SPECIAL ENLARGED ISSUE!

Practical Wireless

3D

AND PRACTICAL TELEVISION

EDITED BY F.J.CAMM

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1934 FURY 4 SUPER

Full Details Inside!

FOR THE NEW WAVELENGTHS

—and how to put it right

to be without this Wireless "Doctor"

OUR latest Gift Offer has been received with tremendous enthusiasm by readers of "Practical Wireless." Reservations are pouring in from all parts of the country, and if *yours* is not among them, the only way to avoid disappointment is to post the Forms alongside without delay.

Remember, this unique and helpful Work has been specially written by F. J. Camm, the Editor of this paper. It is chock-full of practical and intensely interesting advice and hints. It is right up to date and deals with every form of Reception trouble. If your aim is to get the *best* results from your Radio, be sure to avail yourself of this most generous offer before it is too late.

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Practical Wireless

EDITOR:
Vol. III. No. 71 || F. J. CAMM || Jan. 27th, 1934.
Technical Staff:
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Frank Preston, F.R.A., W. B. Richardson.

ROUND *the* WORLD *of* WIRELESS

Six Million Licences

IT is fully expected that by the time these lines are in print, the Post Office will have disposed of its six millionth listening licence, as during November and December the number sold brought up the figures almost to that mark. During the past twelve months over 750,000 were added to the previous total. If, as it is computed, there are twelve million homes in Great Britain, we may now assume that every other house possesses a wireless receiver. There is, therefore, no question of having attained saturation point.

No Reason for Complaint

DURING 1933, the B.B.C. carried out transmissions amounting to 59,966 hours, during which period the average breakdown did not exceed .019 per cent. This is certainly a matter of congratulation, and reflects great credit on the technical staff.

Television in the U.S.A.

ALTHOUGH at times much is heard of the progress of television in the United States, it is interesting to learn that so far no radiovision receivers have been placed on the market by the American wireless industry. Four of the leading television transmitters which were carrying out experimental broadcasts on channels between 100 and 200 metres during 1932-33 have since closed down. At present nine laboratories are working small stations on 2,050 or 2,800 kilocycles. Tests are being specially carried out on ultra-short wavelengths. The National Broadcasting Company now transmits regularly from Radio City (Empire State Building) on 6.8 metres (120 lines).

Another Wavelength Conference

IT is reported that the next meeting of the *Union Internationale de Radio-diffusion* (European Broadcasting Union), will take place in England on June 12-20, when the results of the new Lucerne Wave Plan are to be examined and discussed.

Our Free Query Service

New readers should note that we answer all readers' questions FREE, PROMPTLY, ACCURATELY AND CHEERFULLY.

Germany's Short-wave Network

THE new Zeesen-Koenigs Wusterhausen short-wave transmitters were launched on the ether during the Christmas holidays. They have been provided with directional aerials for broadcasts to Asia, Africa, North and South America. Special programmes for the East are transmitted through DJA on 31.38 metres, those destined to Africa through DJD on 25.51 metres and DJL on 49.83 metres. Transmissions for South America are sent during the late hours of the night *via* DJA on 31.38 metres. Between G.M.T. 23.00 and 02.00 all broadcasts to the American Continent are taken over by DJL on 49.83 metres. For these transatlantic services a selected series of wireless entertainments will be provided, and only certain items of the Berlin programme, of international interest, will be included. Short-wave enthusiasts will find these transmissions of interest.

The New Call from Radio-Paris

SINCE December 18, when Radio-Paris "took the air" as a State-owned transmitter, the station is advertised as the *Poste National* Radio-Paris, and power has been increased to 80 kilowatts. This energy, however, is not considered adequate by the authorities, and steps are to be taken in 1934 to push the power up to 150 kilowatts.

A Cheaper Wireless H.T. Dry Battery

A SUBSTANTIAL concession is given to wireless battery users of the power or triple capacity type of battery by the decision of The General Electric Company, Ltd., to reduce the price of the G.E.C. 60 volt triple capacity H.T. battery (Catalogue No. L.260) from 12s. to 8s. 6d.

Wireless for the Blind

WE are informed that further orders have been placed with Messrs. Burne-Jones & Co., Ltd., of 296, Borough High Street, London, S.E.1, for wireless sets for the use of the blind. This firm has now manufactured and supplied some 24,000 sets of special types, including single and double circuit crystal sets, the latter types being for the use of blind persons in remote areas. Each set employs a special tuning system using Braille characters. It is interesting to note that owing to the stringent method of testing employed, servicing problems are practically nil, amounting to less than ¼ per cent.

Revival of "Florodora"

LESLIE STUART'S popular musical comedy has been specially arranged for broadcasting, and the microphone version of *Florodora* will be given in the National programme on January 29 and through the Regional network on January 31. This famous musical comedy success was first produced at the Lyric Theatre, London, in 1899.

Possible Fate of the Eiffel Tower

IN French wireless circles the fact that in the distribution of the new channels the State has not yet disposed of the national common wave-length of 206 metres leads certain authorities to believe that the wave-length will be reserved to the Eiffel Tower. Such an allocation would permit a continuance of its broadcasts, and the station might carry on a series of experimental transmissions for the French P.T.T.

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

Talk on Bicycle Development

ANOTHER talk in the Midland "stock-taking" series will be heard on January 24th. Dr. William Cramp, who is Professor of Electrical Engineering at Birmingham University, has made a special study of bicycle development in the Midlands, where many notable changes have been introduced. The title of his talk is "From the Penny-Farthing to the Modern Cycle."

Transatlantic Debate

THE next Transatlantic debate will take place on January 27th, and will be between Oxford and Chicago. The subject is: "Resolved, that the Profit motive be eradicated." The Chicago students will speak in the affirmative and the Oxford students in the negative. Mr. Vernon Lyon and Mr. Wells Burnette represent Chicago, and Mr. John Cripps and Mr. David Lewis are the Oxford representatives. Mr. Lewis is a Rhodes scholar from Canada and Mr. Cripps is a son of Sir Stafford Cripps.

Southwell Minster's New Organ

THIS instrument—which has two keyboards, one in the triforium and one in the nave—is to be opened on February 1st. The second of the month marks the jubilee of this fine Norman church's advance to Cathedral status as the centre of a diocese. On the latter date there is a relay from Southwell of an organ recital by the Minster Organist, G. T. Francis, F.R.C.O., and this is to be preceded by a short talk on the Minster, the jubilee, and the previous day's ceremony, by the Ven. Archdeacon W. J. Conybeare, Provost of Southwell. Built by Archbishops of York, Southwell Minster is unique among English cathedrals in having three Norman towers still standing after eight hundred years.

Orchestral Concerts from Birmingham

THE City of Birmingham Orchestra appears in the programmes four times during the week. There is a light orchestral concert from the studio on January 30th, with three Slavonic Dances by Dvorák, ballet music by Delibes, and two of the shorter pieces by Delius in the programme. On February 1st, the Orchestra's luncheon hour concert in Birmingham Town Hall will be relayed; it opens with a Weber overture and closes with Elgar's *Pomp and Circumstance* march in G. Then, on February 3rd, the Children's Concert, which includes six movements from the Nutcracker suite, is to be relayed in the afternoon, and in the evening the Symphony Concert, in which the chief work is Beethoven's Eighth. Leslie Heward conducts at all except the Children's Concert, which is taken by Harold Gray.

Droitwich's New Transmitter

CONSIDERABLE progress has been made with the building of the new long-wave transmitter at Droitwich, which is to replace Daventry 5XX, and we understand that the installation of the plant will begin shortly. It is expected that the station will be ready for service in the early summer this year. The opening of the Droitwich station will mean that the field strength of the National programme over a large part of the country will be such as to make it practicable for listeners in the London, North, and West Regions to receive their National programme from Droitwich instead of the medium wavelength National transmitters in their respective regions. The B.B.C. has, therefore, decided to close down the London, North, and West National transmitters, thus releasing two wavelengths (the London and West National transmitters share a wavelength) for providing a better service in areas which will not be well served, even when the Droitwich transmitter is in operation.

INTERESTING and TOPICAL PARAGRAPHS

FERRANTI VALVES IN THE MAKING

Ferranti valves are made in their entirety at the Hollingwood works, and our illustration shows a portion of the valve assembly department.

Talks on Various Phases of the Supernormal

PSYCHICAL research, telepathy, dreams and what they portend, ghosts, survival after death and other phases of the supernormal are to be discussed in a series of broadcasts in the New Year. The speakers, dates and subjects will be as follows:—January 26th, Lord Charles Hope—"Physical Mediumship"; February 2nd, Professor Seligman—"Primitive Practices and Ideas"; February 9th, Professor Seligman—"Ritual and Healing"; February 16th, Mrs. W. H. Salter—"Telepathy"; February 23rd, Dame Edith Lyttelton—"Dreams and Pre-Vision"; March 2nd, Sir Ernest Bennett—Discussion with another speaker not yet selected on "Guests and Haunted Houses"; March 9th, Sir Oliver Lodge—"Do We Survive?"; March 23rd, Professor C. D. Broad—A Summing Up.

Listeners in the South of France

CORRESPONDENCE received at Broadcasting House from residents in the South of France draws attention to the inability of listeners in that part of Europe to receive the London National programme since the synchronization of the London National and West National wavelengths. Last winter the London National transmissions were very easily picked up all over the Continent, and were greatly favoured, especially by people in the South of France. The B.B.C. points out that a substitute can readily be found. The North National transmitter, working on 301.5 metres (995 kc/s) still gives an excellent service on the Continent of the National programme at night, although this may not be known generally by people who have been trying to get London National. Pending the completion of the new long-wave transmitter at Droitwich, listeners on the Continent would be well advised to tune in to the North National transmissions. On and after January 15th, North National wavelength will be 296.2 metres (1,013 kc/s).

SOLVE THIS!

Problem No. 71.

In his search for better quality Arrowsmith decided to replace his transformer-coupled L.F. stage by a Choke-capacity coupled stage. He therefore purchased a .5 mfd. fixed condenser, a good quality H.F. choke, and a 250,000 resistance, and joined these in the correct manner in place of the transformer. Results were, however, very disappointing, and although he carefully checked all connections he could find nothing wrong. What mistake had he made? Three books will be awarded for the first three correct solutions opened. Envelopes should be marked Problem No. 71 and addressed to The Editor, PRACTICAL WIRELESS, Geo. Newnes, Ltd., 8-11, Southampton Street, Strand, London, W.C.2. All entries must be received not later than January 29th.

SOLUTION TO PROBLEM No. 70.

In wiring up the seven-pin valveholder for his Class B Unit, Atkinson had misread the connections to the pins, and had consequently reversed the anode and grid connections. The following three readers succeeded in correctly solving Problem No. 69 and books have accordingly been forwarded to them: C. M. Dower, 28, Gartmore Road, Goodmayes, Essex; G. C. Jervis, 343, Birchfield Road, Westneath, Redditch, Worcs; J. Simpson, Castlefield, Cupar, Fife.

"Florodora" Broadcast

A BROADCASTING version of the famous musical comedy, *Florodora*, first produced at the Lyric Theatre, London, in 1899, will be given in the National programme on January 29th and in the Regional programme on January 31st; this was one of the most charming of the musical plays of Leslie Stuart; the book was by Owen Hall and the lyrics by E. Boyd-Jones and Paul Rubens—a combination which, in its day, was supreme in its own field. The adaptation and production are the work of Gordon McConnel.

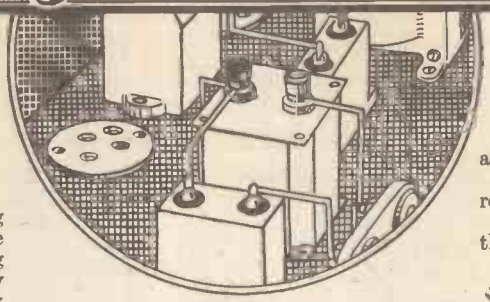
Change of Address

THE Fuller Accumulator Co. (1926) Ltd., announce that the address of their Manchester Depot is now 53, Back George Street, Princess Street, Manchester. Telephone No.: Central 6356.

Improving the L.F. Amplifier

Some Useful Hints for Improving the Efficiency of the L.F. Stages of a Receiver are Given in This Article

By P. S. NICOLL



HERE are a few hints for improving the quality of reproduction at little cost, and at the same time increasing the output from the set. If we can supply a higher voltage to the low-frequency valves, it can easily be seen that the output will be greater and the quality improved. Suppose, for convenience, that the existing set is connected to 120 volts H.T., and that we have .25 megohms in the plate circuit of the detector valve, a coupling condenser of about .002 mfd., and a grid-leak of about 2 megohms (see Fig. 1). These were considered normal values only a short time back. The voltage-drop across the .25-megohm resistance will be 62.5 when the detector valve is passing only .25 milliamp. This means that the valve will be working a long way from its maximum output.

A fuller use of the valve can be obtained by replacing this anode resistance by one of 50,000 ohms: there will be a voltage drop of only 50 when the valve is passing as much as 1 milliamp., which will improve results considerably. Since we have altered the anode resistance we must also alter the grid-leak of the L.F. valve, otherwise the balance of the circuit will be upset. A suitable value is ½ megohm, although other values may be tried.

Parallel Feed

The next thing is to parallel-feed the next valve. To do this the primary of the transformer (usually marked I.P. and O.P. or H.T. and Plate) must be disconnected.

To make this improvement a choke (which will only cost a few shillings) of about 30 henries must be obtained. This choke is connected in the position previously occupied by the transformer primary; the end that was connected to the plate now has a condenser of about .5 mfd. also connected to it, the other condenser terminal is connected to the primary winding and earthed through the transformer, as shown in Fig. 2.

The final improvement consists of disconnecting the speaker and in its place inserting a choke of inductance as high as we can afford. If of the same value as before it will do, but its resistance should be low, about 300 ohms; in fact the lower the better. To the plate of the output valve connect a 2 or 4 mfd. condenser and earth this through the loud-speaker. The grid bias should be increased on both the L.F. valves by one or two volts. The amount of this can easily be ascertained by trial.

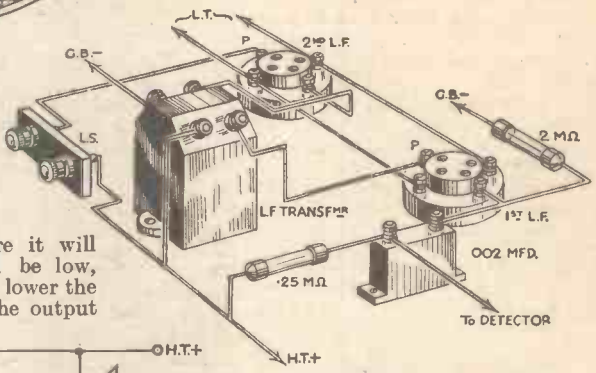
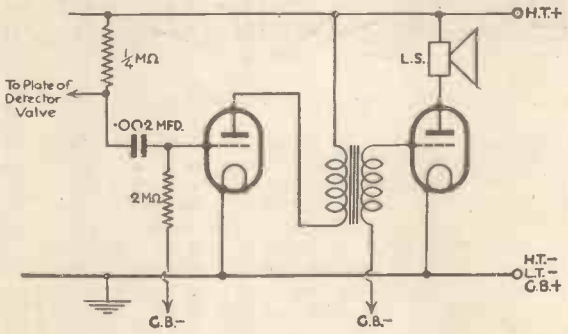


Fig. 1.—An R.C.C. stage employing a high-value anode resistance.



Advantages of the Modification.

The advantages shown by the modified circuit are :—

(*a*) The first L.F. valve can be run at practically full H.T. voltage, there only being a small drop across the choke winding.

(*b*) No direct current passes through the transformer winding, and thereby the inductance will be maintained higher than in the ordinary transformer coupled amplifier. Thus quality will be improved.

(*c*) Again quality will be further improved because the output valve will be working at almost full H.T. voltage.

(*d*) Any tendency to howl will be reduced, the last valve being decoupled.

(*e*) The speaker winding is isolated, and thus a large power valve may be used without any danger of damaging the speaker.

(*f*) The extension wire to the speaker may consist of only one insulated wire, the other terminal of the speaker can be earthed to any convenient point.

The main disadvantage of the circuit is that the two chokes require rather a large amount of space; unless these chokes be large the whole advantage of using them is lost. The chokes and transformer should be well spaced out.

If these components are not provided with iron cases they should also be arranged so that the windings are in opposition, although the provision of an iron case round one of them, and an earth connection to the case, will prevent instability due to interaction. A certain amount of care should be exercised in the choice of the components in order to obviate the risk of over-amplification of a certain frequency due to a similar peak in each component.

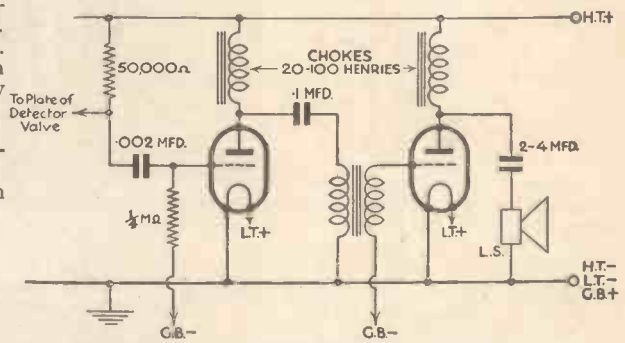
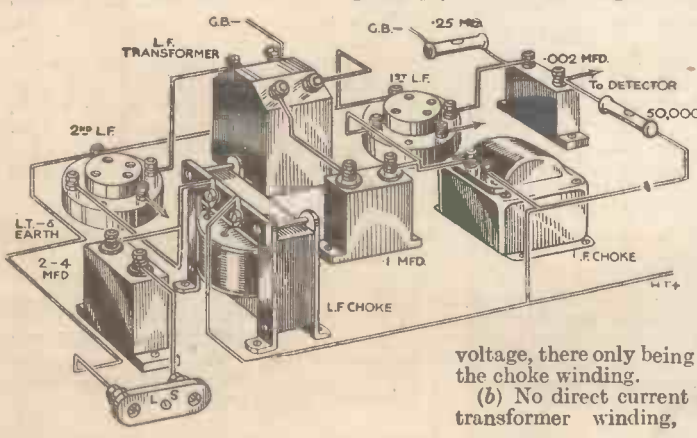


Fig. 2.—Using an L.F. choke in place of an anode resistance, and choke-coupling the speaker.



A NEW LOUD-SPEAKER DESIGN

Details of a Unique Piezo-Electric Loud-Speaker, Specially Designed for the Reproduction of the Higher Audible Frequencies

By "LAMBDA"

BEFORE we can examine the possibilities of the piezo-electric loud-speaker it is really necessary to ascertain what piezo electricity is, in what substance it is found, and how it is obtained.

By compressing a piece of quartz crystal it has been found that charges of electricity appear at its extremities, one side being positive and the other negative. Also, by exerting a force which would tend to extend the crystal, this difference of potential will again manifest itself, but the polarity will be reversed. This phenomena is known as the piezo-electric effect. It is not new, as it has been known for about fifty years. Only in recent years, however, has it been put to practical use.

Rochelle Salts

In addition to quartz, the effect just described is known to exist in such substances as tourmaline and rochelle salts. The former substance is comparatively rare and is, therefore, not suitable for commercial use. Rochelle salts can be made in the laboratory in any quantity, and it is this substance which was selected for employment in the design of this new loud-speaker.

It has certain disadvantages, being affected by moisture and heat, but this does not appear to have made the design of a piezo-electric loud-speaker impracticable. This remarkable peculiarity of certain substances—namely, the piezo-electric effect—has been utilized in the production of a loud-speaker capable of responding to the higher frequencies up to about 16,000 cycles. A remarkable achievement, offering great possibilities in the direction of improved frequency response, with consequently still greater improvement in the quality of reproduction.

The Piezo-electric Effect

How can we apply this effect to the design of a loud-speaker?

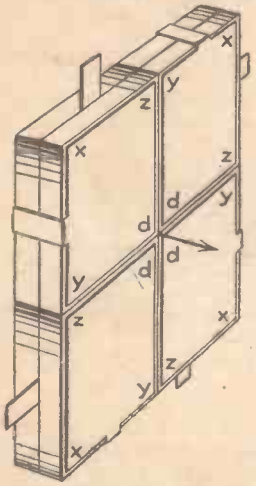
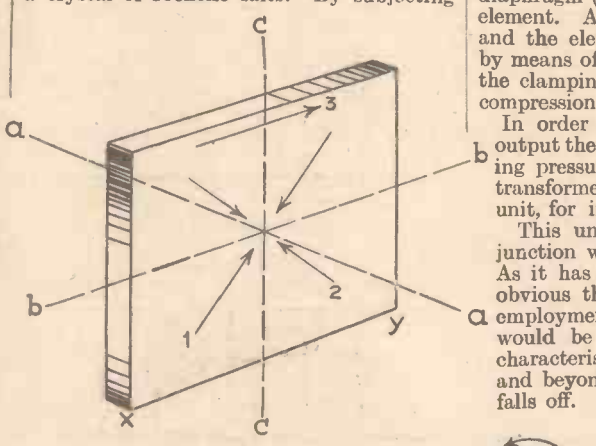


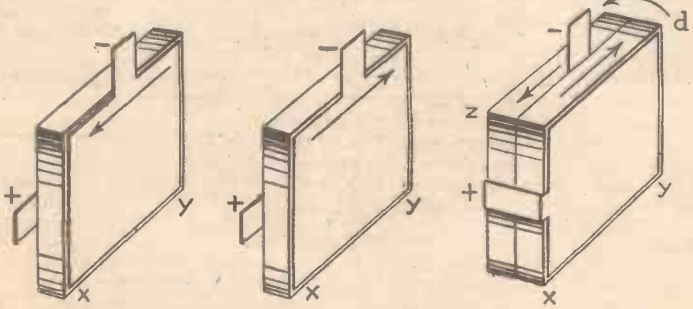
Fig. 3.—Construction of the piezo-electric element.

Before we can answer this question it will be necessary to carry our investigations of the piezo-electric effect a step further. It is known that the piezo-electric effect is considerably greater in rochelle salts than in other substances, consequently, this substance appears to be the most suitable for our purpose.

In Fig. 1 is illustrated a plate cut from a crystal of rochelle salts. By subjecting this plate to an electric field along *a* — *a* it tends to be strained in a direction 45 degrees to the axes *b* and *c*. The arrows 1 and 2 indicate the direction of the strain.

Now let us clamp the corners *x* and *y*; this will result in a slight motion of the upper edge in the direction shown by the arrow 3. In Fig. 2 are shown two such plates provided with metal foil electrodes. They are so arranged that their motions are in opposite directions. This is indicated by the arrows at the upper edges. If the near faces are cemented together and the edges *x* and *y* clamped, the upper corners of the assembly will now tend to twist in response to a potential difference between the foil electrodes. Now clamp the upper corner *z*; the remaining corner *d* will then tend to move in the direction indicated by the arrow.





Figs. 1 and 2.—Diagrams illustrating the principle of the piezo-electric speaker.

Application to Loud-speaker Design

Advantage is taken of this fact in the design of this new loud-speaker. Four of these "torque-responsive" units are employed. Their edges are cemented together and so form the assembly shown in Fig. 3. If this unit is clamped at the edges, or at the corners *x-y-z*, the central points *d*, which are in reality the individual corners of the four separate crystals, as shown in Fig. 2, then these corners will tend to move inwards and outwards.

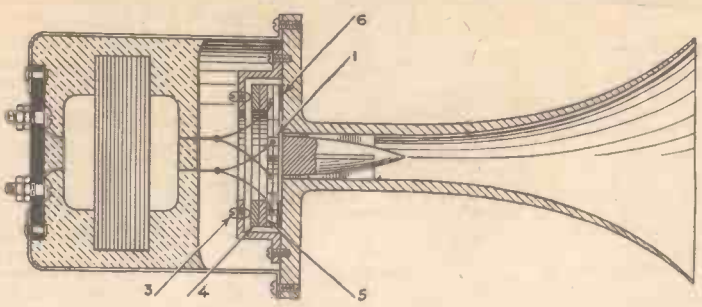


Fig. 4.—Section of the piezo-electric loud-speaker.

An examination of the section through the loud-speaker (Fig. 4) will serve to illustrate the method of construction. The diaphragm (1) consists of the piezo-electric element. A ringed spacer is provided (6) and the element is clamped into position by means of the screws (3) which act upon the clamping ring (4) situated behind the compression ring (5).

In order to obtain the greatest sound output there is a certain maximum clamping pressure which must be exerted. A transformer is mounted at the rear of the unit, for impedance-matching purposes.

This unit is designed for use in conjunction with a moving-coil loud-speaker. As it has a cut-off at 1,000 cycles, it is obvious that it would not be suitable for employment by itself, as bass response would be non-existent. It has a rising characteristic up to about 10,000 cycles and beyond this point the response again falls off.

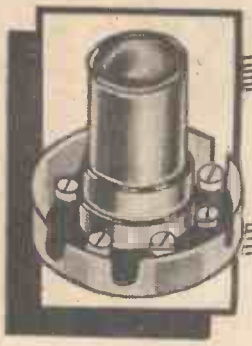
Advantages

All that is necessary to employ this additional unit is to connect it in parallel with the existing moving-coil loud-speaker and place it as near as possible to it.

By a combination of moving-coil and piezo-electric speaker, an approximately straight-line frequency response up to about 10,000 cycles can be obtained. The lower limit depends upon the low-frequency response of the moving-coil loud-speaker and the characteristics of the amplifier.

