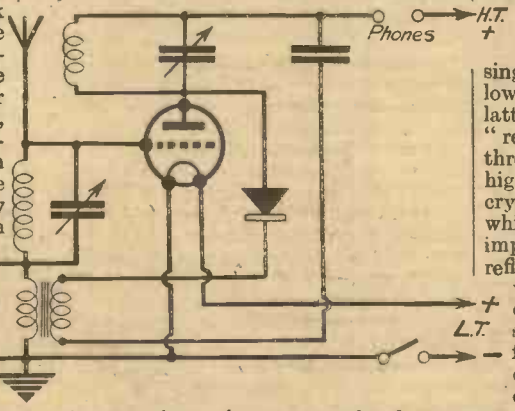


Fig. 4.—An early form of valve-crystal reflex circuit.

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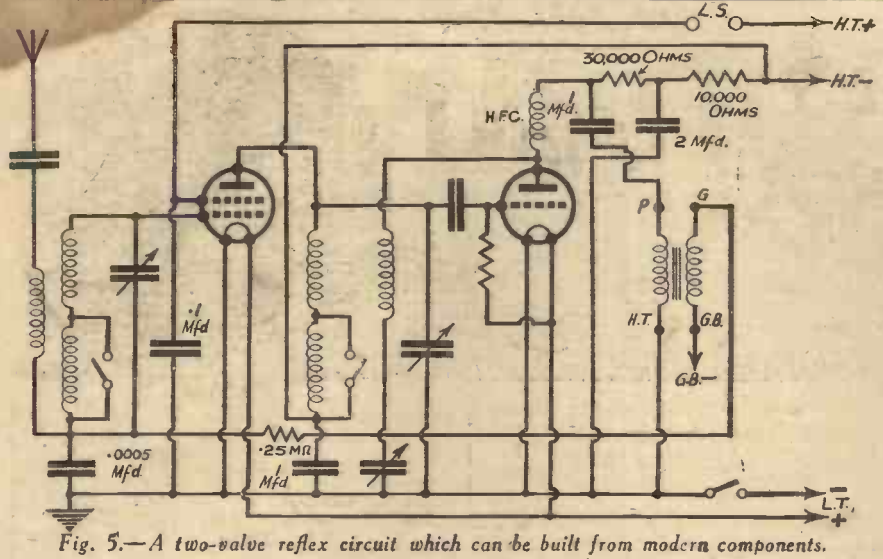

Fig. 5.—A two-valve reflex circuit which can be built from modern components.

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act as a by-pass to the H.F. Still further to improve the efficiency of the arrangement, reaction was often obtained by coupling together the tuned anode and aerial coils. It was claimed that such a circuit was capable of results equal to those given by an ordinary three-valve receiver, and although this was a rather exaggerated statement the circuit was undoubtedly capable of wonderful things once a suitable crystal and L.F. transformer had been found. In reality, the "quality" was probably extremely poor, but this generally passed unnoticed, since it was as good as contemporary speakers and other components were capable of producing. The reflex circuit was always very popular, probably because the very idea of economizing by making one valve do the work of two had a strong appeal to human nature. It is interesting to observe that the reflex is still "living" and that many amateurs would like to revive it. For the benefit of any readers who are interested in trying a reflex circuit with modern components, the circuit represented by Fig. 5 might be useful. In this case the crystal is dispensed with and an ordinary three-electrode valve employed as detector, a screened-grid valve serving the purpose of combined H.F. and L.F. amplifier. Ordinary dual-range tuners are employed and the values of the more important components are indicated.

Super-Regeneration

At about the same time as the reflex circuit was meriting a good deal of attention, other experimenters were trying to get a maximum amount of amplification from a single valve by a different means. It was, of course, known that a detector valve could be made to amplify by feeding back into the grid circuit the H.F. currents appearing in the anode circuit—in other words, by applying reaction. This was satisfactory up to a point, but as the valve fell into self-oscillation (so producing the well-known heterodyne whistle) when more than a very limited amount of reaction was used, it was felt that the valve was not being made to operate at its full efficiency. The consequence was that two new circuits, known as the Armstrong Super-Regenerative and the Flewelling, were invented by the American investigators whose names they still bear. With both of these circuits, which are shown in Figs. 6 and 7 respectively, the principle was practically the same, namely, that although the valve was allowed to remain in a state of oscillation the customary whistle was not heard, due to the fact that oscillation was periodically "quenched" or "damped." The quenching was provided by so arranging the circuit that the valve could oscillate at two frequencies at the same time; one of these corresponded to the signal being received and the other was of about 10,000 cycles, or just above audibility. As a result, the former oscillation was quenched by the latter at the rate of 10,000 times per second. At first, much difficulty was experienced in disposing of a constant "hiss" which marred reception, but by making various fine adjustments it could, at least, be reduced to so low a level that it was not very troublesome. Of the two circuits, the Flewelling was least used and never became very popular. The Armstrong, however, has remained in more or less constant use right up to the present time, and is, in fact, coming very much to the fore at the moment for the reception of ultra-short-waves. There is no need to describe the circuit in detail here, since that was done in an article recently published in PRACTICAL WIRELESS.

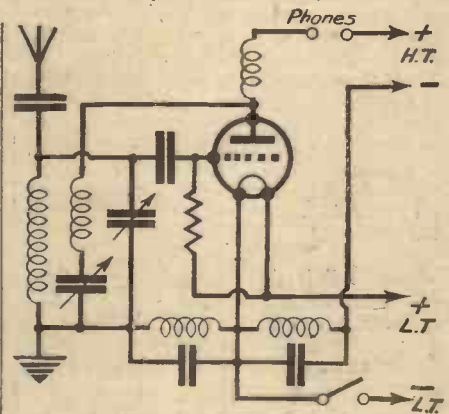

Fig. 6.—Circuit of the Armstrong Super-Regenerative single valver.

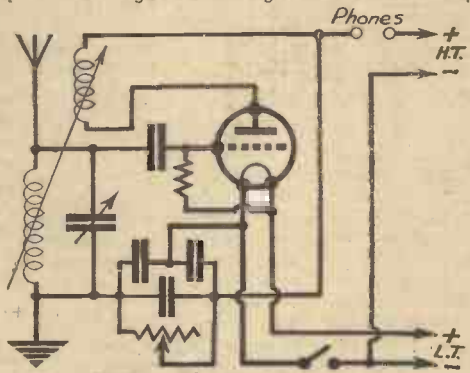

Fig. 7.—The Flewelling circuit.

High-Tension-less Circuits

In evolving new circuits the fundamental idea was almost invariably one of economy, of making one valve do the work of two, or of minimizing the consumption of high-tension and low-tension current. I have already mentioned some circuits whose main aim was to get equal efficiency with fewer valves, so now reference should be made to a scheme that was originated during 1924 for disposing of the high-tension supply. The circuit of a high-tension-less Det.-L.F. two-valve set is given in Fig. 8. From this it can be seen that the valves are of the four-electrode type, having two grids; diagrammatically, they are like the later screened-grid valves, but otherwise they have no resemblance. The inner grid is connected to L.T. positive, the outer one forming the usual "control" grid. To describe how this circuit worked it is necessary to refer to the normal functioning of a triode valve whose filament emits electrons ("particles" of negative electricity), which are attracted to the plate by the positive charge usually derived from a H.T. battery. In the normal type of valve there is a comparatively wide gap between the filament and plate, and to

(Continued on page 636)

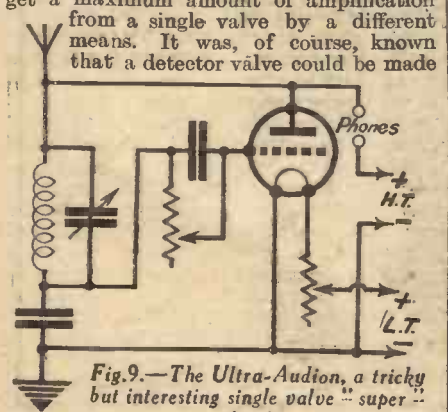

Fig. 9.—The Ultra-Audion, a tricky but interesting single valve "super" circuit.

