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Practical Wireless

AND PRACTICAL TELEVISION

EDITED BY F.J. CAMM

The LEADER 3
A NEW Set
and
A NEW Policy!

Published every Wednesday by
GEORGE NEWNES LTD.
Vol. 3 - No. 76.
March 3rd, 1934.
Registered at the G.P.O. as a Newspaper.

Full Constructional Details Inside!

PILOT AUTHOR KIT

WREN-EASTON 3
the easiest set in the world
to build and to understand

Backed by PETO-SCOTT, Pioneers of Kits since 1919.


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Complete Kit with Ready-drilled Panel, Metaplex Board, etc. Valves and Cabinet. Cash or C.O.D. Carriage Paid.
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All you have to do to obtain your Pocket Tool Kit is:—
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On receipt of Reservation Form and the address label, we will send you a limited Subscription Voucher on which to qualify for your Pocket Tool Kit. Your Kit will be reserved for you, and will be despatched immediately we receive the completed Subscription Voucher.

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No reader may qualify for more than one Pocket Tool Kit.

This offer applies to persons residing in Great Britain and Ireland. Readers in the Irish Free State must pay any duty imposed.

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**The Case, which is made of stout stamped metal, measures 6½ × 4½.**

Recesses are provided for all tools and when loaded, the Kit slips easily into the pocket.

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![Image of Pocket Tool Kit and Tools]

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**a 12/6 POCKET KIT at the PRIVILEGED PRICE of 3/6 AND ONLY 4 GIFT STAMPS**

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**The Test Prods**

**The Viewing Mirror**
Period only!
to Readers repeated urgent requests

with those previously issued, and these we now have pleasure in offering to our readers on even more advantageous terms than before. This time only 4 Gift Stamps (see Conditions) being required, applicants will therefore obtain their Kits in four weeks only.

Sufficient Kits have been obtained to meet the estimated demand, but it must be definitely understood that when these are exhausted no more will be available at any price or under any conditions. Prompt acceptance of this Offer is therefore essential.

As to the Kit itself, this, as stated, has been specially designed by Mr. F. J. Camm, the Editor of this paper. It comprises in handy pocket form a complete battery of tools for the Wireless Constructor's use. Every tool is a sound engineering job. All of them, together with a few of their many uses, are illustrated in this announcement.

It is unnecessary to stress the extreme value of this Kit to the practical man. The tools alone, if purchasable in the ordinary way, would cost not less than 12/6, and being so ingeniously packed into the limits of their 6½ins. by 4ins. Pocket Case, form an outfit which has only to be seen to be appreciated.
Perhaps first-class radio or radiogramophone has always been beyond you? It needn’t be now! The greatest maker in the world has now produced these two superb instruments at your price! The Superhet Five-Forty radiogramophone! The Superhet Four-Forty Radio.

THE FIVE-FORTY
Radio History! Superheterodyne 5 valves (including rectifier) all-electric radio set and all-electric gramophone, combined in a beautiful modern cabinet of figured walnut. Silent-running electric motor with automatic stop and pick-up. Hinged to facilitate easy needle change. Tone control by which upper or lower registers can be accentuated. Selectivity of a very high order. New type “His Master’s Voice” energised moving-coil loud speaker of balanced sensitivity at all registers. A.C. model 20 gns. (D.C. model 21 gns.) or small deposit and monthly payments of £1.

THE FOUR-FORTY
The Superhet Four-Forty is an achievement. It need only be compared with other sets to convince you of its superb Tone-quality, its Sensitivity and its Selectivity—perfect ability to separate completely the station you want from any other. There is volume without distortion. There is ease of tuning. There is a tone control by which upper or lower registers can be accentuated. The energised moving-coil speaker is of the latest type and mains can be used as an aerial. 5-valve (including rectifier) A.C. model 12 gns. D.C. model 13 gns. Or by hire purchase.

Ask your dealer about these two new all-important sets. They are the two exclusive interests today! Listen to the tone! Look at the cabinets! And then consider the prices!

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RADIO & RADIogramophones

Send a postcard immediately for special illustrated leaflet to
THE GRAMOPHONE COMPANY LTD. 168 L. CLERKENWELL ROAD, LONDON, E.C.1 PRICES DO NOT APPLY IN I.F.S.
Low-power Relay Stations

In order to provide a better broadcasting service, especially in Wales, the B.B.C. are considering the question of opening low-powered relay transmitters in various parts of the kingdom, of which one or more may be erected in Wales. In addition, for facilitating the taking of programmes from the Northern districts of the principality, it is proposed to establish a studio at Bangor. Wales was not included in the Regional scheme, as was Scotland, when this system was drawn up in 1927.