No filter or other arrangement is necessary to divert the power between the two speakers. This is due to the fact that the reactance of the unit is inherently capacitative, and when connected in parallel with a unit having an inductive impedance, the power divides naturally.

Another advantage of connecting a capacitative unit in parallel is when pentode output valves are employed. In this case the presence of the high-frequency unit has extremely beneficial effects. The presence of the capacity in parallel restricts the rise in response of the moving-coil loud-speaker with increasing frequency, which happens when the output stage employs a pentode valve.



IS PERMEABILITY TUNING DIFFICULT?

What Has Happened to Permeability Tuning? In This Article the Author Throws Considerable Light on the Problems Involved

THE inductance of an air-core coil depends *principally* on the geometrical dimensions with, generally, a small correction factor depending on the frequency of the current flowing in the circuit. In the case of the newly-developed coils with iron cores, however, the inductance depends not only upon the dimensions of the coil, but also upon the physical properties of the core, and these properties are variable.

Technically speaking, the matter is expressed by saying that the magnetic flux density B, which is induced in a sample of iron by a magnetizing force H, is given by the simple formula $B=\mu H$, and the term indicated by the Greek symbol μ is called the permeability.

A Complex Variation

It is easy to prove, however, that μ is not constant for any one sample, but varies in a complex manner with B or H, as will be seen from Fig. 1, and also varies within wide limits for different samples of iron. The inductance of an iron-cored coil, therefore, depends on the permeability of the iron, and this varies over the cross section of the core, since H is not constant over that area. Moreover, and this is a point which is frequently overlooked when we are dealing with currents which vary as they do in radio circuits, if the current in the coil, by which H is produced, varies, then the value of μ will change. In consequence, as a general rule, in any calculation work it is only possible to select some average value for μ, which experience has shown to be representative for the coil in question.

Readers will therefore appreciate from the foregoing that the problem we are examining is somewhat complex in character. With an air-core coil μ has a value of unity and all is plain sailing, but not so when iron is introduced into the coil.

Not Strictly New

Of course, strictly speaking, tuning by a variation in the inductance of a coil is not by any means new. Those readers who have been working at radio for several years will recall quite readily the variometer tuners, a sample of which is shown in Fig. 2. Two coils, joined in series, were mounted so that one rotated inside the other. In one case, when the planes of the coils were co-axial, the inductance effects of each were additive, but when the movable one was rotated through 180 degrees, the magnetic fields were opposite and the total inductance reduced, intermediate values being secured in intermediate positions. Although a very unselective device, when the broadcasting stations were few and far between, or in those cases where a simple crystal set was sufficient to satisfy the household needs, the component proved quite satisfactory.

Inductance or permeability-tuning devices to contend with modern conditions of broadcasting, however, need a form of design radically different from this. Iron

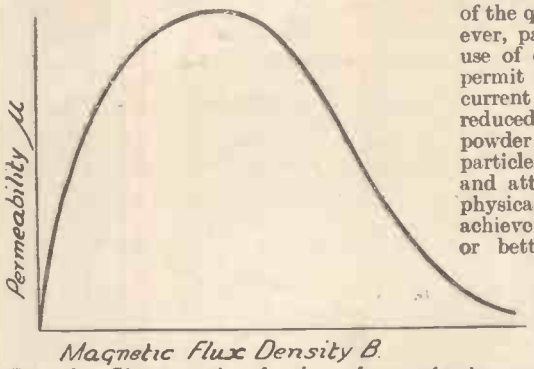


Fig. 1.—Showing the familiar form of a permeability curve.

cores, which can be employed at radio frequencies, have been instrumental in

Fig. 2.—An early form of inductance tuner.

changing coil design very considerably, and in condenser-less tuning the cores play an important part.

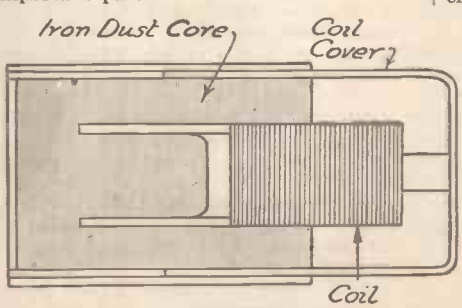


Fig. 3.—One form of permeability tuner arrangement to give telescopic motion between iron dust core and coil.

Modern Iron Cores

Ordinary iron cores, or even thin laminations, are productive of such high losses that their use in high-frequency coils is out of the question. Over forty years ago, however, patents were taken out to cover the use of compressed iron-dust cores, but to permit radio frequency working, the eddy current paths have had to be still further reduced by employing the finest iron powder and also completely insulating the particles. Then, again, the greatest care and attention has had to be paid to the physical design of the cores themselves to achieve a measure of performance equal to, or better than, ordinary tuned circuits.

Two names closely associated with this work are W. J. Polydoroff in America, and Hans Vogt in Germany.

In Fig. 3 is shown one form of design used by the former inventor to change the coil inductance by sliding it over a core of iron dust. As will be seen, the core is arranged to go both inside and outside the coil, while closely-fitting metallic shields of copper or aluminium act as guides for the core when it is inserted into the windings.

An Important Feature

Reverting for the moment to an oscillatory circuit tuned by the usual .0005 mfd. variable condenser, there is one important aspect which has always proved a drawback. In fact, it would not be too much to say that it was partly responsible for the introduction and popularizing of superheterodyne receivers. I refer to selectivity. The inductance of a given coil has to be designed to give the highest wavelength (minimum frequency) when the moving plates of the variable condenser are wholly in mesh with the fixed plates (maximum capacity).

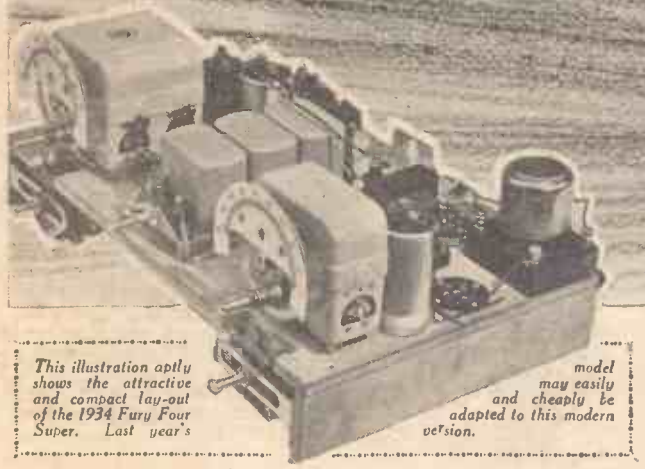
Under these conditions, a good measure of selectivity can be achieved, a factor which can be proved readily both theoretically and practically. As the wavelength is reduced, however (that is frequency increased), the selectivity becomes worse, for with the increase in frequency the losses become greater, while the inductance remains sensibly constant. Hence the ratio of inductance to resistance decreases, and at the minimum setting of the condenser on the medium waves the selectivity condition may be three or four times as bad when compared to the maximum condenser setting.

A Better Condition in Theory

Coming now to an oscillatory circuit arranged for inductance or permeability tuning, it is possible to improve matters very considerably from the theoretical point of view. First of all

(Continued on page 927)

F. J. CAMM'S 1934 FURY 4



This illustration aptly shows the attractive and compact lay-out of the 1934 Fury Four Super. Last year's model may easily and cheaply be adapted to this modern version.

Full Constructional Details of the 1934 Version *Practical Wireless* last year. This really is a Super Super Station Getter. It Worthily Upholds the Standards in Home-Constructed Receiver Design. Readers who made the original Fury Four will be

I EXPLAINED in last week's issue that the latest PRACTICAL WIRELESS receiver is really a modified and considerably improved version of the "Fury Four" which created so much interest and enthusiasm among home-constructors last year. Although there has been no attempt slavishly to adhere to the principal features of the original "Fury Four," it has been found possible to retain many of those which were so popular and which marked a definite forward step in the technique of wireless set design. The same type of chassis has again been used, although in the present case the latest metallized material has been employed for it. It has even been possible to retain the very same chassis dimensions, so that those thousands of readers who made the original "Fury" will be able to make use of the same cabinet (which is often one of the most expensive parts of a receiver). Although in one way the combination of valves is the same as in the 1933 "Fury"—that is, two H.F. stages, followed by a leaky-grid detector and a high-efficiency pentode—the first two valves are now of the variable-mu type, and are used to provide complete volume and selectivity control under any combination of circumstances.

Distortionless Volume Control

The amount of high-frequency amplification provided by the set is truly enormous, and is easily sufficient to make it an easy matter to tune in dozens of stations at full loud-speaker strength without making any use whatever of the effective reaction control. At the same time, the volume of any transmission can be reduced to no more than a whisper by means of the volume control which serves to vary the bias on the two variable-mu valves. Needless to say, this volume control is entirely distortionless, and does not have the slightest effect on the quality of reproduction.

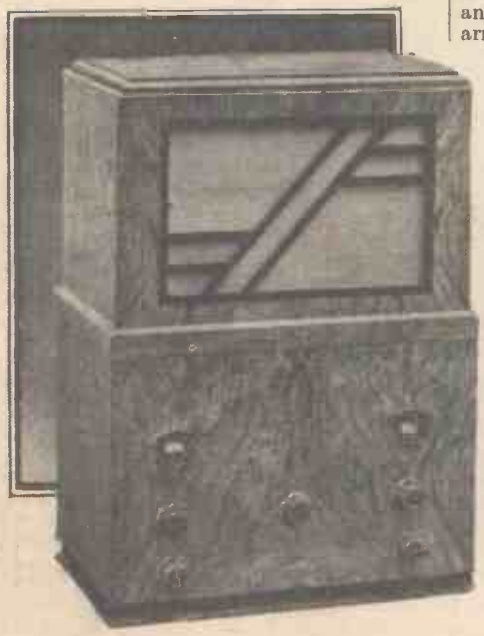
"Mixed" Coupling

The circuit arrangement is particularly interesting, embodying, as it does, a number of unusual and particularly good features. For example, instead of using the same method of coupling between the first and second variable-mu valves as between the second variable-mu and the detector, a tuned-grid circuit is made use of in the first position and tuned anode is used in the second. This will at first seem rather unusual, but it has the extremely beneficial effect of rendering the receiver absolutely stable under all conditions, despite the enormous degree of H.F. amplification which is provided. This does not affect the correct ganging of the two-gang condenser, as might be expected, since the

Mr. F. J. Camm, demonstrating his 1934 Fury Four Super.

of the Fury Four which was Fully Described in Receiver—Super Quality, Super Selectivity, and a Best Traditions of its Predecessor and the Best A Better Four-Valve Receiver does not exist. able to Modify Last Year's Model at Trifling Cost

The 1934 Fury Four Super in its cabinet.



The two-piece cabinet of the 1934 Fury Four Super is here illustrated.

coils themselves are accurately matched and are perfectly suitable for this circuit arrangement. In order to ensure that the voltage applied to the screening grids of the two H.F. valves shall be perfectly accurate, a potentiometer device has been incorporated in preference to the usual series resistance arrangement, and this is in turn provided with decoupling circuits to avoid any possible instability in this part of the receiver. The usual drawback to this arrangement, namely, the continual drain on the high-tension battery caused by the potentiometer across the total supply, has been avoided by the method of utilizing a four-point on-off switch, about which more will be said anon.

Low Detector Grid-circuit Damping

The detector-grid circuit is of rather unusual design, and avoids one of the principal difficulties experienced when high-efficiency coils are employed. The grid condenser, it will be seen, is connected direct to the anode of the second high-frequency valve, and this is in turn connected to a transfer tapping on the grid coil, thus providing a constant load on long or medium waves and enabling full use to be made of the efficient coil on both wavebands. The grid circuit is provided also with a change-over switch for gramophone-record reproduction, and the only slight departure from usual practice here is the method of connecting the grid leak to the grid direct, instead of to the grid condenser. Although this means that the leak is in circuit even when the gramophone pick-up is being employed, it enables the leak to be connected in the most direct manner to the grid, and ensures stability on radio by dispensing with an otherwise long lead. The remaining lead, as well as that for one of the pick-up connections, is carried in the usual metal braiding, which is earthed, and it will be found that the set is thus perfectly stable on both settings of the switch.

Uniform Reaction Control

The reaction circuit, although perfectly normal as a whole, incorporates a small resistance in series with the condenser in order to prevent any possibility of parasitic oscillation on either waveband, and the small anode by-pass condenser forms an essential part of this circuit.

A New L.F. Coupling

Coupling between detector and output valve is carried out by a newly-introduced L.F. coupling device, which includes in the moulded case the anode coupling resistance, a coupling condenser, an L.F. transformer, and yet a further resistance

Every care has been taken to ensure that readers of PRACTICAL WIRELESS can obtain the same results as from the original 1934 Fury Four Super. Mr. F. J. Camm is here seen giving his final O.K. to the drawings.

of high value, which is connected in series with the grid of the output valve, as a further precaution against instability. Thus it will be seen that at every part of the circuit great care has been taken to ensure that no possibility of instability can occur. The high-efficiency pentode valve feeds the loud-speaker through an output filter comprising a tapped choke and large-capacity fixed condenser, whilst also connected in this part of the circuit is a battery economizer of the latest design. The purpose of this is to reduce the normal high-tension current and thus provide one of the principal advantages of Class B amplification, whilst retaining the additional benefits conferred by the pentode. The economizer reduces the total anode current required by the pentode when no signal, or a very quiet signal, is being received, and yet permits the current to rise to any required value to produce loud notes without distortion. We have already explained in PRACTICAL WIRELESS how this is accomplished by a variation of the grid bias applied to the last valve, and a metal-oxide rectifier forms an important part of the arrangement.

Sufficient has been said to show that from every point of view the circuit has been studied and designed to produce maximum efficiency and economy, and the constructor may go ahead in the certain knowledge that yet another "star" receiver has been designed for his especial benefit, and one which is a worthy successor to the original "Fury Four."

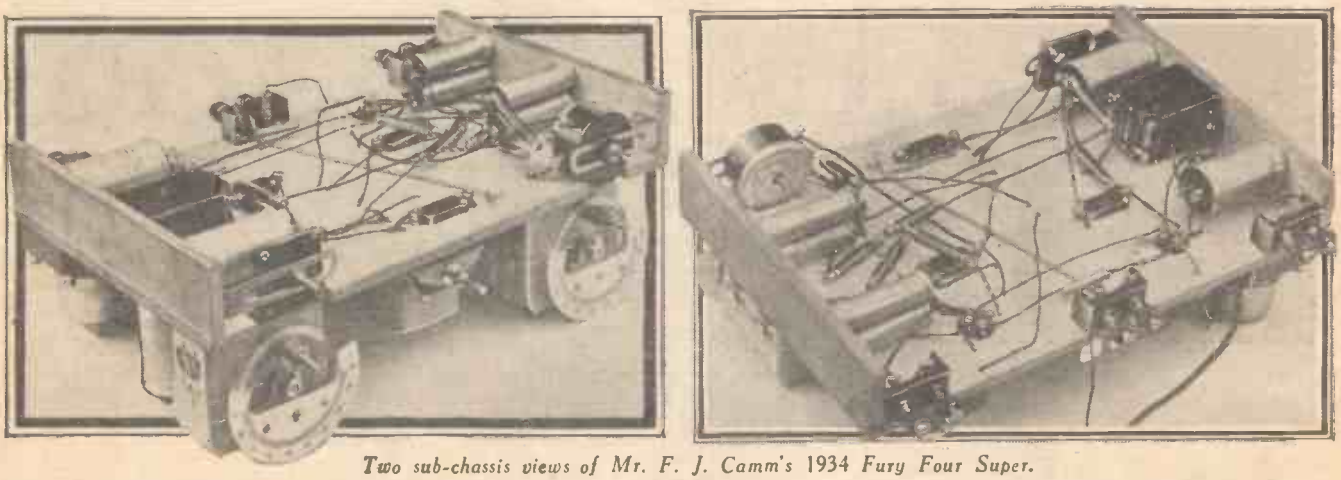
The Construction

The chassis, as supplied by the makers, will be found ready for the components to be mounted, although small clearance holes will have to be drilled in certain places to permit of interconnecting wires being passed from one side of the chassis to the other. The position of these holes may be obtained from the wiring plan (page 906), and, therefore, the first thing to do is to place all the components on the chassis, as shown in this diagram, and to mark their positions. The screw holes may then be started and the wiring holes drilled. The template which is supplied by the condenser manufacturers should be positioned on the chassis and the necessary clearance holes drilled to accommodate the holding-down screws. When this has been done, the two component brackets should be mounted on the side runners, and it will be found easier, although not essential, to mount the fixed condensers on these runners whilst they are still unscrewed from the base of the chassis. In this manner the screws are driven home without difficulty.

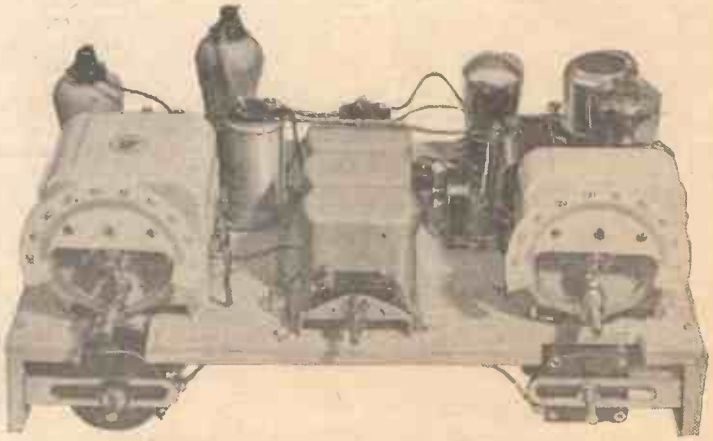
The Coils

The coils will be found to have soldering lugs projecting below the baseplate, and, before the assembly is mounted, nine-inch lengths of connecting wire should be soldered to the required lugs as shown by the wiring plan. It will be seen that two of the wires are kept on the upper side of the base and connected to the fixed sections of the two-gang condenser, whilst the remainder pass down through holes in the base for subsequent connection on the underside of the chassis. These holes are shown in the centre of the wiring plan, and the lugs to which they are connected are indicated by the numbers at the side of these holes. The coils are supplied without a switch on the end of the spindle, and it is most important that the correct type be used in this position. The switch

(Continued on page 905)



Two sub-chassis views of Mr. F. J. Camm's 1934 Fury Four Super.



A neat lay-out, simple construction, extreme selectivity, and easy operation are salient features of the 1934 Fury Four Super.

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You can appreciably improve the performance of your All-Electric Receiver, especially if it is two or three years old, by fitting the correct types of Cossor Mains Valves. Due to their advanced design and their famous Mica Bridge Construction, Cossor Mains Valves possess remarkable efficiency, uniformity and long life. Your dealer will tell you the types you need to make your Set like new again.

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COSSOR A.C. MAINS VALVES (4 Volt Indirectly Heated Cathodes)

Type	Purpose	Impedance	Amp. Factor	Mut. Con. m.a./v.	Price
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*41 M.S.G.	Super H.F. Amp'n	400,000	1,000	2.5	17/6
*†M.S.G.-L.A.	Super H.F. Amp'n	200,000	750	3.75	17/6
†*M.V.S.G.	Variable Mu S.G.	200,000	—	2.5	17/6
**M.S./PEN.-A	H.F. Pentode	—	—	4.0	17/6
†*M.S./PEN.	H.F. Pentode	—	—	2.8	17/6
†*M.V.S./PEN.	Variable Mu H.F. Pentode	—	—	2.2	17/6
*41 M.D.G.	Bigrid	40,000	10	.25	19/-
**D.D./PEN.	A.V.C. (Detector and L.F. Amp.)	—	—	2.7	20/-
**D.D.T.	A.V.C. (do.)	17,000	41	2.4	15/6
41 M.R.C.	R.C.C. or Det.	19,500	50	2.6	14/-
*41 M.H.	Detector	18,000	72	4.0	13/6
41 M.H.F.	H.F. or Det.	14,500	41	2.8	14/-
*41 M.H.L.	Det. or H.F.	11,500	52	4.5	13/6
41 M.L.F.	Low Frequency	7,900	15	1.9	14/-
41 M.P.	Normal Power	2,500	18.7	7.5	14/-
41 M.X.P.	Extra Power	1,500	11.2	7.5	16/6
M.P./PEN.	Pen. Power Output	—	—	3.5	18/6
‡P.T. 41B	Pen. Power Output	—	—	2.25	22/6
‡P.T. 41	Pen. Power Output	—	—	3.0	18/6

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*D.H.L.	Detector	13,000	58	4.5	13/6
D.P.	Power Output	2,800	17	6.0	14/-
D.P./PEN.	Power Pentode	—	—	3.5	18/6
*D.S./PEN.	H.F. Pentode	—	—	3.0	17/6
*D.V.S./PEN.	Variable-Mu H.F. Pentode	—	—	3.0	17/6
**D.D.T.16	Double Diode Triode (A.V.C.)	16,000	40	2.5	15/6

*Supplied with Plain or Metallised Bulbs. **Stocked with Metallised Bulb only.
† Characteristics measured at–1.5 Grid Volts. ‡ Directly heated filaments.
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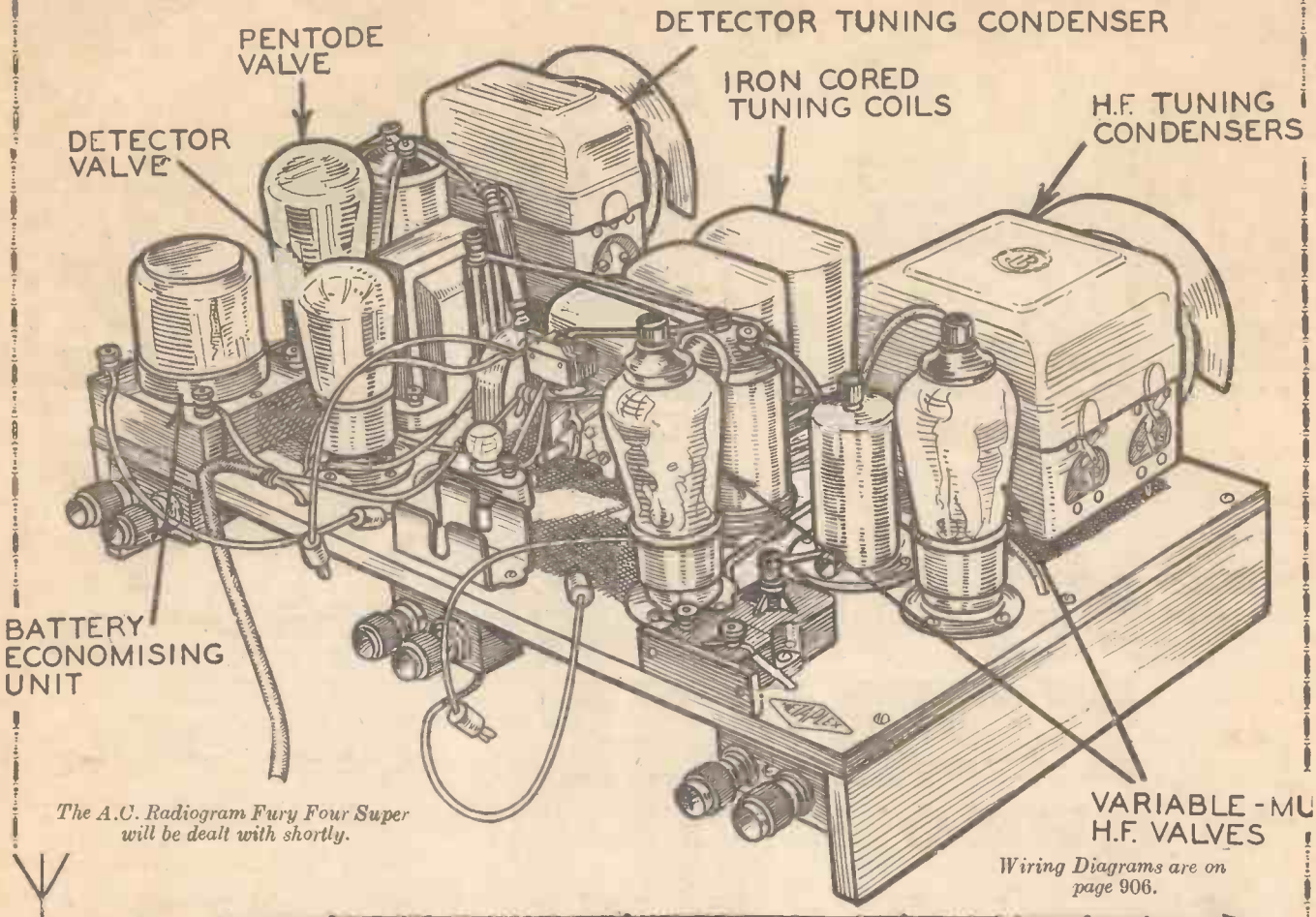
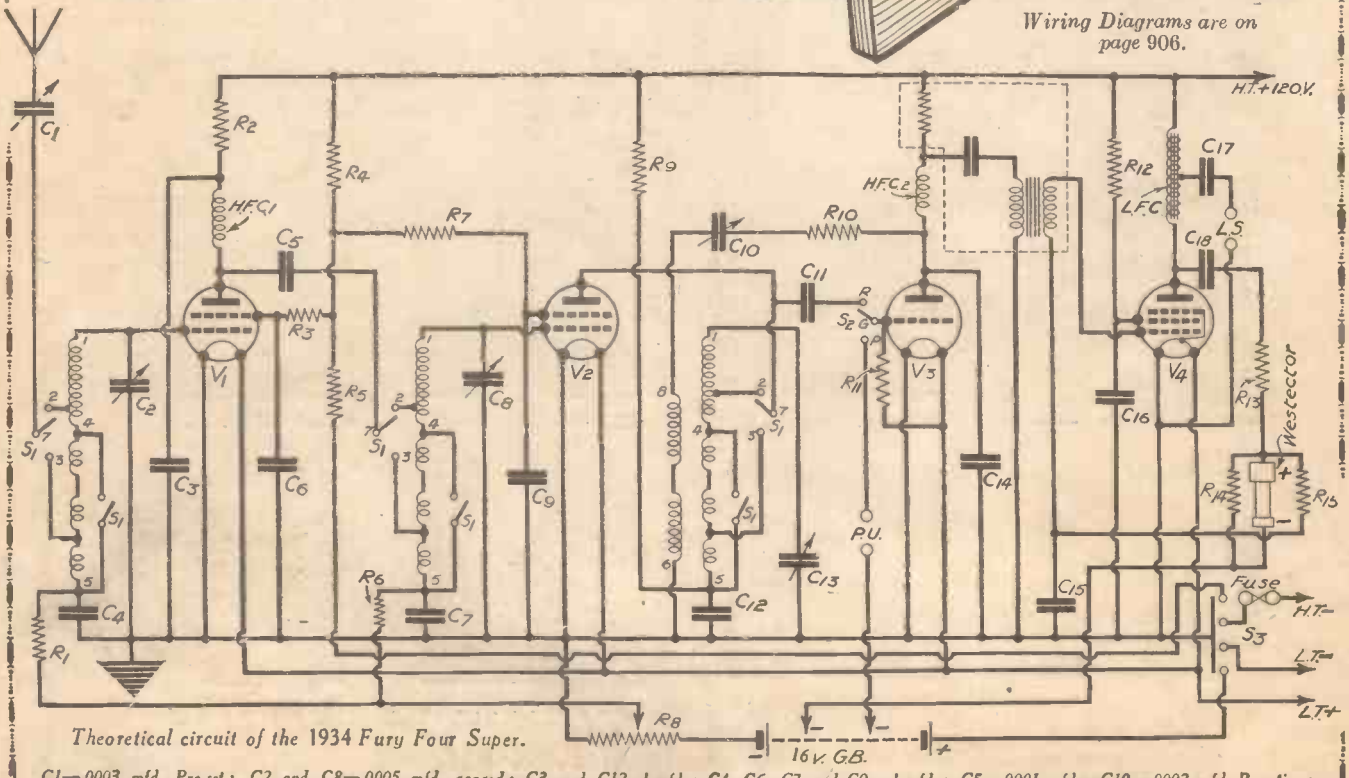
SEE ADVERTISEMENT ON PAGE 933.