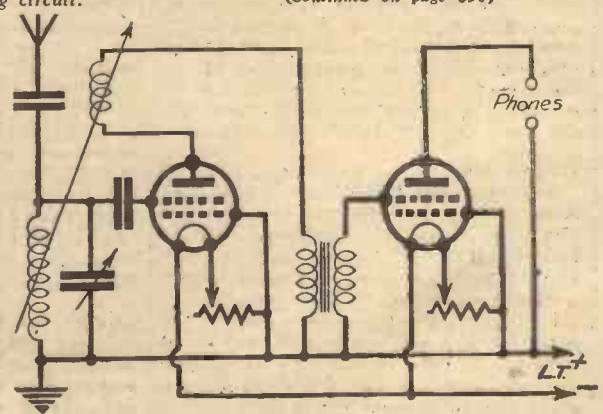

Fig. 8.—Circuit of a two-valve set—L.F. high-tension-less receiver.

THE EASY ROAD TO RADIO

The BEGINNER'S SUPPLEMENT

Conducted by F.J. CAMM

Plug

A device which, in conjunction with a socket arrangement known as a "jack," is used for quickly making or breaking an electrical circuit or circuits. The plug consists essentially of a metal stem insulated from a metal ball at the end of the stem. The other end of the stem is supported in an insulated handle. See Fig. 1. Inside the handle are two small terminals connecting with the ball and stem of the plug. It is to these terminals that the wires from the speaker, 'phones, or other apparatus are joined so that, when the plug is inserted in the jack, contact is made.

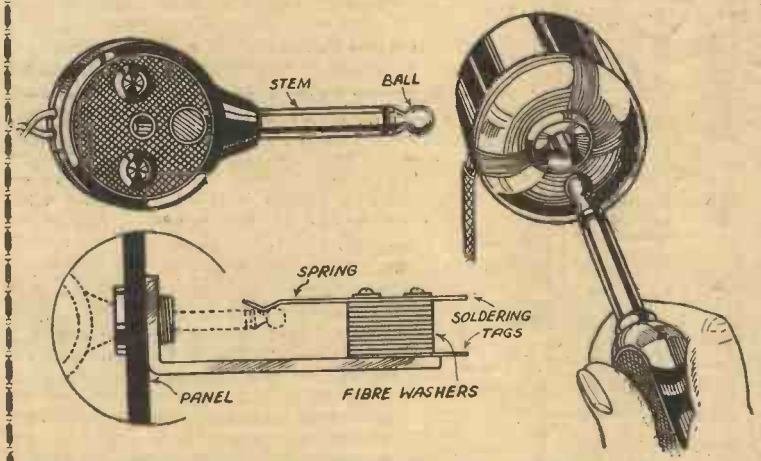

Fig. 1.—Plugs and jacks, showing how the tip and stem of the plug makes contact.

A common use for plugs and jacks is to provide a quick means of changing over the speaker from one room to another. Wall jacks are provided in each room, each jack being connected to the set with wires. A plug is then attached to the speaker cords. In this way the speaker can be plugged in at any desired point. Other uses for plugs and jacks include the plugging-in of a gramophone pick-up to the receiver, the cutting out of one or more of the valves in a multi-valve set, etc. See also *JACK*.

Plug-in Coil

A tuning coil fitted with a plug and socket arrangement specially designed for quick coil changing. The usual type of plug-in coil is illustrated in Fig. 2. It will be noticed that the coil is plugged in to a holder mounted on the baseboard. Another type of plug-in coil is shown in the inset, but this kind is more often referred to as a "six-pin" coil owing to its having six legs or pins which plug in to the six sockets on the special holder.

THE BEGINNER'S A B C OF WIRELESS TERMS

(Continued from July 22nd issue, page 602.)

Plug-in coils are not now used to any great extent, except for short-wave work, as they have been replaced by the more popular dual and triple-range coils in which wave-changing is performed by means of a switch instead of by removing the coils.

Polarisation

When a simple primary cell is being discharged it will be noticed that the current rapidly falls after the first second or so. If the cell is then given a rest it will again deliver the full current, but it will also die down again in the same manner as before. This phenomenon is known, as *polarisation* and is due to the formation of small bubbles of hydrogen on the positive plate of the cell. These bubbles offer a high resistance to the passage of the current through the cell. The reason why the cell or battery recovers after a rest is because the bubbles have had time to clear away.

In ordinary dry cells as are used in flash lamp batteries, H.T. batteries, etc., a special substance is included to dissolve the bubbles as soon as they are formed. This is called the *depolariser* and prevents the battery from "running down" after being in use a short time. Accumulators or *secondary* cells do not suffer from *polarisation*, as no gases are formed during discharging. See also *DEPOLARISER*.

Polarity of a Magnet

Every magnet has what are called "poles." There is the *North*-seeking pole and the *South*-seeking pole. In the case of a bar magnet, if it is suspended from its centre it will swing round until its north-seeking pole points to the earth's north magnetic pole. The "North" pole of one magnet will always attract the "South" pole of another, but two "Norths" or two "Souths" will repel one another.

In a magnet the *North* pole, or to give it its proper name, the *North-seeking pole*, is the end of the magnet from which the lines of force are supposed to emerge, while the *South* pole is the one by which they return. With a battery or dynamo the two terminals by which the current leaves and returns are called the *Positive* and *Negative* poles respectively.

Potential Difference (P.D.)

The difference in pressure or *voltage* which causes an electric current to flow. Just as pressure is needed to cause water to flow along a pipe so pressure is required to produce a current of electricity.

Potentiometer

Strictly speaking this is a "measurer of potential," but the term is used in wireless to indicate a divider of potential. It consists essentially of a resistance with a slider, which can be moved along the resistance element at will. In this way any intermediate voltage can be obtained between that of the two ends. As you know, when a resistance is connected in a circuit there is always a difference of

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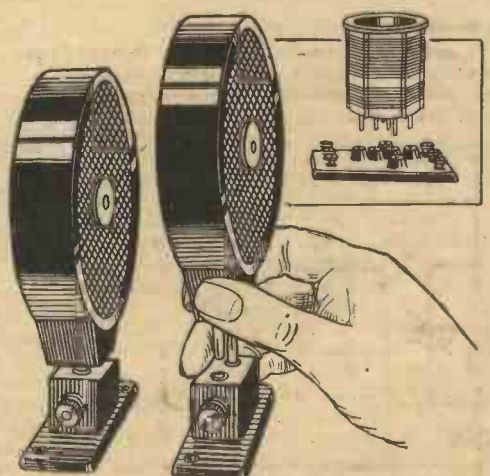


Fig. 2.—Two different types of plug-in coil.

