NEW IDEAS FOR THE EXPERIMENTER

Practical Wireless

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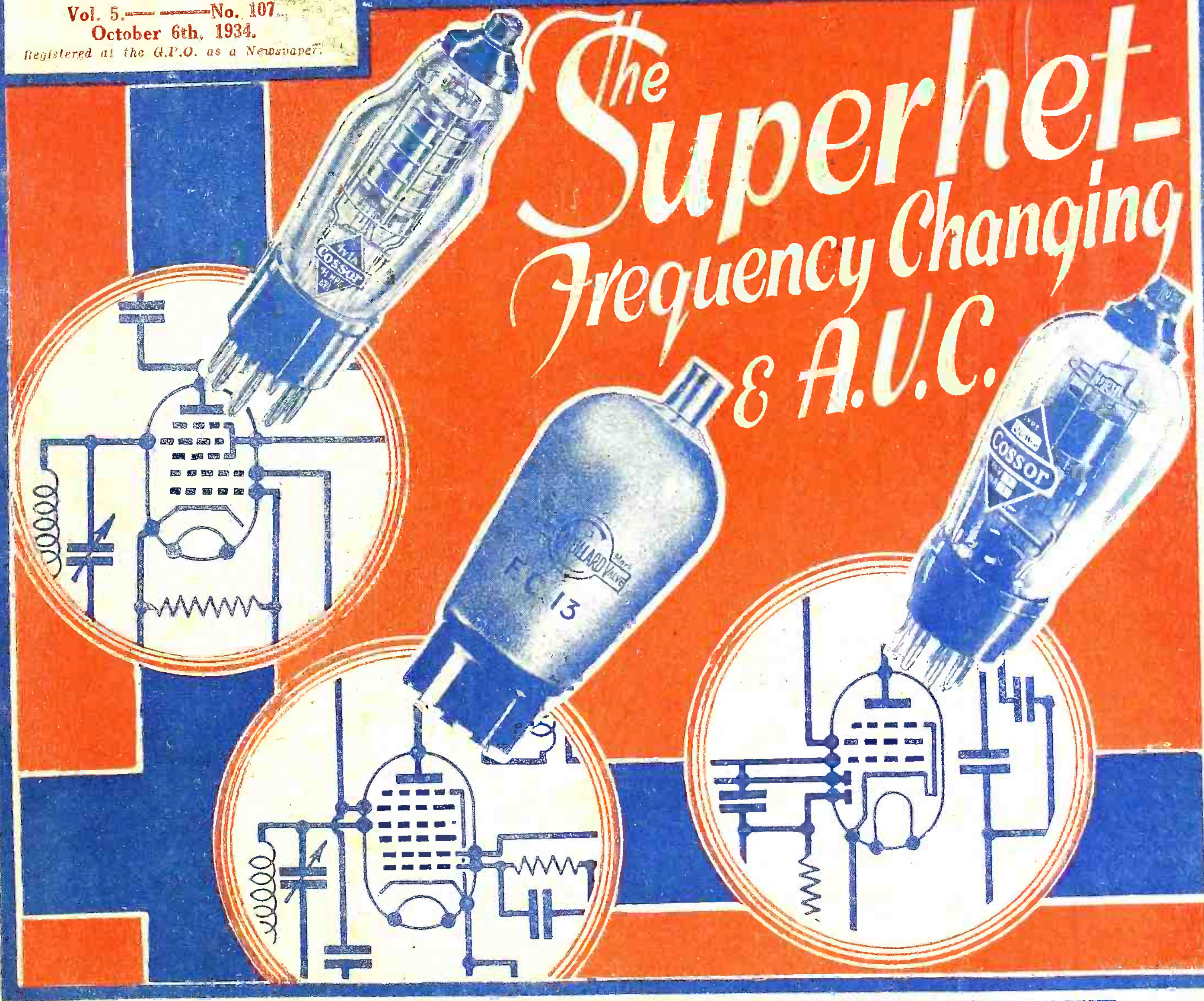
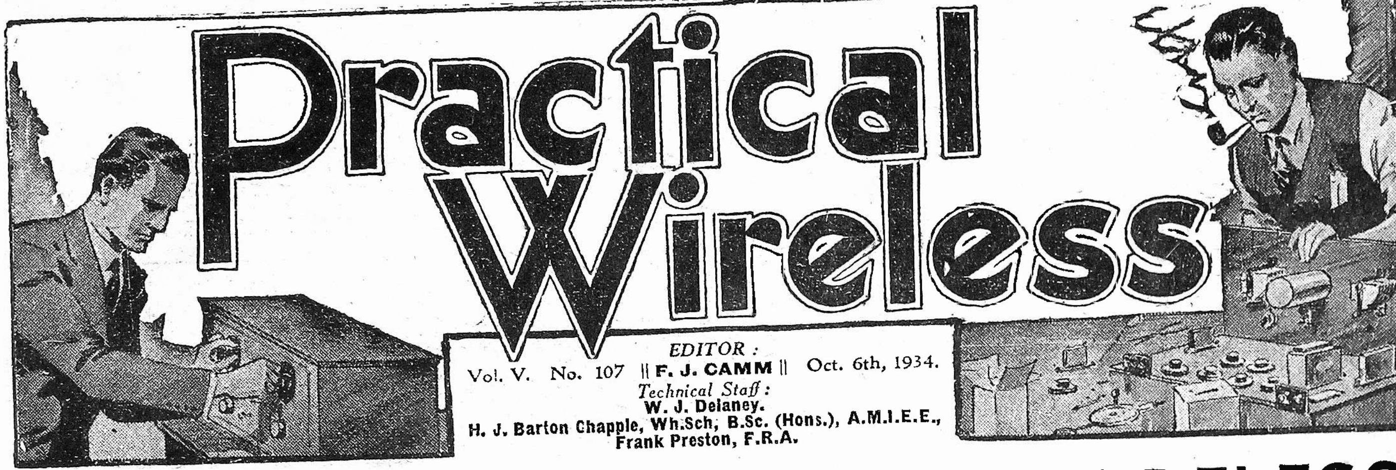


DISTORTIONLESS REPRODUCTION SEE PAGE 100



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Vol. V. No. 107 || F. J. CAMM || Oct. 6th, 1934.
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ROUND *the* WORLD *of* WIRELESS

B.B.C. Symphony Orchestra on Tour

THE B.B.C. announces that the B.B.C. Symphony Orchestra, under the direction of its conductor, Adrian Boult, will visit four provincial cities during the forthcoming season—Manchester on December 5th; Bristol on February 13th; Birmingham on February 27th; and Dundee on April 2nd. Listeners, therefore, in these areas will for the first time be given the opportunity of hearing this orchestra at first hand. Arrangements have also been made for the orchestra to visit Brussels on March 12th next.

Danger!

LOVERS of dramatic events should make a point of hearing the first of a series of thrilling tales of adventure, under the general title of "Danger," which will be broadcast by Captain F. C. Hendry on October 8th. Captain Hendry, who gives his story the name of "Flat Aback," served as an apprentice and an officer in ships sailing round Cape Horn, and obtained a square rigged extra master's certificate. He has also commanded steamers sailing the South China seas. He served for some time on the North West Frontier of India and in Mesopotamia for over four years. Under the nom-de-plume "Shalimar" Captain Hendry has also published numerous tales and novels, mostly about the sea.

About the Stars

IN Lesson 3 of the "Wonders of the Earth and Sky," which is being broadcast to Scottish schools by Mr. D. B. Duncanson, Lecturer in Science, Jordanhill Training Centre for Teachers, Glasgow, on October 8th, the subject will be "What do the Stars tell us?" Mr. Duncanson will supply some very interesting information about these distant bodies and remove one or two misconceptions.

Some Unpublished Works

THE first concert of a series in which only unpublished works by Welsh musicians will be performed will be given for West Regional listeners on October 9th. The artists will be Walter Glynne (tenor) and the Cardiff Ensemble. The Cardiff Ensemble has been in existence for over four years, and during that time more than a hundred concerts have been given, many of which have been broadcast. The aim of the Ensemble is to create a love of Chamber Music among ordinary listeners.

Rob Roy Again

FOR more than a hundred years the romantic drama of "Rob Roy" has attracted a full house wherever it has been played. For the first time, we believe, the play has been adapted for broadcasting, and will be heard on October 11th. In making his adaptation Mr. Andrew P. Wilson, a well-known player and dramatist, has adhered as closely as possible to the original stage play. The broadcast version will be divided into ten scenes, namely, Hostelry at the foot of the Cheviots, Library at Osbaldistone Hall, Living Room in Bailie Nicol Jarvie's house, Outside the Tolbooth, Glasgow, Inside the Tolbooth, Glasgow, Osbaldistone Hall, Interior of Jean Macalpine's Change House at Aberfoyle, Pass of Lochard, The Glen near Aberfoyle, Living Room of Bailie Nicol Jarvie's House.

A Prize Band Concert

A CONCERT by the Cambourne Town Band, conducted by A. W. Parker, will be relayed for West Regional listeners on October 12th. This band has been in existence for more than half a century and during the last nine years has won prizes to the value of £2,000; it also won the Prince of Wales' Trophy five times, in addition to the Championship of Devon and Cornwall. Bernard Fishwick (baritone), who will be the artist in this concert, was an engineer in the North of England: he joined an operatic society and began to study with D'Arcy de Ferrars of the Old Opera Comique. After some further study he took up singing professionally.

A West Country Play

EDEN PHILLPOTTS has written a new play specially for broadcasting, called "Old Bannerman," and it will be produced for West Regional and London Regional listeners, on October 8th, by Cyril Wood. It is interesting to learn that this distinguished West-country author had never been in the habit of listening to wireless plays, but when "The Farmer's Wife" was produced in the West Region in February this year he decided to hear it, for in spite of its run of several years he had never seen his popular play on the stage. As a result of listening, he realized for the first time the many possibilities which radio opens up for the dramatist and decided to try his hand at a radio play. Cyril Maude, the well-known actor, will play the part of Old Bannerman in the broadcast on October 8th.

A Band Change

ONE of the regular broadcasting bands, that of the 2nd Battalion King's Own Royal Regiment, has left the Midland Region, but the Band of the 1st Battalion The South Staffordshire Regiment is now quartered at Whittington Barracks, Lichfield. It will provide a programme in the Birmingham studio on October 7th. James Turtle has been conductor of this band for the past thirteen years, during which the band saw a term of service in India, when it took part in the Bombay Tattoo.

ROUND the WORLD of WIRELESS (Continued)

"Songs from the Films"

JOHN WATT will be both compère and producer of No. 2 of the new series, "Songs from the Films" which will be broadcast Regionally on October 12th in the evening, and at a matinée the following day.

B.B.C. Symphony Concerts

DURING the coming winter months twelve symphony concerts will be given by the B.B.C. in Queen's Hall, starting on October 24th. The conductors are Dr. Adrian Boult, Sir Thomas Beecham, Albert Coates, Sir Hamilton Harty, Igor Stravinsky, Dr. Felix Weingartner, and Sir Henry Wood.

Among the works which will be heard for the first time in England are Stravinsky's "Perséphone"; Yuri Shaporin's Symphony in C minor; a Scherzo from an unfinished symphony by Gustav Holst; excerpts from Alban Berg's opera "Lulu"; and a new symphony by Vaughan Williams.

Two Short Broadcast Plays

TWO short plays which have been specially written for the microphone are to be broadcast in the National programme on October 18th in a dual bill. The first, "Delayed Drop," is by Alan Byrne, and will be produced by S. Bulloch, who is coming over from Belfast for three months whilst Lance Sieveking takes his place in Belfast. The action of the play takes place in and over a flying club in Great Britain.

The second of these productions is a problem play, entitled "Fours into Seven—Won't Go," by Val Gielgud and Stephen King-Hall. Northern China is the scene of the action, and the time is the present. The production will be in the hands of Val Gielgud.

Another A. J. Alan Story

THAT well-known mystery story-teller, A. J. Alan, is to make another of his rather infrequent appearances before the microphone. On this occasion he will broadcast a special story for the Children's Hour in the National programme on October 6th.

Gounod's "Faust"

ON October 13th the first act of Gounod's "Faust" will be relayed from Sadler's Wells Theatre, in the Regional programme. The first scene in this act is laid in Faust's laboratory, and the second takes place outside a church during fair time. The conductor will be Warwick Braithwaite; Sumner Austin will produce and the chorus-master will be Geoffrey Corbett.

"In Town To-night"

THIS topical supplement to the week's programmes, which proved popular with listeners last winter, will return to the programmes on Saturday evenings, beginning on October 6th.

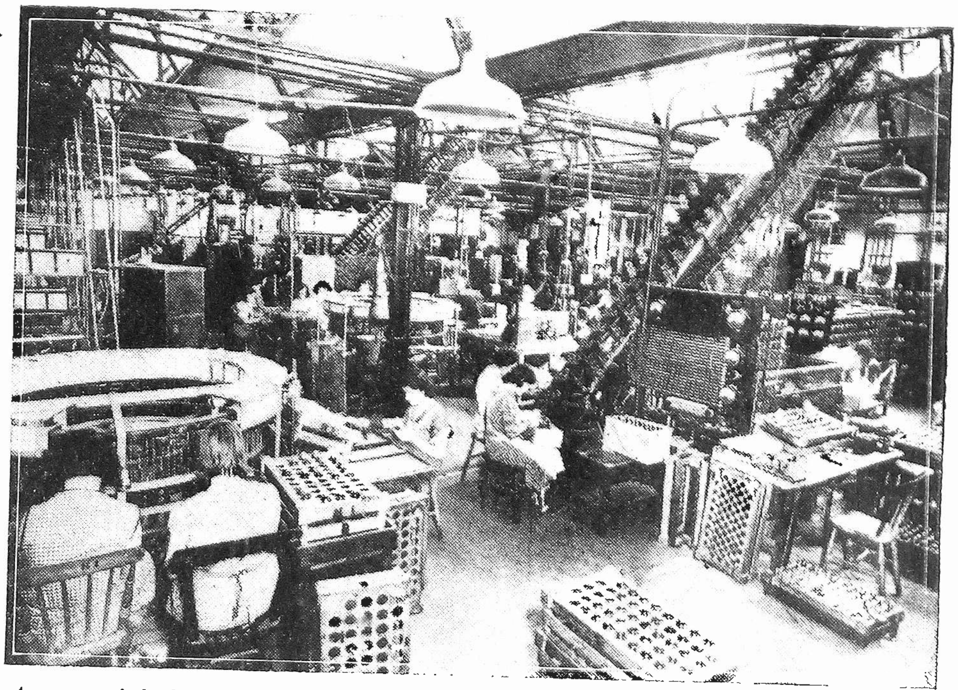
Talks on Town and Country Planning

IN Regional talks this winter, the most important series is to be one dealing with town and country planning. The talks will be given by G. M. Boumphrey, whose broadcasts on Roman Roads were a feature of the National programme last year, and the general title is "Ripe for

INTERESTING and TOPICAL PARAGRAPHS

Development." The series will be introduced by a "Conversation," and the Bishop of Birmingham (Dr. E. W. Barnes, F.R.S.) has kindly consented to help Mr. Boumphrey in the preliminary process of "clearing the ground."

MODERN MASS PRODUCTION METHODS



A corner of the battery-valve room in Messrs. A. C. Cossor's well-equipped factory, showing the conveyor.

SOLVE THIS!

PROBLEM No. 107

Bradbury had a two-valve receiver and decided to add a third stage. He used R.C. coupling, utilizing separate resistances and condenser, but when tested out it failed to function. As the previous two-valver had functioned correctly he naturally decided one of the new components was faulty, and he tried the valve by substitution and also tested the anode resistance and grid leak with battery and phones for continuity. The test showed that these were not broken. Thinking therefore that the condenser was faulty he tested this in a similar manner, and failing to hear any sound he concluded that the condenser was in order. What was wrong? Three books will be awarded for the first three correct solutions opened. Address your envelopes to The Editor, PRACTICAL WIRELESS, Geo. Newnes, Ltd., 8-11, Southampton Street, Strand, London, W.C.2. Envelopes must be marked Problem No. 107, and must be posted to reach here not later than the first post Monday, October 8th, 1934.

Solution to Problem No. 106

The accumulator used by Simpson was in poor condition, and although it was fully capable of delivering sufficient current for the valves in the early stages of his receiver it could not deliver the additional .4 amps required by the Class B valve. The following three readers correctly solved Problem No. 105, and books have accordingly been forwarded to them: J. B. Young-Evans, Llwynhelyg, Caradog Road, Aberystwyth. Norman Moss, The Dingle, Quarry Road East, Heswall. C. Jones, 5, Railway Side, Church Street, West Smethwick, Staffs.

The White Coons

STANLEY HOLLOWAY is, as usual, the bright star of the White Coons' broadcast on October 6th in the National programme. He will be supported by C. Denier Warren, Wynne Ajello, Eve Becke, Dudley Rolph, and Joe Morley, all artists who are closely associated with broadcasting in general and with the White Coons in particular.

"The Limits of Technical Education"

FOR his address as the new President of the Union of Educational Institutions, Sir Josiah Stamp has chosen "The Limits of Technical Education." This will be relayed from the Thirty-ninth Annual Meeting of the Union in the Council House, Birmingham.

Two Broadcast Thrillers

THE Martyn Webster series "Don't Listen to This!" reopens with two thrillers which will be heard on October 13th. In the first, the scene is a large and rather decayed suburban villa, where a murder has taken place a year before. It is called "Anniversary." The author is Rupert Croft-Cooke, of Salperton, Gloucestershire. The second play, "Retrospect," by Loftus Wigram, has a plot in which the robbing of a family vault is the principal incident.

"When the King Came Home"

ANN CASSON, who is playing this season at the Coventry Opera House with the Repertory Company there, is to take the principal part in a Robin Hood play which Midland Regional provides for all Regional Children's Hours on October 13th. The play is called "When the King Came Home," and has been written by Ruth Adam, who is the author of the Literary Tour of Nottingham which was recently broadcast.

NEW IDEAS FOR THE EXPERIMENTER

This Article is Intended Chiefly for the Amateur who Wishes to Experiment with Various Circuits and Arrangements. A Number of Time- and Money-saving Hints are Given. By FRANK PRESTON

THE experimenter is not content to build a new set and then simply to listen to it. The building of the receiver is only a preliminary to the real experimental work, which consists of trying different arrangements of the components, changing the values of various parts, substituting coils of different types, and so on. It is this latter part of the work which provides enjoyment for the keen amateur, and which enables him to extend his knowledge and make new discoveries.

There are doubtless many hundreds of readers who have not taken up wireless experimental work at all seriously and who would like to do so if only they knew how best to make a start. An almost ideal way would be to make every one of the sets described in PRACTICAL WIRELESS, but that alone would not quite "fill the bill," because those designs are the result of considerable experiment and are perfected before they are described. And besides, it would be too expensive for many folk to buy the new parts required for every set, so that the experimenter must contrive to use the majority of his apparatus over and over again in a variety of circuit arrangements.

Use a Separate Set

The best method, therefore, for the experimenter to adopt is to build one complete PRACTICAL WIRELESS receiver for general use and for "family" listening, and to have something entirely different for experimental purposes. For preference the experimental receiver should be completely adaptable to almost any arrangement, whilst it should be possible to replace and exchange components quickly, and without disturbing the remainder of the parts or wiring. There are two ways in which this can be done, one of which is to build up a set on the once-popular "unit" system where, each valve stage is contained in a separate cabinet, the various units being joined together by a series of straps between terminals placed symmetrically on the various units, and the other is to have a single specially-designed chassis and an arrangement of plug-in components.

The former method is not good, since it considerably increases the lengths of the connecting wires, and often leads to necessarily bad component disposition. The second method has practically everything in its favour, and very few points against it. Due to the fact that only a single chassis is required, expense is kept down to a minimum, and the components can always be arranged just as they would in any specially-designed complete receiver. In addition, if it is ever desired to cease experiments for a time the receiver is complete and self-contained so that it can be housed in a cabinet and used as a normal "family" set.

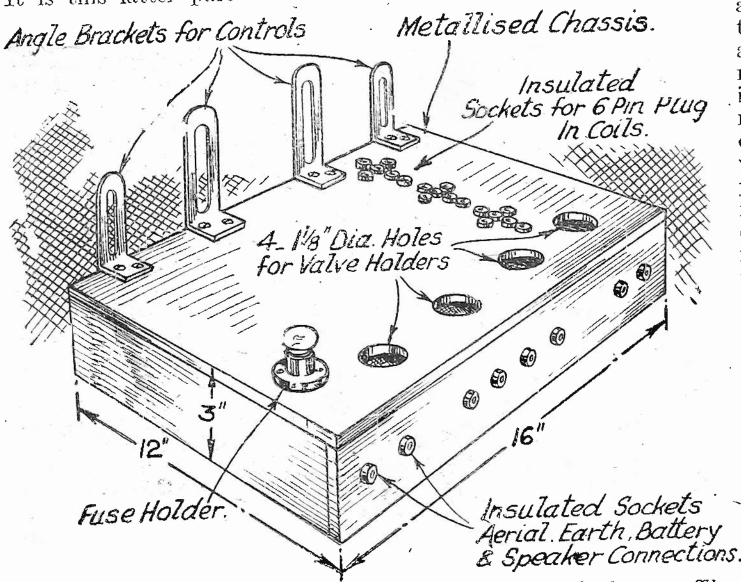


Fig. 1.—A suggested arrangement for the experimental chassis. The dimensions are approximate.