The 1934 Fury Four Super—Our Artist's Impression



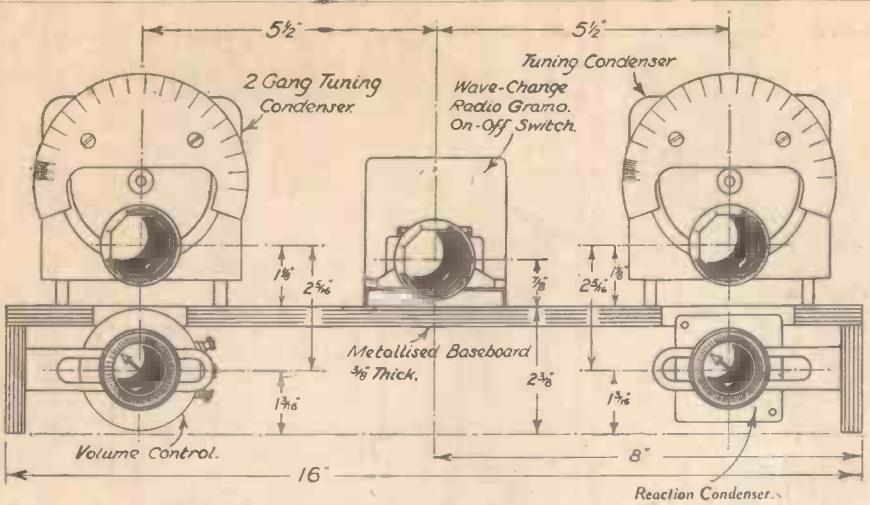
The A.C. Radiogram Fury Four Super will be dealt with shortly.

Wiring Diagrams are on page 906.



Theoretical circuit of the 1934 Fury Four Super.

C1—.0003 mfd. Pre-set; C2 and C8—.0005 mfd. ganged; C3 and C12, 1 mfd.; C4, C6, C7 and C9—.1 mfd.; C5—.0001 mfd.; C10—.0002 mfd. Reaction; C11 and C14—.0002 mfd.; C13—.0005 mfd. Variable; C16 and C17—2 mfd.; R1, R5 and R6—50,000 Ohms; R2, R3, R7, R9 and R12—1,000 Ohms; R4—25,000 Ohms; R8—10,000 Ohm Potentiometer; R10—500 Ohms; R11—1 Megohm; C15, C18, R13, R14 and R15 are all included in the Graham-Farish Booster Unit.



Dimensioned front view of the 1934 Fury Four Super.

(*Continued from page 900*)

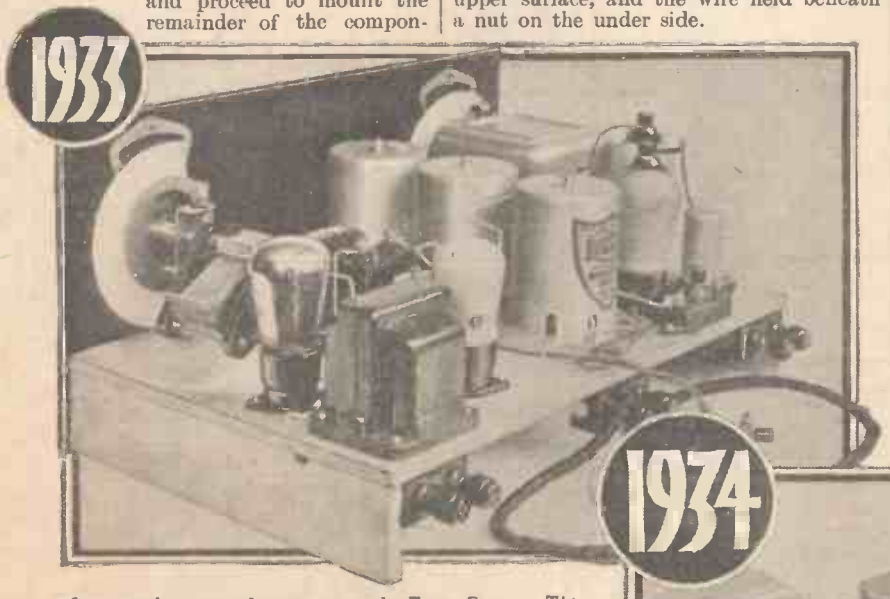
is a Bulgin Type 87a, and it may be obtained with the coils at an extra cost of 1s. 6d. The switch must, of course, be mounted so that the small finger at the end of the coil-switch rod operates the dolly of the switch in the correct manner, and this will be when the two end contacts are towards the right, the coil being viewed from the front. Now screw down the coils, passing the connecting wires down through the holes in the base, and proceed to mount the remainder of the components, using as your guide the wiring plan. There are no difficult points to explain in this part of the assembly, as all parts are quite easy to get at, and there are no pitfalls for the unwary. Before the Booster Unit can be mounted it will be necessary to fit the Westector into the clips provided on its under side. When this has been attached the receiver is ready for wiring, and this should be carried out in a neat manner, avoiding slackness and making quite certain that good contact is provided at the required points.

Earth Returns

It will be noticed that there are one or two points on the wiring plan marked "M.B.," and these are earth return connections which are connected to the metallized surface of the chassis, and in the case of those connections on the upper surface it will be sufficient to twist the wire into a loop to be held down by an ordinary round-head wood screw. Where these letters appear on the under-surface it will be necessary to pass a small bolt through the chassis, with a washer beneath the head making good connection on the upper surface, and the wire held beneath a nut on the under side.

The screened leads must be passed through the metal braiding, and this should be turned back at each end to avoid short-circuits on the inner wire, and small metal brackets used to clamp the braiding to the metal surface. These brackets may easily be made from odd scraps of metal, or they may be purchased from Messrs. Peto-Scott. There is no necessity to screen any leads other than the two indicated in the wiring plan.

Next week we shall give full operating details, together with a Test Report.



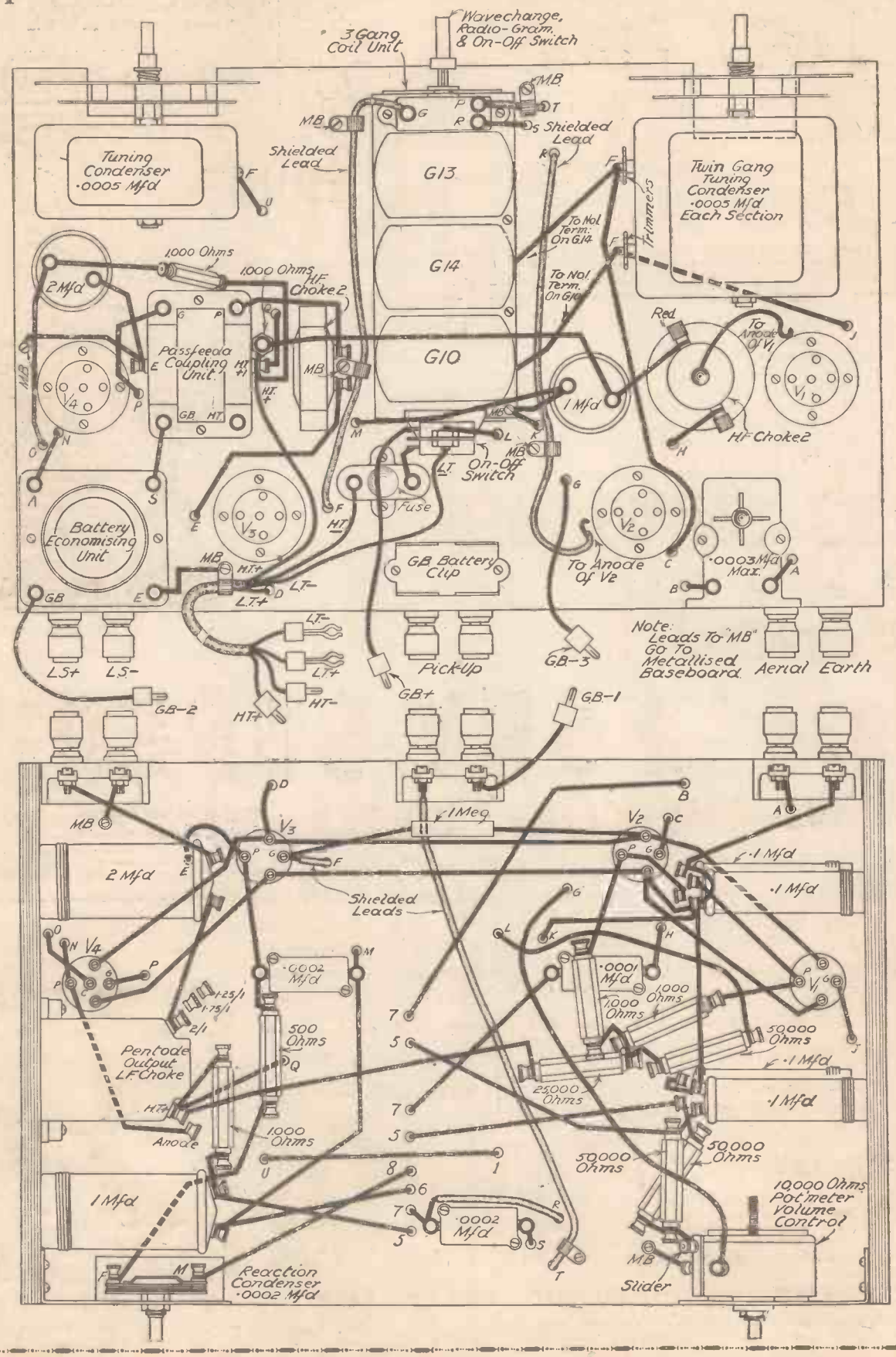
Last year's outstanding success—the Fury Four. This did not incorporate such modern refinements as iron core coils, for such were not then available.

The 1934 Fury Four Super provides the solution to all selectivity problems.

LIST OF COMPONENTS FOR THE 1934 FURY FOUR SUPER.

One Set "Ferrocart" Type "G" Coils (G.10, G.14, G.13) (with Switch—see Text) (Colvern).
One "Nugang" Single Variable Condenser, .0005 mfd. with Type A Drive (C.13) (Jackson Bros.).
One "Nugang" 2-gang Variable Condenser, .0005 mfd. with Type A Drive (C2, C8) (Jackson Bros.).
One Disc Type H.F. Choke (H.F.C.2) (Lissen).
One 1 megohm resistance with wire ends (R11) (Lissen).
One Pre-set Aerial Condenser, .0003 mfd. (C.1) (Lissen).
One "Pentode" Nichoke (Varley).
One Graded Volume Control, Type C.P.158 (R.8) (Varley).
One Super H.F. Choke, Type H.F.4 (H.F.C.1) (Bulgin).
One Fuse Holder, Type F.5 (Bulgin).
One 100 m.a. Fuse (Bulgin).
One G.B. Bias Clip, Type 2 (Bulgin).
Three 50,000 ohm 1½ watt "Ohmite" Resistances (R1, R5, R6) (Graham Farish).
Five 1,000 ohm ditto (R2, R3, R7, R9, R12) (Graham Farish)
One 25,000 ohm ditto (R4) (Graham Farish).
One 500 ohm ditto (R10) (Graham Farish).
One .0002 mfd. Reaction Condenser (C10) (Graham Farish).
One "Booster" Unit (Graham Farish).
Two 1 mfd. Fixed Condensers, Type 9200 B.S. (C3, C12) (Dubilier).
Four .1 mfd. ditto (C4, C6, C7, C9) (Dubilier).
Two 2 mfd. ditto (C16, C17) (Dubilier).
One .0001 mfd. ditto Type 670 (C5) (Dubilier).
Two .0002 mfd. ditto, Type 670 (C11, C14) (Dubilier).
Three 4-pin Chassis Type Valveholders (Clix).
One 5-pin ditto (Clix).
Four Wander Plugs marked G.B.1, G.B.2, G.B.3, G.B.+ (Clix).
One Passfeeda Coupling Unit (B.R.G.).
Two Large Component Brackets (B.R.G.).
Three Terminal Mounts (Belling-Lee).
One 4-way Battery Cord (Belling-Lee).
Six Type B Terminals (Aerial, Earth, L.S.+, L.S.—, Pick-up, Pick up) (Belling-Lee).
One "Westector" Type W.4. (Westinghouse).
One "Metaplex" Chassis (Peto-Scott).
One "Fury Super" Cabinet (Peto-Scott).
Four Valves, Types P.M.12M., P.M.12M., P.M.2DX., P.M.22. (Mullard).
One Moving Coil Loud-speaker, Type P.M.6. (W.B.).
One 120-volt H.T. Battery (Siemens).
One 16-volt G.B. Battery (Siemens).
One 2-volt L.T. Battery (Block Batteries).
Connecting Wire, Length Metal Braiding, Screws, etc.

Top and Sub-baseboard Wiring Diagrams of the 1934 Fury Four Super



Mr. Camm's
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(W.B. Speaker Solely Specified)

Mr. Camm's
"SUPERSONIC SIX"
(W.B. Speaker Solely Specified)

Mr. Camm's
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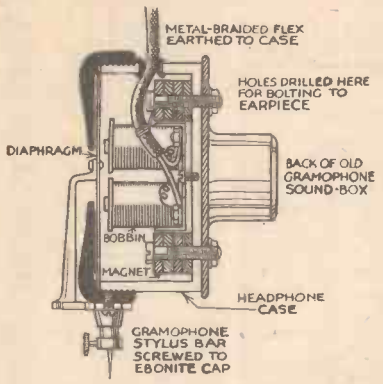
READERS' WRINKLES

THE HALF-GUINEA PAGE

A Home-made Gramophone Pick-up

A VERY efficient pick-up may be made from an old pair of head-phones and an old gramophone sound-box. Remove one of the ear-phones, unscrew the top,



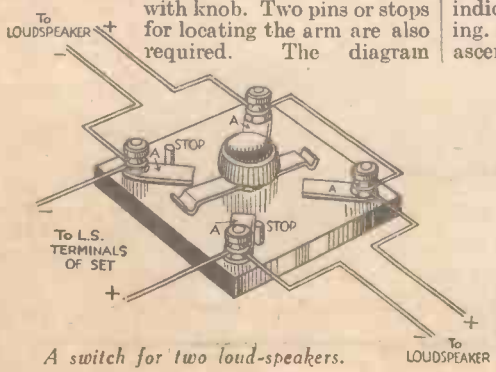
A home-made gramophone pick-up.

and remove the diaphragm, replacing the old lead by a piece of metal-braided flex, long enough to suit your own requirements. At the same time, earth the case by means of the metal braid on the flex. From the old gramophone sound-box remove the back and the needle-holder. Remove the screws which hold the magnets to the ear-phone case and replace them by others about ¼in. longer. Drill two holes in the soundbox back so that they are exactly opposite the protruding screws on the ear-phone case, and fit the two together, holding the soundbox back in position by nuts.

Tap two screw holes in the ebonite cap, and screw the needle-holder to it, fastening the top of the needle-holder to the ear-phone diaphragm by means of the screw provided. Screw the ebonite cap back in place on the earphone and connect up as you would an ordinary pick-up.—J. H. HEYES (Liverpool, 4).

Simple Switch for Loud-speakers

THE switch illustrated is useful for switching into circuit one or other of two loud-speakers. It consists of a piece of ebonite about 2in. square, four terminals, four strips of brass about ¼in. wide (A in diagram), and a moving contact arm with knob. Two pins or stops for locating the arm are also required. The diagram



A switch for two loud-speakers.

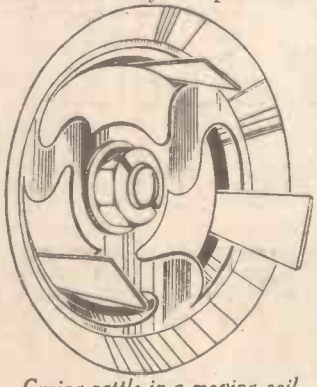
THAT DODGE OF YOURS!

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

is self-explanatory, a turn of the knob bringing either one or both speakers into play.—G. HOWARD (Liverpool, 4).

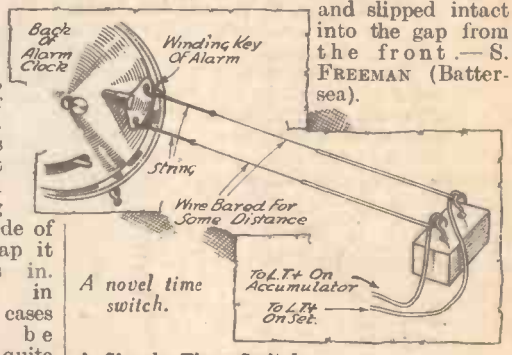
Curing Rattle in M.C. Loud-speaker

MANY set owners are, no doubt, rather chary of adjusting their own moving-coil type loud-speakers. There are, of course, numerous faults which can develop, but without doubt the most common is that of a bad rattle caused by the speech coil fouling one side of the gap it moves in. This in most cases can be cured quite easily provided the actual centring spindle or the diaphragm is not damaged. It is imperative that the speaker be taken out of the cabinet. The trouble can now be traced by running the finger lightly round the extreme edge of the diaphragm while the speaker is working. It will be found that the rattle gets very pronounced at one point, and naturally the rattle should almost disappear when the finger is placed on the opposite side. This merely serves to indicate the point of fouling. Now this has been ascertained, a light visiting card should be cut in to three strips, cut V shaped at one end. The screw which holds the spider in position should be slackened off and one piece of the card *gently* pushed between the speech coil and gap on *the inside*. It is preferable that this should be put where the fouling is occurring. The other two pieces are put equidistant from each other in the same way. It will be realized that the speech coil is now held in the actual middle of the gap.



Curing rattle in a moving-coil speaker.

The fixing screw can now be re-tightened and the slips withdrawn. It should be noted that the thickness of card will vary according to type of speaker. In most cases where P.M. types are used a very thin card or piece of paper must be used, while in a large energized type a considerably larger gap is employed necessitating a thick card to fill up the space. Where the centring of the loud-speaker is done from the back of the diaphragm, a complete piece of paper can be formed into a circle, and slipped intact into the gap from the front.—S. FREEMAN (Battersea).



A novel time switch.

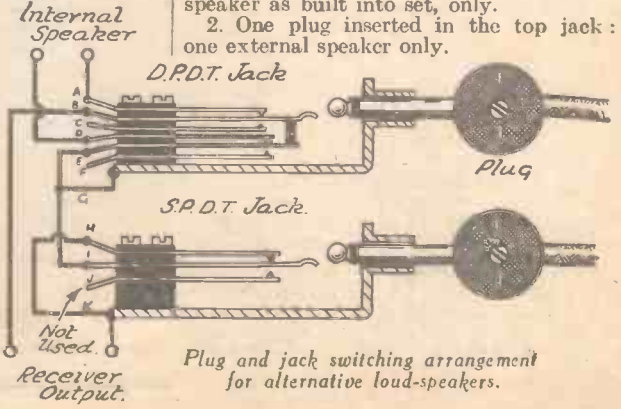
A Simple Time Switch

THE accompanying sketch shows a simple "time switch" for use with a wireless set. The illustration is almost self-explanatory. It will be noticed that when the alarm is set, the key turns, thereby twisting or untwisting the wires. This idea can readily be used for turning a set on or off at any given time.—P. NEWTON NIELD (Loughborough).

Connecting Alternative Loud-speakers

THE following plug-and-jack system, built into the household set, offers many advantages and costs next to nothing. As well as providing a ready means of comparing and testing new speakers, the house may be wired, and by merely inserting one or both plugs the following combinations can be obtained:

1. Both plugs withdrawn: internal speaker as built into set, only.
2. One plug inserted in the top jack: one external speaker only.



Plug and jack switching arrangement for alternative loud-speakers.

READERS' WRINKLES

(*Continued from previous page*)

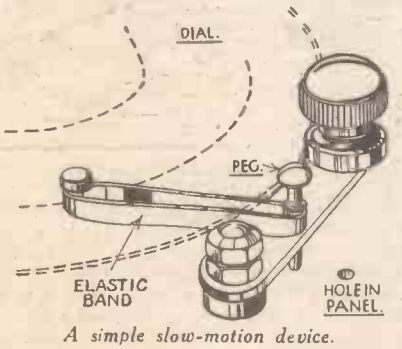
3. One plug inserted in lower jack; internal speaker and one external speaker.

4. Both plugs inserted: two external speakers only.

Output transformer must not be built into set, but wired with the speakers used, unless all speakers are of the same type. —T. S. Ross (Greenford Green).

A Slow-motion Improvement

THE slow-motion gadget, often recommended for attachment to the ordinary condenser in the form of a small spindle with rubber tubing attached, is quite useful, but has its disadvantages. In the first place, the sharp edge of the condenser dial cuts into the rubber in a very short time, and becomes practically useless, and it has to be replaced. This can be avoided by putting a slight flat on this edge by filing in the lathe. Secondly, this state of affairs is hastened because it is possible, when the dial is turned quickly with the ordinary handle, that the small spindle revolves at a fast rate. The writer overcame this difficulty by fixing up the gadget shown in sketch. The small spindle was mounted on a thin strip of brass, working as a pivot at right angles to the periphery of the dial. A movable peg in the strip was connected with a rubber band to a peg fixed in the panel underneath the dial. The rubber band keeps the spindle in contact with the dial. A small hole drilled in the panel enables the small spindle to be put out of gear by simply



A simple slow-motion device.

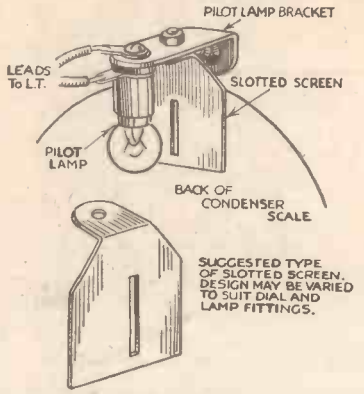
stretching the rubber band and placing the peg in the hole. This prevents wear on the small spindle when the dial is revolved the greater distance, and the small spindle is quickly put in action again by releasing the peg. The operation includes drilling three small holes in the panel, one being beneath the dial, which is removed for the purpose.—W. H. Grayling (Cambridge).