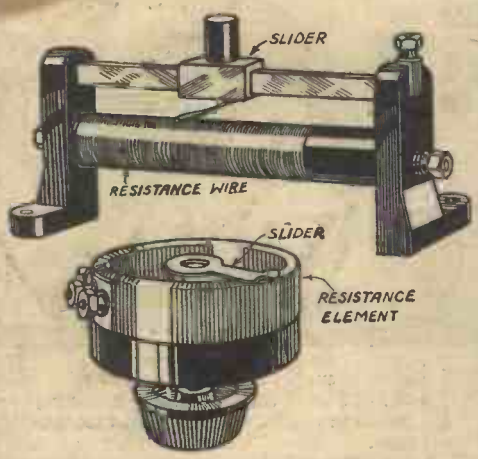


Fig. 3.—Above, a simple form of potentiometer, and below, the more usual type.

(Continued from previous page)

electrical pressure (voltage) between the two ends. If it is desired to connect, say, the grid of a valve or some other part of the set, to a point at a pressure somewhere between that of the extreme ends of the resistance, then a potentiometer is used in place of an ordinary resistance and the connection taken to the slider. By moving the slider the desired potential can be obtained. Fig. 3 gives an idea of what a potentiometer looks like. Two examples are shown.

Power Grid Detector

Probably the commonest way of connecting up the detector valve of a receiving set is as what is known as a "leaky-grid" detector. This method necessitates the use of a grid leak and grid condenser. It is very sensitive if the right values of leak and condenser are chosen, but suffers from the drawback that it is likely to distort when overloaded if the signals being received are too powerful. However, it can be made to handle very powerful inputs if the anode voltage of the valve is increased to about 200 volts and the values of the leak and condenser each reduced. This method is then called *power grid detection*. It should be noticed that it does *not* increase the power of the set, but merely enables it to handle loud signals without distortion.

Power Valve

A valve for use in the output stages of a receiver and, therefore, designed to handle considerable power as compared with valves in the earlier stages.

Primary Cell

A piece of apparatus for producing an electric current by chemical action. In its simplest form it consists of two plates or strips of dissimilar metals dipping in a solution of acid or salt. The acid slowly attacks the metals, or one of the metals, and on joining the two strips with a piece of wire a current will flow. In the Leclanché and bichromate cells one of the metal strips is replaced by a carbon rod. A primary cell cannot be recharged. See *CELL*.

Primary Winding

The winding of a transformer to which the power from the source of supply is fed. From the primary winding it is transferred by *magnetic induction* to the *secondary* winding. See *TRANSFORMER*.

Push-Pull

A method of connecting up two amplifier valves so as to share the total grid swing between the two valves. Its advantages are greatly increased handling power, freedom from distortion, less need for decoupling, etc. The connections for two valves in push-pull are shown in Fig. 4, which also gives the normal connections when using only one amplifier valve. The push-pull arrangement must not be confused with two valves just connected together in parallel. It has definite advantages over parallel connection.

Quiescent Push-Pull

A modification of the push-pull arrangement in which the power consumed from the high-tension supply is proportional to the signal strength. Thus during intervals or quiet parts of the programme practically no current is taken. This is attained by using a very high grid-bias voltage. Quiescent push-pull is an extremely economical method of power amplification and therefore particularly suited to battery sets. Fullest advantage of the system is obtained when the valves used are pentodes.

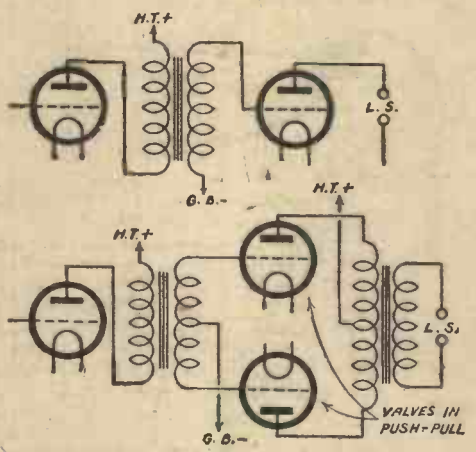


Fig. 4.—How valves are connected in a simple output circuit and in a push-pull arrangement.

Radio-frequency

Frequencies from about 15,000 cycles upwards. See *HIGH-FREQUENCY*.

Reaction

An arrangement by which some of the energy in the anode or output circuit of a valve is fed back to the grid or input circuit. This has the effect of overcoming the resistance of the grid circuit and so gives an increase in signal strength. Reaction can be controlled by a movable coil (magnetic reaction) or by a variable condenser (capacity reaction). If the control is advanced too far the energy fed back more than compensates for the losses in the grid circuit and the circuit breaks into *self oscillation*. When in this state the receiver will produce howls and whistles when tuned to a broadcasting station and will also cause interference with other nearby receivers. See *OSCILLATIONS*.

Rectification

The process of converting alternating current into direct current. The detector valve in a receiver *rectifies* the high-frequency current produced by the incoming waves, that is to say, it changes it from a current moving rapidly first in one direction and then in the other into a current going in one direction only, but still rising and falling according to the rise and fall or *modulation* of the original currents.

Another case where rectification takes place is in the case of a receiver operated from alternating current mains. Here the current must be converted into non-pulsating (direct) current before it can be used to supply the valves. This is carried out either by a *metal rectifier* or a special *rectifier valve* in conjunction with smoothing chokes and condensers.

Rectifier

A device for converting alternating current into direct current. See *RECTIFICATION*, *VALVE*, *METAL RECTIFIER*, etc.

Resistance

The opposition that a substance offers to an electric current passing through it. The energy expended by the current in overcoming resistance produces heat. In the case of an electric lamp, for instance, the heat produced is so great that the filament becomes white hot.

The term *resistance* is also used to denote a *resistor*, that is, a device used to introduce a certain resistance in a circuit. Resistances or resistors are made in various forms. Some contain a coil of special resistance wire and are called *wire wound resistances*, while other types include *metallised resistances*, *composition resistances*, etc.

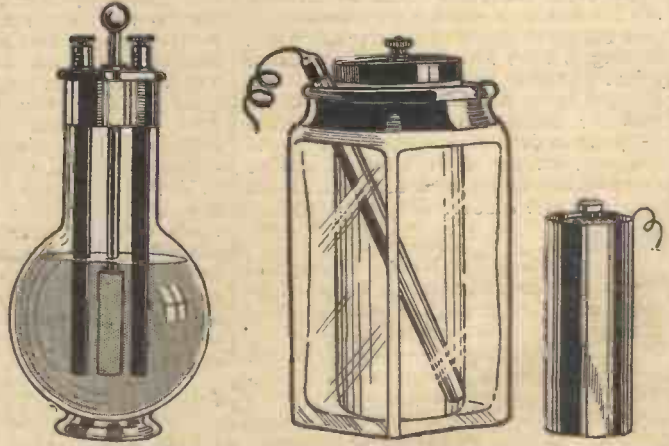


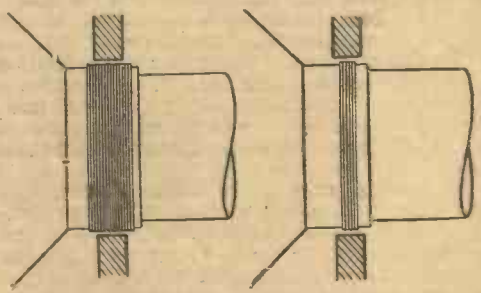
Fig. 5.—Two types of primary cell—the Bichromate battery and the Leclanché cell.

FROM THE FLASHLAMP

By Photon

The Speech Coil in the Gap

THERE are two complementary functions performed by the moving coil, the one of these is to receive electrical energy and the other to deliver this as mechanical energy to the diaphragm and so to the air. The speech coil in its magnetic field is thus a specialized form of electro-motor, and is thus subject to the ordinary electrical laws—namely, the cutting of the magnetic lines of force by the conductor gives rise to back E.M.F., which may be calculated in the same way as the E.M.F. of a dynamo or electro-motor; and the current flowing in the winding gives rise to forces dependent upon the strength of the current, the length of wire in the winding, and the value of B in the gap. The calculation connecting the electrical and acoustic quantities based on these fundamental laws is most instructive, but this does not form the subject of the present article.