The Chassis

In making a set of this kind the first thing to consider is the chassis; a base-board is not nearly so good, since it makes it necessary to spread the components unnecessarily, and leads to general untidiness. The chassis should be either metal or metal-coated, and in most cases the latter will be preferred, due to the fact that, as components are attached by means of wood-screws, they can easily be removed or their positions changed. The most suitable size for the chassis depends chiefly upon the maximum number of valves which may ultimately be employed, but one measuring 16in. long, by 12in. deep, and with 3in. side runners will be found to be amply large for most purposes. Even though the original receiver might have only a single valve, it is a wise plan to provide the chassis with five valve holders in readiness for future work. Although the position is not always ideal, it is most convenient to mount the holders in a line along the rear edge of the chassis. There might be some doubt concerning the type of valve-holders to be fitted, and this depends upon several factors. If the set is to be battery-operated, 4-pin holders will be suitable in nearly every case, although the possibility of using a 5-pin pentode or a 7-pin Class B valve must not be overlooked. Similarly, it should be remembered that many battery H.F. pentodes are now made only with 7-pin bases. In view of the latter remarks, it might be best, if a clear "programme" of experiments has not been formulated, simply to bore suitable holes for the several valve-holders, and only mount those which are actually required; if the holes are made 1⅛in. diameter they will take either 4-, 5-, or 7-pin holders quite easily. A general idea of the suggested experimental chassis can be gained from Fig. 1.

The Coils

Keeping in mind the idea of having the components readily interchangeable, it is best to use coils of the plug-in type. By this it is not intended to imply that the coils should be of the obsolete honeycomb plug-in type, but wound on 6-pin formers. When this is done either 6-pin holders or separate sockets must be mounted on the chassis. The separate sockets will, in most instances, prove most convenient, since wiring can then be carried out on the under-side of the chassis without having to take leads through holes. Provision can be made for three coils by fitting three sets of sockets in a line from back to front of the chassis, and about 3in. from the left-hand edge. Unfortunately, it is not possible to buy 6-pin coil formers fitted with screening cans, but the latter can be bought separately (they should be 3in. diameter) and fitted as shown in Fig. 2, by drilling the end caps of the cans and the bases of the coils and fitting a couple of 6 B.A. screws.

Make Your Own Coils

An alternative method is to use coils made according to the instructions given in the series of articles entitled "Making Your Own Screened Coils," published in the issues of PRACTICAL WIRELESS dated December 9th to December 30th, 1933 (inclusive). These coils were mounted on a base-plate fitted with terminals, but it is an easy matter to replace the latter by banana plugs which will fit into corresponding sockets mounted on the chassis. By following this idea a variety of different tuning circuits can be tried out in a minimum of time, whilst there is no difficulty in using the set on any wavelength range. The secret of success in using this

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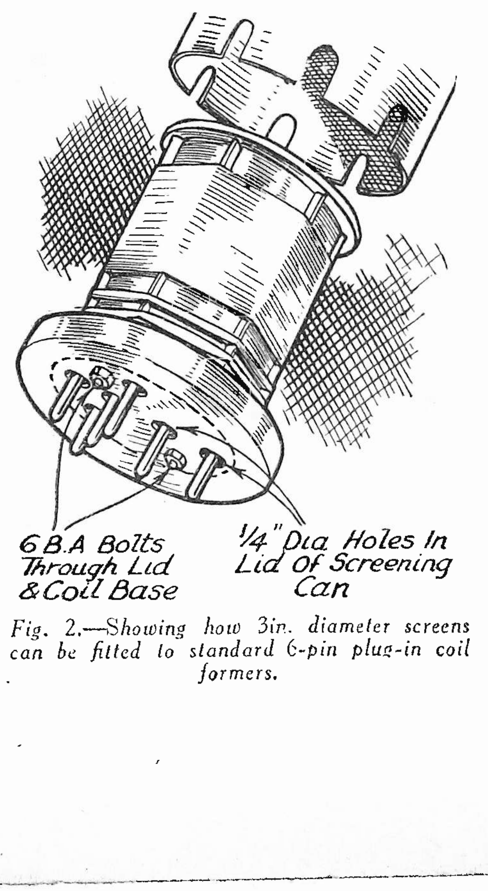

Fig. 2.—Showing how 3in. diameter screens can be fitted to standard 6-pin plug-in coil formers.

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system rests with the use of a fairly standardized method of connecting the coil terminals. For example, terminal 1 should always be the grid connection, terminal 2 the earth contact, and so on. When this is done it will rarely be necessary to modify the wiring of the set when changing from one coil to another.

The "plug-in" idea can readily be extended to such components as L.F. transformers, an ebonite, socketed mount being fixed to the chassis and a plug-base arrangement used for transformer, as shown in Fig. 3. The extra cost of the odd pieces of ebonite, plugs, etc., is very small, and the convenience of the arrangement will easily justify this. It will be appreciated that, when using the plug-in transformer scheme, a change can be made from direct coupling to parallel-feed or to a variety of auto-choke connections without altering the main set wiring in the least; the only alteration will be to the transformer unit, to which can be attached all necessary condensers and resistances.

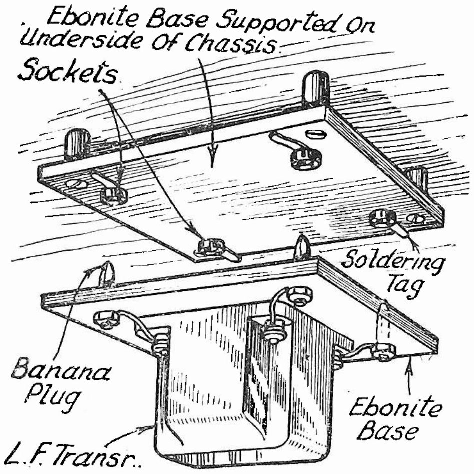

Fig. 3.—Showing the plug-in L.F. transformer idea suggested in the text.

A Resistance-condenser Unit

When making a complete receiver it is generally possible to calculate or otherwise determine the most suitable values of condensers and resistances, but the experimenter always prefers to check his calculations by methods of trial-and-error. This can readily be provided for on the experimental receiver by making one or two resistance-condenser assemblies of the type shown in Fig. 4. Each assembly consists simply of a small ebonite plate fitted with any required number of pairs of terminals to which the wire leads from fixed condensers and tubular condensers can easily be attached. The dimensions given in Fig. 4 are suitable for all the average types of component, but they can be modified to suit any particular needs. It will be seen that soldering tags are provided to take the normal set wiring, the terminals simply being employed as a means of anchoring the looped ends of the component connections.

It will generally be found that two of these assemblies will be required: one for the high-frequency stages, and another for the detector and low-frequency portion. Generally speaking, the detector grid condenser and grid leak should not be mounted along with the anode-circuit decoupling components, and it is better to mount the grid components either on a separate unit, or to wire them up in the normal manner.

With regard to the tuning, reaction, and switching controls, it is usually best to mount these on angle brackets attached to the chassis. Any number can then be added without making any major alterations and without the necessity for drilling a panel. As in normal receiver design, the tuning condensers should be mounted as near as convenient to the coils, the other controls being arranged symmetrically around them. In the experimental set, however, symmetry of lay-out is a somewhat unimportant item which is not nearly so important as the matter of ensuring the shortest possible wiring.

Battery Speaker Connections

The method of connecting the batteries (when used) aerial, earth, and speaker is of some importance, and the greatest possible amount of care should be taken to guard against short-circuits which can so easily take place in the course of experiments. Flexible leads attached directly to the components in the set have something in their favour, but it is nearly always better to fit a series of sockets to the rear of the chassis. The sockets can be arranged to take corresponding plugs attached to the flexible leads from the batteries, etc. The advantage of this system is that all leads can be removed instantly, so making the set more convenient to handle and easier to adjust.

To avoid damage to components and/or the H.T. supply it is essential that a fuse be fitted to the experimental set. In a battery receiver a fuse-holder of the type which takes a screw-in fuse is probably most convenient, and this should be fixed to the chassis in the most accessible position. In the case of a mains set the most convenient type of fuse is one which is fitted into the mains connector, although this might wisely be augmented by another, of the cartridge type, inserted in the mains H.T. positive lead from the rectifier.

Mains Power Equipment

The bulk of the remarks made above refer to battery receivers, but they apply equally well to the receiver portion of mains instruments. By "receiver portion", is meant the set proper, without its associated mains equipment, because it is strongly recommended that an experimental mains set (the same remarks often apply to a receiver of normal type) should be made with all the power-supply equipment as an entirely separate unit. It is also preferable that the mains unit also contains the output valve, since this will not usually be experimented with. If the mains transformer and rectifier are of the Class C (350 volts, 120 milliamp.) type, there will be ample reserve voltage and current, so that a really large output valve can be employed and adequate decoupling can be provided in the H.F. circuits. It is best to include the voltage-dropping and decoupling resistances in the receiver portion when there will only be four supply leads from the power unit, these being two for H.T. and two for L.T. The connections can well be brought out to the terminals of a valve-holder, when connection can be made by means of a standard valve plug.

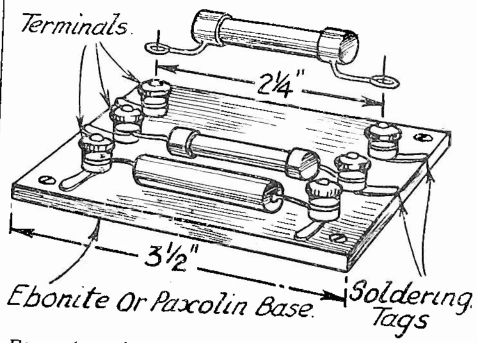

Fig. 4.—An easily made resistance-condenser unit by means of which the components can quickly be replaced.

SKIN EFFECT

Amateurs are often involved in difficulties by what is known as the "skin effect" of high-frequency alternating currents. It is a matter of great importance, both in regard to radio reception and transmission. "Skin effect" is a term which we use with regard to the tendency which high-frequency currents show of always flowing along the outer surface of a conductor. The greater the frequency of the current the more it shows a tendency to confine itself to the surface. Direct current will utilize the whole of the cross section of the conductor, low-frequency alternating current about two-thirds of the conductor, and high-frequency alternating current the outer skin of the conductor. This is a point which should be considered by those who are experimenting with radio circuits, and particularly those for short-wave work. It will be seen from these remarks that the higher the frequency (which means, of course, the shorter the wavelength), the more important it is, in wiring the set, that the conducting wire should have the maximum of surface area in order that as little resistance as possible should be present. This is also one of the reasons why stranded copper wire of the 7/22s variety is the best wire for aerial work, and it should also be borne in mind that if the utmost efficiency in a set is desired the resistance must be cut down to a minimum. Some time ago I visited the workshop of a particularly active radio society, and found quite a number of young men, and, strange to relate, two ladies, all busy building or rewiring radio receivers. One youth I noticed was rewiring his set with a very fine gauge wire. When I asked him why he was using so fine a wire, he replied, "Well, you see, I found when the set was wired with a heavy gauge, I was not getting the results anticipated, so I have come to the conclusion the received signals get away to earth too quickly, and I think by retarding them improved reception will be obtained." I never heard the result of that experiment, but knew what it would be. It was little use endeavouring to explain to the individual in question, who appeared to me to be one of the type who could only be taught by experience.

I have not gone into this question very fully, for there are other things, such as eddy currents and the effects of coiled wire. All have their particular bearing, but it can be taken for granted that if the strongest signal intensities are desired then heavy-gauge wire should be used.—C.D.K.

MEASURING INDUCTANCE AND CAPACITY

When A.C. Mains are Available, L.F. Chokes and Condensers may be Measured by the Use of Simple Apparatus

PROBABLY no radio components in general use present such difficult problems to the experimenter as L.F. chokes, transformers, and fixed condensers. One great difficulty with L.F. chokes and transformers is that their characteristics vary considerably under different conditions. For example, a particular L.F. choke may have an inductance of 30 henries when it is passing a D.C. current of 20 milliamps, but increasing the current to 50 milliamps may have the effect of reducing the inductance to 15 henries or even less. In a similar connection one well-known L.F. transformer has a primary inductance of some 180 henries with 1 milliamp D.C. flowing through the primary, but only 80 henries with 6 milliamps flowing.

As it is essential to have an approximate knowledge of the behaviour of every component under working conditions, and fairly accurate data in some cases, the following details of simple methods of inductance and capacity measurement should prove of interest.

It is only possible to employ these methods when an A.C. mains supply of known frequency is available.

Chokes and Condensers

The circuit shown in Fig. 1 is suitable for measuring chokes which are normally called upon to carry a D.C. current of 1 or 2 milliamps. Chokes having an inductance up to 160 henries, and condensers of .07 mfd. upwards, can be tested by this arrangement.

The mains transformer used may be of any type, providing it has a secondary giving 4 or 6 volts output. The D.C. supply should be a battery or mains H.T. unit giving a variable voltage up to 50 to 60 volts, and this will enable a D.C. current of 1 milliamp to be passed through the highest inductance choke or a greater current through lower inductance chokes.

The valve voltmeter need not be calibrated, and suitable values for this are indicated in the diagram. Unless an ohm meter is available it will be found desirable to calibrate the variable resistances by means of a milliammeter and battery, and to provide these with scales showing the resistance for various settings of the knob, as shown in Fig. 2. This method of resistance measurement is probably familiar to the reader, and space does not permit a complete description in this article.

Balancing Process

The choke or condenser on test is connected to the terminals provided, and if no D.C. current is required the D.C. switch is set at 1. The valve voltmeter should then be connected in turn across the resistance, switch position 1, and the choke or condenser, switch position 2. If the A.C. voltage across the choke indicated by the valve voltmeter is greater than the voltage across the resistance the resistance adjustment must be increased. If, on the other hand, the voltage across the choke is lower than that across the resistance, the resistance must be reduced.

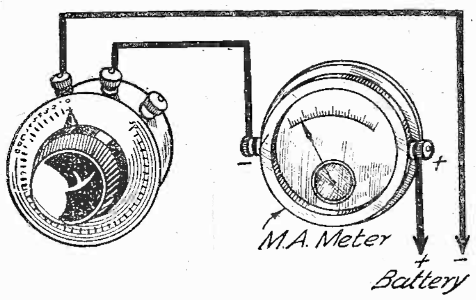

Fig. 2.—Calibrating the variable resistance by means of a milliammeter and battery.

This balancing process should be continued until the valve voltmeter shows equal voltages across the resistance and the choke or condenser being tested. When a D.C. current is passed through the choke the D.C. voltage will require adjustment if the resistance is altered appreciably.

Having found the balanced setting the resistance value can be read off or measured, and this will be equal to the impedance of the choke or condenser. We can assume that the impedance of a choke is equal to its resistance, and since the D.C. resistance of the majority of chokes is low compared with the reactance, this will give sufficiently accurate results for most purposes.

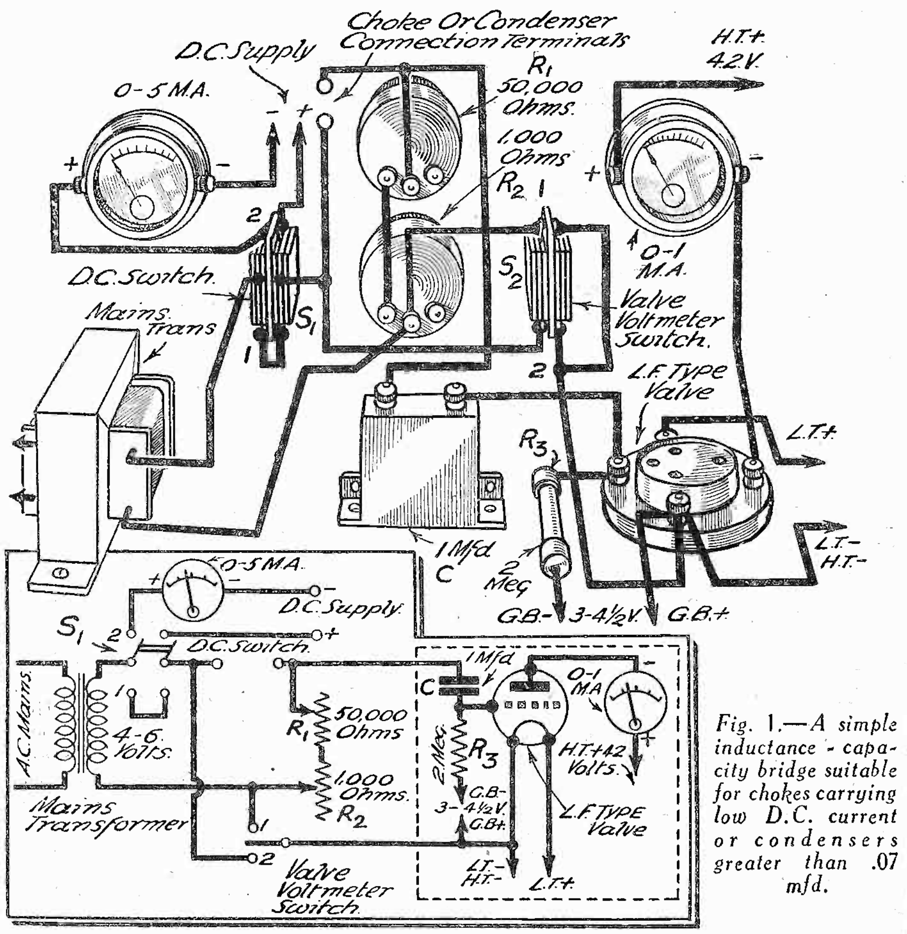

Fig. 1.—A simple inductance - capacity bridge suitable for chokes carrying low D.C. current or condensers greater than .07 mfd.

Determining Inductance

Having found the impedance of the choke its inductance can be obtained from the equation, inductance in henrys=

$$\frac{\text{impedance in ohms}}{6.28 \times \text{supply frequency.}}$$

In the case of a condenser the capacity in microfarads can be calculated from the equation,

$$C = \frac{1}{6.28 \times \text{supply frequency} \times \text{reactance in ohms}} \times 1{,}000{,}000$$

If it is desired to allow for the D.C. resistance of a choke it will be necessary to use the equation,

$$\text{Inductance in henrys} = \sqrt{\frac{\text{impedance}^2 - r^2}{(6{\cdot}28 \times \text{frequency})^2}}$$

where r is the D.C. resistance of the choke.

With careful operation the foregoing method will give results sufficiently accurate for all practical purposes. It is convenient to use the 50,000 ohms variable resistance

(*Continued overleaf*)

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in 1,000 ohm steps, the 1,000 ohms resistance being used as a vernier adjustment.

In order to determine the inductance of a choke while passing a higher D.C. current than 1 or 2 milliamps, the arrange-

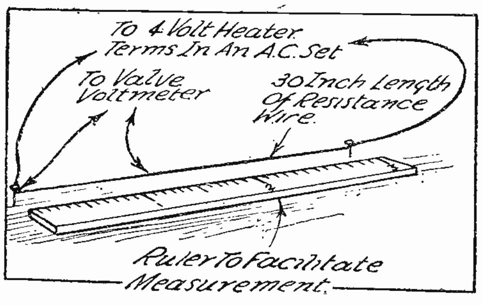

Fig. 4.—An A.C. voltage of ·13 is developed across each inch of resistance wire.

ment shown in Fig. 3 should be used. For this it is necessary to use a calibrated valve voltmeter.

With chokes having a D.C. resistance not greater than 1,000 ohms, a D.C. supply up to 100 volts will be required to provide a D.C. current of up to 50 milliamps through the choke. As with the arrangement shown in Fig. 1, the D.C. current is varied as required by increasing or decreasing the D.C. voltage.

The operation of the system shown in Fig. 2 is quite simple, and simply consists of measuring the A.C. voltage across the choke, and across the 1,000 ohms resistance. The choke impedance can then be determined by the equation

$$\frac{\text{A.C. volts across choke}}{\text{A.C. volts across 1,000 ohms resistance}} \times 1{,}000 = \text{choke impedance in ohms}$$

Having determined the total impedance of the choke its inductance can be calculated as previously described.

Calibration Methods

Probably the simplest method of calibration when a low voltage A.C. voltmeter is not available is that shown in Fig. 4. A length of Eureka resistance wire of 34 or 36 s.w.g., about 30in. long, is stretched out and secured by drawing pins. The ends of the resistance wire are connected to the heater terminals of a 4-volt A.C. valve in a mains receiver, the receiver being switched on while the calibration is effected. Obviously, across each inch of the resistance wire an A.C. voltage of .13 will be developed, and this will enable the valve voltmeter to be calibrated up to 4 volts.

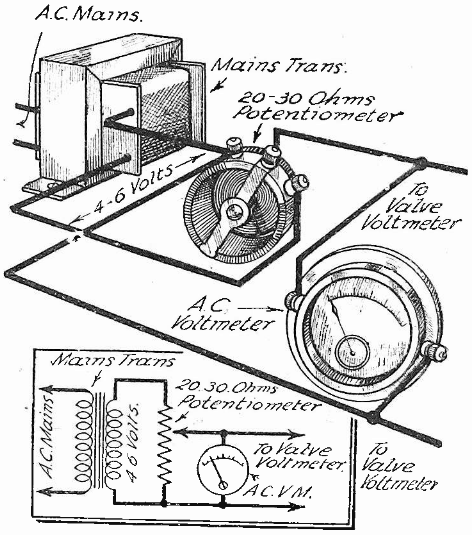

Fig. 5.—An alternative scheme, when an A.C. voltmeter is available.

When an A.C. voltmeter is available the arrangement shown in Fig. 5 may be employed.