A Simple Counter for Coil Winding

IT is generally quite a tedious job to count the turns when winding, say, a mains transformer or other component which demands a fairly high degree of accuracy. By employing this simple dodge the work is considerably simplified. The idea consists of coupling the winder to a sewing-machine, either hand or treadle-driven. Whilst winding one should "stitch" (without cotton) along a piece of paper, meanwhile counting the turns of the winder. When 100 turns have been wound and the paper "stitched" the latter should be cut at the end of the stitches. Now, every time the paper is "sewn" from one end to the other, 100 turns will have been put on, and it is, of course, a simple matter to calculate the total number. It is possible, of course, to use any number as a "base," but 100 seems to be the most convenient.—P. Newton Nield (Loughborough).

An Improved Dial Light

THE usefulness of an ordinary dial light can be increased by employing the simple little dodge illustrated in the accompanying sketch. All that is required is a small piece of thin card or metal,

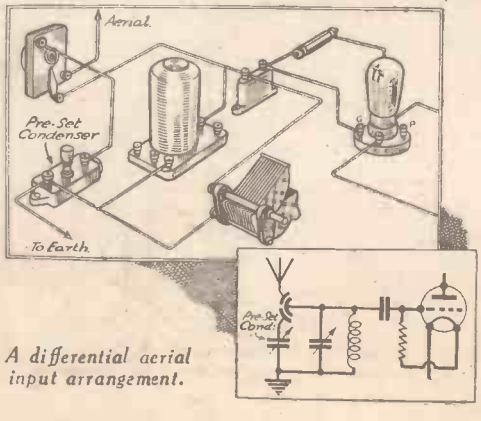


A neat dial-light arrangement.

with a narrow slit cut in it by means of a sharp knife. The card or metal is then attached to the bracket which supports the lamp-holder so that it comes between the light and the dial. By this means the whole of the dial showing through the escutcheon is not illuminated, but only a narrow strip of it which comes opposite the cursor or pointer. As a result it is somewhat easier to adjust the condenser and accurate tuning is simplified.—P. F. (Leeds).

Differential Aerial Input

A COMMON fault of many H.F. input volume controls is their effect upon the tuning of the circuit which they precede, and amongst others the series aerial condenser possesses this disadvantage. The effect is caused by the transference of a variable capacity, formed by the natural capacity of the aerial to earth, and the capacity of the variable series aerial condenser, to the tuned circuit. As the series aerial condenser is varied, so is the amount of capacity across the circuit varied. It is obvious that if it were possible to simultaneously place across the circuit as much capacity as was removed by the reduction of the series capacity, then the tuning would remain unaltered. The desired effect is obtainable in the manner indicated in the accompanying illustrations. A differential condenser of suitable capacity is substituted for the series condenser, leaving one fixed terminal on the differential condenser free. This terminal is connected to one contact of a semi-variable



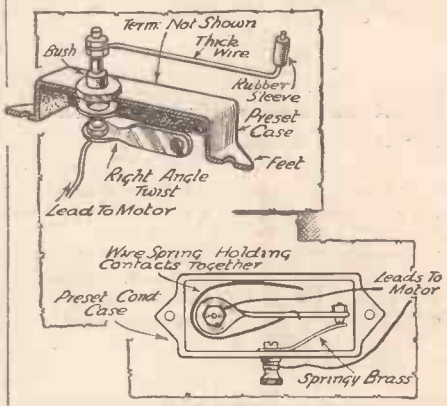
A differential aerial input arrangement.

condenser, the other connection from which is made to earth. In operation, the receiver is accurately tuned to a transmission with the differential control set for maximum volume (*i.e.*, with the aerial plates in circuit). The control is then set to nearly the minimum position, and the pre-set condenser adjusted to give maximum signal strength. The value of the pre-set condenser will depend upon the size of the aerial, but a condenser having a maximum value of .0003 microfarad, with a fairly low minimum value, will be large enough to equal the capacity of aerials of normal size.

The principle of operation is simple, and consists merely in the setting of the pre-set condenser to give a value exactly equal to the value of the capacity to earth of the aerial. This will ensure that the capacity to earth of the upper end of the tuned circuit will remain sensibly constant at all settings of the differential condenser.—Norman Rollason (Canterbury).

Automatic Gramophone Stop

THE accompanying sketch shows an easily-made automatic stop for electric gramophone motors which can be made from odds and ends from the scrap box. The sketch is self-explanatory and shows all the constructional details. To



An automatic gramophone stop.

set the switch it should be screwed to the motor board, the pick-up placed on the last groove of the record and the arm of the stop swung over until it touches the pick-up arm. The switch will then take care of itself.

Of course, it can be adjusted to suit all sizes of records by swinging the arm round as per sketch.—T. Preston (Coventry).

Improvised Resistances

A TEMPORARY resistance can very simply be made by taking a 3in. square of ordinary newspaper, moistening it, and folding it to form a strip about ⅛in. wide. This can then be connected across the ends of the defective resistance by binding short lengths of bared wire round its ends. The actual resistance value might not at first be correct, but it can be adjusted within reasonably wide limits by varying the dampness of the paper.

It will be understood that the resistance will not be of a permanent nature, but it can be kept in use for a whole evening without attention. If it is required for longer periods the paper should be moistened at intervals. A more permanent resistance can be made in a similar way by dipping the paper into Indian ink instead of into water. The ink should be allowed to dry before the resistance is put into use.

Practical Television

Presented Free with "Practical Wireless."

JANUARY 27th, 1934. Vol. I. No. 4.

PHOTOMETRY

Its Application to the Measurement of Cathode Ray Oscillograph Tube Characteristics for Television.

By A TELEVISION ENGINEER

IN the very near future the essential component of the household television receiver will no doubt be a cathode ray oscillograph tube, since, with the advent of ultra-short-wave wireless transmission of vision, high definition will be possible. Much research work is being carried out in several leading laboratories, and in the testing and measuring of tube characteristics photometry plays a leading part. Apart from actual picture tests and the screen colour, it is desirable to know the spot brightness in candle-power, and the spot size in relation to the negative voltage applied to the Wehnelt cylinder, as, with this information, the modulation efficiency of the tube can be seen at a glance. Therefore, before readings can be taken, one must possess a light source whose light intensity is accurately known. This is determined by balancing a suitable lamp against a sub-standard source; and the Hefner lamp is probably the simplest and most satisfactory for this purpose.

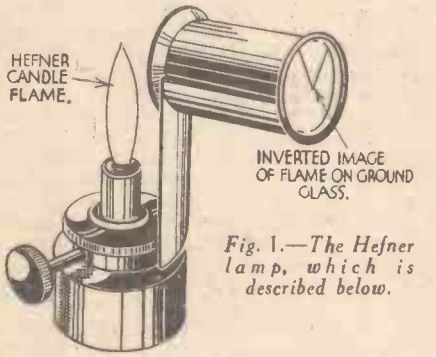


Fig. 1.—The Hefner lamp, which is described below.

Hefner Sub-standard Lamp

Fig. 1 illustrates a Hefner lamp. A wick consisting of fifteen to twenty strands of twisted cotton is inserted through a tube 15 mm. high, 8 mm. internal diameter, and 0.15 mm. thick, into the container, which is filled with a pure grade of amyl-acetate ($C_5H_{11}C_2H_3O_2$). After lighting, the flame tip is adjusted to a height of 40 mm. above the tube level by viewing the inverted image of the flame cast on the ground-glass screen, and adjusting the wick till the tip of the image cuts the horizontal hair line.

Although the lamp is rated to be 0.9 International candle, this is subject to correction, so that

$$I = 1 + .0055(8.8 - e) - .00011(760 - b)$$

I = Corrected candle-power.

e = Humidity in litres of water vapour/cubic metre.

b = Atmospheric Pressure in mm. of mercury.

In the following experiments carried out by the writer, actual figures are given to show how results are obtained.

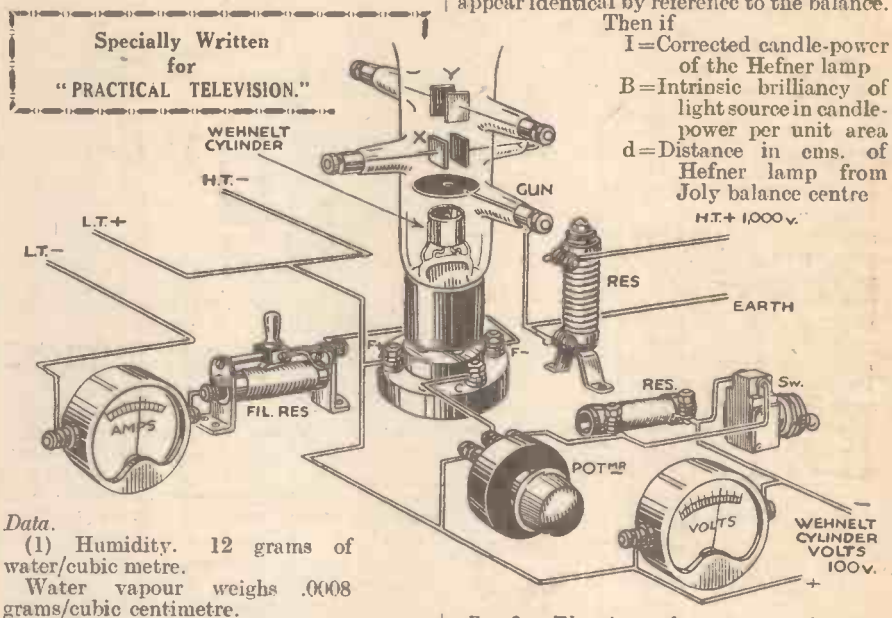


Fig. 3.—This shows the connections for the cathode tube.

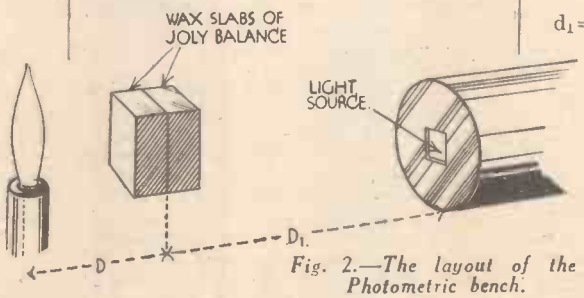


Fig. 2.—The layout of the Photometric bench.

Data.

(1) Humidity. 12 grams of water/cubic metre.

Water vapour weighs .0008 grams/cubic centimetre.

∴ Litres of water vapour/cubic metre of moist air

$$= \frac{12}{10^3 \times .0008}$$

$$= 15 \text{ litres} = e$$

(2) Temperature = 14° C.

Density of mercury at 14° C. = 13.56.

∴ Height of mercury column

$$= \frac{1.016 \times 10^6}{981 \times 13.56}$$

$$= 764 \text{ mm.} = b$$

Substituting in the formula, we have

$I = 1 + .0055(8.8 - 15) - .00011(760 - 764)$

$= 0.9659$ candle-power (neglecting the last term).

ENGLISH TELEVISION TRANSMISSIONS. (30 LINE SYSTEM)

	Vision	Sound
MONDAY	11 p.m. to 11.30 p.m. 261.1 m.	391.1 m.
TUESDAY	11 p.m. to 11.30 p.m. 261.1 m.	391.1 m.
WEDNESDAY	11 p.m. to 11.30 p.m. 261.1 m.	391.1 m.
THURSDAY	NO TRANSMISSION	
FRIDAY	11 p.m. to 11.30 p.m. 261.1 m.	391.1 m.
SATURDAY	NO TRANSMISSION	
SUNDAY	NO TRANSMISSION	

Method of Determining Candle-power of Light Source

A 6v. 30-watt lamp is enclosed in a light-tight box and its beam concentrated down a tube, over the end of which is placed a piece of ground glass. This in turn is covered with a metal cap in which an aperture of 1 sq. cm. is cut (Fig. 2).

A Joly balance consisting of two slabs of wax intersected with a piece of reflecting metal is utilized as the balance. The lay-out of the photometric bench is easily seen by reference to Fig. 2.

The balance is moved in the optical plane of the lights until the intensities appear identical by reference to the balance. Then if

I = Corrected candle-power of the Hefner lamp

B = Intrinsic brilliancy of light source in candle-power per unit area

d = Distance in cms. of Hefner lamp from Joly balance centre

d_1 = Distance of light source in cms. from centre of the balance,

the light intensity being inversely proportional to the square of the distance,

$$\frac{I}{d^2} = \frac{B}{d_1^2}$$

and $$B = \frac{Id_1^2}{d^2}.$$

With d = 16.6 cm. and $d_1 = 21.4$ cm., a value for B is obtained = 1.725 candle-power per sq. cm.

Determination of Spot Brightness and Size of Cathode-Ray Oscillograph Tube

The screen of the cathode ray tube is substituted for the Hefner lamp, and set at a distance of y centimetres from the balance.

The tube is connected in circuit as shown in Fig. 3. No time base being necessary, the X and Y plates are joined to the earth terminal to prevent the spot from moving over the screen.

For varying voltages on the Wehnelt cylinder the spot diameter is measured in mm., and the light source adjusted to x centimetres from the balance until the intensities appear the same.

When the tube possesses colour, a Wratten filter of the same shade is first placed over the light source aperture before measurements are taken.

The actual tube under measurement necessitated a blue Wratten filter having a transmission factor of 2.9 per cent., and

(*Continued on page iv*)

Simple Television Optics

It is Almost Impossible to Grasp Thoroughly the Operation of Television Transmission and Reception Without Some Knowledge of the Science of Light, and This Article, While Avoiding Advanced Theory and Mathematics, will give Just the Information which the Amateur Requires.

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

WHEN our eyes perceive an object, it is because light from that object enters our eyes and stimulates the optic nerves, giving rise to the sensation we call "sight." We must, therefore, find out something about the nature of this Light.

Light is simply one form of radiant energy and belongs to the same group as heat and radio waves; that is to say, it consists of vibrations in the ether. The difference between light waves and radio waves is simply one of frequency or wavelength. Whereas radio waves range from a matter of a few yards to several miles in length, the wavelengths of light range over a few hundred-thousandths of a centimetre.

When light is emitted from a luminous object, it travels outwards in all directions just as the waves from a transmitting aerial, but while it is perfectly correct to think of light waves as ever-growing spherical waves, like the endless successive layers of an onion, it is more convenient to imagine light as an infinite number of rays, projected forth from the source of illumination like, shall we say, the spines of a rolled-up hedgehog.

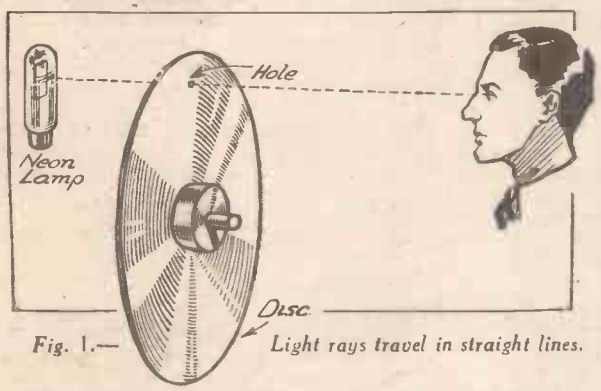


Fig. 1.—Light rays travel in straight lines.

In Straight Lines

We can study light and understand the functions of such devices as mirrors and lenses much more easily if we try to follow their effects upon individual rays of light.

The first point to note about a light ray is that it travels in a straight line through any one transparent medium. Thus, when the light in the studio is projected through the holes in the scanning disc, it falls upon the object to be televised at the spot exactly opposite the hole, and similarly, when viewing the neon lamp through the scanning disc, we see just that spot on the lamp which is, for the moment, in a direct line with the hole in the disc and with our eyes, as illustrated in Fig. 1.

Those substances like air and glass which allow light to pass through them are called transparent; those which stop or absorb light are called opaque; translucent bodies like ground glass absorb some light and allow some to pass through, and these last named are used for making up the screens employed in projection television receivers, such as the lens disc and mirror drum sets.

Persistence of Vision

We shall see later that while light rays proceed in straight lines through transparent bodies, they may have their direction changed in various ways. Before dealing with this part of the subject, however, let us consider a little more the effect of light upon the eye. It has been stated that light gives rise to the sensation of sight, but another very important point is that the sensation of sight remains for an appreciable fraction of a second after the light has ceased. It is this "persistence of vision" as it is termed, which enables us to build up a moving television image in our eyes by presenting several complete pictures in rapid succession with the image-reconstituting device.

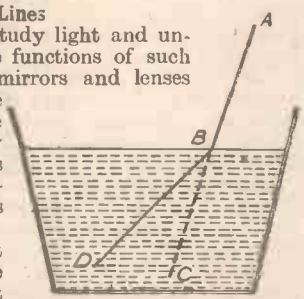


Fig. 4.—A simple example of refraction.

Reflection of Light

In many types of television receivers it is essential to change the direction of the beam of light once or twice, so the next point that arises is how this can be carried out. Everyone is familiar with the effect known as reflection as produced by a mirror. Highly-polished metallic surfaces "stop" rays of light and, in effect, reverse their direction. Fig. 2 represents a mirror and its effect upon a single light ray. The important point to note is that the reflected ray leaves the mirror at the same angle at which it meets it, and in the same plane as the normal. The angle is measured between the ray and an imaginary line called the "normal" at right-angles to the surface of the mirror at the point where the light strikes it. Thus, in Fig. 2 the two shaded angles are equal.

A very good example of how this mirror reflection is put into practice is furnished by an illustration given last week (Fig. 16, page iv). Here we have an experimental television receiver in which the beam of light from the bottom of the tube on the right, containing a signal modulated source, is projected on to the vertical mirror set at an angle of 45 degrees with the tube. This turns the light through a total angle of 90 degrees (angles of incidence and reflection being equal as we have just seen) on to the mirrors of the drum which are normally rotating. Each individual mirror is inclined slightly to the vertical mirror, and the beam reflected back from the small mirror surface on to the vertical mirror is once more turned through 90 degrees and impinges on a small screen mounted on the front of the receiver so as to create vertical strips of light as the mirror drum revolves.

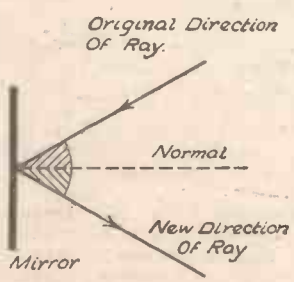


Fig. 2.—When light is reflected the angle of incidence equals the angle of reflection.

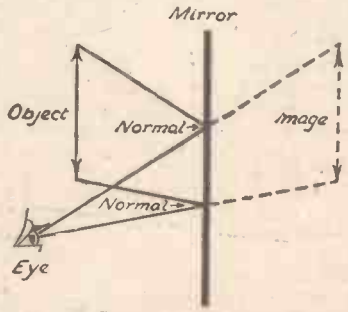


Fig. 3.—Showing why the reflected image appears to be behind the mirror.

It is at first rather difficult to see how this change in the direction of light permits us to see reflections "in" the mirror, but Fig. 3 will explain this. Rays of light from the object are reflected into the eye and obey the ordinary laws of reflection just enunciated. But the eye, used to seeing things only in a straight line, refers the image back along the new path

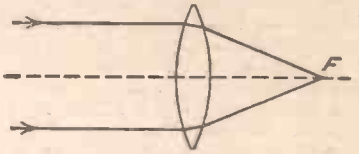


Fig. 5.—The focusing effect of a double convex lens on a parallel beam of light.

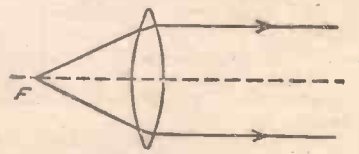


Fig. 6.—A parallel beam from a point source of light using a lens.

of the rays, and *imagines* the object to be as far *behind* the mirror as it is *in front* of the surface.

There is another means by which light rays can have their direction changed. It is called "refraction" or bending, and occurs when light passes from one medium (say air) into another, such as glass or water. Most readers are familiar with the illusion that a stick when dipped into a bucket of water appears to be bent as in Fig. 4. We *know* that the true position of the stick is ABC, but it appears to be ABD.

The reason is that the light rays are bent, and actually this is due to the fact that the light travels at a different speed in different media.

Lenses

It is as a result of this phenomenon of refraction that lenses (commonly termed magnifying glasses) possess their special qualities. Fig. 5 shows a very usual type of lens—namely, a double or bi-convex lens, consisting of a disc of glass whose two surfaces are worked and ground to a curvature corresponding to part of a sphere. A single convex lens has one flat surface and one spherical surface. If a parallel beam of light is passed through the double convex lens, each ray will be bent or refracted as it enters, and again as it leaves, the glass. There are definite mathematical laws connecting the angles to which the light is bent, depending in part on the relative density of the media (glass and air) and the angle at which the light enters the lens. The choice of a spherical curvature ensures that all the rays of a parallel beam are so bent that they meet at a point (F in Fig. 5) called the focus.

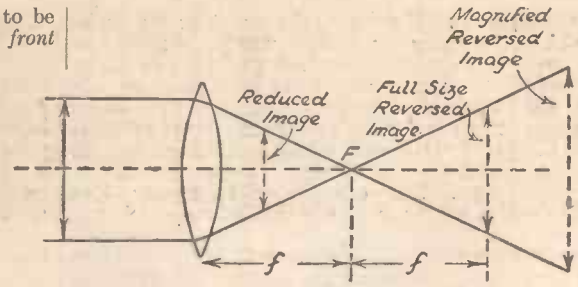


Fig. 7.—Position of the image at different distances from the lens.

It should also be clear that if at the point F we placed a point source of light, the divergent rays collected by the lens will be bent to a parallel beam (Fig. 6).

Again, if an illuminated object is situated on one side of the lens and a screen be placed on the other side, a reduced image the right way up will be formed if the screen is placed nearer to the lens than the focal point, while an inverted image will be formed if the screen is placed beyond the focus (Fig. 7). This inverted image will be reduced if the screen is less than twice the focal distance from the lens, and will be magnified if the screen is more than twice the focal distance.

Users of television receivers will no doubt have noticed that in comparatively few cases is a single lens used to produce the magnified image, this applying particularly to a disc and neon machine.

Using Two Lenses

The reasons for the use of a more complicated optical system are twofold. In the first place, it is due to inherent defects in all simple lenses which form part of a sphere. While the image projected by the central portion of the lens is quite clear and sharp, there is a considerable amount of light "dispersion" at the outer edge of the lens. It is found preferable, therefore, to use two lenses, such as a single and double-convex, as in the case of the recent "Portovisor," using the accurate central portions of the first lens slightly to concentrate the beam on to the central portion of the second lens.

Secondly, where it is desired to focus a beam of light on to a mirror, partial concentration is performed by one lens, (the "condenser") using, of course, the central portion, and accurate focusing by the second lens. By using two lenses the apparatus can be so designed that the second lens can be accurately adjusted in position to "focus" the beam exactly, and in this way secure a "cleaner" image.

AN ENGINEER LOOKS AT TELEVISION

In this Outspoken and Provocative Article Our Contributor Examines the Progress of Television from the Engineer's Outlook and Points out What He Considers to be a Number of Neglected Points on the Mechanical Side.

By RADIOPTIC

AS an engineer more interested in mechanical than theoretical aspects of television, I feel great disappointment when I come to survey from my mechanical point of view the progress that has been made in the science during the past few years. It is granted that it is possible to obtain a better televised image to-day than it was, say, two years ago, but I am strongly inclined to the belief that the improvement is on the transmitting, rather than the receiving, side. The majority of television receivers of the kinds which are considered by many television experts to be remarkably efficient appear to me as a mass of badly-made components assembled in the most amateurish way. There might be reasons for using forms of construction which, to the engineer, are unsound and unreliable, but I feel convinced that considerable improvements could be made if our television theorists would deign to call in the services of competent men who have received a thorough training in the design and construction of mechanical and electrical apparatus. Such men would at once remedy many of the faults to be found in eighty per cent. of the television receivers and components on the market, and their work would prove far more valuable than much of the research work which the theorists are doing to improve the clarity of televised pictures by evolving new systems employing weird and wonderful devices in order to obtain their 90, 120, and 180-line scanning. These latter developments are, perhaps, inevitable for the progress of television, but they should come *after* numerous obvious mechanical refinements which are owing to the apparatus at present in use. It is a case of learning to walk before attempting to run!

When these facts are pointed out to many of these non-mechanical television technicians, they are all too ready to explain that improvements are unnecessary and would be futile with the present systems of transmissions. They are, in fact, very careless in their outlook, and are apparently much too absorbed in the future to give reasoned and studied thought to the present. This is indeed unfortunate, because it seems to me that there can be no doubt whatever that *real* television must come—and in the very near future. Let us hope that our engineers and designers will pay more attention to the mechanical side of things before television receivers are installed in nearly every home in the country. If they do not, the popularity of looking-in is sure to be delayed unnecessarily.

Perhaps those who are responsible for the development of television will consider that the remarks I have just made are unfounded, or that they cannot be justified. I will therefore attempt to be more specific in pointing out details of design which appear very unreliable and distinctly bad from the mechanical point of view. It is particularly important that the electric motor employed to revolve the scanning disc, mirror-screw, or mirror-drum should be maintained at a constant speed. Additionally, it is stressed by those responsible for television that the motor should run dead truly—this is, of course, obviously correct, since the dimensions of the holes or the positions of the mirrors are very important, and should be perfectly accurate. And yet, how many motors do we find whose armatures and driving spindles are accurately balanced? Every engineer knows that a shaft which is revolving at the comparatively high speed of 750 revolutions a minute is bound to vibrate and "whip" if it is not properly balanced. Again, great efforts are made to reduce the weight of the disc or drum in order to reduce the "fly-wheel" effect and make synchronization easier of accomplishment, but despite this a brass spindle bush of 2in. or more diameter is employed to mount it on the motor spindle. Surely it would be more reasonable to make use of one of the innumerable aluminium alloys, many of which are equally as strong as brass.