Figs. 1 and 2.—Showing broad and narrow wound speech coils.

The essentials for good performance from the standpoint of design are:—

1. That the moving coil shall be capable of sufficient free movememt, especially for the rendering of low tones.

2. That the maximum movement permitted shall not affect materially the mean strength of the field or the number of turns within the field.

3. There shall be no selective resonances such as will interfere with a good frequency characteristic.

4. There should be a certain amount of damping to avoid resonances.

5. The motional impedance should be high and the copper resistance low.

Now (1) depends very much on the centring; it is unusual to find the movement unduly limited by the surround, but the centring at the small end of the cone is often cramped. The importance of (2) is often overlooked. If, as in many of the moving-coil speakers of a season or two ago, the winding be made of exactly the same length as the gap, just to match it exactly, then, when any movement of the coil takes place, the number of turns *in the gap* will diminish—this is inevitable. But it may be avoided by making the speech coil winding either much greater than the gap length, Fig. 1, or alternatively very much less, Fig. 2. In either case a quite considerable movement of the coil may take place without any change in the number of turns in the gap field. The type of winding shown in Fig. 1 is the better from the point of view of cost limitation; the whole field is in use all the time. Fig. 2 is most extravagant in the matter of field, but it results in a much lighter moving coil for the duty performed. The winding shown in Fig. 1 is found more suitable for the usual open cone type of speaker; in this the weight of the moving coil and diaphragm as a matter of experience is not a difficulty; in fact, if it be made too light the very high frequencies come through too strongly, and the 9 kilocycle heterodyne from the adjacent station becomes a constant source of annoyance. The type of winding shown in Fig. 2 has been found better suited to the horn type of M.C. speaker, and is used in the Lanchester acoustic tube type.

On the question of clearances. There is a natural tendency on the part of designers to cut the clearances down to a minimum in order to obtain a stronger field for a given cost in magnet steel. In the writer's opinion the internal clearance between centre pole and sleeve should not be less than 5/1000 of an inch, that is, a diametral clearance of .01in. or ¼ mm. and the external clearance about half as much again, *i.e.*, a diametral external clearance of .014in. It may be asked why a greater clearance on the outside? The reason is that if the sleeve touches the centre pole very little harm is done, but if the winding should touch on the outside not only will there be a much greater acoustical disturbance due to momentary shorts, but actual injury may be done, and the coil may have to be rewound.

The question of resonant frequencies, (3) above, also the questions of motional impedance and copper resistance (4 and 5), will be dealt with in a later article.

Composition Resistances

THERE are still many receivers about using old type composition anode resistances. Many of these fall short of the modern variety, inasmuch as their value does not remain constant, but increases with time. An ordinary composition 50,000 ohm resistance may steadily increase in value until there is only a volt or so on the detector valve, with consequent loss of reaction, quality and volume.

Grid Leaks and Instability

GRID leaks have a habit of increasing in value when their age is considerable, resulting in reduced handling capacity, instability and considerable backlash on reaction.

Tuning Correction

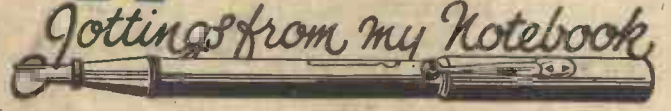
THERE has been much written on the subject of tuning correction by cutting off the top notes with a condenser or stopping them by means of series resistance, but it is seldom that reference is made to increasing low base.

When a resistance-fed L.F. transformer is used much can be done in this direction by choosing a suitable condenser. If the value chosen is such that with the inductance of the primary the circuit forms a tuned acceptor at some definite frequency, say, 60 cycles, the response curve will rise sharply at this frequency.

RADIO RAMBLINGS

By GRID LEAK

Jottings from my Notebook



He Never Switched Off !

A GOOD French story was recently published in one of the Paris "dailies." It concerns a forty-year-old citizen who, wishing to secure an annuity policy from an Insurance Company, consulted his doctor as to the means to be adopted to live to the ripe old age of four-score-and-ten. The practitioner examined him and pronounced him a perfectly healthy case. "Do you smoke ?" he asked the patient. "No." "Do you drink ?" "No." "Do you enjoy big meals ?" "Not particularly," was the answer. "Do you listen to the Paris radio programmes ?" "Yes, I never miss an item." "Great Scott !" said the doctor, "what do you want to live so long for ?"

Another Kind of S.W. Interference

WHILST trying out a short-wave set the other day a rather peculiar form of interference was noticed, which might be of interest unless you have already had the same experience. The set worked very well, and in about half an hour we had made a good "bag" of stations on the 31-metre band, but as soon as it was made to oscillate a programme of dance music could clearly be heard no matter what wavelength the receiver was tuned to. We didn't bother about this for some time, but eventually decided to see who it was. On settling down to listen to it, there was no doubt that the music was being made by Henry Hall and his boys, so we concluded that we must be listening to a gramophone record "churned out" by a local amateur. This theory was soon disproved, because announcements were given by H.H. himself. Could it be an Empire transmission ?

Well, to cut a long story short, the interference turned out to be coming from a neighbour's set which was tuned to the National, because immediately that set was switched off the interference ceased. Rather peculiar, though, that the music should only be heard—and quite clearly at that—when the short-waver was actually oscillating !

Electrical Interference

INTERFERENCE with wireless reception by electrical apparatus appears to be getting worse every day, and it really does seem time that some preventive measures were taken by the authorities. If a man drives down the street in a car whose exhaust emits a "healthy" burble he is liable to be hauled before the magistrates and fined ten shillings and costs for disturbing the peace, and yet a person who causes an ear-splitting noise to be heard in every loud-speaker over a radius of a hundred yards or more, by using a flashing electric sign, does not receive so much as a caution. The Post Office has gone to no little trouble and expense to devise means for "silencing" every form of electrical apparatus and offers to trace and cure interference at a purely nominal charge, but I gather that its services are not very frequently called upon. In more than one European country a person is forbidden to instal any piece of electrical machinery which is not guaranteed to be silent, in the radio sense of the word, so surely it is not beyond the powers of the Government of England to introduce laws which will make electrical interference illegal here.

Precautions Necessary with Mains Apparatus

I SEE that in electrical circles there is some concern being felt about the undue publicity given to cases of electrical shocks resulting in deaths through the use of electrical apparatus in bathrooms. There have been several sad cases of this sort lately, but it has been pointed out that prejudice should not be felt against the use of electricity any more than against such power mediums as petrol or gas. One does not need to be told that it is dangerous to look for gas or petrol leaks with a lighted match, although perhaps it is not so commonly known that it is dangerous to use such apparatus as hair-dryers and massage machines whilst in a bath. All the same, it is not to the interest of progress or to we who, by our constant experimenting, do much to assist the development of radio and electricity in general that fear should be felt by the public in its use. You may say that it is not everybody that wants to listen to radio programmes in the bath, but if I am correct in my opinion of eager radio fans they are not above using their sets anywhere. Therefore, if you use the mains to work your set be scrupulously careful how you wire up the mains leads to the set. Make as few joints as possible and well cover them with insulating tape, or preferably use the special bakelite covered connectors that can be purchased quite cheaply and which make a neat and safe job when two leads have to be joined together. See that the metal case of your mains unit is connected to earth, and also for general safety try to earth any other piece of electrical apparatus that may be in use in your home. Another set of leads that is sometimes abused is that which feeds loud-speakers in distant rooms. There is an idea prevailing that "it is only the speaker lead" while the fact that quite hefty shocks can be obtained from speaker leads from fairly powerful sets is often overlooked, and some people are susceptible to quite low voltages. If you are sufficiently capable to fit further power or lighting plugs in your house, a thing you shouldn't do unless you are sure of what you are doing, find out which is the earthed lead of your mains, as nasty shocks have been obtained from lamp-holders, and the like, even though the switch controlling it was in the off position. This is due to careless wiring, as if the switch is placed in the un-earthed lead there is a danger of a return flow of current to earth via the body of the person who happens to make contact with the other lead. In conclusion, in your own interests and in the interests of radio and electrical development generally, treat the power at your command with the respect your knowledge of it gives.