Six Millions—and Over

With the issue of roughly 1,100,000 wireless licences in January, the Post Office state that the number has now reached 6,124,000 as against 5,366,000 at the end of January, 1933. Although it is impossible to secure actual figures, it is now estimated that some thirty million people in the United Kingdom are listeners to the B.B.C. programmes.

Radio from the Rates

At Ziebach, in Germany, in order to comply with the wish expressed by the Ministry of Propaganda that every household should own a wireless set, the Municipality has voted a gift to its employees of maximum 15 marks (at par 15s.) towards the purchase of a suitable receiver. The money is to be supplied by the communal rates!

Is This a Record?

When, on January 20th, the Vienna station relayed an act of the first performance of Lehár's new operaetta, Giudetta, from the Opera House, the broadcast was taken by 133 transmitters in various parts of Europe. It tells of the return of Johann Strauss

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Another Attempt on the Stratosphere

Although so far the Russians hold the height record, another attempt is to be made shortly to elucidate still further the mysteries of the stratosphere. On this occasion the experiment will be carried out by Professor Moltchanov, of the Science Academy at Leningrad. The balloon will not carry any passengers, but will be of a true "robot" pattern; the working of the various recording instruments will be started by radio from a land station. By this method it is hoped to attain an even greater height than hitherto reached without courting the risk of disaster with loss of life.

This Radio Racket

The National and Regional programmes on March 5th and 6th will prove of interest to thousands of listeners, insomuch as the radio revue transmitted will consist of truthful disclosures of what goes on behind the scenes of a broadcasting studio. The cast includes many well-known names, amongst which are found Doris Gilmore, Lawrence Backstrom, Harry Remaley, Fred & Edo, John Korko, and Fred Hartley.

The Egypt's Gold

Nothing new microphone play will be produced in the National programme on March 5th. It tells of the recovery by divers of a million pounds of bullion from the liner Egypt, which sank off Ushant on May 20th, 1922. Salvage operations were begun seven years later, but it was only in 1934 that the wreck was discovered. The B.B.C. sound effects department are promising a very realistic background to the drama enacted before the microphone.

Italian Broadcasting Network

To permit a National broadcast through all transmitters when occasion arises, the Italian stations have now been amalgamated into two networks. The Northern group, which already included Genoa, Milan, Florence, Trieste, has been extended to Bolzano & Turin; the Southern circuit now comprises Rome, Naples, and Bari, to which by special cable Palermo has been attached. Broadcasts from this studio will now be relayed from time to time to the Capital and other stations situated in the same network.

The Return of Johann Strauss

AUSTRIA, since the installation of its first broadcasting station, has steadily worked to increase the popularity of its late composers, and in particular has regularly transmitted in its programmes works by the Waltz King. During 1934 the Vienna studio proposes to broadcast every melody written by this prolific musician, including fifteen operettas, some of which have not been played for many years. The power of the new Bielberg transmitter will permit them being heard over the greater part of Europe.
CONTROLLING LIFTS BY WIRELESS VALVES

A new system of gearless drive has been introduced to England for the first time in a London building. Where sixteen new lifts have just been installed, the interesting feature of this system is that two thermionic valves, such as are used in ordinary wireless sets, smoothly control the stopping and slowing of the lifts. The illustration shows an engineer replacing one of the thermionic valves.

SOLVE THIS!

**Problem No. 75.**

Although all the wires in Degen’s set were correct, the lead to the coils were badly grounded. In the case of one of the coils the coil-screen, when in position, was made contact with one of the leads to the wave-change switch. Thus, when switched to the long wave position the switch was inoperative owing to the fact that the lead in question was earthed through the coil screen. The switch operated effectively when the screen was removed.

Only one reader successfully solved Problem No. 74, and a book has accordingly been forwarded to D. J. Moes, Pritchard street, Toynbee, Glastonbury.

**Solution to Problem No. 75.**

The lead to the coil was not grounded. The lead to the coil was not grounded.

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**Interesting and topical paragraphs.**

Warren’s expedition to Mafeking in 1885, learned scouting from Selous, the famous hunter, and became one of the pioneers in Rhodesia in 1890.