Disc or Drum Mounting

Although efforts are made to ensure that the disc or drum shall run truly it is invariably attached to the motor spindle by passing a grub screw through the mounting flange. This again is most unscientific and un-mechanical, for it is obvious that the pressure of the screw against the spindle must, of necessity, throw the flange out of truth. What better method could be employed as an alternative? There are several, the most obvious of which is to make use of a slightly tapered motor spindle on to which the flange could easily be driven. Such a method of mounting would be ideal, despite its utter simplicity, because the flange, or rather the spindle, would be entirely self-centring.

Scanning discs, as at present made, strike the engineer as being remarkably flimsy affairs, which are liable to be buckled with the slightest touch. And once they are buckled, it is almost impossible to make the holes "line up" again. Is it beyond the resources of our so-called television engineers to devise a disc, or a wheel

(*Continued overleaf*)

(Continued from previous page)

with the necessary holes in it, which would be much better mechanically and equally as good in effect as the present disc of aluminium foil? Surely there are many ways of achieving such a result by making use of the principles of the bicycle or racing-car wheel.

Punching the Disc

Not only are the manufacturers of television apparatus to blame for much of the downright bad workmanship which goes into the production of television components, but it seems that those who describe how some of the parts can be made at home do not get down to "brass tacks" in regard to the constructional work. They tell the amateur to make his parts by similar unreliable means to those adopted by the professional manufacturers, instead of encouraging the mechanically-minded amateur to adopt more scientific methods. One example that seems particularly bad is in connection with the punching of holes in scanning discs. The constructor is merely told to buy or make a punch of such-and-such a size and to make holes through a prepared aluminium disc along a helical line drawn round the disc. Why does not someone describe how to make a trammel arrangement with screw adjustment so that a scriber is moved the correct distance towards the centre by giving the screw a single turn? And why not a simple press of some kind by means of which the holes can be made without the crude method of striking a punch with a hammer and thereby stretching the metal and causing it to buckle unnecessarily? If there is any reason why the holes should be made with a punch, why not a clamp to grip a large area of the metal so that stretching and buckling is reduced to an absolute minimum?

Perhaps I am too critical, but I do feel that the mechanical aspects of television—and it seems that the whole process is a purely mechanical one—should be considered far more carefully if the science is to make the rapid strides which I should very much like to see. What about it, you television theorists?

Recording Television

THE present television transmissions occupy only half an hour on four days a week, and this naturally restricts the amount of experimenting which can be carried out by the average enthusiast. It must be remembered, however, that it is just as easy to record the television signals as it is to make records of ordinary broadcast music and speech. The standard aluminium disc and a cutting stylus in a gramophone recorder are connected to the output terminals of the receiver and the television transmission (London National, 261.1 metres) is tuned in and the record blank filled. Although this will not enable a complete item to be recorded, it will present sufficient subject matter for subsequent use at a more convenient time. The record is, of course, simply played back through the medium of a pick-up connected in the grid circuit of a valve in the same way as is an ordinary gramophone record, with the television apparatus connected in place of the loud-speaker.

Universal Scanning Disc

The English television system requires that the neon lamp (with a disc receiver) is arranged at the right-hand side and, consequently, produces a vertical picture in which the ratio of the height to the width is as seven is to three. The principal Continental system, whilst utilizing the same ratio, requires that the picture shall be situated at the top of the disc in a horizontal position. If, therefore, it is desired to receive both Continental and English transmissions on a disc receiver, it is necessary to swing the lamp round to occupy the alternative position. It should not be found a difficult matter to arrange a bush round the motor spindle (or on the same level) in order that an arm may be pivoted at that spot to carry the neon lamp-holder. Of course, where the entire receiver is enclosed in a cabinet it will be necessary to arrange a suitable window (with magnifying devices) at both positions.

TELEVISION TOPICS

Push-pull and Television

Many readers prefer the push-pull method of L.F. amplification, and are rather at a loss to know how to join the neon lamp in order to obtain the necessary striking voltage. When the lamp is joined direct in the anode circuit there is, of course, the normal anode current of the valve passing through the lamp, and provided this is of a suitable value it develops the initial glow in the lamp, and this is subsequently modulated by the speech currents. In the push-pull output circuit a centre-tapped choke (or transformer primary) is joined across the two anodes, and it seems at first sight impossible to join a lamp to obtain the necessary striking voltage. The following scheme, however, will be found perfectly satisfactory. The usual centre-tapped choke is joined across the two anodes, and the centre point connected to high-tension positive. A fixed condenser of approximately 2 mfds. is then joined to each anode and the other end of each condenser is joined to the anode and the cathode of the Neon lamp. H.T. positive and H.T. negative are then joined direct to anode and cathode of the neon, and if required, a resistance of the variable type may be joined in the negative lead in order to adjust the neon to the required brilliancy. The fixed condensers prevent a short-circuit of the H.T. supply, whilst they permit the speech current oscillations to pass to the Neon lamp.

PHOTOMETRY—(Continued from page I)

the corrected value of B now becomes equal to $.029 \times 1.725 = .05$ candle-power.

The results are then tabulated. The following figures are taken from a tube with 1,000 volts on the plate and at heater current 0.9 amps.

Intrinsic brilliancy of source = B candles per sq. unit = .05.

Total brightness of spot = K

y cms.	x cms.	Wehnelt Cylinder Volts	d m/m	$K=\frac{a^2By^2}{x^2}$
5.15	69.8	—5	30	.000613
	80	—10	25	.000466
	68.5	—15	23	.000634
	67.25	—20	20	.000659
	66	—25	17	.000684
	75	—30	10	.00053
5.15	29.2	—35	2	.0035
	38.1	—40	1	.00206

Diameter of spot in mm. = d

Area of source = a^2 = 2.25 sq. cms.

Then $\frac{a^2B}{K} = \frac{x^2}{y^2}$

and $K = \frac{a^2By^2}{x^2}$ candle-power.

From the tabulation two curves are then plotted:—

(1) K in relation to Wehnelt voltage (see Fig. 4).

(2) d in relation to Wehnelt voltage (see Fig. 5).

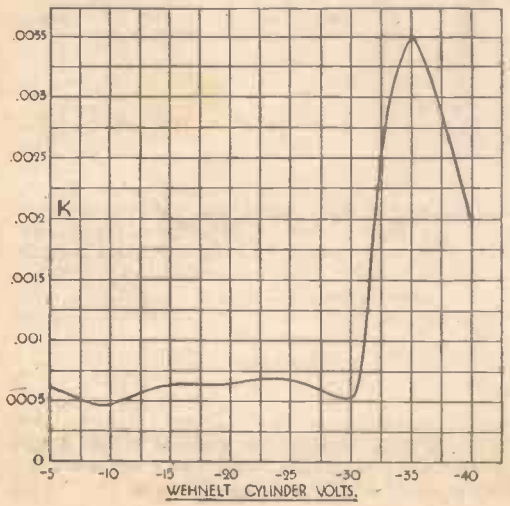


Fig. 4.—Graph showing the relationship between the Wehnelt voltage and K.

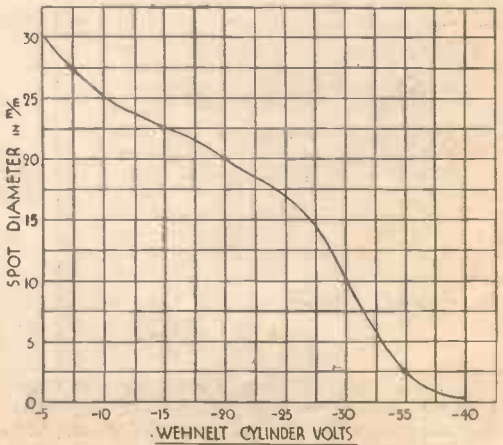


Fig. 5.—This graph shows how the distance d varies with the Wehnelt voltage.

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1 Bulgin Super H.F. Choke type H.F.4		4	6
1 Bulgin Fuse-holder type F.5			6
1 Bulgin 100 m.a. Fuse			6
1 Bulgin G.B. Bias Clip type 2			4½
3 Graham Farish 50,000-ohm 1½ watt "Ohmite" resistances		4	6
5 Graham Farish 1,000-ohm 1½ watt "Ohmite" resistances		7	6
1 Graham Farish 25,000-ohm 1½ watt "Ohmite" resistance		1	6
1 Graham Farish 500-ohm 1½ watt "Ohmite" resistance		1	6
1 Graham Farish .0002-mfd. Reaction condenser		2	0
1 Graham Farish Battery Economiser		7	6
2 Dubilier 1-mfd. fixed condensers, type 9200/B.S.		5	0
4 Dubilier .1-mfd. fixed condensers, type 9200/B.S.		8	0
2 Dubilier 2-mfd. fixed condensers, type 9200/B.S.		7	0
1 Dubilier .0001-mfd. fixed condenser, type 670		1	0
2 Dubilier .0002-mfd. fixed condensers, type 670		2	0
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THE BEGINNER'S SUPPLEMENT

MILLIAMPS WITHOUT MATHS—(Part II)

Assembling the Meter Described Last Week. By E. L. PARKER

IN the previous article details were given of suitable shunts for a milli-ammeter in order to make it into a multi-range meter. This week I am going to tell you how to mount the meter in a cabinet with the shunts, but first it is proposed to show how the meter can be made to read volts. It is a well-known fact that if we place an increasing voltage across a resistance the current passing through the latter will increase in direct proportion to the voltage. Let us assume that we have a potential of 50 volts across a resistance of 50,000 ohms. The current flowing will be exactly 1 milliamp. Now if we double this potential and make it 100 volts the current flowing will also be doubled and will become 2 milliamps. It appears, then, that reading the current flowing, providing we know the value of the resistance, is an indirect means of reading the voltage. If a meter reading 1 milliamp suddenly jumps to 2 milliamps we know that the voltage originally applied has been doubled, or if the reading drops to ½ milliamp, then the applied voltage has dropped to half its original figure.

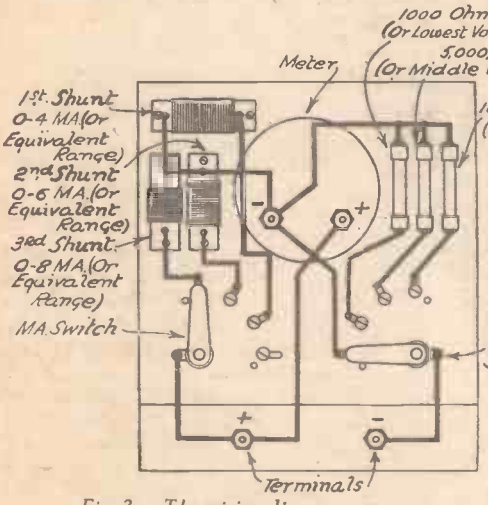

Fig. 3.—The wiring diagram.

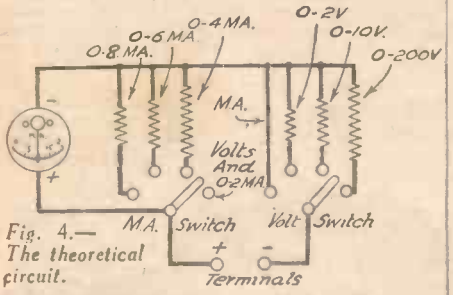

Fig. 4.—The theoretical circuit.

This direct connection between voltage and current, providing the remainder of the circuit remains constant, makes it possible to put resistances in series with the milliammeter with the object of reading volts. The values of these resistances are easily worked out, but to save all trouble an easily-read chart is appended which will enable you to pick out the values of the resistances to give the three most suitable ranges for your meter. By suitable is meant the ranges that will most easily be read on the present scale. For instance, the most suitable ranges for a 0—5 millammeter are, 0—5 volts, 0—10 volts, and 0—150 volts. All the values of the resistances in this chart are easily obtainable at any wireless shop, but if you require your meter to be exceptionally accurate it is wise to get specially-tested resistances. The more accurate the resistances are, the more correct will be the readings, and any of the well-known manufacturers would be pleased to let you have resistances tested to a very fine limit at a cost little in excess of the standard price. It might be helpful for you to know that with an error of 4% (low) a 30,000 ohms resistance in circuit with a 0—5 milliammeter will actually record 144 volts if a potential of 150 volts is applied, so that if resistances with an accuracy of 2% either way are used, the results will be quite as accurate as normal use will require.

Mounting the Meter

You now have the meter, shunts, and resistance; it only remains to fit them into a cabinet. Although it may seem somewhat old fashioned, it is recommended that they are fitted into a neat cabinet with a sloping front, because you will most likely find that in general use it presents the meter in the most easily-read position. But whichever design you decide on, the meter can be built up on an ebonite panel in the manner shown in Fig. 3. The switches cannot be described in detail because the exact design must depend upon the parts used to build them, the remainder of the afore-mentioned filament resistance will probably be very convenient for one of them.

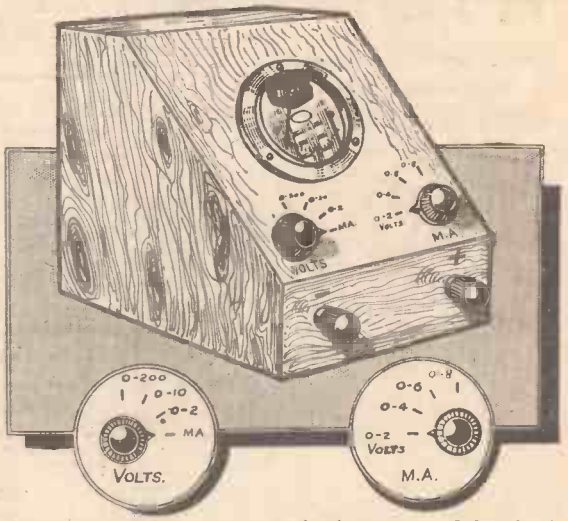

Fig. 5.—Perspective view of the finished meter and details of dial markings.

The wiring can easily be followed from the wiring diagram, but for convenience the theoretical circuit is also given (Fig. 4). If the terminals of your meter are differently marked from those of the meter in the diagram, do not forget to alter the markings on the outside terminals. The switch studs can be round-headed or cheese-headed screws, fitted with solder tags. For simplicity the switches could be built up on pieces of 3/16 in. ebonite or, if preferred, they can be built up on the panel. If built on the panel a thin sheet of ebonite, bakelite, or any other suitable material can be neatly stuck over the front of the panel to cover the holes which must be made to take the studs. If the holes are drilled slightly smaller than the screws you will find that they will cut their own thread and obviate the necessity for tapping. The switch knobs should have pointers attached and the panel should be marked to agree with the various positions. It is important that no matter what readings you have chosen for your meter, the associated shunts and resistances should be fitted in a corresponding order to those shown in the wiring diagram (Fig. 3). The

(Continued on page 934)

TOPICAL TECHNICALITIES

Frequency Doubling

It was shown last week how the crystal can be employed for the purpose of rendering the oscillations in a circuit constant. It is highly improbable, however, that this frequency will be that upon which it is required to transmit, and we must therefore adopt some form of changing circuit. It is by now well known that an oscillation is accompanied by harmonics, and in practice it is found that the second harmonic will prove most useful when converting out crystal-controlled oscillation into the frequency of our transmission. Consequently a valve circuit is supplied at its grid with the oscillations from the crystal-controlled source, and in the anode circuit of the valve a tuned circuit is connected. This tuned circuit is adjusted so that its frequency is twice that of the controlled frequency. By providing the valve with certain optimum voltages it will be found that there is present in the anode circuit an oscillation having a frequency exactly twice that of the original controlled source. Where it is desired to use some other frequency than this, the process may be repeated, each successive frequency-doubler providing the harmonic oscillation, but naturally with reduced strength. It is obvious, of course, that the tuned circuits are critical, as are also the voltages applied to the frequency-doubling valve.

WHICH STATION WAS THAT?

Some Interesting Notes which will help you to Identify the Stations Received Under the New Conditions.

By J. GODCHAUX ABRAHAMS

THE owner of a multi-valve wireless set who limits his activities to the reception of broadcasts from the home stations puts me in mind of the amateur gardener who is satisfied to potter around a ten by four flower bed when he could roam at random and with full freedom through Kew Gardens.

The P.M.G.'s licence for which you are asked to pay ten shillings a year entitles you to listen to *any* broadcast you may be able to pick up in the ether, in addition to the wireless entertainments provided for you by the B.B.C. When you find that with the same ease in handling a receiver you can tune in at will twenty or more different transmissions of interest both to you and to your family, irrespective of distance, the variety of the radio programmes at your disposal from so many sources will whet your appetite. Like Oliver Twist you will ask for more.

To-day, most wireless receivers will gratify these legitimate desires. The bare fact that your knowledge may be confined solely to the English language or, alternately, that you only possess a smattering of foreign tongues—perhaps merely the few words and sentences learnt at school—should not deter you from listening to Continental broadcasters; the actual identification of any individual transmitter, in practice, is much simpler than it would appear in theory. Without any particle of doubt, interest in the programme is considerably enhanced if you know from what country and city it emanates. Possibly when twirling the dials you may have tuned in signals of which you could not trace the origin; possibly, again, you did not recognize the language and to complicate matters during the period you were listening, no call was given and no interval signal was heard. It is true that for some of these reasons the identification of a station may not be an easy one; to beginners in wireless it may appear to be an almost hopeless problem; to others a matter of guesswork, or a question of chance, as by standing by, one might pick up some kind of announcement in the course of the broadcast. Some slight experience, however, acquired later, will definitely prove that although at the time the tyro failed to secure evidence, much of the necessary information was clearly offered to him; *in fact, on most occasions sufficient data is forthcoming to allow him to arrive at a correct conclusion.*

The Logging Chart

It is to be presumed that one of the first "accessories" invested in by the beginner is a complete list of European transmitters with their respective wavelengths. Such a list was given free with last week's issue of PRACTICAL WIRELESS. Now, to identify a broadcast, it is essential to know the channel on which the transmission is carried out as it is to this wavelength or frequency that the receiver is tuned. There are various methods by which this information can be obtained, namely: (a) by actual measurement with a calibrated wavemeter, (b) by plotting a graph based on data already in your possession or immediately available, (c) by compiling your own list of condenser readings worked out on previous loggings of known and identified transmissions and, finally, (d) by inference drawn from the condenser dial degrees in relation to other readings taken of stations heard on previous occasions. Many wireless receivers have their condenser dial or dials marked in degrees (0—100, 0—120, or 0—180); others are calibrated in wavelengths; others, again, bear the names of the stations corresponding to the various wavelengths and/or frequencies. No doubt, at first sight the last method would appear to solve the problem of identification straight away; it would were it not for the fact that many stations have a bad habit of either straying from their allotted channels or of changing their wavelengths to suit their own convenience. The new Lucerne Plan *may*, however, remedy this. In the allocation of wavelengths the geographical position of the transmitter plays an important part and there is every chance that modifications to the original plan will yet have to be made to avoid mutual interference between neighbouring high-power stations. Other factors may also be disclosed which cause unforeseen complications. This would mean inevitable adjustments which would change the position of a number of stations in the broadcasting band, and for this reason alone it would be unwise to rely exclusively on the printed information given on a condenser dial. In my opinion on this ground alone readings in wavelengths, kilocycle frequencies, or mere degrees will be found more useful for establishing a log of stations heard and identified.

Tracking a Station

The first point to ascertain is whether the transmission is made on a channel above 1,000 metres or below that wavelength. The greenest of beginners can establish that fact without further explanations as, barring the oldest type of sets, all receivers are equipped with a switch or other gadget for the selection of the long or medium band. If the required station is broadcasting on the latter band, find out roughly its position in respect to some of the better known home transmitters, such as your local station. Doubtless, at the outset you will have picked up one or two of the B.B.C. National or Regional transmissions, and a glance at your condenser dial will show you whether it is below, say, Midland Regional and above Scottish Regional, or between, say, North National and West Regional. This will greatly limit your search by giving you some rough idea of the wavelength. Here let me suggest two ways of making a note of the data obtained. The easiest perhaps is to jot down, as soon as you have tuned-in a transmission, the exact condenser readings. Where you have obtained a call or recognized the transmitter—there can be no doubt in regard to the British stations—append this information against its wavelength. When a few have been logged you will have collected some definite landmarks, and a glance at the list in conjunction with the readings of the "wanted" transmitter will show approximately the channel on which it is operating.

A more accurate method, and one which may be strongly advocated if the work is taken seriously, is to plot a graph, a description of which has already appeared in these columns. If a little care is used in keeping it up-to-date as each transmission is recognized, much valuable information will be collected. Gradually you will find your log grow, with the result that when a mystery broadcast crops up a glance at the dial, followed by a consultation of the graph, will confine the search to three or four stations, and thus reduce the problem to its simplest form.

The Relays

The question of relays may sometimes prove puzzling, inasmuch as the same programme will be taken by a number of stations, but if, as already explained, a note is made of the groups of transmitters, it is not difficult to trace the relay broadcast back to its "feeder" or mother station. To give an example. If you look at a list you will see that Frankfurt-am-Main, Stuttgart, Langenberg, with their respective relays Cassel, Trier, and Freiburg, take the same wireless entertainment, and that Milan, Turin, Genoa, Florence and Trieste work in the same manner. The calls heard in these instances

(*Continued on facing page*)

NEON DANGER BEACON AT RUGBY WIRELESS STATION

A neon danger beacon which will be visible 50 miles away is being built to the order of the Air Ministry to warn aircraft of the 12 giant wireless masts at Rugby station. Work began only a week ago—a few days before the crash at Ruysselede, Belgium, when an air liner flew into a similar group of wireless pylons with the loss of 10 lives.

(*Continued from facing page*)

will be those of the original station from which the broadcast is made. To continue the illustration, if you heard *Firenze* (Florence) on a reading below that of London National, a reference to your list of wavelengths (and later to your log or graph), will prove that you were *not getting the programme direct*, but will establish the identity of the relay, and so on.

The Language

Next in importance comes the question of language, and this is the one which I think offers to most beginners the greatest difficulty. Roughly speaking, in Europe we must classify the tongues spoken into three large groups, namely, Latin, Teutonic and Slavonic or kindred languages. In the first we find French, Italian, Spanish, Portuguese, in the second, German, Dutch or Flemish, Norwegian, Swedish, Danish, and in the last Russian, Polish, etc. In order to avoid further puzzles I have not extended the classification, but you will also pick up Czech, Romanian, Finnish, Magyar, Slovak, and others.

As you may surmise, it is a difficult matter to give you a concrete idea of what a language sounds like, but a few pointers in this connection may help you. If you hear such words as: Allo! Station (phon: *star-see-ong*) émission (*ay-mees-ee-yon*), *poste*, you may take it that you are listening to a French broadcaster, to Brussels No. 1, or to Sottens (Switzerland). The condenser readings will decide which of these it can be. German is undoubtedly a roughish tongue full of *ach's* and other guttural sounds; Dutch, although somewhat softer, is perhaps more akin to English, as is also Danish. You should find it easy to identify Italian as most of the words end in a vowel; in addition, all studios have women announcers. Spanish, although possessing some resemblance, is more guttural, and Portuguese is a shade harder. Flemish, as picked up from Brussels No. 2, resembles Dutch. When once you have heard Russian—the transmissions are quickly found on 857 metres (Leningrad) and 1,481 metres (Moscow)—you will not fail to recognise it the second time as it is so different from other tongues. Polish is full of *ski's* and Czech seems to contain more *z's*, *d's*, and *b's* than any other letter of the alphabet. Although, perhaps, it may at first sight seem to be a waste of time, it is worth while when tuned in to a Continental station, to "hang on" for a few minutes, even when a news bulletin is being broadcast, if only to catch the intonation and sound of the foreign tongue used.

If you listen frequently to Continental stations your ear will familiarize itself to these different sounds, and after a short period you will be surprised to discover with what ease you can distinguish the family to which a foreign tongue belongs. You may not understand words, but definitely you will be able to say, for instance, that although not French or Italian it may be Spanish or Portuguese.

The Interval Signals

Where interval signals are concerned, be they metronome, bells or musical box, a solution to the problem is at once forthcoming. All you need do is to refer to the list of interval signals published last week in these columns. Familiarity with these sounds again will enable you to identify without hesitation the source of the broadcast and a quick reference to your log will tell you through which channel it is being heard.

WHY SOME RECEIVERS FADE MORE THAN OTHERS

An Interesting Explanation of Phenomena Which are Generally Overlooked

By PERCY RAY

EVERY owner of a "foreign-station-getting" receiver is aware of that annoying phenomenon called fading. In some up-to-date sets this rise and fall in volume is offset by some form of automatic volume control, but it is receivers which are not so equipped that give rise to the question, "Why do some receivers fade more than others?"

Readers will already be aware that fading is due to natural causes outside the control of the receiving set and, from what little is known, the transmitter also. Hence it would, at first sight, seem ridiculous to suggest that one receiver should fade more than another.

There is no question that some types of superhet receivers, and to a lesser extent "straight" receivers, actually accentuate fading, sometimes completely spoiling a broadcast that would have been acceptable on a receiver not troubled with this peculiar fault which, for the purpose of clarity, we will call "Accentuated Fading."

"Accentuated Fading" is a combination of the rise and fall in volume of the received signal *plus* a rise and fall in set efficiency consequent upon it; that is to say, the overall amplification varies with different input voltages.