Carrying Capacity of Fuses

FOR a fuse to be efficient it should be capable of carrying a maximum current considerably less than the filament current of any one valve. It is often found, however, that quite large fuses have to be used, as smaller ones blow every time the set is switched on. This is caused by the momentary heavy current drawn through the fuse to charge the fixed condensers which have discharged while the set has been idle.

This trouble can easily be overcome by connecting such condensers as go to H.T.— or L.T.—, straight to the H.T.— terminal and putting the fuse between H.T.— and L.T.—. Admittedly, this will not offer any protection should one of the condensers break down, but if these are of reputable make there is nothing to fear.

The Valve of the Future !

AT the present moment there seems a rapidly growing danger of valves becoming so complicated and having so many grids in them that the price will be exorbitant, unless the constructors' point of view is carefully watched. There appears to be no limit to the possibilities in this direction. In a recent issue of PRACTICAL WIRELESS, details were given of the new Hexode, but this is only a starting-point for all sorts of possibilities. How about a Class B valve made up of two pentodes ?

Grid Glow Tubes

GRID glow tubes are quite commonplace in America, and there is some possibility, we understand, of their appearing over here. This gadget consists of a little Neon tube which provides a visual indication of tuning.

The general idea is that with a station calibrated A.V.C. set the loud-speaker is shorted by a switch, the wanted station tuned in by watching the grid glow tube brilliancy, and then the L.F. portion is switched on and there is the wanted station, correctly tuned. The idea is to obviate the annoyance of passing over a few dozen stations when tuning from one to another.

THE BEST L.F. COUPLING?

(*Continued from page 616*)

due to its negative bias being momentarily reduced by the positive signal voltage. The other valve, which receives the negative half-cycle, is biased still more heavily and, therefore, does not operate, or, in other words, it remains "quiescent." As positive and negative half-cycles are alternately applied to both valves, the latter work "in turns." In consequence of this the average anode current remains very small in amount, and it can thus be supplied by an ordinary dry battery.

It has become customary to employ a pair of pentode valves in the Q.P.-P stage, and although these do give more amplification there is no reason why small power valves should not be used.

Special input and output transformers must be used for Q.P.-P. for reasons which will be explained. To load the valves fully the input transformer should have a step-up ratio of about 9:1 (as compared with 3:1 for ordinary push-pull). Since the current flowing through the primary winding of the output transformer is rapidly fluctuating between, say, 2 and 20 milliamps, this winding must have a low D.C. resistance of the order of 400 ohms.

Another modification of push-pull is that known as Class "B" amplification. This has the same objects as Q.P.-P., namely, of giving a large undistorted output for a minimum consumption of high tension current. A special "double" valve has been developed for Class "B," and this really consists of two triodes in a single glass bulb; it has two filaments, two grids and two anodes. The new valve functions in almost the same manner as the two valves in Q.P.-P., but instead of requiring a heavy G.B. voltage it is so designed that it passes an almost negligible amount of high-tension current when the grids are at zero potential.

Since the grids actually become positive it is evident that there will be a flow of grid current through the secondary of the preceding transformer. To prevent distortion it is therefore essential that the secondary winding should have a very low resistance, and to ensure this, it must have comparatively few turns. This fact makes it necessary to use a step-*down* transformer in order that the primary may be matched to the preceding valve. To make up for the loss of amplification caused by the step-down transformer an additional L.F. valve must be used prior to the Class "B" stage; this valve is referred to as a "driver," but it is really an ordinary small-power valve.

The circuit arrangement for a Class "B" amplifier is shown in Fig. 5, where the names of the various parts are indicated.

By way of "summing-up" the conclusions drawn above it can be said that the best form of coupling for a battery set which is required to give only a comparatively small volume, or for a mains receiver, is the resistance-fed transformer. For a battery set intended to give a large volume sufficient to produce really good reproduction with a moving-coil speaker the constructor cannot do better than employ Class "B" or Q.P.-P. Special "constant-voltage" eliminators are now made for use with the new systems of amplification, whilst most ordinary eliminators can be suitably modified by connecting a "neon stabilizer" across the output terminals.

Facts and Figures

Components Tested in our Laboratory

BY THE PRACTICAL WIRELESS TECHNICAL STAFF

PREH VALVE-HOLDER

A NEAT bakelite chassis-mounting valve-holder has been submitted for test, and is illustrated on this page. The top is of brown bakelite and is provided at the side with lugs to facilitate the attachment to a wooden or metal chassis. The sockets are slotted

Preh 7-pin chassis mounting valve-holder.

and grip the valve legs sufficiently hard to ensure good electrical contact, but not so tight that the valve may not easily be withdrawn. The illustration is of a 7-pin holder, but it is also obtainable in 4 and 5-pin types. The 7-pin costs 1s.

NEW FERRANTI VALVES

THE well-known firm of Ferranti, specialists for many years now in high-quality transformer manufacture, have turned their activities to the production of valves, and some interesting developments may be expected from this source. Samples of some of the preliminary types have already been submitted to us and are illustrated on this page. They include the first double diode-triode which we have received, a full wave rectifier, and a special H.F. pentode. The full-wave rectifier is known as Type R.4, and is of the directly-heated type, consuming 2.5 amps at 4 volts. The rectified output is 350 volts at 120 mA., and the curves show remarkably good regulation. For instance, with a current of only 40 mA. and an input of 200 volts a D.C. output of nearly 200 volts is obtained. When the current consumed rises to 120 mA. the output is still over 100 volts, so that there is a variation of less than 100 volts between the extremes of 40 and 120 mA. A slightly more powerful rectifier is also produced and bears the reference R.4A. The filament potentials are similar to type R.4, but the output voltage is increased to 500 with a current of 120 mA. The regulation is of the same high order. The electrode construction is very sturdy, and there should be no cause for complaint on the ground of mechanical breakdown. The H.F. Pentode is Type VPT.4, and this is of the indirectly heated type with a 4 volt 1 amp. heater. Maximum anode volts are 200 and the screen voltage is given as 100. Maximum anode current is approximately 5 mA., with a further 2 mA. from the screen current. The impedance is rated at approximately 1 megohm, and the conductance at 2.6. The valve has, of course, a special application. The remaining sample is most interesting, as it is the first of a new type of valve which has already been described in these pages, namely, the Double Diode Triode. (See PRACTICAL WIRELESS, dated April 22nd, page 190.) This is of the indirectly-heated type with a 4 volt 1 amp. heater. It is fitted with the new 7-pin base, and has a cap on top of the bulb. The connections to the pins and cap are given in a recent Data Sheet. The maximum anode voltage is 200, and the impedance is 14,500 ohms. Amplification is rated at 39, and the mutual conductance at 2.7. The special uses of this type of valve have already been given in the article referred to.