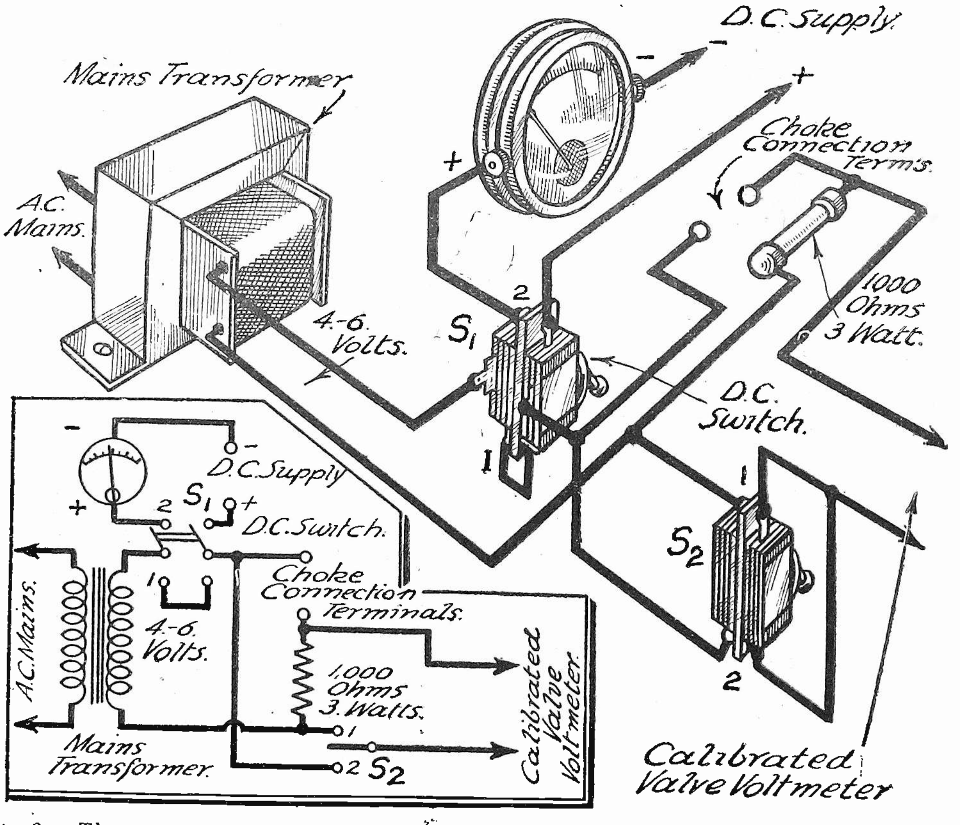

Fig. 3.—This arrangement permits of the measurement of the inductance of an L.F. choke whilst passing a large D.C. current.

RADIO OVERSEAS

JUDGING by reports received from the Channel Islands the main demand there seems to be for battery sets, and manufacturers, in their eagerness to introduce, as the main part of their programme mains receivers, have overlooked quite a potential market. Reception in the island is stated to be excellent and all stations, whether of high or low power, can apparently be received. The difficulty, however, is that no receiver appears to be selective enough for the demands made upon it unless it is of the superheterodyne type, and that does not altogether fill the bill because there is an impression that the best type of reproduction is not to be obtained with this kind of receiver. What is required over there is a very selective three- or four-valve type of battery receiver with which the operator is assured of being able to discriminate between the innumerable stations receivable. Such a set would probably command a ready sale, and it might be worth while for some of our manufacturers to look into the matter.

H.T. Battery Troubles

PERHAPS the greatest difficulty which has to be contended with by the owner of a wireless set in the very remote districts of the Colonies and Dominions is the H.T. battery trouble. Owing to the heat, dry batteries soon become ineffective, and in some parts of Africa the running costs of average radio sets is about 12/6 to 15/- a month, which is mainly made up from this cause. This, of course, is a very serious factor, and has prevented many people in that country from taking up radio. H.T. accumulators are out of the question because the majority of the homesteads are equipped with lighting plant which only permits of 6- or 12-volt accumulators being charged. The British firm, Milnes Radio Co., of Church St., Bingley, Yorkshire, have introduced a special H.T. supply unit which fulfils the requirements of these outlying homes. The unit consists of indestructible nickel iron cells which are kept automatically fed from the low-tension accumulator when the wireless set is not being used, and is always ready to supply a steady unfailing high-tension current.

The L.T. Supply

THE same low-tension accumulator can be used for working the set, as well as supplying the high-tension cells, and requires very little extra charging. The "Alklum" nickel and steel plates which are used in the unit are immersed in a steel preserving solution. Sulphation is an impossibility, and the cells may be overcharged and discharged at practically any rate without fear of damage. This information will also be read with interest by readers at home as the battery is just as efficacious in this country as abroad.

POINTERS IN MAIN-SET DESIGN

A Collection of the Special Details Which Should Receive Attention by the Constructor When Designing and Building His Own Mains-operated Receiver.

DESPITE the many excellent designs for complete mains-operated receivers which are published in PRACTICAL WIRELESS there are many readers who prefer to build an occasional set entirely to a design of their own. The reason for this may simply be the desire to experiment and to add to one's practical experience, or it might be that it is wished to make use of some components which are on hand, rather than go to the expense of buying a new kit. In any case, there is much to be learned by the making of a set entirely of one's own, and, provided that the task is undertaken with the idea in mind that some little experiment might be necessary before the set functions at maximum efficiency, and, so long as a few fundamental points are kept in mind, there is no reason why the undertaking should be any other than successful.

In writing this article, it is assumed that the reader has had previous experience in building battery sets, since the beginner is strongly recommended to make a PRACTICAL WIRELESS design the basis of his first attempt at set construction.

Use Adequate Screening and Decoupling

The points which require especial attention are by no means difficult to follow, and they are certainly not too numerous to remember. In the first place, it must be understood that, generally speaking, indirectly-heated valves for A.C. or D.C. mains working are appreciably more sensitive than the corresponding types of battery valves. Because of this, greater care must be taken to avoid instability, motor-boating, H.F. and L.F. oscillation and allied troubles. This generally means that screening must be more adequate, that components must be rather more carefully spaced, and that decoupling of all the valves must be a little more thorough than in the case of a battery set.

It is not often necessary to decouple the anode circuit of the high-frequency (S.G. or V.M.) valve, provided that it is coupled to the detector on the tuned-grid system, but if tuned-anode or tuned transformer coupling is employed it will nearly always be found a wise precaution to use a decoupling resistance having a value up to about 5,000 ohms in conjunction with a 1-mfd. by-pass condenser. The value of the resistance must depend to a large extent upon the H.T. voltage available and the H.T. current consumption of the valve; if the voltage is less than about 210, or the current in excess of about 5 milliamps, there will be some loss in efficiency by increasing the value beyond approximately 2,000 ohms. On the other hand, if the available H.T. voltage is 300 or more, a resistance can be employed of such a value that the voltage will be brought down to 200. For instance, when this voltage is available and the anode current of the valve is 5 milliamps, the best value for the resistance would be 20,000 ohms. In every case, it pays to apply a voltage of as near as possible to 200 volts to the anodes of normal indirectly-heated amplifying valves, although there are some pentodes which take a maximum voltage of 250, and whose amplification is noticeably reduced if the voltage is brought down to very much below this figure.

Choke Decoupling for Power-grid

The decoupling of the detector valve calls for particular attention, especially if this valve is intended to operate on the power-grid system. This is because a power-grid detector requires the highest possible anode voltage up to the maximum at which it is rated to work. When, therefore, the output from the rectifier and smoothing system is only slightly more than 200 volts the question of providing adequate decoupling becomes rather difficult of solution. The simplest way out consists of using an L.F. choke for decoupling purposes; this must be a good, high-inductance component capable of carrying up to 10 milliamps without its inductance value falling below approximately 25 henries. Choke-capacity coupling is also most suitable in most cases for use with a power-grid detector, and the complete anode circuit becomes like that in Fig. 1.

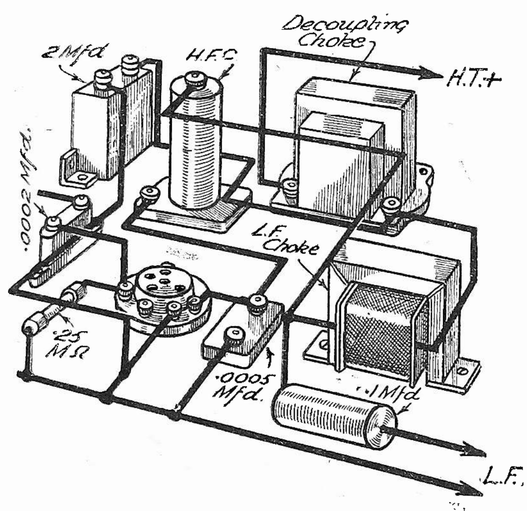

Fig. 1.—The circuit of a power-grid detector using choke capacity L.F. coupling and a choke for decoupling, as mentioned in the accompanying text.

Another point which should receive attention in the anode circuit of the detector is the anode by-pass condenser joined between the anode and earth. This is a practical essential in a high-efficiency set, although it can often be omitted from a battery set without any ill effect resulting; a value up to .0005 mfd. can be employed in place of the more customary .0002 mfd. The reaction circuit must also be considered in connection with H.F. stability, and, particularly if modern efficient coils are used, a fixed, non-inductive resistance of 200 ohms should be inserted in the lead from the anode to the reaction coil or the reaction condenser, according to the exact circuit arrangement used.

Use a Variable Bias Resistance

The L.F. stage does not usually present much difficulty, although particular care should be taken to ensure that exactly the right value of bias resistance is connected in the cathode lead. For experimental purposes it is wise to use a fixed resistance of about two-thirds the value recommended by the valve makers, in series with a variable one having a maximum resistance of 1,000 ohms. It is then possible to find the optimum resistance while the set is in operation, whilst it might be found that the valve can be rather over-biased without impairing the quality of reception, thus increasing its life.

Separate Mains Unit

A point which often arises concerns the actual lay-out of the receiver and power unit sections of the complete receiver. It is certainly possible to have both of these on the same chassis, so long as care is taken to keep the mains transformer and smoothing choke right away from the H.F. components, but it is nearly always better for the beginner to make the two sections on two separate chassis. There are two advantages to be gained by following this scheme; one is that the risk of mains hum and L.F. interaction is minimized, and the other is that the mains unit may afterwards be used for an entirely different receiver. In following out this idea it is advisable to fit all the voltage-dropping and decoupling resistances in the receiver portion so that only four leads (two H.T. and two 4-volt A.C.) are required to connect the two sections together. Simple connection can then be made by means of a valve plug adaptor and a valve holder, as shown in Fig. 2.

When serious experiment with two or three receiver circuits is contemplated, it is an excellent idea to include the L.F. amplifier with the mains unit, whilst if an energized speaker is to be incorporated this also might be included in the mains portion as shown in Fig. 3, which is a section of the "Luxus" A.C. super-het. described in PRACTICAL WIRELESS dated October 14th, 1933.

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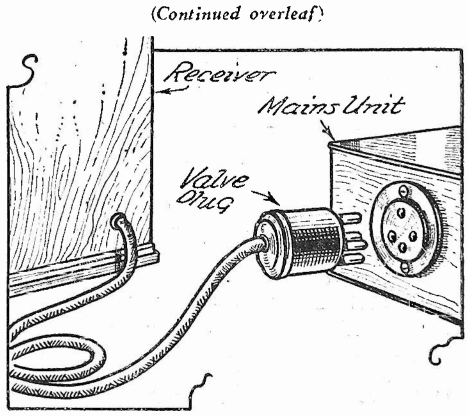


Fig. 2.—When the mains supply system is built as a separate unit, connection to it can be made by means of a valve plug and valve holder mounted as shown.

POINTS IN MAINS SET DESIGN

(Continued from previous page)

Using a Mains-energized Speaker

Mention of using a mains-energized speaker leads up to another point which is frequently overlooked. This type of speaker, if properly used, is usually somewhat more sensitive than a corresponding permanent-magnet type, but it requires a minimum amount of power for its correct operation. That minimum varies slightly, according to the particular instrument chosen, but can generally be taken to be about 2½ watts. This amount of power can be dissipated in the case of a 2,500-ohm field coil (used as a smoothing choke, of course) by passing through it a current of a little over 30 milliamps, or in a 1,500-ohm field, a current of about 40 milliamps. In both instances it must be realized, however, that a fairly large voltage drop must necessarily occur across the winding. The actual figure for the 2,500-ohm field is 75 volts, and for the 1,500-ohm one, 60 volts, under the conditions referred to above. It is evident that the voltage output from the rectifier must be great enough to permit of this voltage loss. It must also be remembered that the figures given are minimum ones, and it is in every case better to exceed them if anything approaching the full efficiency of the speaker is to be secured.

Where R.C.C. Scores

When the mains unit and receiver portion are to be mounted together on a common chassis, and if the parts cannot be widely separated, particular care must be taken to avoid the setting-up of troublesome mains hum. If the parts are not carefully arranged—and sometimes if they are—hum is caused due to feed-back between the mains transformer and the L.F. transformer. One method of avoiding this is to use R.C.C. instead of transformer coupling, although this is rather "begging the question." This method cannot usually be employed when power-grid detection is in use due to the fact that the detector anode voltage is unduly reduced, but it is definitely worth a trial if ordinary leaky-grid detection is incorporated. Not only does the resistance coupling overcome the feed-back trouble, but it often also improves reaction control. Contrary to expectations, it rarely cuts down the volume to a very appreciable extent, and if a pentode is used in the output stage the slight loss is not noticeable.

If the last valve is a triode and the greatest possible output is desired it might be found necessary to screen the L.F. transformer and/or the mains transformer. The screening must be kept away from H.F. components and must consist of heavy-gauge iron; aluminium and copper are useless for this purpose. It is hardly necessary to add that the screening metal must be effectively earthed, as also should the cores of the transformers.

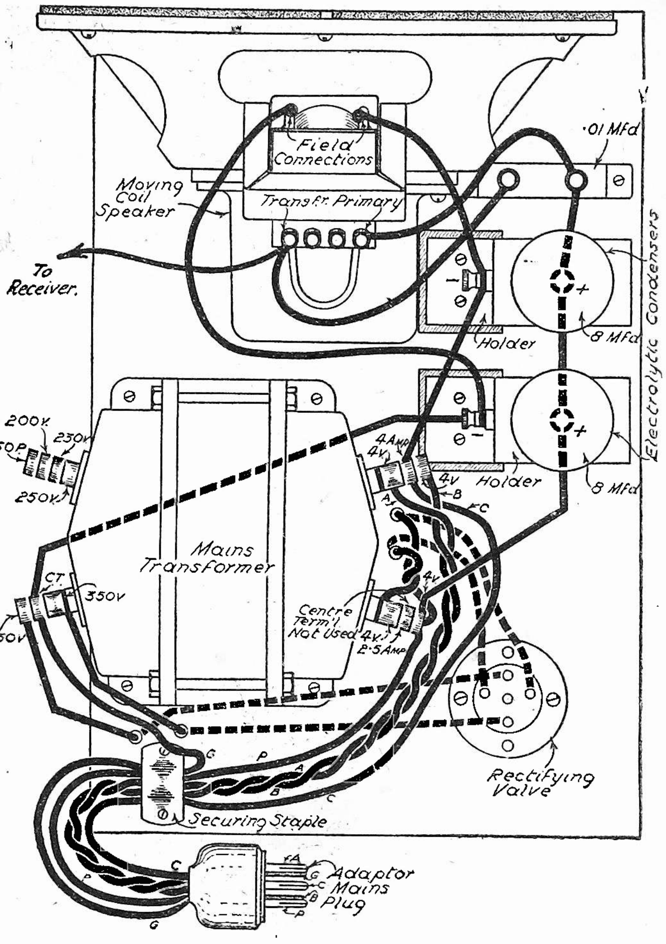


Fig. 3.—Wiring diagram of the mains unit used for the Luxus A.C. Superhet.

The Variable-mu Control

When a variable-mu valve is employed in the high-frequency stage it is not uncommon to find that the useful range of movement of the volume control resistance is very small. This might be due to the use of a resistance value which is too high, or to the fact that the resistance is not of the "graded" type. If this difficulty is encountered it can most readily be overcome by connecting a fixed resistance of about 1,000 ohms in parallel with the terminals of the variable component, as shown in Fig. 4. This has the combined effects of reducing the maximum resistance and of giving a "grading" effect, due to the fact that fixed resistance produces a greater proportional reduction when the variable resistance is full in than when its value is reduced.

In all experiments with mains apparatus it is well to be generous in the use of fuses, so that in the event of a short-circuit no real harm will be done. One (1-amp.) fuse in each mains lead and one (.25 amp.) in the positive output lead from the rectifier should be taken as the minimum.

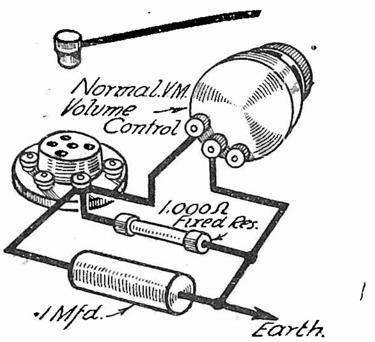


Fig. 4.—Volume control with a V.M. valve can often be improved by connecting a fixed resistance in parallel with the volume-control potentiometer (used as a variable resistance). The reason is explained on this page.

THE IMPORTANCE OF THE EARTH

It would be amusing if it was not such a serious point that so many people spend a great amount of time and care in erecting a perfect aerial, but imagine that anything will do for the earth. In many cases it has been found on examination that a receiver which has been carefully constructed, and attached to an efficient aerial, has an earth connection which is little better than none at all.

Aerial As Well

It should be borne in mind that the efficiency of the earth connection is just as important as that of the aerial and the receiver. It is not generally understood that the signals are received by both the aerial and the earth, since they act as the plates of a large condenser, with the air between them as the dielectric. The plates of a good condenser must be made of a good conducting material and, for the same reason, the earth connection must be a good conductor. Dry earth is of little use, and it is necessary in some cases to go deep down into the ground until wet clay is found. The common way of arranging an earth is to connect a wire to a cold water pipe. This generally forms a good earth because the pipes run down deep into the ground.

Don't Use Gas

In order to get the best service from this type of earth the connection should be made as close to where the pipe enters the building as possible. The gas pipe should never be used for an earth, as there is in almost every installation a non-conductive material introduced in all the joints.

In the absence of water pipes, the best method of reaching the earth moisture is to drive a copper tube of from three to five feet long into the ground. A metal plate is also good, but requires more time and labour to do it satisfactorily.

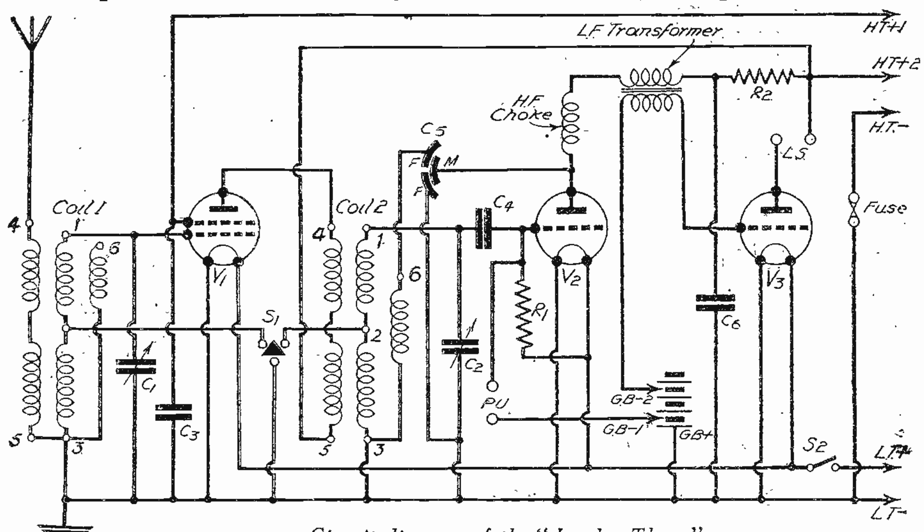
Water Is Effective

In remote country places a very good earth can be made by fastening a piece of lead to the end of a wire, and dropping it to the bottom of a well, which should, of course, be close to the house. No matter what kind of earth is used, the wire leading to the set should be soldered at every joint. An earth which is very good in the winter may be very poor in the summer when the ground becomes dry. This accounts to some extent for the better reception we get during the rainy seasons.

DECIDING ON A CIRCUIT

Brief Particulars are Given in this Article of a Wide Variety of Receiver Circuits which have been Specially Developed for "Practical Wireless" Readers

WHENEVER a new set is contemplated the question arises as to what is the most suitable circuit arrangement, number of valves, and so on for one's own particular requirements. The answer to this question is not always easy to find and depends upon a large number of deciding factors. In the first place it is wise to settle upon the maximum amount of money which it is proposed to spend, since the final choice must be very largely dependent upon this. If the amount is five pounds or less it will generally be found that a simple three-valve battery-operated receiver will be most suitable, and it would be hard to improve upon the popular "Leader Three" described in the issue of PRACTICAL WIRELESS dated March 3rd, 1934. If a still cheaper set were desired, the "Sixty-Shilling Three," for which constructional details were given in our issue dated December 2nd, 1933, would prove very suitable.



Circuit diagram of the "Leader Three."

Limitations of the Simple Circuit

In building sets of this type one must fully realize the limitations which are imposed, for, although both receivers mentioned are as good as any in their class, they cannot be compared with such high-class sets as the "All-Pentode Three" and the "Summit," which have been described more recently, and which are appreciably more expensive. Nevertheless, the "Leader Three," for example, will enable extremely good reception to be obtained from ten or more stations, at the same time proving amply selective for use up to five miles or so of a Regional transmitter or some twelve miles of Droitwich. This does not mean that the set would be useless inside the radii mentioned, but that it could scarcely be expected to cut out the local station within 30 metres or so on each side of its wavelength, except when using a small aerial—which would limit the reception of more distant transmitters.

On the score of volume the "Leader" might fall rather short of some readers' requirements, since it has only a single L.F. stage, this comprising an ordinary small power valve. In such cases, and where selectivity is not of very great importance, such as, for instance, when the set is used fifty miles or more from a Regional station, or where really good reception of only about half a dozen stations is required, the "Sixty-Shilling Three" (described in the issue dated December 2nd, 1933), with its two L.F. stages, is to be preferred.

A Two-valve Mains Set

If a mains supply is available, it is possible to get somewhat better value for the hypothetical five pounds, and a two-valve receiver will give even better reception than a three-valver for battery operation. A two-valve mains set which has proved extremely popular is the "A.C.-D.C. Two," and this was fully described in our issue dated October 7th, 1933. This set can be operated from either A.C. or D.C. mains, it will give real "mains-set" volume, and several readers have reported the reception of over twenty stations on it. The set is, however, chiefly intended for full-volume reception of four or five stations when true reproduction is desired. Though not super-selective, this set will easily separate the two "locals" at a range of five miles, even when a good outdoor aerial is used.