This state of affairs is due to a valve that is working on a portion of its characteristic curve where small changes of input bring about relatively large changes in the working characteristics. What actually happens is that when the signal fades the declining input brings about a corresponding decline in the efficiency of the receiver. From this it will be seen that there are two forces, both reducing the signal strength and accentuating the original degree of fading.

Due to the Detector

It is interesting to explore the possible stages in which "Accentuated Fading" may arise. If it were anywhere in the low-frequency portion of the receiver the effect would be to make soft passages of music almost inaudible, and would come into effect on the orchestration of the music more than on the varying strength of the incoming signal, consequently the trouble must arise somewhere between the aerial and detector.

"Accentuated Fading" could occur to a very small extent in a screen-grid stage, but it would be too slight to make its presence known to the human ear, even if two or three stages were concerned. All stages have now been eliminated except the detector or second detector in straight or superhet receivers respectively; in a superhet there is also the first detector, but this usually has a small load in its anode circuit and a relatively high anode voltage, and further does not handle powerful signals—consequently it can be ruled out.

Anode Bend

The biggest offender is an anode-bend detector, particularly if it has a high working impedance in the region of a megohm or more. An anode-bend detector that is behaving in this manner can often be improved by a change in screen voltage accompanied by an appropriate change of grid bias; but, unfortunately, this procedure often brings about considerable sacrifice in efficiency before an acceptable improvement is brought about.

The true solution is to do away with anode-bend rectification altogether, as even if the constructor is willing to buy another type of screen-grid valve and to try using this method again, there is no assurance that matters will be any better unless he has the means and knowledge to gather together a mass of data relative to both valve and set.

The alternative is to use power-grid detection, but this method must be approached with care for two reasons. The use of a triode valve is out of the question, owing to lack of amplification, unless there is more H.F. amplification available than was originally necessary. The most obvious thing to do is to use either a low-impedance screen-grid valve or a high-frequency pentode as a power-grid detector, which will offset, with something to spare, the adverse effects of the necessary grid current damping imposed (by a grid detector) on the preceding tuned circuit.

Secondly, certain types of I.F. transformers will to a small extent lose efficiency out of proportion to the increase of grid current damping, thus accentuating fading.

Leaky-grid Detector Faults

Leaving the question of superhets. adverse fading can occur on a simple three-valve receiver; if battery valves are employed it is usually due to the grid leak having developed an abnormal value, or to a leak in the grid condenser.. In a mains receiver the trouble may also be attributed to the use of a power-grid detector arranged to handle a far bigger input than the single high-frequency stage can offer it from a distant station; on the other hand, the trouble can be caused by an overloaded detector, but distortion would make itself apparent; more so than "Accentuated Fading." Remember that fading will only occur on a distant station, and the overloaded detector will, therefore, seldom be the root of the trouble.

There is no doubt in the writer's mind that "Accentuated Fading" will develop into a serious problem, especially if ordinary fading continues to become worse, as it has done for the last four years. This article does not pretend to point out the true remedy, but it shows how it may be minimized. It is probable that all the H.F. and I.F. stages contribute to this undesirable happening.

For the benefit of those who would like to point out that it does not matter as the sets of the future will have A.V.C., it will be well to point out that A.V.C. does not do away with the distortion that accompanies fading, and "Accentuated Fading" will turn to "Accentuated Distortion." For those who would submit the diode detector as a "cure-all," there is the point that another I.F. stage is almost inevitable, which will bring other troubles in its wake.

RADIO RAMBLINGS

By JACE

Jottings from my Notebook

Persistent Mains Hum

IT sometimes happens that a mains set is troubled with a bad mains hum that nothing will stop; the set may be made of the best components and material obtainable, and everything known to stop mains hum may have been incorporated without the least improvement. Such persistent trouble is almost sure to be due to a defect in the actual valve itself, a short-circuit or low-resistance path between the cathode and heater wire, allowing the A.C. that is feeding the heater to reach the cathode. The only cure is, of course, to use another valve.

Faulty A.V.C.

NOW that automatic volume-control is becoming quite general, certain pitfalls are beginning to show themselves. A very common trouble with an A.V.C. circuit is failure of the system to function so that the set works exactly as it would if A.V.C. were not incorporated. This is almost always due to either a broken resistance connected to the diode, or to the A.V.C. decoupling condenser leaking; it is imperative that this condenser is perfect.

A Novel Tester

AN American firm has just placed upon the American market a simple gadget which they are pleased to call a "growler." This is a very useful device; it consists of a torch case, but the usual bulb is replaced by a small buzzer; there is also a small pick-up coil provided. The idea is to enable the amateur to test almost every component with no additional equipment other than a pair of headphones. It can be connected across a transformer with the headphones across the other winding and a broken winding would be instantly noticeable. It will also test condensers, tuning coils, continuity of any description, or lack of it, and with the pick-up coil it is possible to trace short-circuits.

Queries to Manufacturers

MANY listeners have occasion to correspond with the manufacturers of some component or receiver regarding trouble or advice; if the product in question can be readily identified the reply is likely to be more detailed and helpful than if the answer has to be a scanty reference to six or seven different types. It is not sufficient to refer to a receiver as a Blanker three-valve screen-grid; the makers possibly have issued a dozen sets that would answer to this description. When referring to a product quote the catalogue number or name ("Panther," "Pye Q," etc.); do not use a general name like "Melody Maker" that is used for a series of models.

Self-Winding Speaker Leads

IN Germany almost every loud-speaker has a self-winding cord concealed in the base; when it stands on the set it appears to have a neat taut lead a few inches long. When the speaker is required in another room, it is only necessary to pick it up and carry it in; when returning it to the set the lead automatically winds itself up into the base.

Anode Current and Screen Voltage

MANY experimenters have found that a low voltage on the anode of a screened-grid or pentode valve makes practically no difference to the anode current, even if it is dropped from 150 to, say, 50 volts. The reason for this is that the *anode* current is almost entirely controlled by the *screen* voltage.

Interference with a Vengeance

A RADIO scientist has discovered that there are over 3,000 different electrical devices in a big city that can interfere with radio; can anybody think of another, or, better still, can everybody thinking together compile such a list? We doubt it.

Crystal Detector and A.V.C.

A CORRESPONDENT suggests using a crystal detector for rectifying the signal to provide bias for an A.V.C. system instead of the usual metal rectifier. Theoretically, this may sound all right, but a crystal has a relatively low reverse resistance. Anyhow, who would like to adjust the cat's whisker before starting the evening's ether tour?

Keep Sets Free from Damp

DAMP is likely to cause premature breakdown in a receiver, and it also impairs reception. If a set stands in a damp place, such as near French windows that are often open, it is a good plan to cover all the ventilation holes, except one, for an hour about once per week; care should, of course, be taken to see that the set does not get unduly overheated.

Time Delay on A.V.C. Systems

SOME constructors are experiencing a *time* delay on their A.V.C. systems; that is to say, the volume adjusts itself some two or three seconds after the station has been tuned in; on a powerful station the row can be awful during this delay. The trouble is due to over-generous decoupling on the A.V.C. line. A 2 mfd. condenser takes some little time to charge up through half a million ohms, especially if the condenser has even the smallest leak.

The Ultra-short Waves

IN spite of all this 5-metre work that we are hearing so much about, there does not seem to be much progress in this field. The old theory that the waves might behave like light has died a gradual death as the experiments have progressed and, really, what reason is there to suppose that this should be so? X-Rays and light rays are nearer to each other than light rays and 5-metre radio rays, yet X-Rays are certainly very different from light rays. The comparison of "ultra-short waves" to light may have been the result of early experiments, since many shielding effects can be noted, but now it has definitely been shown that sometimes the 5-metre

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(Continued from facing page)

radiations can get round corners which light cannot get round. It is now generally recognized that very little progress is likely to be made, at any rate in the matter of long-distance records. The waves below about 10 metres are known to penetrate both the known "ionospheres" or refracting layers, and unless a third layer exists or comes into existence at some other time in the eleven-year cycle, all communication must be done by the direct ground wave, which dies away rather quickly.

Progress is, however, being made in the apparatus used for local communication. In the receiving line the receivers are being more carefully constructed and are very much easier to handle. The super-regenerative type predominates and for this there is a very good reason. Down on the 5-metre wavelength oscillators become very unstable in the same way that receivers do, and when the oscillator is modulated with speech, the wavelength goes "all over the place." It is as if the London Regional wobbled up and down between 300 and 400 metres! Super-regenerative receivers are easy to tune and can be made extremely small for portable work, this being an important consideration. In such sets rods, mounted on insulated handles, are used in place of the more usual frame aerials. One interesting result is that a stronger signal is received when the rod is tilted towards the ground than in the horizontal position, but the directive effect is stronger in the horizontal position.

Good Situations

THERE has been much talk lately of the merits of short-wave receivers of different designs. One writer has for several years now insisted that if anyone cannot hear distant stations in some part of the world or another, then his receiver must be at fault. Only in one case in one hundred is the bad situation of the receiving station to blame. That is his opinion! But I am sure that few short-wave listeners in the eastern part of London will agree with this theory. I have heard of few spots worse than these regions, and I am sure it is not because all the people in East London build bad receivers and all the people in South London build good ones. So long as a receiver is well constructed and operation is easy, then I think that it will work well in a good situation and must work badly in the bad districts. The statement that every case, except one in a hundred, where bad reception is encountered is due to the receiver is rather wild.

My own receiver is simply awful in the matter of bringing in DX stations, though the locals come in at terrific strength. When DX is to be heard here I always get it very weakly, but at the same time stations in other regions get it at almost local strength. It is not mere bragging on the others' part, because I have visited them and heard the signals for myself. Some time back, however, an opportunity arose to take the receiver to an amateur field-day, and the performance was wonderful. The situation was in Essex, about twenty miles from London, and the journey down did not do the set much good. In fact, when I arrived I found one of the fellows of the district hard at work with a soldering iron, somewhere in the bottom of the set! But when we got the set working, what signals were to be heard! On 80 metres American amateur telephony was received at fine loud-speaker strength, a thing which has certainly not occurred at home.

NAPS

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A BRAND NEW WORD CONTEST FOR OUR READERS

SECOND WEEK OF OUR NEW PHRASE-FORMING CONTEST

"Naps" is the title of our new phrase-forming competition which we feel sure is bound to make an appeal to all readers. It is quite simple. You form a sentence from a list of words and compose another phrase having an apt bearing on the sentence. Now read the full details and make up your mind to win a prize with your first attempt.

HOW TO WIN

First, from the list of words choose from one to four to form an Example line. In order to give you greater scope, you may take any two which, joined together, form one, such as MAD and CAP—MADCAP, or FOOT and BALL—FOOTBALL. These would each be counted as one word. After you have made your Example line you compose an apt sentence consisting of not more than five words—using any five words you like.

Here is a specimen of joined words to use in the formation of an Example. The word "NO" combined with the word "WHERE" gives "NOWHERE." Run on the two words TO LIVE and "NOWHERE TO LIVE" becomes an Example line. Compose a phrase such as "ANOTHER RANK OUTSIDER," and you have a "Nap" that is bound to catch the judges' eye.

A good Example line, compiled of separate words from the list, would be "ON THE ICE" and a "NAPS" phrase, such as "ONLY CRACKS COUNT" would immediately attract the judges' eye. But these are merely helpful suggestions. It's "up to you" to go one better and win.

LIST OF EXAMPLE WORDS

MAD	MOTHER	ON	COCKNEY
CAP	CRY	TENDER	WHERE
FROM	IN	GOLD	SAID
NO	THERE	WHY	CUP
FOR	FORE	AGAIN	TIE
TO	FAILED	WHEN	NEIGHBOURS
A	STUPID	WOMEN	LOCAL
THE	FROM	RULE	GOSSIP
AND	TENT	SIMPLE	NEWS
OF	LAW	TOWN	AGENT
AT	GOING	BAND	MANSIONS
PA	JUST	CATCHING	LIVE
FOOT	ICE	COLD	BROTHER
BALL	VENT	WHAT	

A FEW READY-MADE EXAMPLES

NOWHERE TO LIVE	TO THE FORE
STUPID LAW	THE RULE OF GOLD
ON THE ICE	IN THE NEWS
THE FOOTBALL CUP	MANSIONS TO LIVE IN
CATCHING PA	LOCAL JUSTICE
FROM TENT TO TOWN	MADCAP FROM TOWN
FORE !	FROM MOTHER TO PA
JUST MOTHER	STUPID AND TENDER

Mr. GILBERT FRANKAU, the famous author, has agreed to examine and adjudicate upon the selection of attempts submitted to him by the Judges. He will select those attempts which appeal most to him and arrange them in order of merit.

RULES.—1.—You may enter as many "NAPS" as you wish. 2.—The entrance fee is 3d. for one line, 6d. for two, and so on. Postal Orders for amounts of 6d. and over should be made payable to "Editor," *Tit-Bits*, crossed "& Co.," and YOUR FULL NAME AND ADDRESS MUST BE WRITTEN ON THE BACK. 3.—The Prizes will be awarded in the order of merit, according to the opinion of Mr. Gilbert Frankau, who will make the final decision. 4.—The Editor's decision in all other matters relating to this contest is final. 5.—Proof of posting will not be accepted as proof of receipt or delivery. 6.—No employes (or members of their families) of George Newnes, Ltd., and associate companies are allowed to enter.

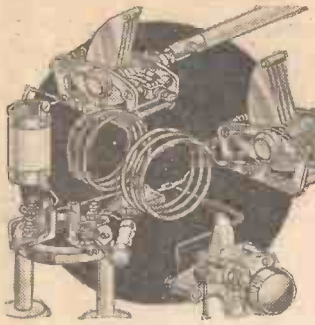
Signed.....

Address.....

No. of Postal Order.....P.L.W. 2.

EXAMPLES, ONE TO FOUR WORDS.	"NAPS," ONE TO FIVE WORDS.	
		3d.
		6d.
		9d.
		1/-
		1/3
		1/6
		1/9
		2/-

CLOSING DATE, TUESDAY, FEBRUARY 6th. Address your envelope Naps 2, "Tit-Bits" Comp. Dept., 39, King St., Covent Garden, W.C.2



Short Wave Section

BELOW TEN METRES (PART 2)

An Experimental Oscillator and Wavemeter.

By B. PEDDER

CONSTRUCTORS of ultra-short-wave receivers who wish to calibrate the condensers and check the wavelength range of various sizes of inductance coils and loops will find that the simple oscillator and wave-meter here described will not only enable them to do this, but also prove useful in other interesting experiments. The circuit diagram (Fig. 1) shows the oscillator, which consists of two single-turn loop coils A and B and two small-capacity variable condensers C and D. The latter act as balancing condensers and serve for tuning. The wavelength of the oscillations is increased by increasing the capacity of condenser C, while a decrease in the capacity of condenser D counterbalances this by decreasing the wavelength, and thus, by adjusting both, a perfect electrical balance is obtained for any desired wavelength within the range of the coils and condensers employed. The remainder of the components are a fixed condenser, the value of which is not critical, and may be between .001 mfd. and .005 mfd., a space-wound high-frequency choke and a variable resistance of from 1,000 to 5,000 ohms. A 2-volt power type valve is suitable. Loose-coupled to the oscillator is another single-loop coil connected across the ends of two parallel wires bridged by a small indicator lamp (Fig. 2). This may be set at various points along these extended wires for calibrating the wave-meter, as shown.

The Lay-out

The lay-out of the components for the oscillator is shown in Fig. 3. Each single loop coil of 18 S.W.G. bare copper wire is mounted on a pair of ebonite or fibre rod pillars, ⅜in. diameter, standing on washers of the same material, about ¼in. thick. These are set up so that the coils are about 1¼in. apart, and the top ends of the pillars are drilled and tapped 4 B.A. to take short, threaded brass stems, the connecting wires being put on first and secured by means of a thin brass nut, whilst the coil loop is added last and fixed by a small nut again. This allows of other loops of different overall diameter or another gauge of wire being tried. The connecting wire from the fixed terminal of the 40 m/mfd. condenser to the grid socket of the valve-holder, the loop of coil B and the remainder of the wire to the terminal of the variable resistance could, with care, be all in one piece, so that there are no joins, the same plan being followed with the other loop. These two coils must be correctly coupled or it will not be possible to obtain the required effect and wave-range, unless the winding sense is the same; hence the crossed connection to condenser D. The .002 fixed condenser interrupts what would otherwise be a two-turn coil between the anode and grid sockets of the valve-holder.

The Condensers

Small variable condensers of the "Midget" type have been used. C has a capacity of 15 m/mfds., and D is 40 m/mfds.; the former was made up from another 15 m/mfd. size to have less plates, and the metal bar passing underneath the set of fixed plates is drilled and tapped to fit on the end of the screw which comes up through the stand-off insulator, only enough screw being left above the locknut to pass into the condenser frame. Both sets of moving plates are connected together and to L.T. negative. A small panel for each condenser has been indicated by dotted lines if it is desired to mount the condensers in this way. A piece of ply-wood fixed to the edge of the baseboard in these positions, and having one side covered with a thin cardboard scale drawn in Indian ink, is used to mark condenser settings. A short-wave type valve-holder is mounted on four legs 1½in. high, secured to the baseboard by means of wood screws from the bottom

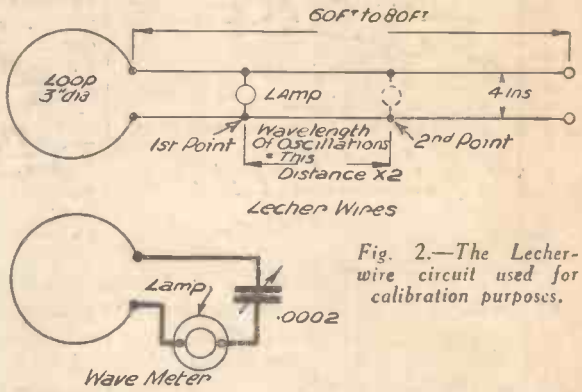


Fig. 2.—The Lecher-wire circuit used for calibration purposes.

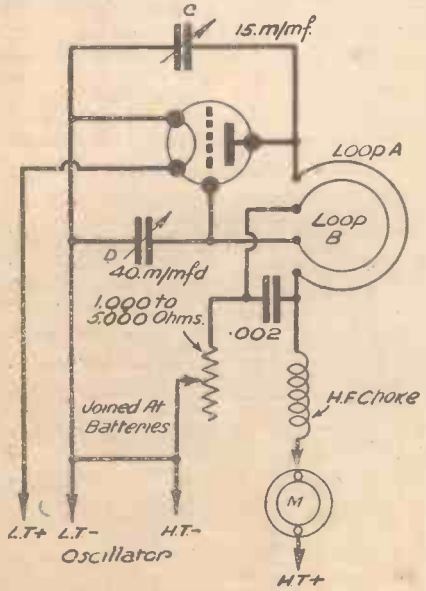


Fig. 1.—Circuit arrangement of the oscillator described.

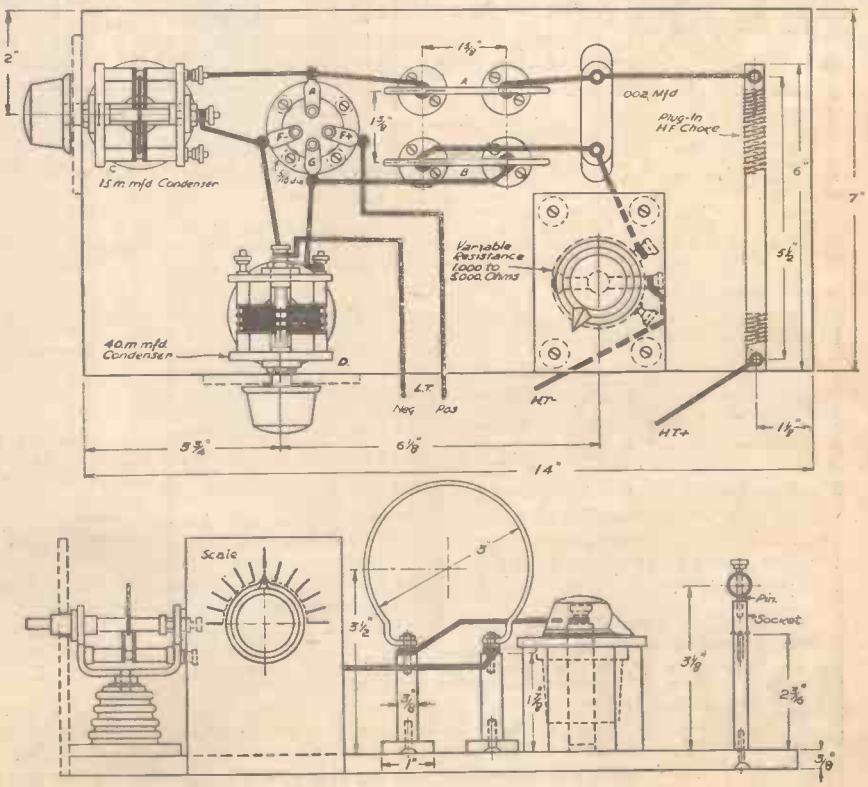


Fig. 3.—Showing the lay-out of the oscillator.

(*Continued from previous page*)

and the variable resistance is fixed to a small panel on legs secured in the same way. Two ¼in. diameter by 2 3/16in. long pillars are fixed at 5½in. centres for the H.F. choke, and the top ends are drilled and tapped to take two brass sockets with threaded stems such as were used at one time for valve-holders, tags being soldered on to each for connecting; ⅜in. diameter rod (dry wood dowel or ebonite with screw threads), 6in. long over all, is used for the high-frequency choke. Split-pins with screwed stems and terminal nuts are fitted at each end, and the wire fixed under these. More than one choke may be made up, using the same length of rod with pins but a different winding. The one shown had 60 turns of No. 28 S.W.G. D.C.C. wire on ⅜in. ebonite rod threaded 14 threads per inch, so that the turns are spaced apart.

The Wavemeter

There is little in the wavemeter construction (Fig. 4) to call for comment, except that the flash-lamp holder is raised on a small wood block, and the 3in. diameter loop of 12 S.W.G. copper wire is at the same centre height as the coils on the oscillator and receiver previously described.

Several flash-lamp bulbs will have to be tested before a suitable one is found, and those which give the brightest glow when the wavemeter is moved well away from the oscillator should be used, and one or more set aside as spares.

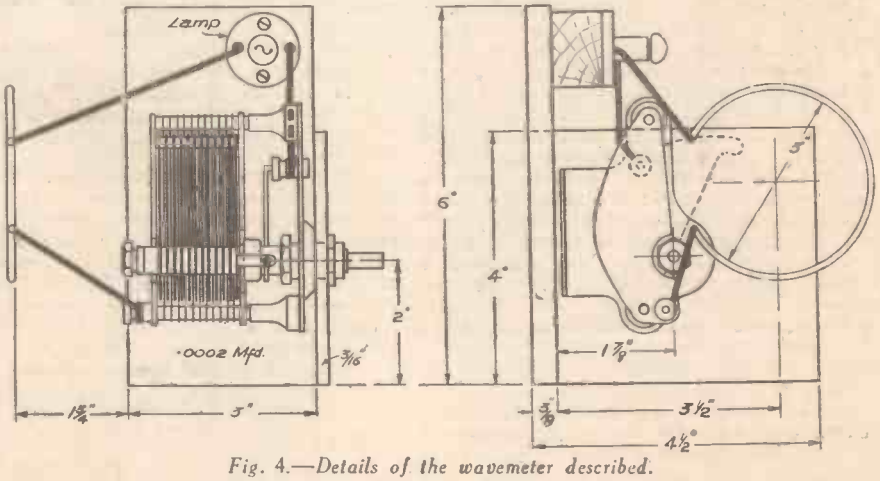


Fig. 4.—Details of the wavemeter described.

A suitable aerial for coupling to the oscillator consists of another 3in. diameter loop of No. 12 S.W.G. copper wire on pillars similar to the pairs used for coils A and B and placed at about 3 to 4in. from coil A; two equal lengths of the same wire, each 18in. long, are fixed to each pillar in contact with the coil ends.

For calibrating, Lecher wires are used, the length being 60ft. or more, and the two wires spaced 4in. apart and about 4ft. above the ground, well insulated at both ends and at two or three points along the length by light spreaders. A small tubular flash-lamp holder with contact screws and two stiff wire leads of equal length, say about 2½in. long, are required to slide along the Lecher wires. The test bench ends of the Lecher wires are connected to the coupling coil used for the aerial in place of the 18in. lengths. Hook the slider lamp over the Lecher wires and the apparatus is ready for use. A milliammeter should be connected in the H.T. positive lead, and the batteries joined up. Set condenser C so that moving plates are half-way out, and adjust condenser D to obtain the balance point which is indicated by a minimum anode current reading on the milliammeter. Slide the lamp along the Lecher wires until a point is found where the bulb glows brightest, note the position and move the lamp along till a second point is found where the bulb again glows brightest. Twice this distance between glows in meters is the wavelength of the oscillation. If this wavelength is too low, increase capacity setting on condenser C and re-balance. If too high, decrease on C and re-balance. The process is carried out until the required wavelength is obtained. It may be noticed that as condenser D is moved there is an unsteady movement of the milliammeter pointer, and in this case the variable resistance should be set to a lower value, and the correct setting is found when the current falls steadily to the minimum and then rises again as condenser D is adjusted to and past the position of balance.