AMPLION TAPPED OUTPUT CHOKE

THE correct matching of loud-speakers to a Class B or Q.P.P. output stage is a matter of some importance, and the correct transformer should in all cases be used, not only in the interests of obtaining the best quality, but also to operate the valve correctly. Most loud-speakers are already fitted with a transformer, but this is not always suitable for Class B circuits, and there is then a question as to how best to carry out the matching. Messrs. Amplion have produced a 3-ratio tapped output choke which is designed to enable a Class B or Q.P.P. stage to be coupled to any speaker fitted with a transformer. Three ratios are provided, 1 to 1, 1.5 to 1 and 3 to 1. A trial will soon indicate the correct connections to employ. The component is nicely made and finished in a bakelite case, and a terminal is provided for earthing the core. The price is 9s. 6d.

TUNGSRAM CLASS A OR B VALVE

AN interesting new valve is announced from the Tungsram factory. This is the PX.46, which contains two grids in addition to the usual filament and anode. By connecting the two grids together the valve acts as half of a Class B valve, and by connecting the grid nearest the anode to the anode it acts as a Class A valve. As a Class A valve the impedance is 2,350 ohms and the amplification factor 5.6. For Class B operation the anode to anode load should be 5,800 ohms. A driver transformer of 1.5 to 1 ratio is required, and the output approaches really large dimensions. It should be noted that for the correct operation of the Class B arrangement two of these valves are required, and each one is treated as the half of the standard Class B valve. The anode voltage may be of the order of 400 when the undistorted output is 21 watts. This represents a really radical departure from present practice, and we hope to have more to say regarding this valve at a later period.

O'CONNOR DRY CELL

WE have received a 60-volt dry battery from the O'Connor Dry Cell Manufacturing Company of Ballina, and we are submitting this to tests for shelf-life and discharge. A full report will be given in a future issue.

BULGIN COMPONENTS

TO facilitate connections for battery receivers, mains receivers or experimental apparatus, the Bulgin Multi-Cable Plug will be found a valuable accessory. This consists of an ebonite plug, very similar to an ordinary valve base, and is fitted with either 4 pins or 5 pins. A domed metal cap is provided with a thread and fits over the terminal ends of these pins, and the ends of a battery cord or similar cable may be passed through this cap, attached to the different pins, and the cap screwed into position to furnish a really neat end to the cable. An ordinary valve-holder then serves to complete the connection to the receiver or experimental apparatus. The price of the 4-way plug is 2s., and the 5-way is 2s. 6d. The Spirohm resistance has also been improved, and these are now rated at 20 watts. A special heat resisting core is employed, and this is wound with nickel chrome wire. A porcelain former is provided with a spiral thread, and the resistance element is wound round this. So that various values may conveniently be tapped off, special clips are obtainable, and these clamp round the element. These are 6d. each, and the resistances are obtainable at 3s. 6d. to 6s., in ratings of 300 ohms to 100,000 ohms.

The new rotary toggle switch is also interesting as it may be mounted on a panel and furnished with a knob in the same manner as the remaining controls of a receiver and operated by a rotary movement of the knob. The switch itself is of the usual quick-make-and-break 3 amp. type.

LISSEN I.F. TRANSFORMERS.

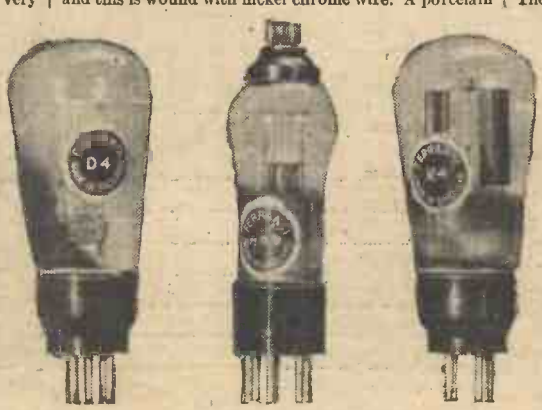
A VERY neat intermediate frequency transformer for superheterodyne receivers has been produced by Messrs. Lissen and this incorporates some interesting features. Of the band-pass type, the two coils are wound on paxolin formers, and these are fixed at the correct distance apart on a central column. The two trimming condensers are fitted under the bakelite base of the coil, and these are adjusted at the factory to provide the necessary frequency, which in this

The Lissen I.F. transformer.

particular case is 126 cycles. There is thus no need for the amateur to touch the condensers and they are covered by the metal base out of harm's way. The screen fits down round the bakelite base and when used with a metal chassis complete screening is effected. If a wooden baseboard is used, however, a separate earthing lead should be joined under the terminal on top of the coil and connected to a convenient earthed point. The transformers may be recommended, and the price is 7s. 6d.

WHARFEDALE LOUD-SPEAKERS

WE have tested the Bronze chassis speaker manufactured by the Wharfedale Wireless Works, and this is only one of a range of loud-speakers manufactured by the firm, and which include the Blue Wharfedale, the Golden Wharfedale, and the Energized models. The particular model under review is priced at 39s. 6d. and is rated to handle up to 4 watts without distress. When given this load it was found to function perfectly, and 5 watts was handled quite well. The frequency response is rated at 50 to 8,000 cycles, and this is certainly borne out on an ordinary radio test. There is no undue resonance at any part of the musical scale, and the bass is well reproduced, although not boomy. The top is clear without being squeaky, and speech is characterized by a forwardness and cleanness of tone which is very satisfactory. The transformer which is fitted seems to be a really high-class job, and is available for practically any type of output circuit. The current carrying capacity is 50 mA. For those who prefer a more expensive speaker, the Golden Wharfedale is available at 63s. This model is rated to handle 6 watts.



A group of new Ferranti valves.

NEWS ITEMS

A NEW iron-core coil, with adjustable core, will shortly make its appearance. Tuning may be adjusted by the user to line up with already calibrated receivers.

* * *

A COMPLETE Class B stage, built on a loud-speaker, is also shortly being introduced.

* * *

A COMPLETE television receiver, with viewing screen and loud-speaker will be seen at the Exhibition.

* * *

THE new season's full vision scales will, in many cases, be provided with a dial light which moves with, and behind, the pointer.

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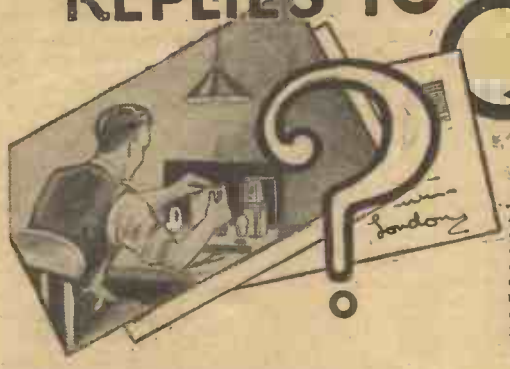

The coupon on this page must be attached to every query.

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.

HIGH-PITCHED WHISTLE

"I have finished a three-valve set employing S.G. valve, detector, and a pentode output. I am troubled by a very high-pitched whistle all the time the music is on, although signals are fairly clear and loud. The whistle is still there when the station closes down. Can you help me to get rid of this annoyance?"—(R. P., No address.)

There are several causes of whistles in a simple receiver, some of which are due to H.F. instability and some to L.F. instability. For a start, reverse the connections to the secondary of the L.F. transformer feeding the pentode valve. This may cure it. If not, examine carefully the H.F. end of the receiver and make certain that the H.F. valve is not oscillating. Connect the aerial to the anode lead of the S.G. valve, and remove that valve. If the whistle ceases it is due to the H.F. valve, and it should be examined for faults and the various voltages checked. A resistance in series with the pentode grid lead may also prove of assistance. A value of about 100,000 ohms should be tried.