When one feels justified in spending between five and ten pounds there is a much greater choice of excellent home-constructor receivers. If the set is for battery operation, and "hair-line" tuning is required, combined with good range and reasonable volume, the latest PRACTICAL WIRELESS receiver, the "All-Pentode Three," will prove ideal. This set employs up-to-date iron-core coils and has three accurately tuned circuits, the first two of which are in the form of an inductively coupled band-pass filter. The set is provided with an efficient volume control acting upon the variable-mu pentode first valve, whilst a very smooth control of reaction is available, due to the employment of an H.F. pentode in the detector stage.

Low-priced Selectivity

A slightly less expensive receiver with similar characteristics, but rather lower degree of selectivity (even so, it will cut out the London transmitters at six miles within 1½ degrees of the condenser scale), is the "Summit," which was one of our 1934 "Radiolympia" sets, and described in the issue dated August 18th. Incidentally, it should be mentioned that the "Leader," "All-Pentode Three," and "Summit" can all be operated from a standard type of H.T. battery, since they require only about 8-10 milliamps. current. Additionally, any one of them can be fed from a simple type of H.T. battery eliminator.

For the Connoisseur

For the reader who wants a superlative performance in the way of really long-distance reception in moderate conditions, or when only a comparatively poor aerial

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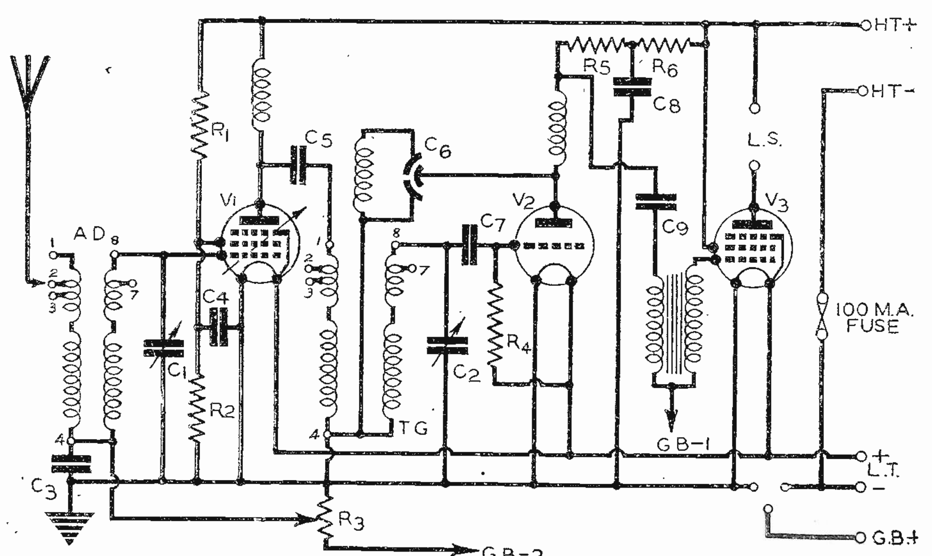


Theoretical circuit of the "Summit," a good example of a straightforward three-valver employing the popular S.G. detector and output arrangement.

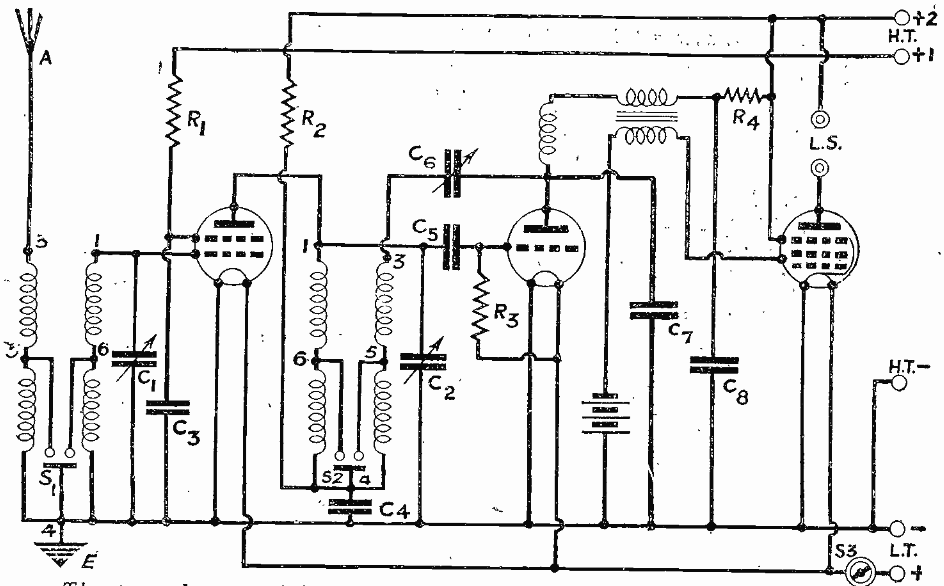
(Continued from previous page)
can be erected, selectivity adequate for all purposes, combined with good loud-speaker output and modest current consumption, will find the "1934 Fury Super" ideal. This receiver was described in the issue of PRACTICAL WIRELESS dated January 27th, 1934; it has three tuning circuits incorporating iron-core coils, two variable-mu H.F. stages, and power-pentode output. An interesting feature is the incorporation of a battery economizer for varying the H.T. current consumption of the output pentode according to the volume being handled; this effects an important saving in running costs.

A mains version of this receiver, which can form the basis of a high-class radio-gramophone, was described in the issues dated February 10th, 1934, and although this set costs approximately £12, it is by no means expensive considering the performance which it gives. The "A.C. Fury Super" gives a signal output of 3 watts, combined with an unlimited range of reception. It is a set for the connoisseur.

An Ideal Portable

A portable receiver is a great convenience, not only for use out of doors, but also for carrying from one room to another, and the "Atom Lightweight" portable, described in the issue dated June 2nd, 1934, is undoubtedly the best in its class. This set has only three valves and operates on its self-contained throw-out aerial and midget loud-speaker. The circuit comprises an S.G. valve, followed by a detector and pentode, and is of simple, reliable form, whilst the construction and operation are within the possibility of any average person. This set is probably the smallest loud-speaker portable ever offered to the constructor, and weighs less than eighteen pounds complete. It is by no means costly, the price of the parts being only £6 15s., inclusive of everything except batteries, so that the set might well be made for use as an addition to the normal broadcast receiver.

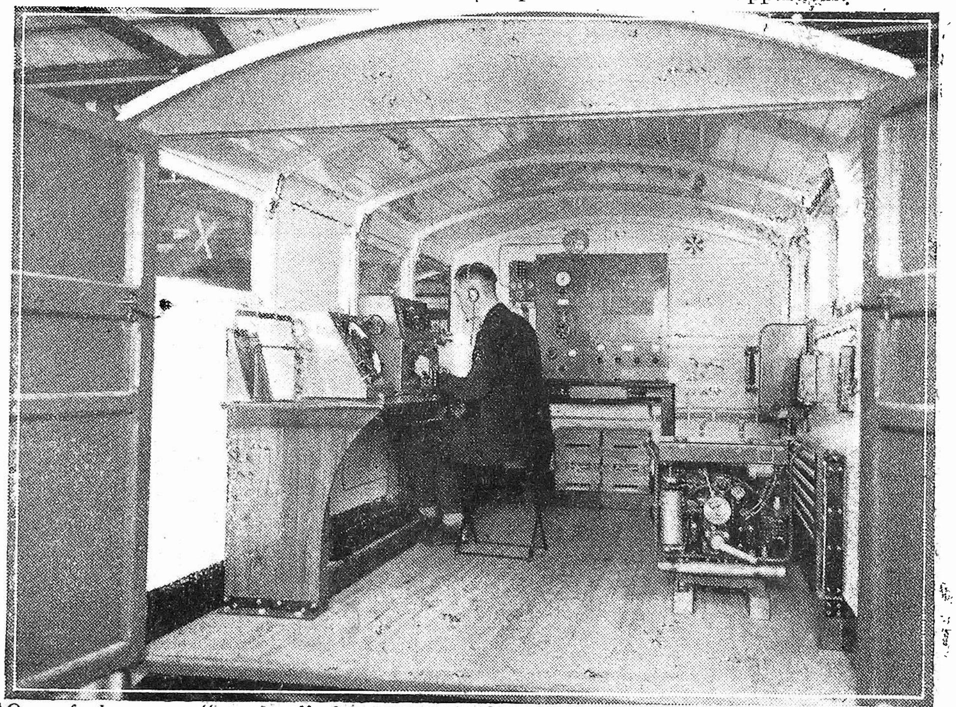
We have not touched upon every recent PRACTICAL WIRELESS receiver, but mention has been made of a representative range, one of which is sure to appeal to every reader. New readers, or others who have mislaid back numbers of the issues in which the sets were described, can obtain them for 4d. each post paid upon application to The Back Number Dept., Messrs. Geo. Newnes, Ltd., Exeter Street, Strand, London, W.C.2.



The circuit diagram of the "Atom Lightweight" portable referred to in the article.

WIRELESS AT BRITISH AIRPORTS

THE recent demonstration of air-and-ground wireless communication at Newtownards, Belfast, when Lord Londonderry, at the opening of this new acrodrome, made an address from the air which was relayed through loud-speakers to the crowd, is a reminder of the progress that has been made by the British Air Ministry this year in equipping new civil airports with wireless apparatus.



One of the motor "trailers" fitted with Marconi transmitting and directional receiving apparatus as installed for the British Air Ministry at the Hull, Belfast, and Portsmouth aerodromes. In this photograph the apparatus is shown undergoing tests; under service conditions, the receiving equipment, and switchboard for controlling the transmitter remotely, are usually removed from the lorry or trailer together with the operating table shown on the left of the photograph.

Hull (Hedon), Portsmouth, and Belfast now all have up-to-date aerodrome wireless stations in regular operation, the equipment consisting of Marconi transmitters suitable for either telephone or telegraph operation, and directional receivers enabling navigational aid to be given to aircraft in flight.

Mobile Apparatus

The transmitters and receivers are of a type designed for mobile use and can be accommodated, together with all necessary running machinery, switchboards, and batteries, in a motor lorry or trailer. This point is of some interest in the present stage of rapid development of British civil aviation, when the airports which may eventually attain the greatest importance for wireless services have to be determined.

The Marconi transmitter adopted by the Air Ministry for these stations has a rated power of 500 watts (to the valve anodes on continuous-wave telegraphy) and is known as the Type D.M.1A. It is particularly suitable for aerodrome work, as it is arranged for quick wave-changing and remote control, and can therefore be used very conveniently for any of the various classes of services for which a modern aerodrome transmitter must cater. These include telephone and telegraph communication with aircraft in flight, contact with other aerodromes for the exchange of traffic information.

The Marconi directional receivers for Hull, Portsmouth, and Belfast are of a type that have been selected by the Air Ministry after extensive tests. They can be used both for general reception and for direction finding by the Bellini-Tosi system.

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TO EVERY READER — OLD OR NEW

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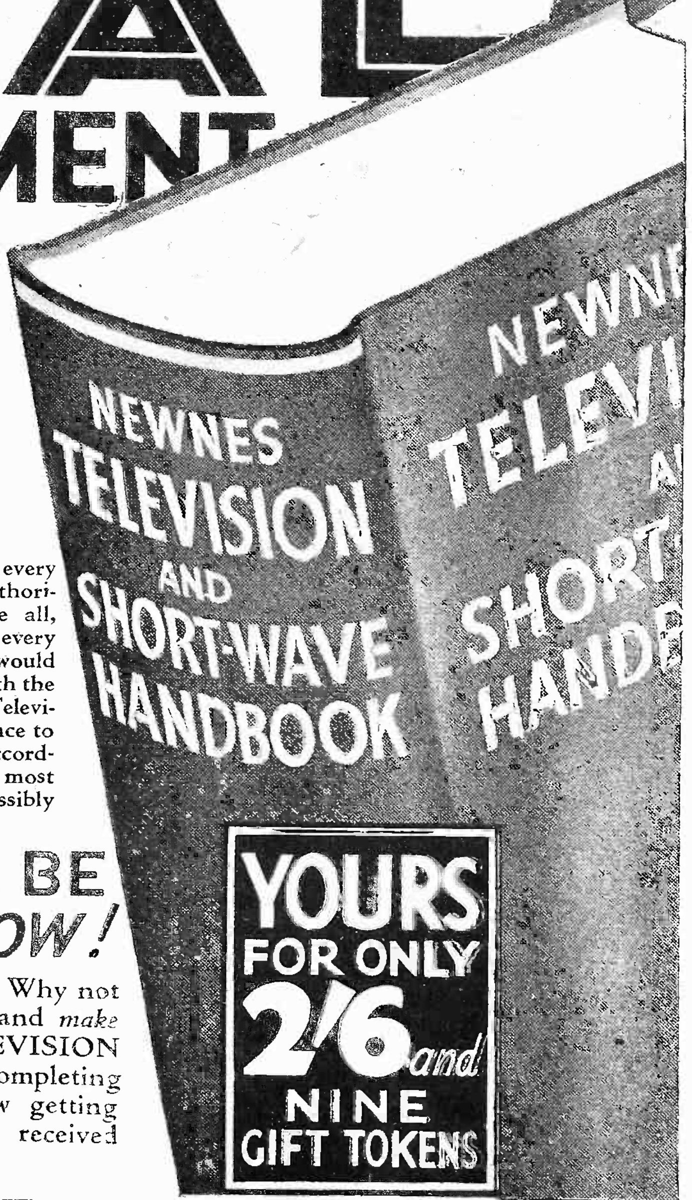

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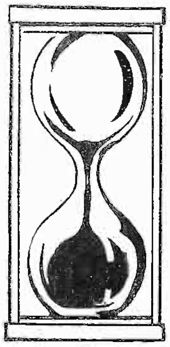

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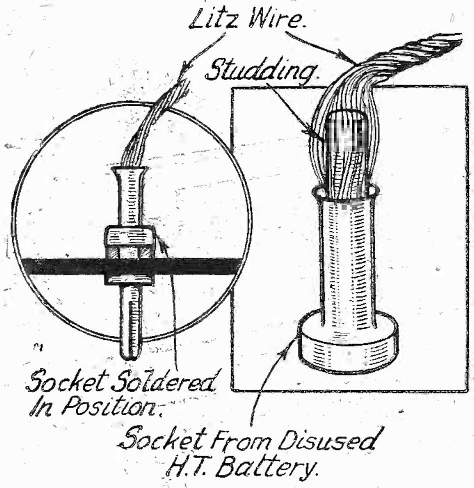
READERS' WRINKLES

THE HALF-GUINEA PAGE

Litz Wire Connections

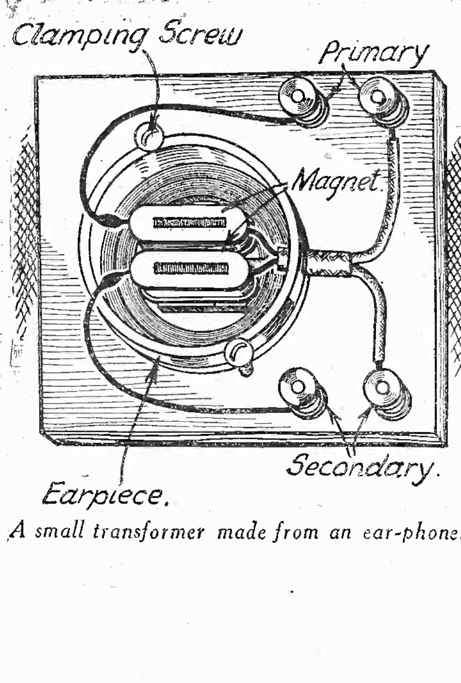
LITZ wire is excellent for coils, particularly L.W. coils, but the difficulty always arises, when one contemplates using it, of soldering twenty-seven wires round the periphery of a small screw or pin, which is invariably fixed on the coil. Here is an easy way of doing it. Inside an old H.T. or G.B. battery at the top of the carbons are to be found a number of small wander-plug sockets. Detach one of these, and solder it on to the screw, as shown in the sketch. Find a piece of rod, or studding, a loose fit in the socket, and it is then a simple matter to clamp the wires firmly round the rod's periphery. To make a firm job they can be soldered in place.—P. NEWTON NIELD (Loughborough).



Method of making neat Litz wire connections.

A Small Transformer

A SMALL but efficient 1 to 1 ratio transformer can be constructed by the method described below. Take a pair of ordinary headphones and remove one earpiece, cutting the flex and leaving about 6ins. attached. Next, remove the cap and the iron diaphragm. As the two magnets are joined in series it will be necessary to part the two centre connecting wires. These are usually lightly soldered and a touch with a hot soldering iron will part them. A short length of thin cotton-covered copper wire is then soldered to each of these bared ends, after which a little wax is melted on to each connection to provide the necessary insulation. The primary winding connections are to one of these flex leads, and to the central wire lead of the same magnet winding. The secondary connections are made to the other magnet windings in the same way. The earpiece may then be mounted on a small wooden base by fixing tightly between two wood screws, and four terminals can be fixed to take the primary and secondary leads.—GEORGE HILL (Bradford).



A small transformer made from an ear-phone.

A Flat-dweller's Aerial

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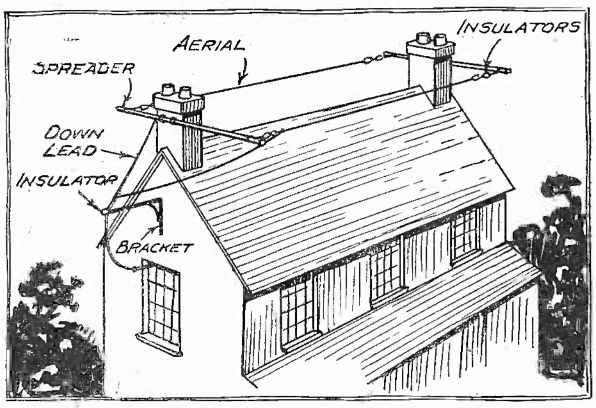

An efficient type of aerial for use where garden space is limited.

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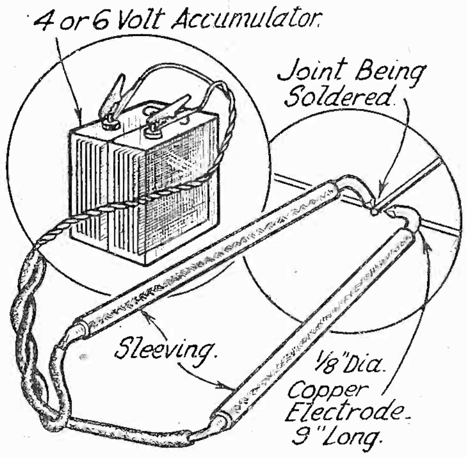

A novel method of soldering small work.

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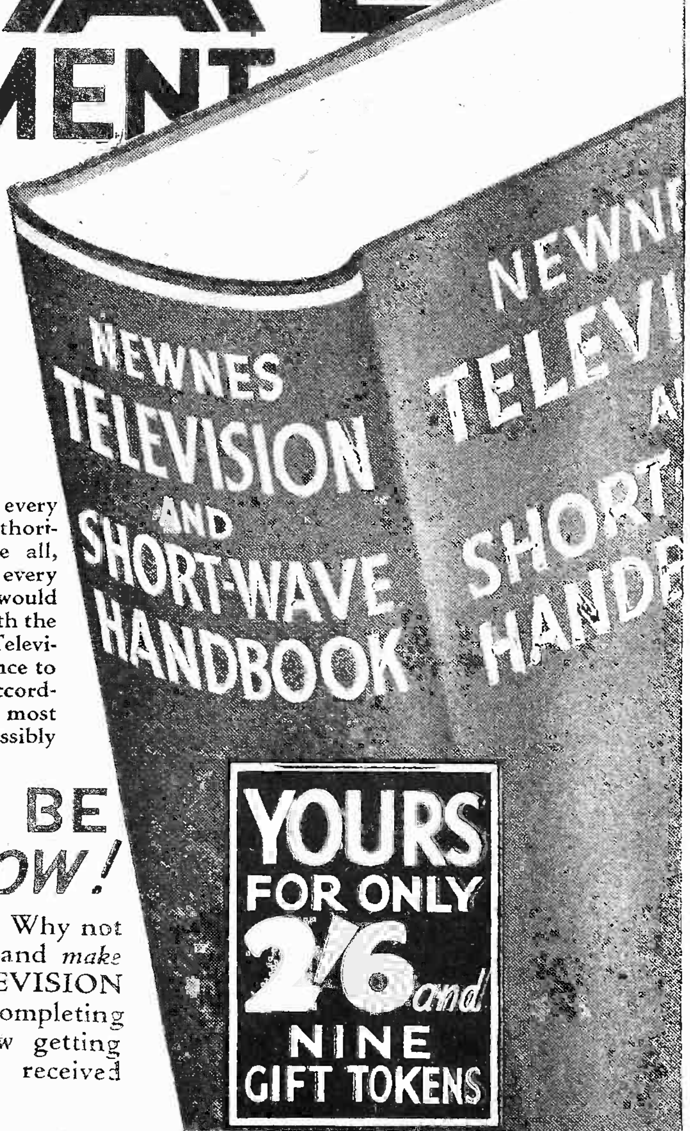

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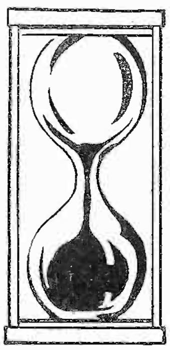

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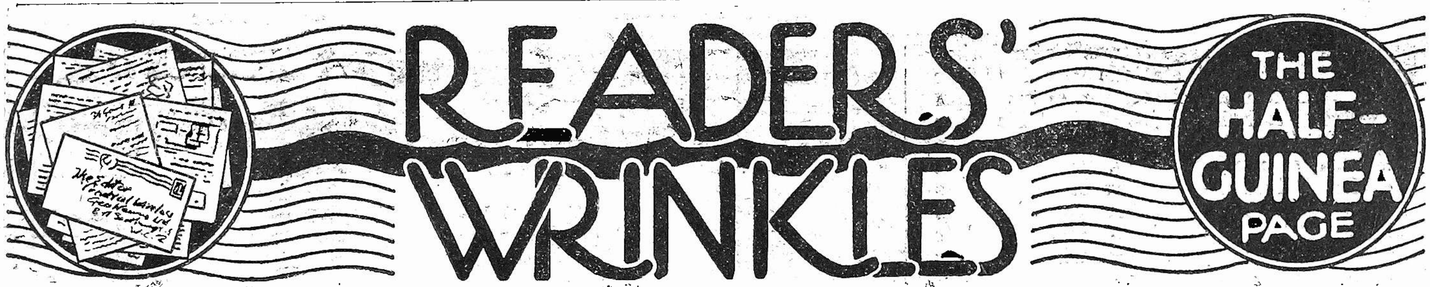

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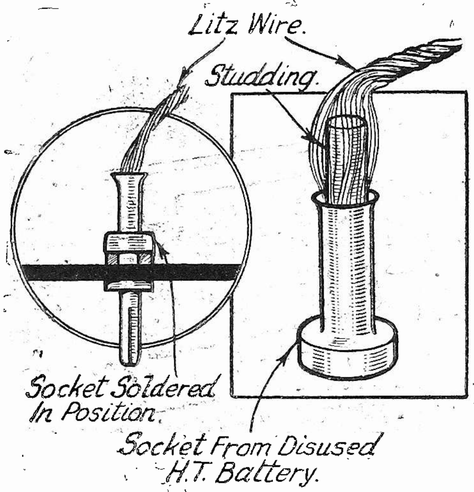

Method of making neat Litz wire connections.