Calibrating the Wavemeter

The wavemeter is calibrated by having it as loosely coupled as possible to the oscillator, and getting the brightest glow in its flash-lamp bulb at the greatest distance away and adjusting it to resonate with the oscillator. Repeat for different wavelength settings and note the wavemeter dial readings for each and make a chart on squared paper, checking with the measured distances along the Lecher wires.

LIST OF COMPONENTS FOR OSCILLATOR.

3/8in. thick baseboard 7in. by 14in.
15 m/mfd. variable condenser—Jackson Bros.' "Midget" or Eddystone "Microdenser."
40 m/mfd. variable condenser—Jackson Bros.' "Midget" or Eddystone "Microdenser."
2 Stand-off insulators—Eddystone No. 916.
1 Short-wave type valve-holder.
1 variable resistance 1,000 to 5,000 ohms.
1 .002 mfd. fixed condenser.
18 S.W.G. copper wire for coils and connection wires, etc.
Assorted pieces of ebonite rod, etc.—"Belco."

LIST OF COMPONENTS FOR WAVEMETER—FIG. 4.

1 .0002 mfd. variable condenser—"Utility."
1 No. W181 micro-dial—"Utility."
2 Flash-lamp bulb-holders for baseboard mounting.
2 Flash-lamp bulbs.
Wooden base, 3in. by 6in.
Panel, 4in. by 4½ to 5in.
12 or 18 S.W.G. wire for loop coil.

(Continued from page 897)

the coil is designed so that it has a good selectivity performance at low wavelengths, by employing a small coil shunted by a fixed condenser considerably higher in capacity than the minimum of a variable condenser. The inductance to resistance ratio can be made quite high, equally as good as the high wavelength condenser tuning condition. And then what happens as the core is inserted gradually to tune to the higher wavelengths? The high-frequency resistance of the coil itself is reduced (reduced frequency), but the *effective* high-frequency resistance (this is equivalent to the increased losses owing to the insertion of the iron core) is increased. The inductance is also increased, however, and by careful design it is possible to keep the inductance to resistance ratio substantially constant and so give uniform selectivity.

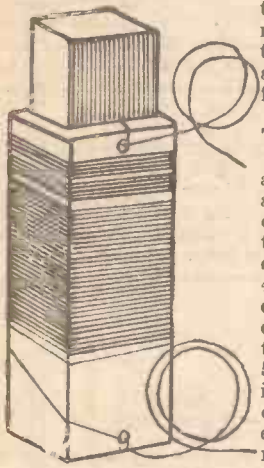


Fig. 4.—An experimental tuning coil with movable iron core.

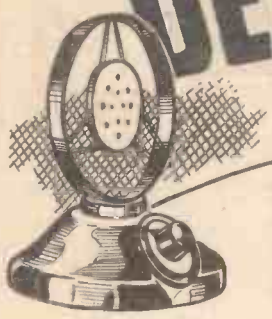
Tuning Range

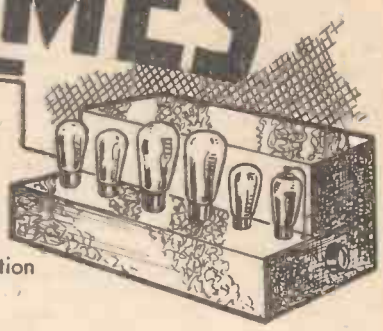
Some months ago I carried out a few tests in connection with this permeability question, and Fig. 4 shows one of the experimental coils employed. To tune from 200 to 550 metres an inductance change of nearly eight times is necessary, while on the long wave-band, that is, 1,000 to 2,000 metres, the change is four times. The iron powder is best produced chemically to achieve the necessary degree of fineness for low losses, and this can then be moulded into a core with bakelite as a binder.

With core withdrawn, that is, small inductance, the permeability can be taken to be the same as air which, of course, is unity. The resonant frequency under this condition is given by the well-known expression $\frac{1}{2\pi\sqrt{LC}}$. When the core is inserted and the presence of the iron becomes noticeable, the formula is changed to include the permeability term, and is now expressed as $\frac{1}{2\pi\sqrt{\mu LC}}$. The effective average permeability increases as the coil is still further inserted, and, in consequence, very careful measurement and design becomes necessary to produce a component which efficiently carries out the purpose for which it is required, together with uniform amplification.

Another very important factor which bears on this problem is the question of ganging so that two, three, or even four tuners may be operated from a single drive, and yet keep in step. No doubt this can be solved by using air-condenser trimmers, as is the case with present condenser ganged circuits. If so, then the overall dimensions of not only a single permeability unit, but also the complete ganged component, should be considerably smaller than its present coil and condenser counterpart. This, of course, falls in with modern design, which aims at smaller chassis.

DEAF AID SCHEMES





In This Article the Author gives a great amount of Useful and Practical Information in regard to the Construction and Improvisation of Various Types of Amplifiers to Enable Those who are "Hard of Hearing" to listen to Broadcast Programmes and General Conversation

By FRANK PRESTON

THERE are very many people to whom broadcast programmes are of little interest, due to the fact that they cannot be followed in comfort because of defective hearing. In a large majority of cases, however, these unfortunate persons could hear perfectly well if they had a suitable device for amplifying sounds. It is not suggested that all deaf folk could be enabled to enjoy broadcasting, but those who are only partially deaf or, to use a common expression, are "hard of hearing" can certainly benefit by the use of a simple amplifying device.

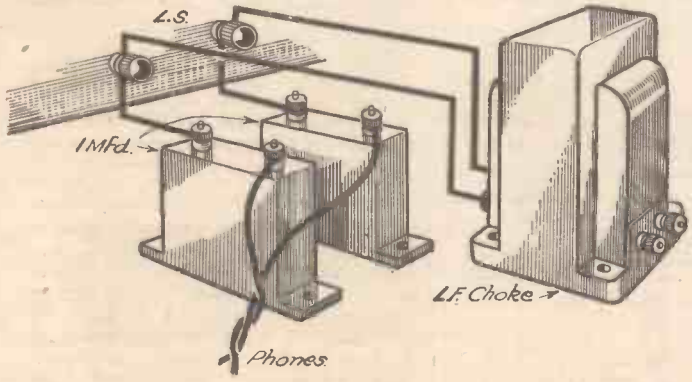


Fig. 1.—A simple method of connecting 'phones to the speaker terminals of a powerful receiver.

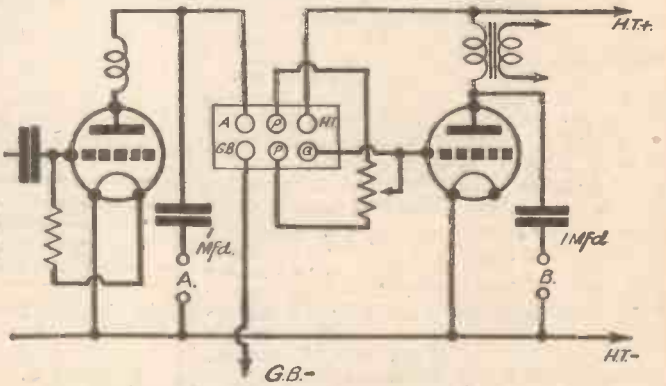


Fig. 3.—Two alternative positions in which 'phones can be connected are shown in the above circuit. The T.C. transformer represented is a multitone.

High-note Response

Merely to use a microphone in conjunction with a valve amplifier would probably prove only partly satisfactory in many instances, since most people whose hearing is defective can hear high-pitched sounds much more easily than low ones. For that reason it is in nearly every case advantageous to employ an amplifier which gives greater response to the high than to the low notes. Probably the ideal system is to equip the amplifier with an effective tone-control device, so that the response can be varied at will to suit individual requirements.

Rather than simply give a single design for a deaf-aid amplifier, it is proposed to offer a number of practical suggestions which can be tried out in the easiest and most economical manner by any reader. Obviously, the most convenient type of amplifier in most cases is the L.F. side of the ordinary broadcast receiver. When this is to be used to amplify speech it is only necessary to connect a microphone (which must be provided with the requisite transformer and battery) to the pick-up terminals on the set and then to join a pair of ear-phones to the speaker terminals. This can usually be done without the need for any modification, but in the case of a more powerful receiver, particularly one of the mains-operated type, it is necessary to isolate the 'phones from the high-tension circuit by some means or other. The most straightforward is shown at Fig. 1, where a low-frequency choke is connected to the two speaker terminals, the 'phones being connected through a pair of 1 mfd. fixed condensers. These latter should be of a good make and have a rated working voltage of not less than 400, so that they will be free from the possibility of breakdown.

In order to prevent overloading of the 'phones, and also to keep down the volume to a reasonable level, it is essential that some kind of L.F. volume control should be incorporated. Most modern sets already have such a control, but when they have not it is a simple matter to connect one in the microphone circuit as shown at Fig. 2.

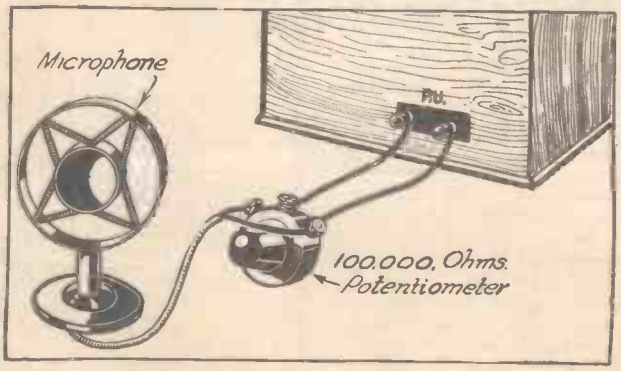


Fig. 2.—A simple method of connecting a volume control between the microphone and set.

Tone Control

It has already been mentioned that those whose hearing is not too good are more sensitive to the higher frequencies. Thus, if a tone-control knob is provided on the set, this should be adjusted to the "high" or "treble" position. When tone control is not a feature it will be found worth while to incorporate it in some form or other.

The easiest way of doing this, for the purpose under discussion, is to replace the first L.F. transformer by one of the type designed for extra high-note response, connecting a variable resistance between the terminals provided for it. By so doing, additional emphasis can be given to the higher frequencies when desired or the normal tone can be obtained simply by varying the setting of the resistance.

Another way, which is somewhat better in the case of a receiver which is for normal domestic use, is to replace the first transformer by one designed for complete tone control. It will then be possible either to "raise" or "lower" the normal pitch of reproduction given by the set in an instant. Special tone-control transformers are made by two or three firms, and in most cases they can simply be used as replacements for others of ordinary type, the only difference being that a potentiometer must be connected to three terminals provided for it.

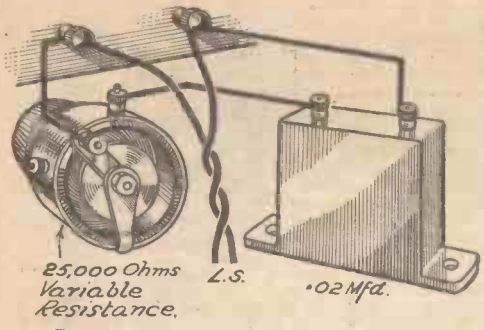


Fig. 4.—A tone-control arrangement for reducing high-note response by the speaker.

In every instance the manufacturers give full particulars for fitting.

Screen the Microphone Leads

At this juncture it might be mentioned that when the receiver is employed as an amplifier along with a microphone, it will generally be found most convenient to place the latter on a table in the centre of the room, connecting it by means of a long double wire to the set. The wire used for connecting the microphone should be screened, for otherwise there will be a danger of introducing L.F. instability, which will give rise to an objectionable "hum" or "groan" in the ear-phones. The metal screening should, of course, be connected to the earth terminal on the receiver.

It need hardly be mentioned that the methods of using a set with 'phones and a microphone which have been described are equally applicable to ordinary radio reception, and the same points in regard to high-note response should be observed. In the majority of cases several people—in addition to the one who is deaf—will wish to listen to the broadcasts at the same time, and therefore the method of connecting the 'phones which was mentioned above is unsuitable. There are two ways of overcoming this difficulty, however, the more obvious of which is to replace the L.F. choke by the loud-speaker, leaving the 'phones connected as before. The disadvantage of this is that loud-speaker reproduction will be "screechy" because of the increased high-note response. Additionally, the 'phones might be grossly overloaded, although the volume of reproduction from the speaker is probably quite inadequate for comfortable listening. This state of affairs can be remedied most simply by connecting the 'phones in an "earlier" part of the receiver—in the anode circuit of the detector or first L.F. valve; the two most convenient positions in the circuit are shown theoretically in Fig. 3. Position B is better because the 'phones then "follow" the tone-control transformer so that full use is made of the additional high-note response provided. To prevent this affecting speaker reproduction, however, it will be necessary to fit an "opposing" tone-control arrangement across the speaker terminals. The control will merely consist of a .02 mfd. fixed condenser wired in series with a 25,000 ohm resistance as shown in Fig. 4.

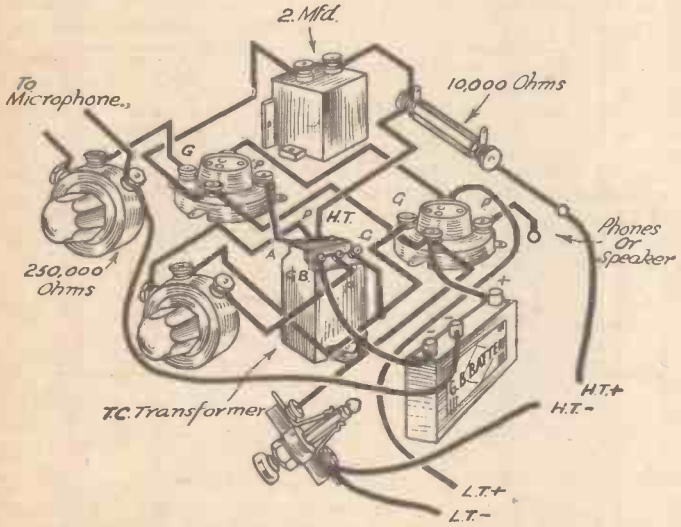


Fig. 5.—The circuit arrangement for a two-valve deaf-aid amplifier.

A "Deaf-Aid" Amplifier

Many readers might prefer to construct a special amplifier for "deaf-aid" use, and this can be done very easily by making use of the circuit arrangement given at Fig. 5. It will be seen that two valves are employed, these being coupled together by means of a tone-control transformer. A 250,000-ohm potentiometer is used as an input volume control from the microphone, and this will serve to vary the signal strength in the 'phones from maximum to the quietest whisper. Apart from the tone-control arrangement the circuit is perfectly standard and identical with that made use of in numerous gramophone and wireless amplifiers. An objection to a circuit such as this is that it cannot be made up in a really portable form, although it is quite ideal for use in the home. When it is desired to carry the amplifier about, a somewhat simpler, though less efficient, system must be adopted. An ultra-simple circuit for a single-valve amplifier, which can, if necessary, be built into a cigar box, is shown at Fig. 6. It will be seen that the valve is a pentode, and that it receives only 16½ volts H.T. with 1½ volts G.B. There is no provision for volume control, and tone control is cut out because the pentode itself tends to give emphasis to the higher frequencies. As a matter of fact, the whole arrangement is just about as simple as it could possibly be made, and lends itself admirably to the requirement of portability.

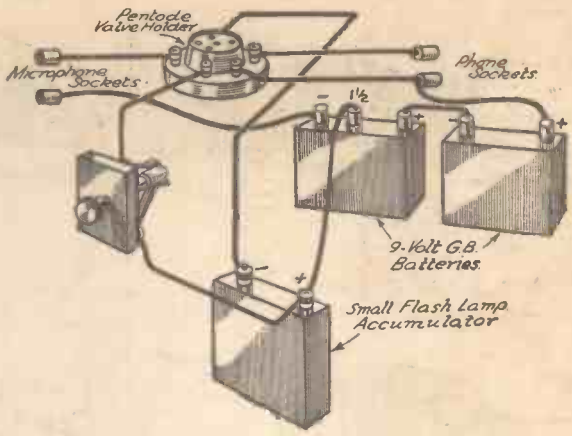


Fig. 6.—A single-valve amplifying circuit using a pentode with only 15 volts H.T.

A Portable Amplifier

So as to give an idea of the appearance of an amplifier built around this circuit Fig. 7 has been drawn. This shows the most suitable lay-out of the parts, and also shows that high tension and grid bias are supplied by a couple of 9-volt grid-bias batteries fixed into the box by means of a brass strap. Low tension is obtained from a small unspillable accumulator which may be of the "flash-lamp" type or one of those made for use in model boats. Alternatively a 3-volt dry battery could be used by wiring a suitable resistance in series with one L.T. lead, but this would not prove nearly so satisfactory or economical. Four insulated sockets are fixed in the end of the box, two of which are for connecting the microphone and two for the ear-phones. The outfit does not call for any further description, but it might be mentioned that the box will need to be of the "50" or "100" size and should be chosen according to the dimensions of the G.B. batteries and L.T. supply which it is proposed to use.

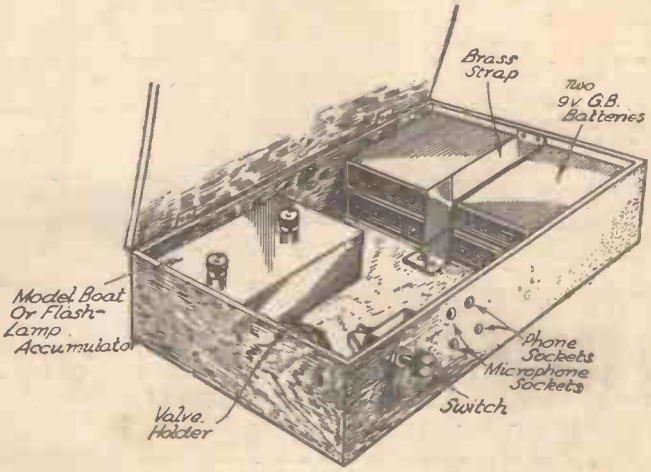


Fig. 7.—A practical arrangement of the circuit given at Fig. 6.

By T. Onearm

THOSE who scoff at the music of great masters cannot fail to have their opinion altered if they listen to some of the records mentioned here. The greatest achievement of the list, and, in fact, one of the greatest achievements in the history of the gramophone, is an almost complete recording of Strauss's delightful opera, *Der Rosenkavalier*, on thirteen double-sided records, *H.M.V. DB*2060-72. Here is a performance of this melodious opera, with its entrancing waltz, which it has never been possible to perform in the flesh. If one's pocket will not stretch to the complete set of records the following numbers should be heard without fail: *DB*2061, *DB*2065-7, and *DB*2071-2. Whilst these records are the most juicy plum that has fallen to opera lovers during the last few years, musicians will delight in the recording of Yehudi Menuhin and the Orchestra Symphonique de Paris, of Lalo's *Symphonic Espagnole*, on *H.M.V. DB*1999-2002. It is a unique work in many ways; although it is called a symphony, it is really a concerto; it has a Spanish tang, and was written by a Frenchman, and has four movements instead of the usual three. The conductor, Georges Enesco, was Menuhin's teacher, and the boy genius is now a greater artist at the violin than his master. Chopin's *Fantasie in F Minor* is the subject of two brilliant records, *H.M.V. DB*2031-2, by Alfred Cortot.

New Gilbert and Sullivan Triumph

Another achievement by the "His Master's Voice" Company is an abridged recording, made under the personal supervision of Mr. Rupert D'Oyly Carte, of *The Sorcerer*, in which many past and present Savoyards are responsible for the principal parts. These include Dorothy Gill, Darrell Fancourt, Muriel Dixon, and Derek Oldham. Gilbert and Sullivan enthusiasts all over the world have been grateful to H.M.V. for the authentic recordings they have issued in the past of all the Gilbert and Sullivan operas with the exception of this one. These new records, *H.M.V.* 8054-59, in order that they may reach a wide public, have been issued at a popular price.

Record of the Month

Many will consider the best single record of the month to be Lawrence Tibbett's dramatic recording of *The Song of the Flea*, coupled with *The Pilgrim's Song* on *H.M.V. DB*1945. This artist, who possesses one of the finest baritone voices, has given a remarkable performance of this song, which depicts the adventures of a flea that went to court. Another more than good vocal record of music, which can only be described as ethereal, is Richard Crooks' singing of the lovely *Dream* from *Manon* on *H.M.V. DB*2093. Those on the look-out for a bargain in operatic records should secure Joseph Schmidt's recording of *Blazing to the Sky* from *Il Trovatore* and *So Pious* from *Martha* on *H.M.V. B*8036. Rarely is singing of this high order obtainable on a plum label record.

Among a good batch of vocal records in English is Derek Oldham singing *I Still Love Mary*, which is a sequel to *Her Name is Mary*, on *H.M.V. B*8087. These two "Mary" ballads were written by a cinema organist and refer to his wife.

Joseph Hislop sings *The Island Herdmaid* and *An Island Sheiling Song*, from *Songs of the Hebrides*, at the beginning of one of which he explains the significance of a phrase in the song.

Stuart Robertson, who has a seafaring father, gives authentic representations of *The Bay of Biscay* and *The Saucy Arethusa*, and Peter Dawson has produced another stirring record, *Song of the Drum* and *Westward Ho!* both composed by McCall. As McCall is Peter Dawson's pen name there is little doubt that these songs are sung as the composer intended.

First Father-and-Daughter Disc

Records of piano duets do not often appear in gramophone companies' lists, and the first of this kind made by father and daughter is released by "His Master's Voice" this month. On *H.M.V. C*2634 Mark Hambourg and his fourteen-year-old daughter, Michal, give a brilliant performance of Schumann's *Andante and Variations, Op.* 46.

Several records of light orchestral music will be of interest, including the London Philharmonic Orchestra's performance, conducted by John Barbirolli, of Quilter's *Children's Overture*, *H.M.V. C*2603, which has, of course, popular nursery tunes as its theme.

Cinema organ admirers will want *Lily of Laguna* and *Il Bacio*, by Sydney Gustard, on *H.M.V. B*8088, whilst adherents of brass bands will be interested in a Medley of Sousa Marches by the Coldstream Guards on *H.M.V. C*2598, and the last record made at the Tidworth Tattoo—*Marche Militaire* and *Bullfighters March* on *H.M.V. B*8039.

Dance Records

Dance band enthusiasts are also in luck this month, for there are at least three big hits among the new H.M.V. records. On *H.M.V. B*6438 Ray Noble and his Orchestra play *My Song Goes Round the World* and *Song Without Words*, and on *B*6432 *When You Were the Girl on the Scooter*, with *La-di-da-di-da* on the other side, played by the orchestra and sung by Bobbie Comber, who is responsible for this number in the show *That's a Pretty Thing*. A very polished performance of *Without that Certain Thing*, by Jack Jack-

(*Continued on page 934*)

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.

BURNT OAK AND DISTRICT RADIO SOCIETY

A Radio society has just been formed at Burnt Oak, and is endeavouring to increase its membership. Any readers in the district who are at all interested are cordially invited to write for fuller details to the Hon. Sec., Mr. A. Donati, 59, Horsecroft Rd., Burnt Oak, Edgware.

SMETHWICK WIRELESS SOCIETY

At a recent meeting of the Smethwick Wireless Society, Dr. Hughes, of the Multitone Electric Co., Ltd., gave a lecture on "Sound." He said that all forms of reproduction began and ended with sound, and that the object of the apparatus used was to give as good a copy as possible of the original. Further, the human ear being an uncertain instrument, it was necessary to measure, and analyse, input and output by scientific methods. He went on to explain the range of frequencies required for reproducing various instruments and the Rayleigh disc and condenser microphone methods of measurement. Polar diagrams and response curves for various types of loud-speakers and microphones were given, and finally the effects of tone control were briefly mentioned. The lecture was illustrated throughout by a series of interesting lantern slides.—Hon. Sec., Mr. E. Fisher, 33, Freeth St., Oldbury, Nr. Birmingham.

SLADE RADIO

A lecture on "Metal spraying" was given by Mr. G. Gordon Hoare at a recent meeting of this society. After stating that it was difficult to describe in a short lecture the very wide field the process covered, he went on to describe the various substances to which it could be applied. The reasons for use, including prevention of oxidation of metals, corrosion, or attack by acids, were given, also the apparatus was described, after which followed details of the progress which had been made since the year 1900. Examples were then given of the various metals which could be used and also the effects of same. On the radio side he showed the large number of uses to which the process could be put, and illustrated his remarks with a number of excellent slides. A few words on a medical application of the process concluded an exceedingly interesting lecture.—Hon. Sec., 110, Hillaries Road, Gravelly Hill, Birmingham.

ANGLO-AMERICAN RADIO AND TELEVISION SOCIETY

It has been decided to form a branch of this society in the Gravesend district, and Mr. E. Ingleton, "The Haven," Chalk, Nr. Gravesend, Kent, has undertaken the duties of secretary, from whom particulars can be obtained by enclosing a stamped addressed envelope. A strong membership is anticipated as there are a large number of keen radio and television amateurs in the locality.

Y.M.C.A. RADIO CLUB (BOLTON)

At a meeting of this club held on January 6th an interesting lecture was given by Mr. Dean, of the Mullard Valve Company. The lecture was much appreciated by the audience. Interested readers residing in the district are invited to attend any of these lectures, which are given every Thursday evening at 8 p.m. Admittance is free. Further particulars of this club can be obtained from the Assistant Sec., Mr. J. E. Crompton, Y.M.C.A., 125, Deansgate, Bolton, Lancs.