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**Post Office activities against Wireless Pirates.**

**Problem No. 76.**

Jarvis had read that the impedance of an iron-cored choke varied with the frequency. He also understood that the equivalent impedance of a pure resistance did not vary with frequency. He therefore decided that he would obtain improved results if he used a resistance in place of the choke in the output filter of his receiver and he accordingly looked up the valve-maker’s instruction sheet and found that the optimum load for his output valve was 8000 ohms. He fitted a 8000 ohm iron-core choke, but results were worse. Why ? A book will be awarded for the first three correct solutions opened. Address your attempts to The Editor, PRACTICAL WIRELESS, Geo. Newnes, Strand, London, W.C.2.

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**CONTROLLING LIFTS BY WIRELESS VALVES**

On March 5th, a massed band concert will be relayed to Midland Regional listeners from the De Montfort Hall, Leicester, where the city’s annual brass band festival concludes. James Oliver will conduct. The programme includes Henry Hall’s arrangement ‘Sweethearts of Yesterday’, the fantasia ‘Other Days’ by Sorley MacKinnon, and an arrangement of ‘Three Hymn Tunes’, by Handel Parker.

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**Rounding the world of Wireless (Continued).**

**On Exmoor with a Camera.**

Hunting on Exmoor.—With a Camera. In the title of a West Regional talk to be given by Mr. Alfred Vorles on March 7th. In this talk Mr. Vorles will tell of his experiences in photographing birds, the story of his work in photographing birds.

**Orchestral Concert from Folkestone.**

FOLKESTONE. Municipal Orchestra and Choral Society, on March 5th, will be relayed to Midland Regional listeners. The orchestra, which will be under the direction of E. E. Newman, will be heard in Eric Coates’s suite, London Every Day, and in a “Music-hall” programme entitled ‘There is Gladness in Remembrance’, on March 3rd. These are no imitations, but the genuine articles; the genuine articles; the genuine articles.

**Music Hall Broadcast by Stars of Yester-year.**

Veterans of variety will be presented by Mr. John Southern in a ‘Music-hall’ programme entitled ‘There is Gladness in Remembrance’, on March 3rd. These are no imitations, but the genuine articles; the更改为“stars” of yester-year singing hits; and their original "stars" of yester-year singing hits; and their original ‘Stars of Yester-year’ programme, on March 5th, will bring to St. George’s Hall, for the first time in a London building, where sixteen new lifts have just been installed, a new system of gearless drive has been introduced to England for the first time in a London building, where sixteen new lifts have just been installed.

** контролируемых лифтов посредством беспроводных вентилей.**

**Глазов с экрана.**

Глазов с экрана. Глазов с экрана. Глазов с экрана.

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**Round the World of Wireless (Continued).**
HOW TO CONSTRUCT A SIMPLE CAPACITY BRIDGE

By W. L. PATTULO

A simple device for testing condenser capacities

THE small instrument about to be described can be made and calibrated with apparatus from every amateur's junk-box. It will give sufficient accuracy for all normal purposes and is quite easy to use. The meter will measure the capacity of any condenser, except the electrolytic variety, from 10 mfd. down to .0001 mfd. This range is covered in three steps.

It is not intended to discuss the theoretical circuits, which is given in Fig. 1, but for those who are interested it is sufficient to say that it consists of a simple resistance bridge, which is adjusted until the hum from the A.C. mains, or other source of oscillations, heard in the telephones, is balanced out. The unknown capacity can then be calculated from the formula:

\[ X = \frac{2}{A + B + C} \]

where \( X \) = the unknown capacity in microfarads
\( B \) = the total resistance of the bridge in ohms, minus \( A \)
\( C \) = the standard capacity used, in microfarads
\( A \) = the resistance between the points "a" and "b" in ohms. See Fig. 1.

Parts Required

One 10,000 ohm potentiometer (Watmeal).
One 2 mfd. condenser (T.C.C.).
One .1 mfd. condenser (T.C.C.).
One .001 mfd. condenser (T.C.C.).
Three Clix sockets with two coloured erinoid washers to slip underneath the heads.

Lay-out and Construction

The lay-out adopted is not very important, but that shown in Figs. 2 and 3 was adopted by the writer. Note the use of a narrow base-board at right-angles to the panel, for mounting the condensers and so saving space. When wiring up, be careful to avoid parallel or bunched-up wires, which may introduce unwanted capacity and make the calibration of the low-capacity range inaccurate.