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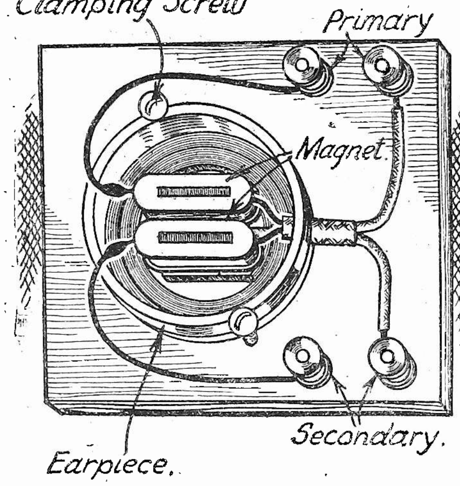

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A Flat-dweller's Aerial

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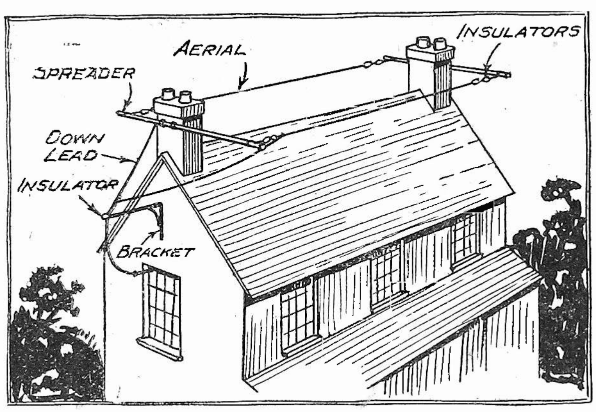

An efficient type of aerial for use where garden space is limited.

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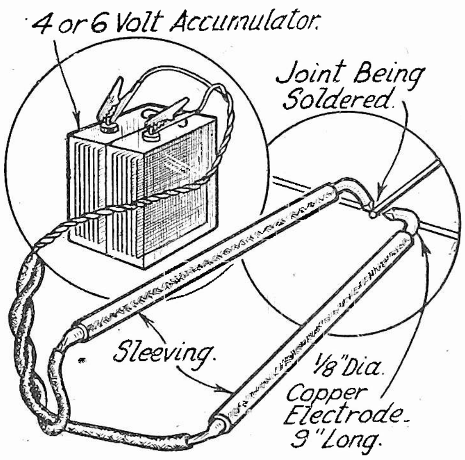

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A PRACTICAL ARTI

DISTORTIONLESS

The Design of Distortionless L.F.

A FEW years ago it was claimed that the B.B.C. stations provided far more faithful transmissions than receiver technique justified. This was undoubtedly a fact, and is still true in the case of many receivers. The congestion of the medium and long wavebands prevents frequencies above some 3,500 to 4,000 cycles being reproduced, if heterodyne and other interference are to be avoided when receiving other than local stations.

To obtain perfect reproduction it would be necessary for all frequencies between 30 and 15,000 to 20,000 cycles to be amplified and reproduced equally. In practice, no broadcasting stations transmit frequencies above 9,000 or 10,000 cycles, and a range of 30 to 9,000 cycles can be taken as providing practically perfect reproduction.

Those who happen to reside within thirty miles or so of a Regional transmitter can obtain almost perfect reproduction of this station's programmes if they wish to do so, but when a programme relayed over a long land line before it reaches the transmitter is reproduced on a high quality receiver, the loss due to the land line is usually very noticeable.

L.F. Distortion

The distortion caused by an L.F. amplifier is of three kinds, amplitude, frequency, and phase distortion. Amplitude distortion is always present to some extent, but it occurs to an appreciable amount when the input to any of the amplifying valves is greater than the valve is intended to accept. This kind of distortion is the most common cause of the mutilated reproduction given by many receivers.

Amplitude distortion can be reduced to a minimum by arranging the amplifier so that each valve, other than the output, is only called upon to deal with an input voltage of about half the grid-bias voltage.

Frequency distortion is due to the amplifier amplifying some frequencies more than others. A certain degree of frequency distortion is barely noticeable, but most L.F. transformers cause severe frequency distortion above 6,000 cycles or so. Using resistance-capacity coupling enables frequency distortion to be reduced to a negligible degree over the required frequency range.

Phase distortion is generally considered to be unimportant in sound reproduction, but in television amplifiers it must be avoided.

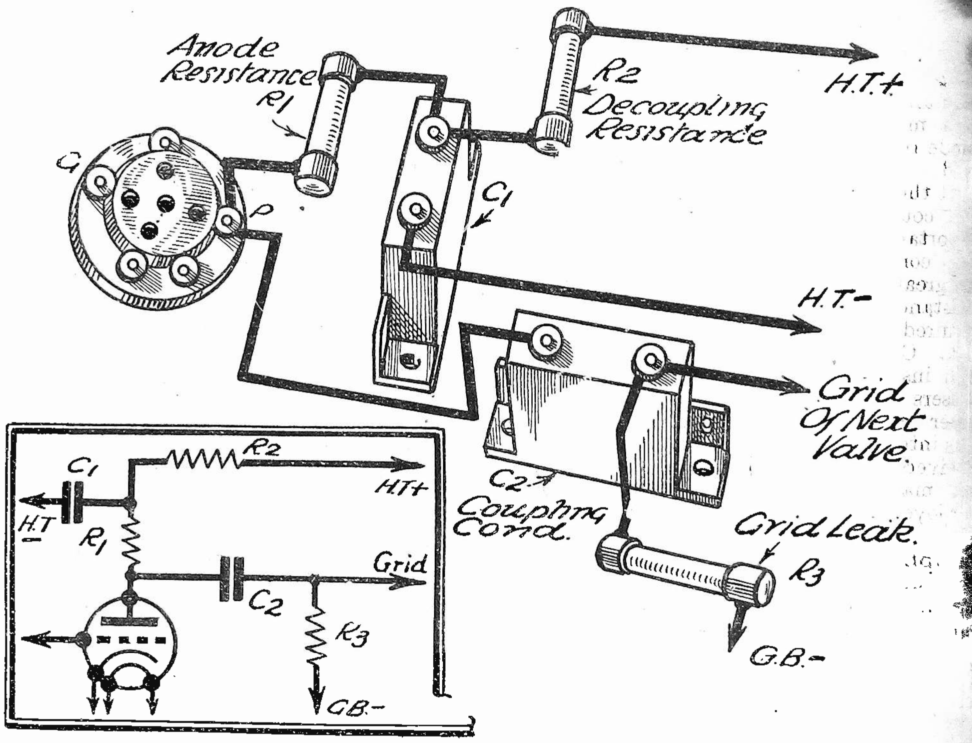


Fig. 1.—A typical resistance-capacity coupled stage. As the grid leak is, in effect, in parallel with the anode resistance, it must be of considerably higher value.

L.F. transformers, and iron-cored apparatus in general, introduce severe phase distortion, and also amplitude distortion. Apart from this cause and overloading, this form of distortion is caused by the non-linear operation of valves. Except from the output stage this source of amplitude distortion can be kept at a negligible level by working the valves at less than their maximum capacity, as already mentioned.

In the output stage the distortion due to amplitude distortion is not appreciable if a valve of adequate power-handling capacity is used. However, it can be reduced by using push-pull output.

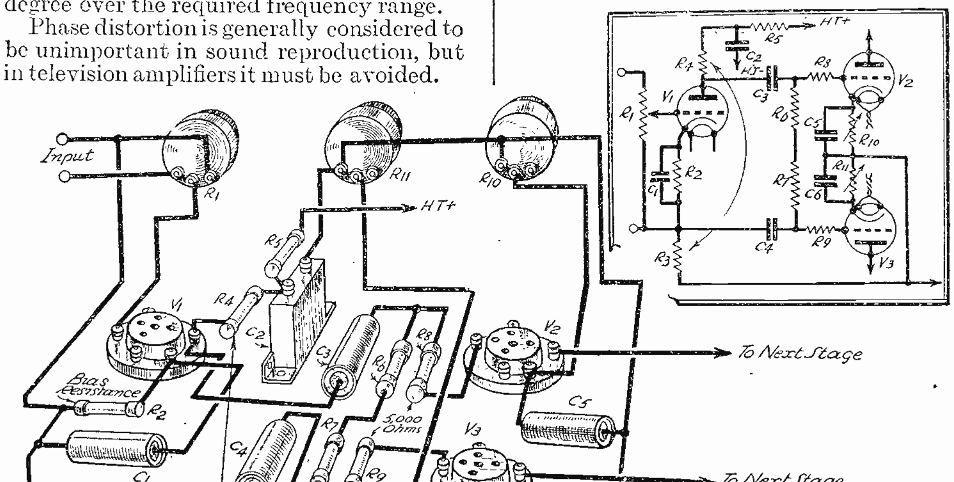


Fig. 3.—In this arrangement the desired phase opposition is obtained by splitting the V.1 anode resistance, inserting one half in the anode circuit and the other half in the cathode circuit.

Resistance-capacity Coupling

It will be obvious from these considerations that for a high-quality amplifier it is desirable to use resistance-capacity coupling. The slight distortion introduced by an output transformer, or choke, is negligible, and in any case this component cannot economically be eliminated. When using resistance-capacity coupling it is essential that the coupling components be of the correct values, as otherwise serious frequency distortion may occur. When designing a resistance-coupled stage, as shown in Fig. 1, the values of the anode and decoupling resistances should be determined first. The total resistance in the anode circuit should be such that the maximum permissible voltage is applied to the anode of the valve. For example, in Fig. 1 a total H.T. voltage of 400 may be available, and V.1 may take 6 milliamps with an anode voltage of 200. In this instance the total anode circuit resistance should be approximately 35,000 ohms, and this would permit an anode resistance of 25,000 ohms to be used with a decoupling resistance of 10,000 ohms.

The grid-leak resistance should be at

DEALING WITH REPRODUCTION

...ifiers for Sound or Television

... six or seven times that of the anode ...tance, 150,000 or 200,000 ohms being ...ect for use with a 25,000 ohms anode ...tance. In order to keep high-note loss ... minimum, comparatively low value ...c resistances and grid leaks should be ...

... the other end of the frequency range ... coupling condenser capacity is of ...rtance. The impedance of the coup... condenser at 30 cycles should be greater than one-tenth of the grid-leak ...tance. A .25 mfd. condenser will be ...ired for use with a 200,000 ohms grid ... Coupling condensers must have very ... insulation resistance, and mica con...ers are preferable, although some ...r condensers are sufficiently good. ... interesting to note that in some of the ...vers marketed by a famous transfor... manufacturer resistance-coupling is ...oyed.

...phase Amplification

... was mentioned that push-pull could be ...oyed to reduce distortion in the output ... As the use of an input transformer ...t entirely desirable, it would be neces... to adopt resistance-coupled push-pull, ...r known as paraphase amplification. ...is type of amplifier was developed ... years ago, and is widely used in ...rn de luxe radio-gramophones. The demonstration receiver at the Science Museum in Kensington employs this form of L.F. amplifier.

The paraphase, or "parallel anti-phase," amplifier consists, as its name implies, of two valves in parallel in which the voltage on the grid of one valve is 180 degrees out of phase with the grid voltage of the other valve. In this respect it is similar to transformer-coupled push-pull. Actually the only difference between transformer-coupled and resistance-capacity-coupled push-pull is that in the resistance-coupled circuit a phase-reversing device is necessary for one of the valve chains.

Owing to the comparatively low amplification afforded by resistance-capacity-coupled valves it is barely possible to prevent overloading of a single valve used before a push-pull output stage, and therefore it is usual to employ two valves in the preceding stage. It is necessary to use a penultimate push-pull stage for another reason, that is, in order to obtain the necessary phase reversal.

A typical A.C. paraphase amplifier is shown in Fig. 2. The input and output stages are quite straightforward, but the penultimate stage comprising V.2 and V.3 may require explanation. The input voltage applied to the grid of V.3 must be 180 degrees out of phase with the input to V.2.

The A.C. voltage developed in the anode circuit of a valve is 180 degrees out of phase with the voltage in the grid circuit of the same valve. Obviously, if the voltage on V.3 grid is in phase with the anode A.C. voltage of V.2 it will be out of phase with the grid voltage of V.2.

By using a potentiometer in place of the V.2 anode resistance it is possible to tap off the voltage required for the grid of V.3. The correct potentiometer setting is obtained by inserting a pair of headphones at X, and turning the potentiometer knob until zero signal is heard in the 'phones. If the phase reverser is accurately set, no signal should be heard in the 'phones with the amplifier working at maximum capacity.

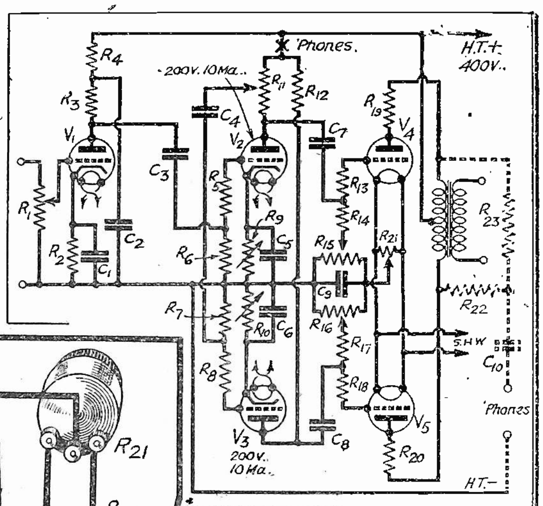
Grid-bias Adjustment

Before making a final setting of the potentiometer the grid-bias adjustments should be set so that each pair of valves, V2, V3 and V.4, V.5 take identical anode currents. If desired, a check may be applied to the output stage by connecting the 'phones as shown by dotted lines, and noting whether the same setting of the V.2 anode potentiometer gives zero signal.

Another phase reverser circuit is shown

(Continued on page 113)

Pictorial and Theoretical diagrams



A QUALITY AMPLIFIER

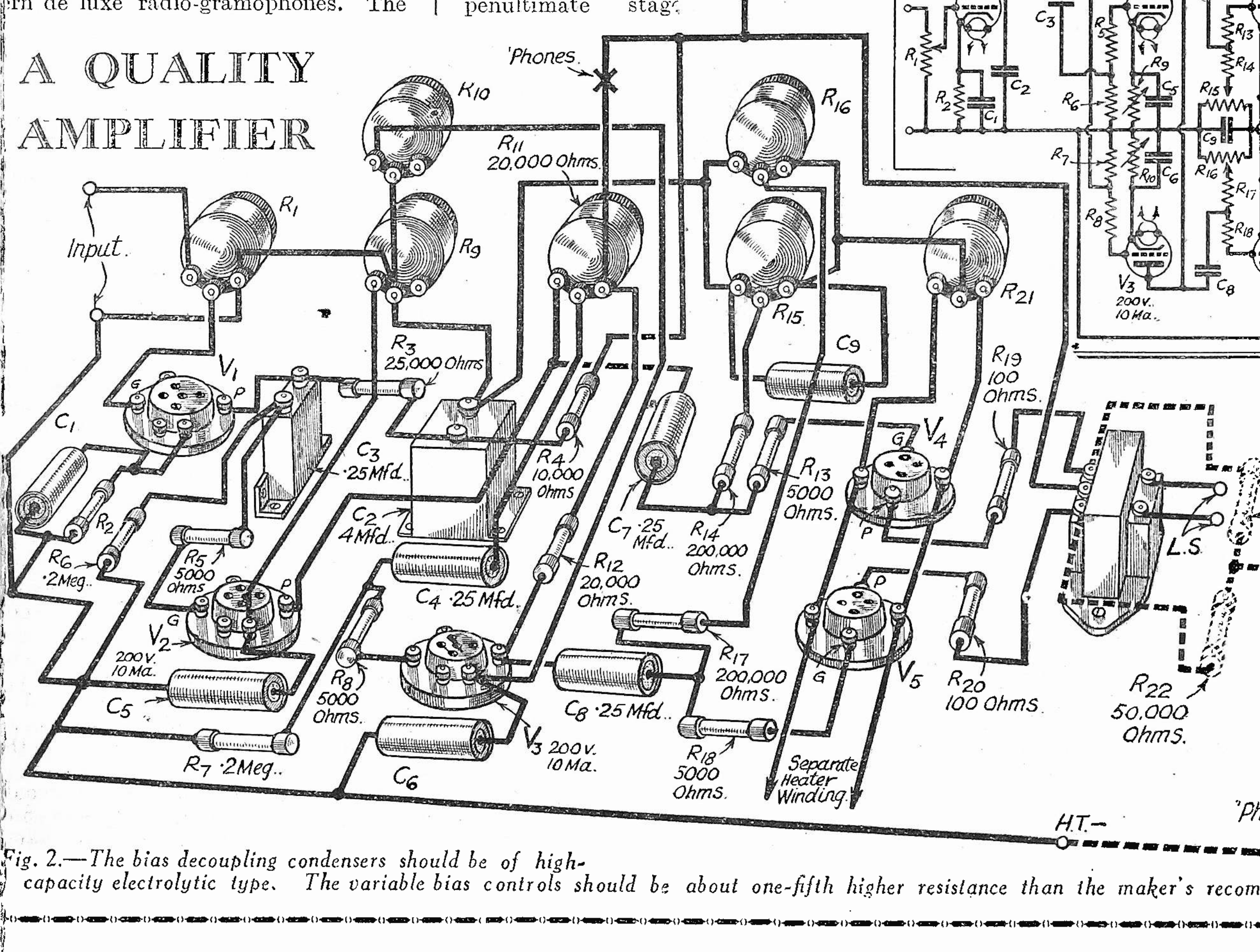
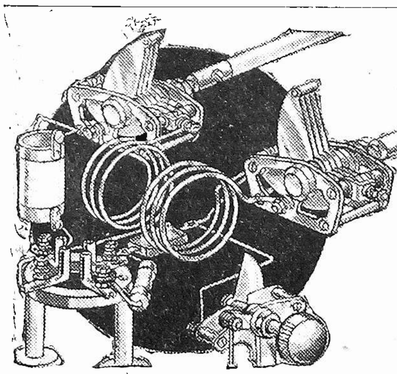


Fig. 2.—The bias decoupling condensers should be of high-capacity electrolytic type. The variable bias controls should be about one-fifth higher resistance than the maker's recommended value.



Short Wave Section

FURTHER HINTS FOR SHORT-WAVE EXPERIMENTERS

By ALF. W. MANN.

THE fact that as signal strength is increased background ratio to signal volume is also increased is sometimes overlooked, and it is a good idea to arrange for a two-valve output for use with headphones during periods of adverse conditions.

It is not the writer's intention to deal with H.F. amplification in this article, and whilst there are definite advantages to be gained by the addition of one or more stages of H.F. if one can afford the extra H.T. consumption, it is foolish to add an S.G. stage merely as a cure for threshold howl, dead spots, or lack of sensitivity, as it is quite possible to build an O-V-2 as stable and sensitive as one could desire, free from all the defects or troubles commonly associated with "straight" short-wave circuits, by careful attention to lay-out, decoupling, and general constructional work.

The new experimenter, however, naturally wishes to experiment with L.F. amplification before tackling H.F. problems, and, quite apart from that, must add to his experimental equipment by degrees. Financial considerations are a ruling factor in that respect. Under the circumstances, the O-V-2 is worthy of consideration. If constructed on modern principles, this well-tried type of circuit will give highly satisfactory results. The writer numbers amongst his receiving apparatus an O-V-2 and an S.G. multi-valver, and bases his opinions upon personal results and is not in the least influenced by outside reports. Every circuit has its limitations. One must realize that, and quite apart from its limitations, the effects of location and short-wave phenomena should not be forgotten.

To think in terms of volume, and to attempt the construction of an O-V-2 from a theoretical diagram without previous experience, to substitute L.F. transformers where R.C.C. units are specified, and to attempt the design of a receiver exactly to one's own liking before constructing a receiver to published specification, is wrong.

Aerial Coupling

Aperiodic and aerial series capacity coupling (neutrodyne type variable in series with aerial) are well known to old hands. The beginner naturally wishes to know which is best. Try both and decide for yourself. I favour aperiodic coupling, as the noise level is slightly lower than when the other system is used and selectivity is slightly better. Aerial series capacity, however, gives a slight increase in volume, but is more susceptible to pick-up of outside interference.