BROKEN GRID CIRCUIT

"My set has developed a very peculiar fault which prevents our listening-in. When we switched on the other night things were all right for about twenty minutes, and then suddenly there was a faint plop and the music stopped. Within a few seconds it had come on again just as loud, but it gradually got quieter, there was another plop, and it was gone. This kept on, and it won't keep playing for any time now, but just goes plop and stops for about ten or fifteen seconds. Where shall I look for trouble?"—F. H. (Brixham).

It is almost certain that one of the grid circuit leads or components has broken down. First of all, examine the grid-bias battery and make certain that this is not exhausted and see that the bias plugs are fitting tightly in their sockets. Then examine all wires leading to grid terminals and make certain that none has come adrift. If you can do so, replace the grid leaks and transformers (where such are fitted) to ensure that these are in order. We think one of the above tests will find the fault.

MUSICAL COMPONENTS

"I do not understand all the mysteries of wireless, but here is a point which I cannot understand. I have read most of your articles on the working of a wireless set, and according to these the signals appear from the valves and their action. This is what I do not follow, however. When I disconnected my speaker the other night I could still hear the music coming from the set itself, and although it was faint it was apparently perfect in quality. We did not, in fact, need a loud-speaker. How can this be?"—S. J. L. (Romford, Essex).

The sounds you could hear were coming from the L.F. transformer laminations. The sound impulses pass through the windings of the transformer, and these are wound over a number of thin pieces of iron (the laminations). Theoretically, these should be tightly clamped by means of bolts, but in many components this point does not receive sufficient attention, and the bolts are either insufficiently tightened at the factory, or they work loose in transit, etc. Consequently, the thin strips are made to vibrate in sympathy with the impulses through the windings in exactly the same manner as an ordinary armature loud-speaker. If the transformer is in a case you will probably be unable to do anything. If the clamping bolts are visible, however, they should be tightened, and you will then find that the sounds will cease. There is risk of microphonic troubles if the vibrations are permitted to continue.

IRON SCREWS

"I should like to receive your advice on the following delicate point. I have built several sets, and have suddenly thought of the point of the type of screws used. Will iron screws introduce any losses or other troubles? Should all the components be fixed down with brass screws or otherwise? Please give me your ruling."—R. A. (Scarborough).

DATA SHEET No. 45

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

CONVERSION TABLE—METRES TO KILOCYCLES

Metres	Kilocycles	Metres	Kilocycles
10	30,000	600	500
25	12,000	650	461.5
50	6,000	700	428.6
100	3,000	750	400
150	2,000	800	375
200	1,500	850	352.9
250	1,200	900	333.3
300	1,000	950	315.9
350	857.1	1,000	300
400	750	1,250	240
450	666.7	1,500	200
500	600	1,750	171.4
550	545.4	2,000	150

Iron screws would, of course, give rise to certain effects if they were included in a magnetic field. The majority of wireless components are usually designed so that the fixing holes are out of the fields, but provided a little care is exercised in the choice of the size of screw and the components which are fixed by iron screws, we do not think you will find that any troubles can arise from their use.

A.V.C. AND QUALITY

"I would like to raise the following point regarding the quality of reception obtained when automatic volume-control is employed. As this method of control acts upon the strength of the carrier-wave which is received, surely it is logical to suppose that it will also act upon loud and soft passages in the modulated carrier-wave and so even up the musical piece and cause it to be reproduced at one even strength. Thus the A.V.C. method will ruin that which it sets out to obtain, namely, quality of reception."—S. K. (Kensington).

The method in which automatic volume-control functions is such that only the carrier wave is employed to produce the required voltage for H.F. control. It does not take into account any modulation of that wave and consequently there can be no effect on the material which is being received by means of the carrier wave. You may therefore employ A.V.C. without any qualms as to the quality of reception.

FOREIGN VALVE

"The second valve in my set has burnt out, and I have seen some very cheap valves in a local shop. Is it worth while buying one of these to replace my old one? I do not want to waste any money and am therefore asking your opinion first."—G. T. (Birmingham).

While it is possible to obtain cheap valves which will apparently work as well as good ones, you will find that the life of such valves is usually fairly short. On the other hand, it is not a bit of use going into the shop and asking for one of those valves without first of all ascertaining that it has similar characteristics to those possessed by your old valve. Differences in anode current, impedance, etc., will affect results, and therefore, if you are unable to obtain the characteristics of the cheap valve you must replace your valve with one of similar make. In any case, remember that cheap valves invariably only give "cheap" results.

FAULTY SWITCH

"I used to get very good results on both wave-bands on my commercial set, but now I can only get fair signals on the medium waves. There does not appear to be any alteration in the strength on long waves, but when switching over the medium I can only just hear London fairly faintly. Can you suggest what is wrong?"—T. H. (Barking).

The most likely cause of such a fault is a wave-change switch. We do not know what type of switch is fitted but if you can gain access to it, examine the contacts which are made when the switch is turned to the medium-wave position. You will find that they have either got dirty or corroded, or that the springiness has gone out of them and they do not make proper contact. As the receiver still functions on the long waves the coil winding must be in order, and the switch is the most likely cause of the difficulty.

SHORT CIRCUIT IN SPEAKER

"I have a D.C. mains receiver with mains excited moving-coil loud-speaker. When I turn the volume up on the loud side I get a nasty 'spitting' sort of noise in the speaker. It is something like a sharp crackling very sudden and hard, and only comes on when the set is working nearly all out. I have searched all over the place, but as it comes from the speaker I feel it must be there, although I know that all the sounds in a set also come from the same source eventually. What can I look for which is most likely to be the cause of this noise?"—T. M. C. (Teddington).

Before doing anything to the set itself we would recommend you to examine the loud-speaker. If there is the slightest sign of a short-circuit between the speech coil and the pole-piece this is the cause of the noise. As the field is excited direct from the D.C. mains, and as the mains are no doubt employed for the H.T. supply of the set, it is quite simple to short the mains through a partial short in the speaker, and the sound is similar to that described by you.

GRADED POTENTIOMETERS

"I have bought a potentiometer to connect across my gramophone pick-up to control the volume which I get from the gramophone. When I unpacked the component I see that the strip on which the wire is wound is wider at one end than the other. How is this intended to be used. It cannot surely give an even control of volume if the resistance is not even. I should like to have your remarks before sending the component back."—D. C. M. (Pontypridd).

The component is intentionally made that way, D. C. M., and it serves a very useful purpose through being so wound. As you remark, the resistance will vary throughout its length, and, therefore, there will be a greater variation in resistance at one end for a given amount of movement than there will be at the other end. Connect the instrument across your pick-up with the thin end joined to grid-bias negative (or earth, if it is a mains set). The arm is, of course, joined to the grid of the L.F. valve. Now, when you rotate the arm from the point of maximum volume towards the other end you will find that the sound output may be very evenly reduced whereas, if the resistance was of equal value throughout its length there would be only a small part of the resistance which would be of real use, and then volume would drop off suddenly.

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This coupon is available until August 5th, 1933, and must be attached to all letters containing queries.

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BROADCASTS TO SCHOOLS

THE annual programme of Broadcasts to Schools for the year September, 1933, to June, 1934, is now available, and may be obtained free on personal application to Broadcasting House, London, W.1, or for one penny by post. This publication covers the whole of the school broadcasting programme for the three terms; in it are included a review of the general principles of school broadcasting, notes on each subject and a separate schedule of timings and subjects for the Autumn Term only, giving all the talks for that term in a handy form. Similar schedules will be published in December and March, giving details of the Spring and Summer Terms of 1934, respectively.