THORNTON HEATH RADIO SOCIETY

A meeting of this society was held at St. Paul's Hall, Norfolk Road, on Tuesday, the 9th instant. Mr. S. J. Meares presided. Mr. O. L. Crossley gave a talk on Light and Optics, dealing with the likeness of the wireless wave to the light ray, and explaining that television was a combination of both. In the course of his lecture Mr. Crossley mentioned the speed at which a ray of light travels, and also explained the method adopted by scientists to calculate this speed. He also explained how the discovery that light was made up of several colours was made, and demonstrated this with the aid of a lantern and a glass prism. He also showed how a ray of light passing through a tank of water was deflected, and finally demonstrated the use of the polariscope. Particulars of future lectures and demonstrations can be obtained on application to the Hon. Sec., Mr. J. T. Webber, 368, Brigstock Road, Thornton Heath.

INTERNATIONAL SHORT-WAVE CLUB (LONDON)

It was members' night at the meeting of the London Chapter held at the R.A.C.S. Hall, Cavendish Grove, Wandsworth Road, S.W.8, on Friday, 5th January. The first half of the evening was given to Morse Instruction under Mr. L. F. Reading (2ATI). This will be a regular feature at each meeting from 7.45–8.15 p.m. Mr. P. J. L. Macfarlane (G5MK), then continued his talk from the last meeting on short wave receiver design. Members' own receivers were then demonstrated.—A. E. Bear, Sec., 10, St. Mary's Place, Rotherhithe, London, S.E.16.

PRACTICAL LETTERS FROM READERS

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

Band-pass and S.G. Detector Circuit Wanted

SIR,—I have followed your excellent paper from almost its first publication, and I would like to praise its never-ending source of interest. You have designed so many circuits that I hesitate to suggest yet another. The circuit I would like to see is a band-pass arrangement with an S.G. detector. Something like the band-pass H.F. unit, recently described, but followed by two L.F. stages, instead of the usual detector circuit. I think an arrangement like this would prove very economical, and have ample selectivity. A short time ago Mr. H. J. Barton Chapple talked about quality, and mentioned a receiver he was designing. Please let us have this soon.—INTERESTED READER (Newcastle).

German S.W. Station : New Address

SIR,—The German short-wave transmission and programmes are now a separate organization, as regards administration, under the Hitler Government, and it may be of interest to you to note that I have just heard the new address announced recently in English, as follows: Germany Short-Wave Station, Broadcasting House, Berlin, Germany.—ALF. W. MANN (Middlesbrough).

An Engineer's Approval

SIR,—I received the tool kit quite safely, and wish to thank you for it. I am very pleased with it, and I think it is a fine and accurate set of tools. I am an engineer and, of course, have a good knowledge of tools. I am only a beginner in radio, however, so I have been fortunate in securing good tools to start with. I like your paper very much and am most interested in your problems. I do not attempt to solve them at present, but am contented to read them and learn. I wish you and your paper every success in the future.—S. HALL (Newark).

"Canned" Television

SIR,—I have followed up your articles on television, which are interesting but, of course, outside the scope of the average wireless enthusiast owing to cost and lack of programmes. To my mind, television would become more popular if it were "canned" or "bottled," so to speak.

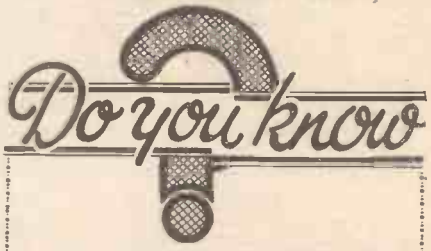
I see no reason why sound and vision should not be recorded on one record by the gramophone companies, the sound taking one-half of the record and the vision the other half, each commencing with a "start" mark and recorded at a slow speed, say thirty-three revolutions per minute (same speed as cinema records). At the receiving end the motor driving the scanning disc could be geared down sufficiently to drive a turntable with two pick-ups, each connected to their respective amplifiers for vision and sound, thus serving a double purpose. In this way one could have unlimited pleasure in "looking" and "listening" in without having to wait until last thing at night to receive half an hour's programme, which, you must admit, does not encourage the average listener.

I know this sounds ambitious, but it does not strike me as being improbable.—H. HEVEY (Dagenham).

Congratulations from S. America

SIR,—Allow me to congratulate you on the "Wireless Constructor's Encyclopædia," which I have just received. It is splendid. Just the book required by all amateurs. I also wish to thank you for the handy little spanners I received some time ago with PRACTICAL WIRELESS, and which I have found to be very useful. At the same time I wish you every success with your weekly journal. I am sure we in this part of the globe would appreciate it very much if you would publish in PRACTICAL WIRELESS an A.C. three-valve short-wave circuit with home-made coils. The coils you use in your circuits are all factory-made, and are unobtainable in this country.—J. PUDDINGTON (Buenos Aires, S. America).

CUT THIS OUT EACH WEEK.



—THAT a water-pipe is not an efficient earth connection unless it passes straight to earth from the point of connection.
—THAT many water-pipes pass up to a cistern in the upper part of the house and are effectively insulated at the point of junction with paint.
—THAT the glass of a window may be used as the dielectric of a series-aerial condenser by connecting the lead-in to a metal plate stuck on one side, and taking a similar lead to the receiver from the other side.
—THAT a small value fixed condenser may temporarily be constructed by twisting two insulated wires together.
—THAT H.F. chokes should be joined in the output circuit of a short-wave receiver in order to avoid losses.
—THAT hum can be caused in a battery-operated receiver by induction from the house wiring through a wall.
—THAT a screened lead-in, fitted with a specially-designed transformer at each end, will enable practically any length of wire to be used without ill effects.

NOTICE.

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

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

FACTS & FIGURES

Components tested in our Laboratories

BY THE PRACTICAL WIRELESS TECHNICAL STAFF

COLVERN GANGED COILS

THE Ferrocart coils produced by Messrs. Colvern have before been mentioned in these pages, and have, in fact, been employed in several of our receivers. The latest form of this coil is the "G" type, in which the coil screens are not cylindrical as in the first type, but are flattened at the side, thus enabling the entire assembly to be made more compact. In addition to this feature the base-plate is designed to accommodate both an on/off switch and a radio-gram change-over switch. No terminals are provided for connection, but short lugs project below the coils and are very clearly indicated by numbers embossed on the underside of the aluminium base-plate. The coils may be obtained with various types of switch, whilst the radio-gram change-over switch is permanently fitted to the base nearest the control knob. At first sight it might appear that the lack of provision of terminals might reduce the usefulness of the coils, but from experiments which we have carried out we much prefer this arrangement, as it not only permits of simpler connection to the remainder of the circuit components, but reduces one of the troubles of the usual canned coil, namely, short-circuits to the coil screen. With the ordinary type of coil terminals are arranged round the upper surface of the coil base and the screen is slotted to fit over the wires which are joined to these terminals. It often happens that the connecting wire is bare where it passes through this cut-out and short-circuits arise which either prevent the set from working or result in damage. With these new coils this trouble is very definitely removed, and we have employed the assembly in the new Fury Four which is described in this issue. As will be seen in the constructional details of this receiver, we recommend that nine or ten-inch lengths of connecting wire be soldered to the connecting lugs, and these wires either passed down through holes in the chassis or brought out through the slots provided at the side of the base-plate. The unit is then screwed to the chassis and connections completed in the ordinary way. The coils themselves are totally enclosed in bakelite mouldings, and they may be obtained in various types. The control knob is clearly marked for the various positions of the switch, which operates in a very definite manner with a snap action which can be felt as well as heard. The three-gang assembly costs 37s. 6d., and an extra 1s. 6d. is charged for the switch, which may be of the mains type or for battery use.

The "G" type Colvern Ferrocart coil unit.

CENTRALAB POTENTIOMETERS

FROM Messrs. Rothermel we have received some samples of the well-known American Centralab potentiometers, and these have many features not usually found in components of a similar type produced on this side of the Atlantic. They are extremely compact, occupying a back-of-panel space of less than an inch and being only just over an inch in diameter. The case is of bakelite with a small metal dust-cover over the end. The actual movement is very ingenious, and is insulated from the control spindle. The element is of the usual carbon or graphite track deposited on a strip of material which is coiled round the inside edge of the container. Just inside this is a thin metal ring, slightly smaller in diameter than the composition ring. At the end of the control spindle is a cam-shaped metal disc, to the end of which is fitted a curved arm bearing at its end a small block of hard wood. This is soaked in oil and bears against the inner metal ring, and is of such a length that it presses the latter into contact with the resistance element. Thus, as the control arm is rotated, the inner metal disc rocks and is in contact with the resistance element over a small section, which travels round the entire circumference. This results in an absolutely noiseless movement and is also delightfully smooth to the touch. The friction is just enough to enable one to "feel" the control, and the passage from minimum to maximum is carried out in a most easy and smooth manner. The control may also be obtained fitted with a mains-type switch rated at 1 or 2 amps, and this comes into operation at the end of the travel of the arm, in a crisp and certain manner.

A NEW TUNGSRAM RECTIFIER

THE latest addition to the already comprehensive range of Tungsram Universal AC/DC valves is the indirectly heated Rectifier PV 4018. This rectifier may be used as a voltage-doubler or as a half-wave rectifier. The rectifier PV 4018 comprises two separate cathodes and two separate anodes. If a half-wave rectifier is required, it is only necessary to connect the anodes together and the cathodes together, and the rectifier will then deliver a rectified current of 100 milliamps. However, the most useful feature of this rectifier is that it may be used as a voltage doubler, i.e., at a mains supply voltage of 110 volts a D.C. output is obtained of approximately 200 volts at 40 milliamps. This feature, of course, makes the rectifier an indispensable part of an A.C. receiver operating from a low mains supply voltage. Full operating details of this rectifier are available on request to The Technical Department, Tungsram Electric Lamp Works (Great Britain), Ltd., 72, Oxford St., London, W.1.

CLIX CONTINENTAL VALVE-HOLDERS

THE increasing popularity of the continental high-voltage mains valves has led Messrs. Lectro Linx Ltd., to develop a model of their well-known Clix chassis-type valve-holder to accommodate these valves. Until recently they were only obtainable from the suppliers of the actual valves, and were of continental origin. The arrangement of the pins on these valves is different from any English arrangement, and furthermore certain types of these valves are provided with a short metal screen inserted in the bakelite base of the valve and connected to the cathode and in some cases to the external gauze screen with which the valves are fitted. The heaters are joined on one side of this screen and the remainder of the electrodes (except in certain cases) on the other side, and thus hum is prevented owing to this ingenious screening device. In order to complete the screening the valve-holder, when used with this type of valve, should be similarly provided with a screen and the valve-holder in the lower part of the illustration shows this screen. The price of this holder is 1s. 8d. with terminals, and 1s. 3d. without terminals. The unscreened holder costs 9d. without terminals and 1s. with terminals.

The new Clix "Continental" chassis-type valve-holders.

Reserve Your Presentation Copy of "Newnes' Everyman's Wireless Book" Now! See pages 890 and 891.

CATALOGUES RECEIVED

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

NEW STATION IDENTIFICATION CHART

NOW that the Lucerne plan is in operation almost every station has a new position on your tuning dial. For making re-identification a simple matter Messrs. A. C. Cossor have issued a new Station Identification Chart, giving the new wavelengths, frequencies, and power of British and foreign stations; space is also provided for recording the new dial readings. Copies of the chart are available from radio dealers or from Messrs. A. C. Cossor, Highbury Grove, London, N.5, for 2d. post free.

NEW COSSOR BOOKLET ON CLASS B AMPLIFICATION

TO those readers who are users of battery receivers, Messrs. A. C. Cossor's book B.21 on Class B amplification will be of special interest. This is a particularly useful little book for the constructor who, hitherto, has been restricted to the small output of a power valve. It tells him how to incorporate a Class B valve in his receiver to obtain output comparable with that of a mains receiver. Several circuits are given, together with advice on how this latest form of output may be most successfully used, and added to suitable existing receivers.

Certain precautions may have to be taken and refinements added to ensure satisfactory results, and this book clearly explains what these additions are, and how they are best utilized. A copy of the booklet is available free to readers of PRACTICAL WIRELESS on application to Messrs. A. C. Cossor, Ltd., of Highbury, N.5.

HIVAC DRIVER+B VALVE

THE latest addition to the Hivac series of high quality low-priced valves for battery sets is the Hivac+B. This valve combines in one bulb two separate systems operating respectively as Driver and Class B output. This latest development in design, which gives added efficiency, reduction in cost, and simplifies wiring, is the result of extensive experimental work in the Hivac laboratories. The new valve is of particularly robust construction, and embodies mica spacers, and filament suspension springs, the anodes, grids, and filaments being housed between a side supporting framework. Interested constructors should write for a copy of the Driver+B leaflet, giving full particulars, prices, and characteristic curves, to The High Vacuum Valve Co., Ltd., 113-117, Farringdon Road, London, E.C.1.

LISSEN PRODUCTS

A VERY extensive range of their popular components is given in a well-illustrated folder recently issued by Lissen, Ltd. Full particulars of the new Lissen iron-cored coils are, of course, included, and these coils have iron-dust cores, thus permitting very efficient coils of very small dimensions to be manufactured. Litz wire is used, and every strand is carefully insulated from the others until it reaches the point where it is soldered to the terminal. There are several types of these coils available, suitable either for aerial coils, band-pass, tuned-anode circuits, tuned-grid circuits, and windings are provided for reaction. Amongst the other components listed are the Lissen superhet three-ganged coil unit, dual and four-range coils, variable and fixed condensers, valve-holders, switches, chokes, potentiometers, wire-wound resistances, and the popular Lissen H.T. eliminators. Transformers, loud-speakers, and balanced armature units are also listed, together with the new Lissen permanent-magnet moving-coil loud-speaker. This high-class instrument is fitted with a universal transformer, and is suitable for use with either power valves, pentode valves, Class B. or Q.P.-P. circuits. There are also the Lissen Needle Armature Pick-up, valve adaptor, panel brackets, and plugs and sockets. Copies of the folder can be obtained from Lissen, Ltd., Lissenium Works, Worple Road, Isleworth, Middlesex.

IMPRESSIONS ON THE WAX.

(*Continued from page 930*).

son and his orchestra on *B*6436, will make this record extremely popular, whilst there is a good comedy version of *Two Can't Sit on a Three-Piece Suite* by the same band, coupled with *What's the Use of it Now?* on *H.M.V. B*6435. There are several good records by famous American bands, including Paul Whiteman and his Orchestra, but hot rhythm fans will be interested to know that Cab Calloway and his Cotton Club Orchestra are now recording exclusively for "His Master's Voice" and present as their first disc *Evenin'* and *Harlem Hospitality* on *B*6437. This band is due to make its first London appearance early in March.

THE BEGINNER'S SUPPLEMENT

(*Continued from page 916*)

panel should then be marked with the chosen ranges in the same order as those shown in the pictorial view of the finished meter (Fig. 5). This will ensure that your switch positions will agree with the wiring of the resistances.

Using the Meter

Having completed the assembly, a few notes on the method of using the meter may be of some assistance. The left-hand switch is, of course, the voltage selector, and the right-hand switch the milliamp selector. The bottom stud of the "volt" switch is marked m.a., and the pointer should always be set to this when milliamp readings are required. Similarly, when the meter is required for measuring volts, the milliamp switch must be set in the *volts* position. In this position with the "volts" switch set at m.a., the meter will naturally be set for the lowest range of milliamps, the adjustment of the "volts" switch to any other point setting the meter for the voltage range indicated. This, then, completes the multi-range meter, and if reasonable care has been taken in its construction, you should now have an accurate 7-range instrument at your disposal. There is no reason why you should not modify the design suggested if you consider that such a course would be more convenient. For instance, if you are artistically inclined you could make a neat paper scale giving both the volt and milliamp readings. So long as you follow the instructions dealing with the making of the shunts and the selection of the resistances explicitly, then you can be sure that results will be satisfactory.

Series Resistance for:—	FULL SCALE READING IN MILLIAMPS				
	0–2	0–3	0–4	0–5	0–6
0–2v.	1,000	—	—	—	—
0–3v.	—	1,000	—	—	500
0–4v.	—	—	1,000	—	—
0–5v.	—	—	—	1,000	—
0–9v.	—	3,000	—	—	—
0–10v.	5,000	—	—	2,000	—
0–12v.	—	—	3,000	—	2,000
0–150v.	—	50,000	—	30,000	—
0–160v.	—	—	40,000	—	—
0–180v.	—	—	—	—	30,000
0–200v.	100,000	—	—	—	—

SOUTHERN RADIO'S Bargains.—Set manufacturer's 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), 1,000v. D.C., 7/- each; 20 mfd. (2+2+2+2+2+2+2+1+1+1+1), 1,500v. D.C., with terminals, 11/6; 10 mfd. (2+2+2+2+1+1), 7/3; Dubilier 4 mfd. (2+1+1), 1,000v. D.C., 2/9; 4.5 mfd. (2.25+2.25), 3/-; fixed 4 mfd., 2/3; 2 mfd., 1/6; 1 mfd., 1/-.

SPEAKERS.—Permanent magnet moving coil, 7in. cone, 28/- (list 49/6); 21/- (list 39/6); D.C. mains, energised for all voltages, 9in. cone, 21/- (list 42/-); 16/6 (list 32/6); Magnavox, model 154, 17/6; Blue Spot, 100U, 13/6 (list 39/6); 66K, complete in cabinet, 16/- (list 42/6); G.E.C. Stork, complete in magnificent cabinet, 19/6 (list £3/15); Celestion P.P.M. Soundex Permanent Magnet, 17/6 (list 27/6); all speakers are new, in original cartons.

PICK-UPS.—B.T.H. Senior 1934 model, with volume control, 28/6 (list 37/6); Blue Spot, model "88," with volume control, 26/- (list 63/-); Marconi No. 19 (1934), 26/- (list 32/6).

CONSTRUCTORS' Kits.—Ready Radio Meteor "A" 3-valve, screen-grid kits, with cabinet and moving-coil speaker, less valves, £3/7/6; with valves, £4/10 (list £8/7/6); Ready Radio S.T. 400 kits, all specified components by Scott Taggart, £2/19/6 (list £4/17/6); Osram Music Magnet Four, complete with 4 Mazda valves, £4/19/6 (list £10/5); all kits new, in original sealed cartons.

MISCELLANEOUS Items.—Pifco All-in-One Radiometers, 9/3 (list 12/6); Ferrocart coils, G1, G2, G3, 31/6 (list 37/6); S.T. 500 coils, 5/6 per pair; Hellesen's 8 mfd. electrolytic condensers, 2/9 each; Westinghouse metal rectifiers, H.T. 6, 7, 8, 9/3 each; Radiophone volume controls, with switch, 3/- (list 10/6); Amplion loud-speaker units, 2/3 (list 12/6); Ferranti choke, 20 henry 60 m.a., 6/9 each; Kolster Brandes gramophone motors, dual, for A/C or clockwork, complete with turntable and all accessories, 110/250 volt, 25/- each (list 63/-); all new and guaranteed.

MAINS Transformers and Chokes.—Please send for complete list; specials can be supplied within 3 days of order.

ALL Transformers and Chokes Guaranteed for 12 months.

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.

PEARL and PEARL, 190, Bishopsgate, London, E.C.2. All the following bargains guaranteed new goods. Cash or C.O.D., carriage paid.

LEWCOS Frame Aerial eliminates outdoor aerial and increases selectivity. List price 27/6, our price 9/6.

EDISWAN 2-volt non-spill accumulators, 80 ampere hours. Over-all measurements, height, 6¼in., width 3¼in., depth 3¼in.—7/6.

REGENTONE Pentode 2-valve A.C. all-electric receiver, complete with valves. Original price £6/10/0—our price £2/19/6.

LINCOLN STEWART D.C. Eliminator, 25 m.a., 4 tappings, list price 32/6, our price 16/6.

THE "Lincoln Super" Permanent Magnet Moving-Coil Loudspeaker, all purpose universal tapped transformer for Q.P.P., Class B Pentode, Power, and Super-Power output. Will carry 3 watts undistorted output. List price 42/-. Our price 19/6.

FORMO 2 mfd. Mansbridge Condensers, tested at 800 volts D.C. Our price 1/11.

SLEKTUN dual range screened coils, 200-550 met., 800-2,100 met. Every coil complete with wiring diagram. List price 6/6, our price 2/11.

SLEKTUN H.F. Coils for use with above dual range aerial coils. List price 6/6, our price 2/11.

K.B. D.C. "Pup," self-contained, simple, safe, and trouble-free. The K.B. 2-valve D.C. "Pup" is an excellent and reliable mains-operated receiver. List price £7/10/0, our price £3/12/6.

SURPLUS H.M.V. 3-gang .0005 mfd. Variable Condensers with drum drive, beautifully made in one piece to avoid backlash. To clear, 7/6.

T.C.C. 10.5 mfd. block condenser, working voltage 250 D.C. tapped for 8 different values, price 3/11.

STOCK of Telsen Major Chassis. This is a super bargain and is available while stock lasts. Usually 10/6, our price 3/3.

PEARL and PEARL. All above bargains sent cash or C.O.D., carriage paid. 190, Bishopsgate, London, E.C.2.

REPAIRS to Loud Speakers, 4/-; Blue-Spots, 5/-; Transformers, 4/-; Moving Coils and Eliminators Quoted for. All repairs remagnetised free. Guaranteed. Discount for trade. Clerkenwell 0009. S. C. Mason, 44, East Road, N.1.

ERICSSON 3/1 L.F. Transformers, List Price, 17s. 6d. New and guaranteed. Our price, 2s. 3d. post free U.K.—Pioneer Radio, Coptic St., London, W.C.1.

RAD-AUTO-GRAM buy Modern Second-Hand Components for Cash.—39, Tulketh St., Southport.

BIRMINGHAM RADIOMARTS Manufacturers' Bankrupt Stocks; post free over 6/-, otherwise 6d. New list stamp.

RADIOMART.—Limited quantity Philco Heavy Duty Class "B" Driver Transformers—boxed—2/9.

RADIOMART.—British Radiophone 27/6. Straight 3-gang standard dust-cover and trimmers 12/6.

RADIOMART.—Polar 1934 Superhet Monodial 3-gang, front section 110 kc/s, fully screened with trimmers 12/6.

RADIOMART.—British Radiophone 7/6, wirewound logarithmic potentiometers with mains switch 10,000 ohms, ditto 5,000. Heavy duty no switch, either type 2/-.

RADIOMART.—Marconiphone solid Walnut 535. Radiogram Cabinets, real quality 45/- carriage forward.

RADIOMART.—Wearite transformers 300/300, 250/250, HT8. HT9, all with 2CT.LT's., not stripped types, 10/6.

RADIOMART.—Metvick 35/- super transformers 250/250, 4v.2 amps., 4 v. up to 5a., fitted terminals 12/6, 110v. or 230v. 25 cycles same price.

RADIOMART.—440v. electrolytics T.C.C. 8 mfd. aqueous 3/11, Hellesen ditto 3/3. Utility 2/6, mains switches 9d.

RADIOMART.—Non-inductive tubulars 0.1 mfd. T.C.C. 375wkg., 0.01 mfd. 1,500v. test 6d. 0.5 mfd. 9d.

RADIOMART.—Magnum wirewound 25,000 potentiometers, ditto Colvern 2,500. Radiophone 3,500 ohms. 1/9.

RADIOMART.—Magnum radio to gramophone dissolvers as used De Luxe R.G.D. 2/9. 30 ohm. C.T. humstoppers 1/-.

RADIOMART.—Lotus 3½-1 pushpull intervalve manufacturing tag connections 2/-. Heavy Duty not C.T. 1/6. B.T.H. 15/- boxed 2-1, 3/6. B.T.H. (15 and 18-1) 10-1, 20-1, output 3/6.

RADIOMART.—12/6. Centralab 3in. Senior 100,000 potentiometer 2/6, ditto H.M.V. ½ meg. 1/6.

RADIOMART.—Erie 1-watt. 300, 320, 350, 400, 1,000, 5,000, 10,000, 15,000, 20,000, 27,000, 30,000, 35,000, ½ meg., 1 meg., 8d. each, 6/9 dozen.

RADIOMART.—Kilsawan vacuum anode resistances five assorted 1/-, ditto Metvick moulded 1/-.

RADIOMART.—Special offer H.M.V., Phillips, Lotus 1-watt resistances 15. Our selection 3/-.

RADIOMART.—Lotus 2.25 x 2.25 mfd., 1000 v. test 2/6. T.C.C. 0.2, or 0.25 mfd. 7½d.

RADIOMART.—Lotus 2/-, Jack Plugs 9d., Midget jacks 4d., Brass .0003. Variables 1/-. Ditto bakelite differentials 1/6.

RADIOMART.—Low capacity lever switches double throw 3- or 4-way 9d. Lewcos 7-way leads boxed 1/6.

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RADIOMART.—Hammarlund Isolantite Variable compression condensers listed 8/4. Ideal short-wave trimming aerial series, station finder 6d.

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RADIOMART.—Guarantees Prompt Despatch, perfect goods, no misrepresentation.—THE SQUARE DEALERS, 19, JOHN BRIGHT ST., BIRMINGHAM.

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JUNIOR 2½in. bench lathe is ideal for your experimental work. Price with compound rest 32/-, list free. Ward & Pollard, Orchard Works, High Street, London, S.E.18.

P.W. Gift Stamp No. 4

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