The Detector Valve

The choice of a detector valve may appear to be difficult. The modern H.L. 210, which is metallized, provides exceptionally smooth regeneration, good sensitivity (other things being equal), and complete freedom from microphonic noises. High impedance valves, 25,000 ohms or so, are the most suitable for S.W. detection. Always remember, however, that the higher one goes above this figure, the more chance there is of being troubled with microphonics.

Extension Rods

If a designer specifies long extension rods between condensers and tuning dials, use them. If not, do not re-build your receiver and incorporate them in order to cure instability. Clearly it is your own work which is at fault, and by trying various methods in order to get things right you will learn quite a lot. It is a good plan to keep a data book, and whenever you come across a cure relative to short-wave receiver troubles, make a note of it straight away. Do not trust to memory—however good. It is far better to have half a dozen remedies in a book than two in your head—because the remedy suitable to one receiver may not be successful when applied to another, and to find that those you remember don't seem to work is, to say the least, annoying.

THE EASY ROAD TO RADIO.

THE BEGINNER'S SUPPLEMENT

THE USE OF "NON-INDUCTIVE" CONDENSERS

This Article Shows the Reason for Using this Type of Condenser in Modern Receivers and Explains its Principles and Functions.

UP to within the last few years home constructors were kept singularly uninformed on many important technical points. For instance, the most careful scrutiny of the pages of the majority of radio journals failed to reveal the fact that it was possible for a fixed condenser to possess any qualifications other than so much "capacity." Consequently, when we wanted a condenser we simply went to the dealer and asked for a three 0's five microfarad or one microfarad condenser, or whatever size we required. Nowadays, however, we find that many of the condensers specified in modern receivers must possess such attributes as the ability to withstand a certain "peak voltage" or, again, they must be "non-inductive." It is the meaning of this latter qualification that is explained in the present article.

The Function of a Condenser

Before explaining how a condenser can be "inductive" or "non-inductive," it is well to remember that a condenser is a device for use in circuits where the electric current is fluctuating. It has no use whatsoever where only a steady direct current is present. At first this statement may appear to be open to question. "What about the use of condensers across direct-current mains and in D.C. eliminators?" you may ask. Well, the answer is, of course, that the mains current is not a steady one. It rises and falls slightly due to the nature of the dynamo producing it, while it may also fluctuate owing to local electrical interference. This interference results in tiny alternating currents being induced in the mains, and these being superimposed on the main current cause it to fluctuate in strength. To use a simple analogy, a steady direct current may be compared to a train moving at a steady rate. Now suppose a man is walking up and down the corridor of the train. His walking movement may be used to represent the small alternating current due to the interference. First it flows in one direction and then in the other. Now if you consider the combined effect of the man's walking and the train's motion you will see that, in relation to the ground over which he is passing, the man is travelling at a varying speed. Thus when he walks towards the front of the rain his speed increases, while on his return walk it decreases. This combined movement of man and train is like the current flowing in the mains. It is still a direct current in that it travels all the time in one direction; but it is not a *steady* direct current, which is the usual interpretation of the words "direct current."

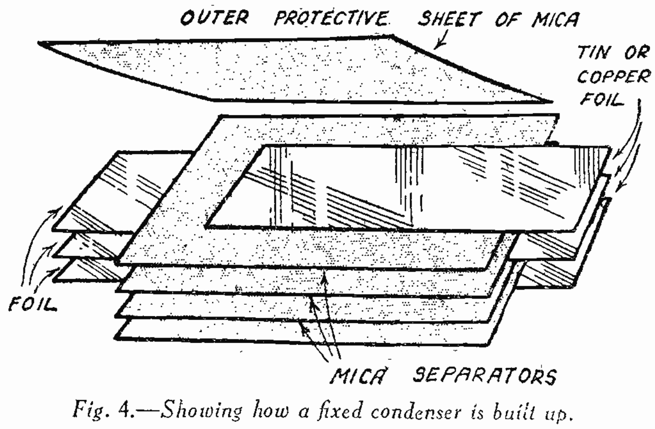


Fig. 4.—Showing how a fixed condenser is built up.

How it "Passes" a Current

One of the chief uses of a fixed condenser in wireless is to give a free passage to alternating currents but to stop the flow of direct current. Currents which flow backward and forward—either very rapidly (high-frequency) or more slowly (low-frequency)—are often present in the same circuit with a steady direct current, and it is the object of the condenser to divide their paths. To understand how a condenser makes the separation in this another analogy is given. Fig. 1 represents an arrangement of two inter-connected pistons working in two cylinders. Each cylinder is joined to a pipe containing water, while the pistons are maintained in position by a spring behind each. The pipes represent wires, the water electricity, and the cylinder and piston arrangement represents a condenser.

When a direct current attempts to flow through the condenser (the current travelling along the wire is here represented by water flowing from A towards B) the water pours into the left-hand cylinder and forces the piston P to the right against the pressure of the spring. It will push it until the resistance of the spring equals the pressure of the water, when it will stop as in Fig. 2. Since the two pistons are joined together this action will mean that P1 will also be pushed to the right and some of the water in the right-hand cylinder will be expelled towards B. Now if you consider the action of the device from the time the water enters at A until the pistons stop in the position shown in Fig. 2, you will see that for all intents and purposes the pipe from A to B might be continuous. Thus water flows in at A and an equivalent amount flows out at B. This is exactly similar to the action of a condenser when it is first connected in a circuit in which direct current is flowing. The current pours into one plate of the condenser, and out from the other until the condenser is fully "charged." Once it has arrived at this state it is not possible for any more current to flow, and the condenser acts as a definite barrier in exactly the same way as the pistons P and P1 act as a barrier to any further passage of water

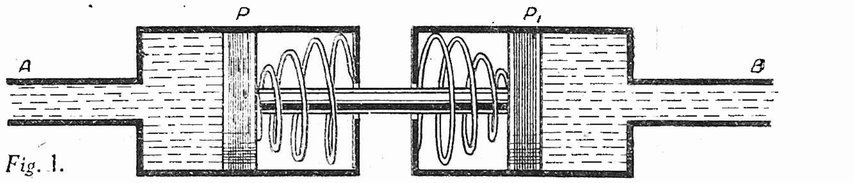


Fig. 1.

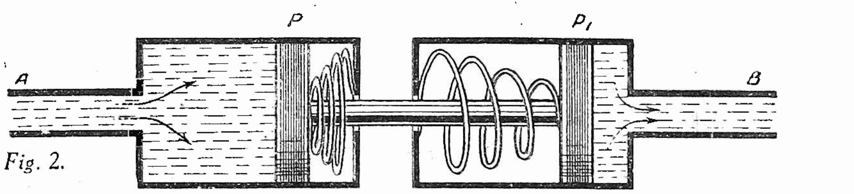


Fig. 2.

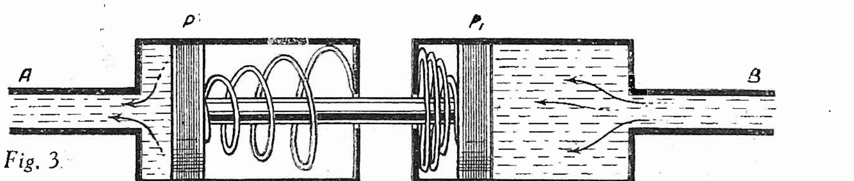


Fig. 3.

Figs. 1, 2, and 3.—Illustrating the action of a condenser by the analogy of a hydraulic piston.

once they have reached the limit of their movement. It will be readily understood from this simple analogy how a condenser offers no passage to a direct current except during the very brief moment whilst it is charging up.

Now let us see how the condenser behaves towards an alternating current. This type of current flows first in one direction and then in the other. Thus, to refer once again to the diagram, it is obvious that when the current attempts to flow from A to B it will force the two pistons to the right as in Fig. 2. In other words, the current will "pass" from A to B. However, the next moment the current will reverse its direction of flow. It will now be travelling from B to A. The water (which represents current) will flow in from B and push the pistons to the left as in Fig. 3, so that an equivalent amount of water is expelled from the left-hand cylinder in the direction A. It will now be seen how the current flows in and out of the condenser almost as though the wire were unbroken. Of course, the water flowing out of the one pipe is not composed of the same identical particles as that which flows into the other pipe because there is no direct communication between the two cylinders. In the same way, the electrons or particles of electricity which emerge from one plate of a condenser are not the same identical particles as those which flow into the other plate. The electricity does not pass through the condenser in this case any more than it does in the case of direct current. The electrons flowing into one plate do not jump the space between the plates but simply cause an equivalent number of electrons to be dislodged from the other plate.

Impedance and Inductance

Having disposed of the fundamentals, we are now in a better position to understand the more abstruse properties of the condenser. Like any other component used in wireless, a condenser offers a certain opposition to the flow of an electric current, and as we are dealing with alternating current this opposition is called its *impedance*. The impedance of a condenser is dependent mainly on two things, namely, *capacity* and *inductance*, and the capacity of a condenser will affect the opposition it offers to a current, because the smaller the capacity the smaller will be the current which it will pass. A condenser of small capacity is similar to having small cylinders in the water-pump device in Figs. 1 and 3. If the volume of water which attempts to flow into and out of the cylinders is greater than they will hold, then the flow will be restricted. What is, perhaps more important still is the fact that the impedance of a condenser due to its capacity varies according to the speed with which the current fluctuates, that is, according to the *frequency* of the current; thus the higher its frequency the less is the impedance offered by the condenser. This is why, for decoupling and such purposes, it is possible to use smaller condensers in the high-frequency parts of the circuit than in the low-frequency stages. A small condenser by-passes a high-frequency current as readily as a large one would a low-frequency current.

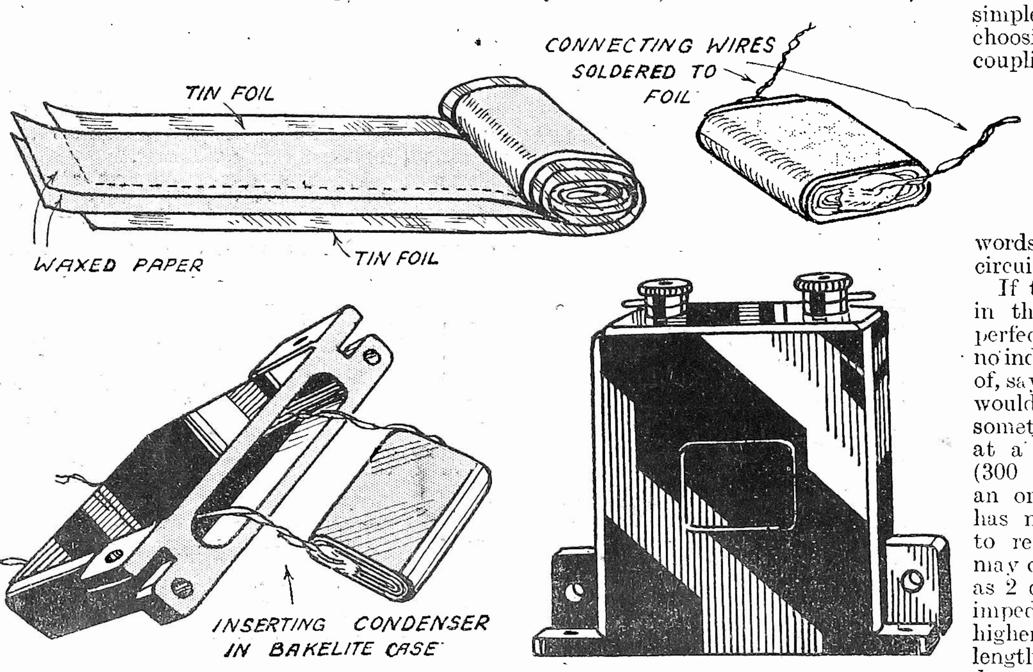


Fig. 5.—A paper condenser and details of its construction.

The Effect of Inductance

That the impedance of a condenser decreases as the frequency of the current is increased is perfectly true when the condenser possesses capacity only, but when it possesses inductance as well this rule no longer holds good. Inductance is a property associated essentially with tuning coils and chokes, etc. There is no need to go into a lengthy explanation of inductance here, suffice it to say that it is due to the magnetic field created round a wire when an electric current passes through it. A wire which is wound in the form of a coil will have a greater inductance than a straight wire, since the magnetic field surrounding one turn of wire interacts with that surrounding the adjacent turns. Of course, a simple condenser consisting of two or more flat plates, as in Fig. 4, has very little resemblance to a coil, and its inductance is, in fact, negligible. However, with the paper type of condenser, in which long strips of metal foil are rolled up with an interleaving dielectric of paper, as in Fig. 5, there is a marked similarity to a tuning coil. The rolled-up foil acts as a small coil, and possesses considerable inductance.

Now the effect of inductance in a condenser is the reverse of that of capacity, for whereas the impedance of the condenser due to its capacity *decreases* with an increase in the frequency of the current, yet the impedance due to its inductance *increases* with the frequency. To take a simple example, suppose we are choosing a fixed condenser for decoupling purposes between the screening grid and the cathode of a screen-grid valve or H.F. pentode valve. This condenser must offer the minimum possible impedance to high-frequency currents, in other words, it must provide a virtual short circuit for high-frequency currents.

If the condenser which we install in this position is theoretically a perfect one possessing capacity but no inductance, then one of a capacity of, say, 1 mfd. would be suitable. This would have a very low impedance of something like one-seventh of an ohm at a frequency of 1,000 kilocycles (300 metres). However, if we use an ordinary paper condenser which has not been specially constructed to render it non-inductive, then it may offer an impedance of as much as 2 ohms or more. Moreover, this impedance will increase rapidly at higher frequencies (lower wavelengths). This is because the impedance due to inductance becomes increasingly greater with the increase in frequency, and more than outweighs the decrease in impedance due to capacity.

It is because the presence of a small amount of inductance produces such a marked increase in the impedance of a condenser at high-frequencies that the non-inductive types are specified in the H.F. stages of a receiver. In the L.F. stages, however, a non-inductive condenser is not so important.

(*To be continued.*)

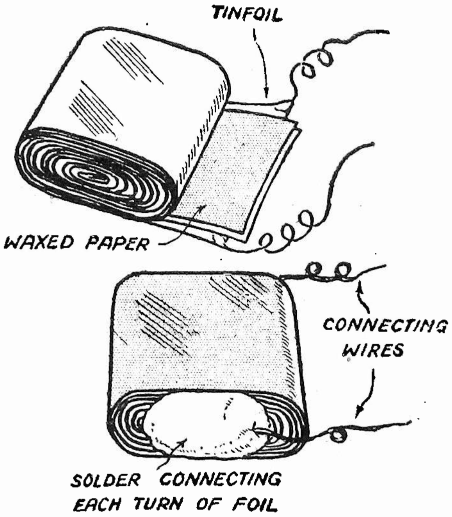


Fig. 6.—The top sketch shows a paper condenser which would be inductive, connections being taken from the ends only of the foil. That shown below is non-inductive since each turn of foil is connected.

RANDOM JOTTINGS

Selectivity and Rainy Weather

MANY radio fans complain that during rainy weather the tuning of their receiver becomes much broader. Investigation as to the reason for this usually points to defective aerial and earth systems. Examination should be made of the insulators, and it is a very important point that only insulators of the glazed porcelain or glass type should be used. Unless they are glazed, they become porous and permit of leakage of current in wet weather. The lead-in wire should be kept well away from the side of the building. The insulators cause a leakage path between the aerial wire and the pole, and when this is of the tubular iron type the leakage is very marked. When the pole is composed of wood it is dampened by the rain and thus forms another easy leakage path. This leakage of energy causes the tuning of the set to be broadened, and also makes it difficult to receive stations on the lower waveband, because a portion of the building, or the pole, has been added to the electrical circuit. Large porcelain insulators should always be used, but not heavy enough to place a strain on the aerial wire. It is also advisable to use a pole which consists of heavy hard wood that will withstand dampness. The point where the lead-in wire is joined to the aerial proper should be well soldered and wrapped with a heavy covering of tinfoil. Over the foil bind a little insulating tape to prevent water from reaching the joint.

Soldering Iron to Steel

A DIFFICULTY often experienced by constructors is that of soldering iron to steel, and the following method of making a satisfactory joint may prove useful to readers. The parts to be soldered should first be cleaned with a file and emery paper, and then washed in a solution of copper sulphate. Mix one teaspoonful of sulphate in an ounce of water, using either a piece of copper wire or a wooden stick for the purpose. This process puts a coating of copper on the iron.

The Aerial System

MANY people believe that the better the aerial the better the signals. This is true, but it does not necessarily mean that a long aerial is best. The function of the aerial is to transfer to the receiver the small electric currents which are set up by the magnetic waves transmitted through the ether. The receiving apparatus must discriminate between the electric impulses due to the radio wave it is desired to receive, and the impulses due to the undesired waves. This aerial question has much to do with the selectivity of any receiver, and the most selective one offers a high resistance to the flow of current which would be set up by the waves from undesired stations and offer a low resistance path for the flow of current due to the impulses from the waves it is desired to receive. Unless you have a good aerial system you cannot expect, even with a selective receiver, to hear the stations you desire without interference from others. The receptive ability of an aerial is determined by the height of its horizontal portion above the earth. Experiments have shown that for the most perfect results, its location should be perfectly clear and free from surrounding objects. have a height of approximately 35 feet, and an overall length, from the far end to the receiver, of not more than 60 feet.

(Continued overleaf)

RANDOM JOTTINGS

(Continued from previous page)

An Aerial Question

IT is difficult to understand why there should still be any doubt as to how an aerial should be erected, but there appears to be one point concerning the down lead which is not properly understood by some readers. The mistake should never be made when erecting an aerial of having two separate lengths of wire, one for the horizontal section, and one for the down lead. The aerial should be in one piece from the free, or mast, end to the lead-in tube. Where the down lead leaves the horizontal section the end of the wire should be passed through the insulator and then wrapped round the straight section three or four times before taking it down to the tube. When this is done there is no risk of loose contacts, and corrosion can be prevented by covering the twists with a length of insulation tape.

Wired Wireless

WE occasionally hear from a reader seeking advice regarding the advantages of installing a wireless set, or using at a small cost per week the service of wired wireless which is being given in many districts. While the latter system has quite a number of advantages, it is really only the forerunner of owning your own receiver. The reproduction and service is good, and the plan entirely practical and useful in densely populated areas where difficulty is experienced in erecting aerials, but it will never supersede the wireless set. The one quality of a broadcast receiver which has gripped public interest is its universal freedom. It reaches everywhere, and is free for all who provide themselves with receiving sets and licences, whereas with wired wireless there is a limit of reception to two or three stations.

Electrolytic Rectifier Solution

EVIDENTLY there are a large number of amateurs using, or considering the use of, electrolytic rectifiers, judging by the number of inquiries we have received asking for information on how to make the solution. The solution is prepared by dissolving pure borax in distilled water. The borax is added to the water until no more can be dissolved. The solution should then be put aside for a short time to allow the extra borax to settle in the form of crystals at the bottom of the container. The clear solution can then be poured off to use in the rectifier. Remember only pure borax should be used.

Soldered Joints

ALTHOUGH a great number of radio kits are so arranged that no soldering need be done, there is always the risk, when the leads are simply screwed down beneath terminals, of their becoming loose eventually with consequent scratching noises in reproduction. It is far better to have soldered connections, and these can be properly made after a little practice. The best plan is to apply some solder to each section of the joint first, after putting a little flux on each. Then when the two ends are held together the soldering iron is applied until the joint is made and the flux is evaporated. The finished joint should be cleaned by wiping it with a clean rag moistened with alcohol.

SUPPLEMENT TO "PRACTICAL WIRELESS"

AMATEUR TELEVISION

TELEVISION SIGNAL DISTORTION AND CORRECTION

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

WHEN it is desired to transfer a television signal from one point to another, a line channel must be used for at least part of the way, even although the main link may be constituted by a radio channel. In order, therefore, to preserve the characteristics of the signal which are essential to the proper reproduction of a television image at the receiving station, the lines which are employed must either possess certain electrical features or be artificially imbued with them.

A Perfect Transmission Line

Any uniform two-conductor line possesses resistance, inductance, capacity, and leakage (the last-named is generally represented as a resistance between the lines, as shown in Fig. 1). Mathematically it can be proved that if there is to be no phase divergence of the various components which go to make up the television signal, and which differ in frequency, then the simple expression

$$\frac{L}{C} = \frac{r}{g}$$

must hold throughout. A line possessing this continuous balance of inductance,

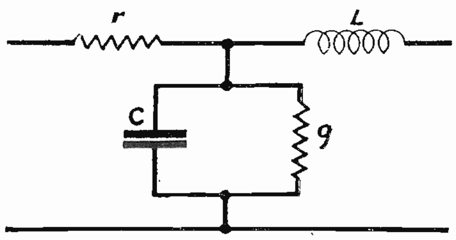


Fig. 1.—Representing the four quantities possessed by two uniform lines.

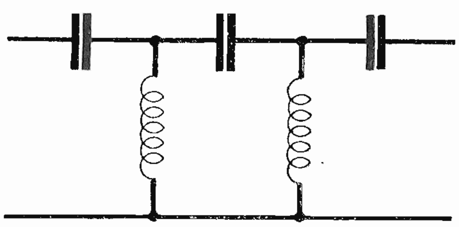


Fig. 2.—An ordinary two section T-filter.

capacitance, etc., is termed a distortionless line, but in practice such a line is necessarily either expensive or wasteful of power, or a mixture of both. Artificial methods have therefore to be adopted in an effort to make transmission lines more nearly perfect, and the cheapest form of carrying this out is known generally as lumped correction, which is simply the introduction into the line channel at some convenient point of a network, or cascade of networks, designed to have a characteristic approximately the reverse of that line.

A Complex Wave

Since any television signal consists of a complex wave containing many components throughout a range of frequencies, it is essential that frequencies throughout

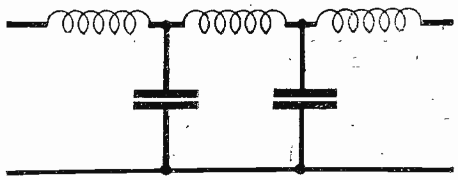


Fig. 3.—A low-pass inverse filter.