FERRANTI ELECTRIC CLOCKS

A CLOCK which always keeps correct time, requires no winding or regulating, and costs only 1d. per quarter to run with electricity, has many advantages over an ordinary timepiece. In Ferranti Electric clocks, which are for use only on A.C., accuracy of timekeeping with a minimum of attention are outstanding features. The usual spring and escapement mechanism is replaced by a small, beautifully-made electric motor, so designed that its speed is proportional to the supply frequency. In a booklet we have just received from Ferranti, Ltd., a fine range of these clocks is given. Most of the timepieces are for mantel use, and are available in highly finished cases, either in bakelite or polished oak, mahogany or walnut. A Ferranti movement, specially designed to replace movements in existing clocks, is also available. The address is Hollinwood, Lancs.

DUBILIER COMPONENTS

SOME constructors will find much to interest them in two booklets recently issued by the Dubilier Condenser Company. One deals with condensers and resistances and gives particulars of mica condensers, paper condensers, block condensers for use with mains receivers and battery eliminators, and high voltage electrolytic condensers. Resistance capacity coupling units and anti-interference filters are amongst the other components listed. The other booklet deals with Dubilier metalized resistances, designed especially for use in mains-operated receivers for voltage dropping and decoupling purposes. Useful tables giving maximum currents and voltages, and graphs showing the voltage and current ratings at a glance, are also included in the booklet. Interested readers should write for copies of these booklets to Dubilier Condenser Co., Ltd., Ducon Works, Victoria Road, North Acton, London, W.3.

ALL ABOUT CLASS "B"

EVERYTHING in connection with class "B" amplification and its associated equipment is fully dealt with in a twelve-page folder we have received from Radio Instruments, Ltd. Diagrams, tables and technical data are given for the application of the class "B" system of amplification to battery sets, and to enable constructors to easily select the right valves and appropriate Drivermu transformers and output chokes. Prices of these components are also included in the folder. The address is Purley Way, Croydon, Surrey.

GARRARD SERVICE MANUAL

THE Service Manual for the new Garrard Automatic Record Changing Unit is now ready, and gives full information concerning this interesting piece of apparatus. Whilst intended primarily for Service Engineers, users of the apparatus will find the information very useful in understanding the working of the mechanism.

CORRECTION: A Simple Distributor Switch

A SLIGHT error occurred in respect to Fig. 2 of the above article (which appears on page 388 of the issue for June 3rd). Terminals 2 and 6 of the distributor switch on the right of the drawing should be connected together. If this connection is omitted the switch will not operate when the arms are on the contacts marked "2."

OLD CIRCUITS REVIVED

(Continued from page 626)

make the electron stream traverse this gap a high positive charge must be applied to the plate. With the special two-grid valve, however, the inner grid is very near to the filament, so that its small positive charge (derived from the accumulator) is sufficient to attract the electrons shot off from the filament and to give them so much impetus that they are able to pass through both grids and reach the plate. The valves in use at the time the "Unidyne" (as this circuit was called) was being tried out were of the four or six volt type, and consequently, the filaments were fed through rheostats. Due to the method by which the inner grid was connected the voltage drop across the portion of the rheostat in use was employed to provide an additional positive grid potential.

Despite the fact that the H.T.-less set could show numerous advantages over one of the normal type, especially when built in portable form, and although the circuit was given wide publicity, it never proved to be a real success. It lacked power, and was incapable of giving sufficient output to operate a loud-speaker in anything like an efficient manner. The idea was, nevertheless, of more than passing interest to the experimenter in that it defied conventions.

A single-valve arrangement that met with a fair amount of success in the early days of broadcasting was that known as the Ultra-Audion circuit. A diagram of this is given in Fig. 9, from which it can be seen that a single coil was used both for aerial tuning and reaction. Instead of controlling reaction by the usual swinging coil or variable condenser method, it was done by adjusting the variable grid leak and filament rheostat. The circuit was extremely critical, and depended very much upon the correct choice of valve and associated battery voltages, but despite these disadvantages, however, the Ultra Audion has often been known to produce excellent results when handled by the patient experimenter. Even at the present time it is worth a trial as a short-wave receiver, although some difficulty might be experienced in obtaining a variable grid-leak.

In writing this article I have not by any means mentioned all the "super" circuits that have been used since broadcasting began, but reference has, I think, been made to all the more important ones. During the next few years there will probably be many more circuits evolved, and there is still plenty of scope for the amateur experimenter.

Interesting items relating to the latest developments announced as we go to press. Where desirable further details will be given later.

NEW FERRANTI COMPONENTS

We have just learned that Messrs. Ferranti are producing the latest type of valve for use in superheterodyne receivers. Commonly termed the Pentagrid (although we see no reason for departure from the usual "ode" nomenclature), this valve is being named by Messrs. Ferranti under the name of Heptode—a term which is, of course, more in keeping with the English method of describing valves. In addition, a constructor's kit for a short-wave receiver, and a novel valve-tester will also be produced in time for the Exhibition. They are also producing a home-constructor's television kit.

TELSEN IRON CORE COILS

From the Telsen factory comes the announcement that iron core coils will shortly be produced. Full details are not yet available.

LISSEN IRON CORE COILS

Lissen coils on the iron-core principle are now in our hands, and these possess many novel features. The principal point of interest is the very small former upon which the coils are wound.

Replies to Broadcast Queries

P. THOMAS (Aberystwith): Details given are too vague to trace transmitter, but possibly aerodrome station working with 'planes. ALLAN (Newburgh): G2CK, City and Guilds College, Exhibition Road, London, S.W.7; G2YM, R. W. Piper, Chiltern View Road, Uxbridge (Mdx.); G2KO, J. A. North, Thorndale Farm, Wetwang, Malton (Yorks); G5NW, E. J. Allan, 8, Westfield Place, Dundee; G5BR, G. L. Brownson, 13, Redbourne Av., Church End Finchley, London, N.W.3; G5NZ, P. Nicoll, 167, Todmorden Road, Burnley (Lancs); G6LY, J. H. Blakeley, 2, Hazel Grove, Blackpool (Lancs); G6GG, G. Golding, 5, Elm Cottages, Elm Road, Shoeburyness (Essex); G6WL, J. Kyle, Hillend, Dalry, (Ayrshire, N.B.); G6RO, O. H. Reilly, 29, Ocklynge Road, Eastbourne, (Sussex). Cannot trace G6FB and G5KO.

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AJ 829458	AL 921971	AN 724318	AN 770623	AO 917458	AP 943271	AQ 588593

☞ **This offer applies to licences which are actually in force on Saturday, July 29, 1933.**

Before the awards are paid, claimants will be asked to undertake a simple publicity service in distributing leaflets to encourage the sale of licences amongst those who at present do not fulfil their obligations by taking out a Post Office Wireless Licence before receiving broadcast programmes. Claims cannot be considered in connection with any Licence the date of issue of which is after July 27, 1933.

AWARDS MUST BE CLAIMED BY AUG. 4, 1933

If the number of your wireless licence appears above you only have to forward the licence for official verification by registered post, and state the name and address of the Newsagent who supplies you with your weekly copy of "Practical Wireless." Address your application to Wireless Dept. (74), 8-11, Southampton Street, Strand, W.C.2.

Claims received later than Friday, Aug. 4, 1933, will be disqualified.

All licences will be returned by registered post.

For Complete List of Licence Numbers See

TIT-BITS

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