Calibration

The next step is to calibrate the instrument. There are two ways of doing this. The first method is not quite so accurate as the second, but has the advantage of only requiring a pair of compasses to carry it out. The second method requires the use of an ohm-meter such as has been described several times in Practical Wireless. Those who have such an instrument are advised to use it.

Method No. 1

Prepare a circular paper or thin card scale, diameter about 5in., and draw on it two concentric circles with a radii of about 1in. and 1in. respectively. Fit the scale under the knob of the potentiometer and mark on it the two extreme points of movement of this knob.

Divide up the portion of the scale over which the pointer of the knob travels into ten equal parts, and subdivide each of those into ten additional parts. Now each degree of the scale equals 100 ohms, therefore using the table given on page 1080, mark off the various resistances given. Print against each mark the capacities shown in columns 2, 3, and 4, using the inner circle of the scale for column 2 and the centre circle for column 3, etc. Figure 3 shows how the finished scale appears.

Note that the lowest resistance starts from the end of the potentiometer, which is connected to one of the terminals labelled "Capacity" (see Fig. 1), and that therefore the highest capacity readings on the scale will commence from this end. If coloured erinoid washers have been fitted under the Clix sockets on the panel, then the three sections of the scale should be labelled accordingly. The scale is now complete and may be glued down. A piece of
WILL THE PENTAGRID REVOLUTIONIZE THE SUPERHET?

The Pentagrid Valve is a Newcomer with Many Interesting Possibilities:
Its Advantages are Interestingly Described in This Article by PERCY RAY

The pentagrid is beginning to engage attention of every serious constructor, and when news of this valve first became available it was taken for granted that it would revolutionize the superheterodyne, and yet it seems to have achieved little popularity up to the present. It is, therefore, not surprising that the constructor is losing confidence in the pentagrid and wondering if it is already dead. The writer is of the opinion that the pentagrid is far from dead, and for this reason will very briefly be reviewed.

Frequency Changing

The main difference between the superhet and all other types of receivers is that most of the amplification takes place on some predetermined wavelength other than that of the received signal; the incoming signal is made to beat with a locally-generated "carrier-wave" of such frequency that the resulting beat-note has a frequency corresponding to that of the I.F. amplifier. This wavelength mixing takes place in a stage generally called the frequency-changer, which may employ one or two valves, or, in certain exaggerated American superhets, three valves. Obviously, this stage is vital to the overall performance of the superhet, and it is probably true to say that 90 per cent. of the superhet receivers that have proved disappointing to their owners would be quite satisfactory if it were not for trouble in the frequency-changer.

The original form of frequency-changer consisted of a triode detector coupled to a triode oscillator. This arrangement possessed among its various disadvantages the very low stage gain and a terrible tendency towards "cathode ringing" which is the pulling out of tune of one tuned circuit by the other. It should be understood that the frequency-changer can actually amplify; in fact, the output from this stage can be so much greater than the input that a single I.F. stage may suffice, while with a poor changer two such stages would be necessary.

The many forms of frequency-changers can be divided into two groups: namely, the various methods of frequency-changing which are based on the "frequency-mixing" principle, and the arrangements which employ some form of "autodyne changer," which is that form of frequency-changer which is a true autodyne circuit where a single valve performs both the function of oscillator and detector.

The pentagrid has many advantages, including the important one of electronic frequency-mixing, but there may be one point in favor of the two-valve method—greater amplification.

It was suggested that mixing should be used, whether inductive, capacitive, or both, in order to be more efficient at a certain frequency, and the only truly uniform coupling that can be found for the pentagrid where electronic mixing is employed. This will readily be understood when the strange functioning of this altogether unorthodox valve has been described.

So far the grids S1 and S2 have been ignored for the simple reason that they do not materially influence the proper functioning of the valve; they are situated on the inside and outside of the signal grid, and screen it from the other electrodes. This is the vital fact to remember in the mixing action between the aerial tuning and oscillator tuning circuits, and prevents one from dragging the other off its proper setting. This valve cannot be considered as being similar to the screening grids in a screen-grid valve, and are joined together inside the valve, as shown in Fig. 1, and a single lead is brought out.