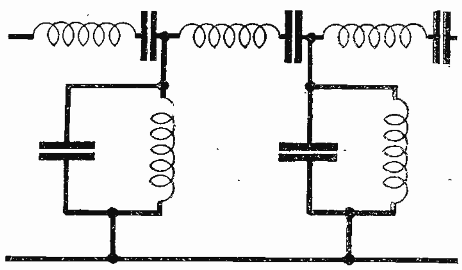


Fig. 4.—A modified circuit designed to give a band pass.

this range can be transmitted so that they arrive at the end of the line in their correct relative amplitudes, and also in their correct relative phases.

In order to achieve the first condition it is sufficient to pass those frequencies which are most susceptible to attenuation in the line at sufficiently great amplitude to enable them to be separated from line noises and parasitics in subsequent amplifiers. The less attenuated frequencies can then be attenuated artificially to their correct relative level.

The second condition will be fulfilled if the line has, or can be artificially imbued with, such a characteristic that all frequencies are retarded in phase by an amount proportional to their frequency. Networks which are designed to produce the first condition are termed amplitude equalizers or just eqtializers, while those made to ensure the second condition are called phase correctors.

Filters

As an indication of the practical applications of schemes of this character reference can be made to Figs. 2 and 3. The first represents an ordinary two-section T-filter for passing high frequencies and attenuating low ones. By a careful choice of values for capacitances and inductances the series impedance can be made fairly small at those frequencies which it is desired to pass, while the shunt impedance (through the coils) can be made reasonably low at low frequencies without attenuating very much the high frequencies to be passed by the filter. Analogously the coils in the low pass inverse filter of Fig. 3 tend to attenuate high frequencies more than the low ones by reason of the fact that the impedance of each, namely, $2\pi fL$ increases with frequency, while the shunt impedance is low at high frequencies because the impedance of each condenser, that is $\frac{1}{2\pi fC}$ decreases with every rise in frequency.

A modified circuit giving a band-pass is shown in Fig. 4, the tuned circuits in the shunt branches being designed to resonate at the same frequency, somewhere in the region of the band of frequencies which it is desired to pass, while the series circuits are also designed to resonate at the same point. The subject of "networks" is a vast one, and interested readers can turn to books of reference if desired, but in practice a very special type of network is used for lumped equalization and correction. One of the distinctive properties is that it presents an impedance which is equivalent to a pure resistance of constant value when it is closed at the output end with a pure resistance of that value.

Particular Cases

An inverted-L circuit of this type is shown in Fig. 5, being designed for equalization, and mathematically it can be shown that

$$R^2 = \frac{L_2}{C_1} = \frac{L_1}{C_2}$$

is the relationship which must hold to fulfil the equalization conditions. Besides the inverted-L type of structure many others may be devised with identical characteristics, the transition from one type of structure to another proceeding according to simple formulæ connecting the values of the elements in the various branches.

Turning now to the design of circuits for phase correction it is possible to use networks having properties analogous to those used for constant resistance equalization. That is to say, these networks present an impedance equivalent to a constant pure resistance at all frequencies to input currents, giving, in addition, relative phase shift in various parts of a range of frequencies without relative attenuation. A circuit of this nature is shown in Fig. 6. This has a lagging phase angle at frequencies below, and a leading phase angle at frequencies above the condition for which the expression $4\pi^2f^2LC=1$ holds good. As before, mathematically it can be shown that the constant resistance condition is given by $R^2 = \frac{L}{C}$

(To be continued)

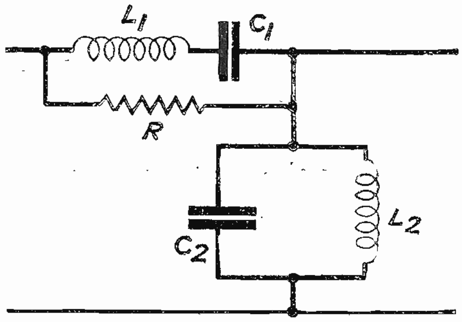


Fig. 5.—An inverted L-type circuit designed for equalization.

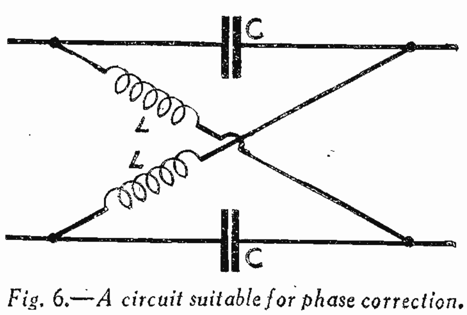


Fig. 6.—A circuit suitable for phase correction.

Facts and Figures

Components Tested in our Laboratory

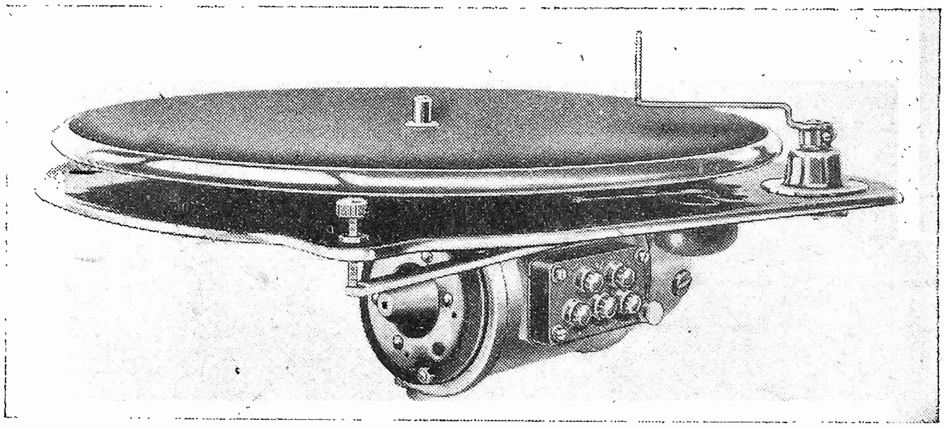
BY THE PRACTICAL WIRELESS TECHNICAL STAFF

B.T.H. Gramophone Motors

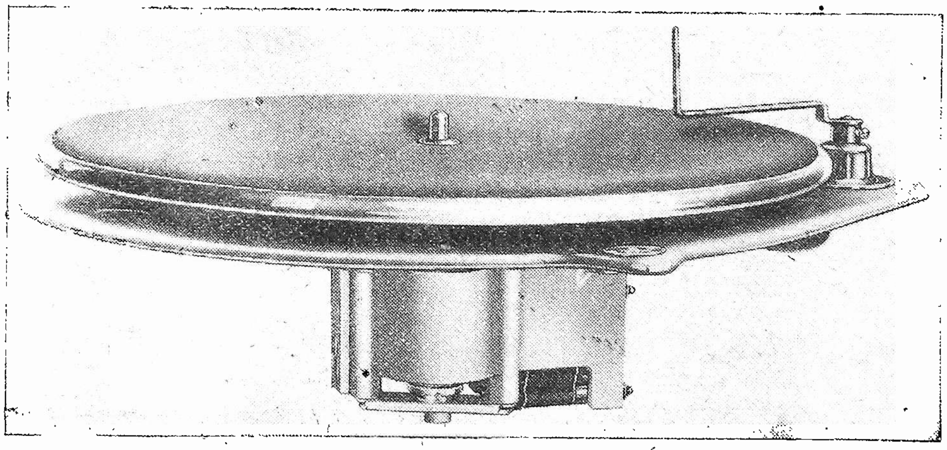
FOR the 1934-5 season, the British Thomson-Houston Co., Ltd., is putting forward three types of electric gramophone motors, comprising the "Truspeed-A.C.," the "Truspeed-D.C.," and the "Universal" models. Each of these motors has its own particular characteristics, but all possess ample power to deal with the heaviest recordings without speed fluctuations. Also they eliminate entirely the ceaseless spring-winding which detracts so much from the pleasure of gramophone music. The distinctive features of each motor are given below, but it may be mentioned here that all are fitted with an automatic "on" and "off" stop switch, adjustable to any make of tone arm and operative on any record with a run-off groove, and a 12-inch plush turntable. The models are attractively finished in Florentine bronze. The "Truspeed-A.C." motor is the only self-starting synchronous motor offered for gramophone work. Apart from its low purchase price, its playing speed is electrically controlled without variation, and it costs only about 6d. a year to run. It is provided with ample bearings and good gearing, and has no rubbing contacts, so ensuring silent and trouble-free operation. Also it is free from radio interference. This model is suitable for portable or cabinet gramophones, and is priced at £2 9s. 6d.

The "Truspeed-D.C." universal model was designed primarily for D.C. circuits, but can be used on 40-50 cycle A.C. circuits if desired. It is silent in operation and extremely economical to run, the consumption being only 15 watts. Correct playing speed is maintained by a well designed governor, and is adjusted by a speed regulator. The totally-enclosed motor cannot be fouled by dust or dirt, and the bearings are self-aligning. The torque exerted is ample for the heaviest record passages. The price of this model is £3 7s. 6d.

The Universal model is a powerful A.C. or D.C. motor of universal application for arduous service in the home, club, or café, and for those districts where the supply may be changed from direct to alternating current. The turntable is driven direct from the motor spindle, and complete speed control is afforded by a well-designed governor and speed regulator. As with the other models, care has been taken in the design to ensure that this machine is completely silent in operation. The price is £4 19s. 6d.



The "Truspeed D.C." (Universal) gramophone motor for A.C. or D.C. operation.



This is the "Truspeed-A.C." model for use on 100 to 250 volt, 50 cycle, A.C. mains.

Wilson Metal Chassis

WE have received from Wilson Radio Electric, of Newson Street, Ipswich, a sample metal chassis for the Midget Short-Wave Two recently described by us. This is a fine sample and fully meets our demands of a high-class article at a reasonable cost, and we have no hesitation in recommending it to our readers. We understand that this firm is able to supply aluminium or steel-sprayed chassis for any type of receiver, and readers who are interested should get into touch with them.

G.P.O. and Goltone Interference Suppressors

IT is interesting to note that a comprehensive range of Goltone interference suppression devices is being exhibited by the G.P.O. The range was first shown at the Radio Exhibition at Olympia, and then at Glasgow. The Exhibition at Belfast is also furnishing an exhibit, whilst a further exhibition will be seen at the Waverley Market, Edinburgh, from 10th to 20th October. Free literature covering the Goltone devices will be available.

T.C.C. Price Correction

IN our issue dated August 25th we referred to the new No. 2 T.C.C. interference suppressor. It was stated that the price of this component was 12s. 6d., and we now understand from the makers that the price is actually 18s. 6d.

A Magazine Hack-saw

A NOVELTY in hack-saw designs has been received for test from Messrs. James Neill and Co. (Sheffield), Ltd. The frame, which is of tubular design, utilizes the bow to form a magazine in which five spare blades of assorted pitch are carried. In addition, the handle is engraved with a useful table setting out the correct type of blade for any kind of job. Both tension pieces may be turned instantaneously to enable cutting at right angles to be carried out. This is a most handy saw for the engineer, electrician, or radio amateur, and the price, complete with six 10in. Eclipse flexible blades, is only 5s.

Two New Cossor Valves

TWO interesting valves have now been added to the range of Cossor valves, and these include a 2-volt Pentagrid and a Universal (A.C./D.C.) H.F. Pentode valve. The former has a .1 filament and is designed for use with a maximum anode voltage of 150, and its use is, of course, in a superheterodyne receiver, where it performs the dual function of first detector and frequency changer. The second valve has a 13 volt .2 amp heater, and is designed for a maximum voltage on the anode of 200, with 100 volts for the auxiliary grid. In addition to its normal use in the high-frequency stage, it may also be used as a highly efficient detector. The price of this valve is 17s. 6d., whilst the other valve costs 18s. 6d. The reference type numbers are 210 P.G. for the battery valve, and 13 S.P.A. for the Universal H.F. Pentode.

PRACTICAL LETTERS

(*Continued from previous page*)

practical tests working against the clock would take away a little apparent self-conceit. The ability to cure parasitic noises and instability does not qualify him to sneer at men who get on the radio bus where he apparently gets off. Such ability is within the powers of the amateur, and a little more besides. It is clear, "Another Serviceman," that your informant failed to bring you down to earth, and I hope, therefore, that this letter will have the desired effect.—" EXPERIENCED " (Middlesbrough).

DISTORTIONLESS REPRODUCTION

(*Continued from page* 101)

in Fig. 3, and while this has the advantage of requiring no balancing adjustment it complicates the input connections.

H.F. Amplifier-detector Unit

The H.F. amplifier-detector unit used to feed an amplifier of this type, should be designed so that high-note loss, due to very sharply tuned circuits, is not appreciable. If it is desired to use the receiver and amplifier for reception of the more powerful distant stations a single H.F. stage preceded by a band-pass filter, and followed by a diode detector, would be suitable. A double-diode-triode could conveniently be used in this case, the triode section being used as V.1 of the amplifier shown in Fig. 2.

To prevent heterodyne, and similar interference, when receiving stations, other than the local, a heterodyne filter could be arranged to be switched into circuit when desired.

RADIO CLUBS AND SOCIETIES

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

SLADE RADIO

"MULTIPLE Electrode Valves" was the title of the lecture given by Mr. E. N. Shaw, of the Marconiphone Co., Ltd., at the last meeting of this Society. After stating that he would deal with the diode and its developments, he drew what he styled "the family tree" of valves. Starting with the diode he gave suitable circuits for the various valves, including the Pentagrid, Heptode, Class B, double diode, and double diode triode, also explaining the various points in connection with each type. A.V.C., delayed A.V.C., amplified delayed A.V.C. and squelch systems were explained, also balancing control and squeeze systems, together with automatic modulation control. Hon. Sec., 110, Hillaries Road, Gravelly Hill, Birmingham.

INTERNATIONAL SHORT-WAVE CLUB (LEICESTER CHAPTER)

THE members of the Leicester Chapter held a special meeting on Sunday, September 16th, at 3 p.m., on the occasion of a personal visit of Mr. A. E. Bear, the European representative of the International Short-Wave Club. Mr. Bear gave a very interesting talk on the formation of the I.S.W.C. by three members in the U.S.A. five years ago, and went on to say that the club has now over 9,000 members in 94 different countries of the world. The club has the support of many well-known broadcasting stations, of which Mr. Bear had a very fine display of photographs. The membership of the I.S.W.C. is only 4s. 6d. per year, and includes the club's monthly magazine, *International Short-Wave Radio.*

Any readers of PRACTICAL WIRELESS are invited to attend the Leicester Chapter's headquarters at No. 4B, Princess Road, Leicester, any Wednesday evening after 8 p.m. Secretary, C. Cramp, 49, Avenue Road, Leicester.

EXETER AND DISTRICT WIRELESS SOCIETY

THE programme for the Autumn Session, 1934, is as follows:—

October 8th. "The New Radio Season's Developments." Mr. E. F. Gibbs, of A. C. Cossor, Ltd.

October 15th. "The Refraction of Wireless Signals by the Detector." A new theory, with demonstration. Mr. D'Arcy Ford.

October 22nd. "The Orthodox Theory. Is it Wrong?" A reply to Mr. D'Arcy Ford, by Mr. A. H. Pratt.

October 29th. "When shall we get real Television?" A lecture on the practical aspect of Television, by Mr. T. D. Humphreys, of the Edison Swan Electric Co., Ltd. (Mr. Humphreys will be well remembered for his highly successful demonstration of television reception at the Society's headquarters last autumn.)

November 5th. Open Night, W.R.R.L. Reports, discussion of members' problems, etc.

November 12th. "Recent Advances in Quality Reception." Lecture by the Marconiphone Co., Ltd.

November 19th. "Stop Press Night." Details to be announced later.

November 26th. Visit to the Washington Singer Laboratories of the University College of the South-West. Members will be conducted over the buildings by Mr. V. Searle, M.Sc.

December 3rd. "Recent Short-Wave Experiments." Mr. H. A. Bartlett. (G5QA).

December 10th. Junk sale of members' apparatus.

All members are invited to bring their friends. Lectures commence at 8 p.m. at the Y.M.C.A., High Street, Exeter. Annual subscription 5s. Hon. Sec., W. J. Ching, 9, Sivell Place, Heavitree.

THE CROYDON RADIO SOCIETY

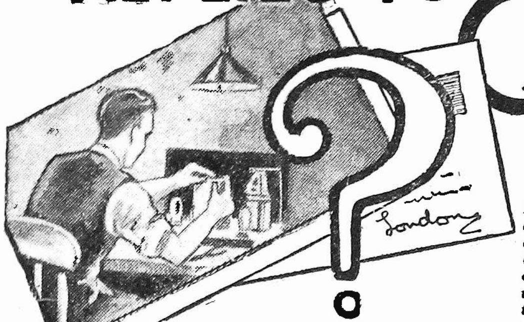
THIS Society will be ten years old on Tuesday, October 9th, 1934, on which date the new session commences. For the birthday programme itself Captain P. P. Eckersley, M.I.E.E., will give a talk, entitled "From Writtle to 1934," and with his usual breezy manner, the first decade of broadcasting should be well and truly aired at St. Peter's Hall, South Croydon. Moreover, the Society's President, Mr. H. R. Rivers-Moore, B.Sc., A.M.I.E.E., is presiding for the occasion.

The committee has had difficulty in maintaining this standard for succeeding meetings, but such items as the ever-popular gramophone pick-up and loud-speaker nights are worthy of the birthday session, while lectures on the new season's valves, and accounts of the latest developments in loud-speaker design, are important events. A member, Mr. H. G. Salter, is giving another musical programme on records, and as his recitals have steadily been growing in popularity, this one should be warmly received.

PRACTICAL WIRELESS readers are urged to apply for the first half session's fixture card, giving programmes in detail up to Christmas. Anyone interested are invited to come along and enjoy the Croydon Radio Society's tenth birthday, and other evenings. Hon. Secretary, E. L. Cumbers, Maycourt, Campden Road, S. Croydon.

REPLIES TO QUERIES and ENQUIRIES by Our Technical Staff

LET OUR TECHNICAL STAFF SOLVE YOUR PROBLEMS



The coupon on Page 114 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.

Chassis Design

"In looking at many old receivers, as well as many up-to-date commercial receivers, I notice that a flat base with a vertical control panel is used. On the other hand, many commercial sets (especially mains types) as well as all of your designs are fitted with an inverted tray type of base either of metal or metal-covered wood. I am only a recent subscriber to your magazine and should be glad if you would explain the differences in these methods of building."—R. W. E. (Aberystwyth).

Apart from the simpler method of construction which the flat base calls for, there is a much neater wiring plan possible when the tray type of base is employed. The greatest point in favour of the latter method of construction is to be found in the increased stability which results from the separation of individual circuits. Thus, the anode-circuit components may be arranged beneath the tray and the grid circuits on top (or vice versa), and the metal tray, which is earthed, completely separates the two sections and prevents instability due to interaction. The final receiver is also more compact.

Improving the Leader

"I have built the Leader 3, and am exceedingly pleased with the results. I get dozens of stations, but many of the foreigners are not quite loud enough on the speaker to be comfortably audible, and I therefore wish to add a further L.F. stage. Are there any special precautions which I should watch when adding this stage? I intend to use a standard arrangement with separate H.T. voltage for the present output stage."—G. B. (Blackpool).

Apart from the fact that we do not advise any modification to our published circuits, there is the fact that the addition of a further L.F. stage will introduce difficulty due to overloading of the extra valve on many stations. The only practical manner of obtaining a greater output from the circuit in question is the substitution of a pentode valve for the present output stage, but you must carry out this modification at your own discretion.

Eccentric Aerials

"My neighbour has recently carried out a modification to his aerial wire, the addition of a number of spiders of wire at frequent intervals giving him greatly improved results. I am informed that this is a standard method of improving pick-up, yet I believe I have read that such schemes are bad from a technical point of view. Can you tell me whether this is, in fact, so?"—K. A. (Highbury).

We have seen a number of aerials decorated in the manner you mention, but in the majority of cases it has been found that the improvement is very slight, and could have been improved upon by arranging two twin wires in place of the existing single wire with its decorations. The only advantage is the increased area of wire which is available for reception, and it is possible to spoil a good single wire aerial by adding odd pieces of wire in the manner indicated. Two wires separated by a distance of not less than three feet will be found of advantage where only a short garden space is available.

H.F. Choke Unnecessary

"I have an old three-valve set in which R.C. units are employed between the valves. I have recently cleaned up the set and have started to take an interest in set building, following the various details published in your pages. I notice with alarm that there is no H.F. choke in the detector circuit of my set, yet reaction is perfectly smooth and controllable. I should like to know whether a choke must be included?"—B. T. A. (Worthing).

It was customary some time ago to omit the choke when a high value anode resistance was employed, but we would certainly recommend the inclusion of a choke as it functions differently at various frequencies from the resistance, and you will be more certain of keeping the H.F. currents out of the L.F. amplifier with the possibility of purer reproduction.

What is a Coherer?

"I have been reading some old wireless books and have come across the term coherer. I should be glad if you could explain briefly what this device is, and where it is included in a modern set, or what has taken its place."—T. H. (Bangor).

The coherer was the original form of signal detector, and consisted in principle of a glass tube in which were loosely arranged some iron filings. A cork plugged each end and wires were led into the corks. On the application of a signal the filings became "energized" and consequently joined up or "cohered." Theoretically, on the cessation of the signal the filings would fall apart again and thus break the circuit. The crystal took the place of the coherer and the valve has superseded the crystal.

No Grid Leak

"I have an old two-valve set in which a straight detector and output arrangement is used. I was trying out some experiments recently and found that signals were still obtainable in undiminished strength when the detector grid leak was removed. Can you account for this, as I understood the valve would choke if no leak was fitted?"—W. E. (Stockport).

Provided that signals could be obtained for long periods without the leak, it tends to show that there is already a leak in circuit. In an old receiver it is possible that the valve-holder is made from an inferior moulded material and a leakage path exists between the grid and filament terminals, thus providing the necessary path without the inclusion of a separate grid leak.

THE QUERIES COUPON APPEARS ON PAGE 114

Miscellaneous Advertisements

Advertisements are accepted for these columns at the rate of 3d. per word. Words in black face type and/or capitals are charged double this rate (minimum charge 3/- per paragraph). Display lines are charged at 6/- per line. All advertisements must be prepaid. Radio components advertised at below list price do not carry manufacturers' guarantee. All communications should be addressed to the Advertisement Manager, "Practical Wireless," 8, Southampton Street, Strand, London.

PREMIER SUPPLY STORES

Offer the Following Manufacturers' Surplus New Goods at a Fraction of the Original Cost; all goods guaranteed perfect, carriage paid over 5/-, under 5/- postage 6d. extra, I.F.S. and abroad, carriage extra. Orders under 5/- cannot be sent C.O.D. PLEASE SEND FOR ILLUSTRATED CATALOGUE POST FREE.

STUPENDOUS Purchase of Set Manufacturers' Stock. All electric 3 Valve (S.G. Det. Pen.) Set in Walnut Cabinet with moving-coil speaker 200-250 volt 40-60 cycles. Chassis built. 200-2,000 metres with 4 valves, £4/19/6.

ALL Electric 3-stage Amplifiers, 200-250v., 40-60 cycles, 10 watts, undistorted output, complete with 5 valves, £7/7/-. Suitable speakers, pick-ups and microphones can be supplied.

TYPE 4480, 9in. diameter, permanent magnet. Handles 4 watts. 7 ohms speech coil, 13/6. Multi-ratio transformer, 4/6 extra.

PREMIER SUPPLY STORES Announce the Purchase of the Complete Stock of a World Famous Continental Valve Manufacturer; all the following standard mains types, fully guaranteed, 4/6 each, H.L., power, High, Medium, Low magnification, Screen Grid. Directly heated Pentodes, 1 watt, 3 watt and 4 watt A.C. outputs.

THE following Type, 5/6 each; 350 v. and 500 v., 120 milliamp full wave rectifiers, 2½ watt indirectly heated pentode.

THE Following American Types at 4/6; 250, 227, 112, 171, 210, 245, 26, 47, 24, 35, 58, 55, 37, 80 and the following types, 6/6 each: 42, 77, 78, 25Z5, 36, 38, 83, 39, 44, 53, 6B7, 2A5, 2A6, 2A7, 2B7, 5Z3, 6C6, 6A4, 6D6, 6F7.

ELIMINATOR Kits, including transformer, choke, Westinghouse metal rectifier. Condensers, resistances and diagram, 120v., 20 m.a., 20/-; trickle charger, 8/- extra; 150v., 30 milliamps, with 4v., 2-4 amps. C.T., L.T., 25/-; trickle charger, 6/6 extra; 250v., 60 milliamps with 4v., 3-5 amps. C.T., L.T., 30/-; 300 v. 60 m.a. with 4 volts, 3-5 amps., 37/6; 200v. 50 m.a. with 4v. 3-5 amps. L.T., 27/6.

PREMIER chokes, 40 milliamps, 25 hys., 4/-; 65 milliamps, 30 hys., 5/6; 150 milliamps, 30 hys., 10/6; 60 milliamps, 80 hys., 2,500 ohms, 5/6; 25 milliamps, 20 hys., 2/9.

ALL Premier Guaranteed Mains Transformers have Engraved Terminal Strips, with terminal connections, input 200-250v., 40-100 cycles, all windings paper interleaved.

PREMIER H.T.7 Transformer, output 135v. 80 m.a. for voltage doubling, 8/6; 4v. 3-4a., C.T. L.T., 2/- extra; with Westinghouse rectifier giving 200 v. 30 m.a.,) 17/6.

PREMIER H.T.8 and 9 Transformers, 250v., 60 m.a. and 300 v. 60 m.a. rectified, with 4v. 3-5a. and 4v. 1-2a., C.T. L.T. and screened primary, 10/-, with Westinghouse rectifier, 18/6.

PREMIER H.T. 10 Transformer, 200v. 100 m.a. rectified with 4v. 3-5a., and 4v. 1-2a., C.T. L.T. and screened primary, 10/-; with Westinghouse rectifier, 19/6.

PREMIER Mains Transformer, output 250-0-250v. 60 m.a., 4v. 3-5a., 4v. 2-3a., 4v. 1-2a. (all C.T.) with screened primary, 10/-.

PREMIER Mains Transformers, output 350-0-350v. 90 m.a., 4v. 3-5a., 4v. 2-3a., 4v. 1-2a. (all C.T.) with screened primary, 10-/.

PREMIER Auto Transformers, 100-110/200-250v. or vice versa, 100-watt, 10/-.

WESTERN ELECTRIC Mains Transformers, 300-0-300v. 65 m.a., 4v. 1-2a., 4v. 2-3a., 6/6; 500-0-500v., 150 m.a., 4v. 3-5a., 4v. 2-3a., 4v. 2-3a., 4v. 1a. C.T., 4v. 1a. C.T., 19/6.

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

PREMIER L.T. Charger Kits, consisting of Premier transformer and Westinghouse rectifier, input 200-250v., A.C., output 8v. ½ amp., 14/6; 8v. 1 amp., 17/6; 6v. 2 amp., 27/6; 30v. 1 amp., 37/6; 2v. ½ amp., 11/-.

B.T.H. Truspeed Induction Type (A.C. only) Electric Gramophone Motors. 100-250v.; 30/- complete.

COLLARO Gramo. Unit consisting of A.C. motor. 200-250v. high quality pick-up and volume control, 49/-; without volume control 46/-.

SPECIAL Offer of Wire Wound Resistances, 4 watts, any value up to 50,000 ohms, 1/-; 8 watts, any value up to 15,000 ohms, 1/6; 15 watts, any value up to 50,000 ohms, 2/-; 25 watts, any value up to 50,000 ohms, 2/6.

EDISON Bell Double Spring Gramophone Motors, complete with turn-table and all fittings, a really sound job, 15/-.

WIRE Wound Potentiometers 1,000, 2,500, 50,000, 90,000, 150,000, 200,000, 500,000, any value 2/- each; 1,000 ohms wire-wound semi-variable resistances, carry 150 m.a. 2/-.

CENTRALAB Potentiometers, 50,000, 100,000 ½ meg. any value, 2/-. 200 ohms. wire wound, 1/-.

POLAR Star, manufacturers' model, 3-gang condensers, fully screened, 7/6; with trimmers.

AMERICAN Triple Gang 0.0005 Condensers, with trimmers, 4/11; Utility Bakelite 2-gang 0.0005 screened with uniknob trimmer, 3/6; Polar Bakelite condensers, 0.00035, 0.0003, 0.0005, 1/-.

BRITISH Radiophone 110 kc/s Intermediate, 3/-.

MAGNAVOX D.C. 152, 2,500 ohms, 17/6; D.C. 154, 2,500 ohms, 12/6; D.C. 152 magna, 2,500 ohms, 37/6, all complete with humbucking coils; please state whether power or Pentode required; A.C. conversion kit for above types, 10/-; Magnavox P.M., 7in. cone, 18/6.

RELIABLE Canned Coils with Circuit accurately matched, dual range, iron-cored, 3/6.

RELIABLE Intervalve Transformers, 2/-; multi-ratio output transformers, 4/6.

T.C.C. Electrolytic Condensers, 550v. working, 650v. peak, 8 mf., 4/-; 4 mf. or 8 mf. 440v. working, 3/-; 15 mf. 50v. working, 1/-; 25v. working, 25 mf., 1/3; 6 mf. 50v. working and 2 mf. 100v. working, 6d.; 8+4 mf., 450v. working, 4/-; 50 mf., 50v. working, 2/9.

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

WESTERN ELECTRIC Condensers, 250v. working, 1 mf. 6d., 2 mf. 1/-, 4 mf. 2/-.

H.M.V. Condensers, 400v. working; 4+4+1+1+1+1+1+0.1+0.1+0.1+0.1, 4/9; 4+2+1+1+1+1+1+0.5, 3/9.

DUBILIER Condensers, 8 or 4 mfd. dry electrolytic 450v. working, 3/-.

VARLEY Constant square Peak Coils, band-pass type BP7, brand new in maker's cartons with instructions and diagrams, 2/4.

VARLEY H.F. Intervalve Coils BP8 band-pass complete with instructions in original cartons, 2/6.

SCREENED H.F. Chokes by One of the Largest Manufacturers in the Country, 1/6.

PREMIER British-made Meters, moving iron flush mounting, accurate, 0-10, 0-15, 0-50, 0-100, 0-250 m.a., 0-1, 0-5 amps. all at 6/-.

A LARGE Selection of Pedestal, table and radiogram cabinets, by best manufacturers, at a fraction of original cost, for callers.

THE Following Lines 6d. each, or 5/- per dozen.—Chassis valve holders, 5-, 6-, or 7-pin, screened screengrid leads, any value 1-watt wire end resistances, wire end condensers, 0.0001 to 0.1 Bulgin 3-amp. main switches. Cyldon capacitors, double trimmers.

PREMIER SUPPLY STORES

20-22, High St., Clapham, S.W.4. Telephone: Macaulay 2188. Nearest Station, Clapham North Underground.

WOBURN RADIO OFFER FOLLOWING MANUFACTURERS' SURPLUS:

UTILITY CONDENSERS, air spaced, 0005 with dial and escutcheon, 3/6. Mershom Electrolytics, 8mfd., 500v., 2/9. Dubilier 2mfd., 1000v. test, 1/3. Wego, 750v. test, 1 mfd. 1/-, 2mfd. 1/2, 4mfd. 2/3. Popular iron cored canned coils, 2/6. Eston iron cored coils, 2/6. H.F. Chokes, 10d. Binocular, 1/2. S.W. Chokes, 10d. Tubular Condensers: 0.1, 0.01 and 0.02, 6d. Toggles, 6d. Polymet 0001 tag condensers, 1/3 half doz. Edison 002, 005, 006, 3d. Chassis mounting valve holder 4/5 pin, 1/3 half doz. Igranic tubulars 001, 4d. Class B Drivers and Chokes, 8/6 pair, with B.V.A. Valve and 7 pin holder, 17/-. Rothermel wire wound resistances with switch, 10,000, 25,000 and 50,000, 3/6. Astra differentials 0002, 1/2. Polar 00035 mica reactions, 1/2. Columbia L.F. Transformers, 3/1 and 5/1, 3/-. Westinghouse Rectifiers. H.T. 5, 6, 4/6. Eston Morse Keys, with code, 3/6. Lissen Output Transformers, 23/1, 3/6. Western Electric microphones, very sensitive, boxed, 2/3. Microphone transformers 85/1, 2/3. Marconi transformers, Push-Pull, 4/-. Microphone transformers (Ideal), ratio 100/1, 3/6. Sistoflex 7 yds., 6d.; screened flex, 3d. yd. Ormond twin gang 0005 condensers mica dielectric, with trimmer, and disc drive and escutcheon, 3/9. British Radiophone straight line dials with escutcheon and twin dial lights, 3/9.

RESISTANCES: Bargain parcels of 13 wire wound 1½ watt, resistances accurate 1%, values 100 ohms to 50,000, at 3/9 each, postage 2d.

W.R.C. Eliminators: 150v. 30 m.a. Three positive H.T. Tappings. Guaranteed 12 months. A.C. Model with Trickle Charger (2v. 4v. 6v. ½ amp.), 32/6. A.C. Model, 21/-. Universal A.C./D.C. Model, 21/-. D.C. Model, 9/6. (Carriage extra 1/- on each).

NEW Trade List now ready, enclose heading and stamp.

WOBURN RADIO CO., 9, Sandland Street, Bedford Row, W.C.1. Holborn 7289.

● H.T. THAT LASTS YEARS ●

"Extremely satisfactory service for 12 months on 6 valves."—R.N.W., Portsmouth. Install a Standard Wet Battery. Cheap annual replenishment. Saves Pounds. **120-v. 12,500 m.a. £2, carr. paid.** All Standard H.T. Spares.—Write: **Wet H.T. Battery Co., 95, Dean St., London, W.1.** *Any voltage supplied.*

SOUTHERN RADIO'S Bargains.—Set manufacturers' guaranteed surplus.

VARIABLE Condensers.—Lotus 3-gang 0.0005, 12/6; Lotus 2-gang, 0.0005, 8/6; Lotus Dyblock single, 0.0005, 4/9 (list 9/6); all these condensers are complete with dials, escutcheons, knobs, fully screened with trimmers, and boxed; Hydra block condensers, 16 mfd. (2+2+8+2+1+1), 1,000 v. D.C., 7/- each; Dubilier 4 mfd. (2+1+1), 1,000 v. D.C., 2/9; 4.5 mfd. (2.25+2.25), 1,000 v., for mains noise suppression, 3/-; fixed 4 mfd., 2/3; 2 mfd., 1/6; 1 mfd., 1/-; Utility Midget 2-gang variable condensers, 0.0005, with concentric trimmers, 3/5; T.C.C. 0.1+0.1, 1/3 each.

SPEAKERS.—Blue Spot permanent magnet, with universal transformer for power, super power, pentode and Class B; 23/- (list 39/6).

S.T.400 Kits, all specified proprietary components; £2/19/6 (list £4/17/6).

REGENTONE A.C. Eliminators. Type W5A, combined with trickle charger. 20 milliamps. Brand new and sealed, 39/6 (list £4/12/6).

IGRANIC Superhet Coils, set of 4 (1 Osc., 2 I.F., with pig tails, a L.F. plain); 12/6 (list 50/-).

LISSEN Superhet 3 Coils Kit, screened, ganged on base with wave change and filament switches; type L.N.5181, for battery or mains; 12/6 (list 30/-).

VARLEY Constant Square Peak Coils, complete with all accessories, new, boxed, B.P.5; 2/4.

VARLEY H.F. Inter-valve Coils B.P.6; 2/3.

FRAME Aerials.—Lewcos dual wave superhet, 9/- each (list 27/6).

PICK-UPS.—Marconi No. 19 (1934), 22/6 each (list 32/6).

READY Radio Instamat Transformers, for matching any valve to speaker; Junior model, ratios 1 : 2, 1 : 1, 1½ : 1, 2 : 1, 3 : 1, 7/6 (list 27/6); Senior model, ratios 10 : 1, 12½ : 1, 14 : 1, 16 : 1, 20 : 1, 25 : 1, 12/6 (list 37/6).

OSRAM Thirty-Three Music Magnet, complete with G.E.C. speaker, 2 Osram screen-grid and Osram power valves in moulded bakelite walnut cabinet; £3/12/6 (list £9/9); in original sealed cases.

BOTOLPH Lightweight Portable Receivers, complete with 5 Mullard valves, Exide batteries and accumulator, overall size 13in.×11in.×8in., £2/19/6 (list £8/8); a real suitcase portable.

READY Radio Meteor Screen-grid 3-valve Kits, all specified components new, in sealed cartons 25/-, less valves; with 3 Mullard valves, 42/6 (list £5/7/6).

MULLARD Radio for the Million, "Station Master Three" battery kits, complete with cabinet and 3 Mullard valves (screen grid, H.L., power), brand new in original sealed cartons; £2/19/6 complete.

MISCELLANEOUS.—Westinghouse metal rectifiers. H.T. 6, 7, 8, 9/3 each; Ferranti chokes, 20 henry 60 m.a., 6/9 each; Lewcos superhet, 8-way bases, complete with valve holders, grid leak, fixed condenser type "48," 2/- each; Lissen base turntables, 1/6 (list 5/-); Lewcos coils, B.P.F./R., 4/-; T.B.F./C., 3/3; O.S.C./126 (Extensor), 3/3; T.O.S./R., 3/3; Morse tapping keys, with buzzer and flashlight signal, complete with battery and bulb, 2/- each.

BRAND New American Valves. All Types Available. Please Ask for Quotations.

ALL Goods Guaranteed and Sent Carriage Paid.

BRANCHES at 271-275, High Rd., Willesden Green, N.W.10, and at 46, Lisle St., W.C.2. Please send all post orders to 323, Euston Rd., N.W.1.

SOUTHERN RADIO, 323, Euston Rd., London, N.W.1 (near Warren St. Tube). 'Phone: Museum 6324.

VAUXHALL.—Magnavox Permanent Magnet Loudspeakers, universal, suitable for Class B power or pentode; 7in. cone, 17/6; 10in. cone, 23/-. Energised 2,500 or 6,500, 10in. cone, 22/-; 7in. cone, 15/3. All new with humbucking coils.

VAUXHALL. U.S.A. Rola Energised 8in. diameter, 2,500, 6,500 ohms, 17/6; 10in. diameter, 25/-; P.M. 8in. diameter, 28/-; 10in. diameter, 33/-.

VAUXHALL.—Radiophone Radiopaks, Band-pass or R.F. superhet, with Lucerne wavelength station-named scales, medium and long, complete, 32/6.

VAUXHALL.—Radiophone I.F. transformers, with terminals, 6/-. Radiophone volume controls, with switch, 3/6.

VAUXHALL.—Coils, set of three on base with switch, 16/6. Three-gang condensers, with covers—superhet., 14/6; ordinary type, 12/6. Disc drives, complete, 4/9.

VAUXHALL.—Pick-ups, 8/—£2. Write for quotation. State make, B.T.H. Collaro Motors, 32/6. Gramophone switches, 3/6.

VAUXHALL.—Westinghouse Rectifiers. H.T.8., 9/6; H.T.9, 10/-; Westectors', W4, WX6, 5/9.

CASH with Order, post paid over 2/6, or c.o.d.; all goods unused manufacturers' surplus; guaranteed perfect. Lists free.

VAUXHALL UTILITIES, 163a, Strand, W.C.2. 'Phone: Temple Bar 9338. (Facing Bush House, over Dennys.)

RADIALADDIN (Disposals) Ltd. Exchange your old set for any new model, balance cash or H.P. Write for free quotation to largest radio exchange in U.K. Also clearance sale of reconditioned sets and radiograms at gift prices £1 to £10. Write for list.—46, Brewer Street, Piccadilly Circus, W.1. Gerrard 4055.

HUGE OCT. BARGAINS!

At the "GOLD-MINE" STORES, of London.

Listed supplementary to the "RADIO-GOLD-MINE," now available. Enclose 3d. stamps for COPY TO-DAY, the greatest surplus lists in Radio.

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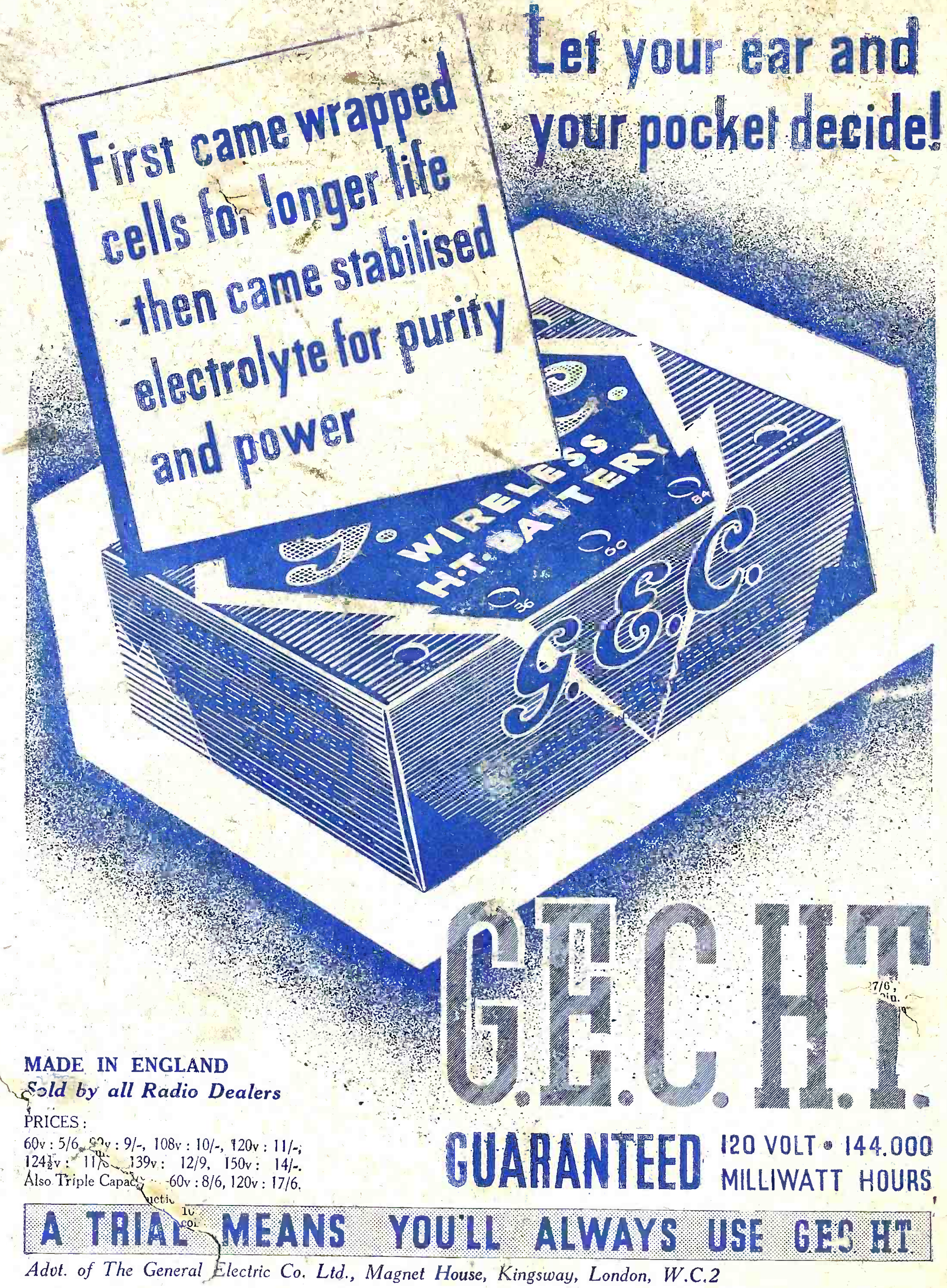

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