Pentagrid Circuits

The circuit diagram (Fig. 3) is one of several variations for using the pentagrid as a frequency-changer. The others are very similar; one makes use of a tapped anode coil in place of L5 and L4. In this circuit L1 is the tuned oscillator-grid coil and is connected to grid "OG"; it is coupled to the detector anode "T" by means of the anode coil L6. L4 and L5 are the two windings on the I.F. input transformer, while L9 is the aerial coil; it will be observed that the low potential end of this coil is taken away to the automatic volume control feed, the oscillator portion of the pentagrid having variable-mu characteristics permitting the smooth gain control associated with this type of valve. If A.V.C. is not used, the resistance R1 can be variable to give manual control of volume.

R5 is the bias resistor to apply the small fixed bias in the usual way, while R6 gives a bias on the oscillator grid by means of the voltage-drop across this resistor due to the passage of grid current through it. R6 and R5, in conjunction with C1 and C2, are for decoupling purposes; C3 is a blocking condenser to prevent the partial shorting of the resistors R9 and C4, C5 and C6 are ordinary by-pass condensers.

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When mixed, the electron cloud is in between two areas that are not crowded it could only be caused by the electron stream slowing up; the same effect is produced on a road.

(Continued on page 111)
Forming parts of two separate circuits are generated inductively in the coupled circuit. The frequency current embraces part of another magnetic field of one circuit or component—various parts of the second.

The whole arrangement acts as a magnetic screen.

The trouble is that these spurious signals are amplified in succeeding stages of the set. At "the best" they spoil loudspeaker reproduction, but, if originally received from one of the later stages and fed back into an earlier stage, the re-amplification may be sufficient to upset the stability of the circuit and cause oscillation and howling.

Two Main Methods

There are two ways in which interaction may take place, namely, by magnetic and electrostatic coupling.

Magnetic coupling arises when the magnetic field of one circuit or component carrying an audio-frequency or radio-frequency current embraces part of another circuit. The whole arrangement acts as a transformer, alternating voltages being generated inductively in the coupled circuit.

Electrostatic coupling exists if conductors forming parts of two separate circuits are sufficiently close to each other to form the plates of a small condenser, for under these circumstances alternating energy will be transferred from one circuit to the other.

Not only may spurious signals be introduced in this way, but often the feeble but precious energy of the true signal may be dissipated, resulting in a loss of volume and power.

Two important points in connection with the design and layout of a circuit, which have a profound effect in avoiding interaction are, first, to see that wiring and components which might affect each other are well spaced apart, and, second, that they are so disposed that their magnetic fields are not likely to interlink.

Indeed, in the earlier years of broadcasting these were the only precautions taken to avoid retro-action, and they were usually fairly efficacious because apparatus in general was comparatively insensitive, and the amounts of energy handled relatively small. Hence, the losses due to interaction were usually masked by the still greater losses in the somewhat crude apparatus used.

Reducing Electrostatic Coupling

As the efficiency of individual components and receivers as a whole improved, however, and especially when A.C. mains operation was introduced and sensitive valves came into use, the effects of interaction became more noticeable. The complete solution to the problem was provided by combining sound layout and spacing with more or less complete screening of the various circuits.

Before describing the several methods of screening components and circuits, it is necessary to see exactly what effect screening has on the different kinds of interaction. First of all, then, consider how metal screening can reduce electrostatic coupling.

Fig. 1 shows two wires, aa and bb, which, it can be assumed, form parts of two different circuits. Suppose aa is carrying a radio-frequency signal (say the anode current of a high-frequency valve) and bb is part of the grid circuit of the same valve. If these two wires run side by side and are fairly close together, they will form a small condenser, and this will give rise to an unwanted feedback or reaction. If, now, a metallic screen is placed between them and connected to earth, the wire bb will be isolated from the electrostatic field of aa, and energy cannot pass between the two circuits.

Note, however, that the wire aa and the screen now form a condenser, so that energy will be lost by the circuit aa as by passing away to earth. Furthermore, there will be additional losses due to eddy currents being set up in the metal of the screen. These losses will be greater at high frequencies than at low frequencies, and it is therefore essential to combine the design of the screening with adequate spacing in order to minimize losses and eddy-current damping.

Magnetic Shielding

Magnetic interaction can, of course, be cured only by a screen of iron or steel—thin plate, which is tinned iron sheet, is also efficacious. But it is quite useless to try to prevent magnetic leakage from, say, the circuit and cause oscillation and howling.

(Continued on next page)
the power pack of an A.C. mains set by surrounding it with an aluminium screen. Even an iron screen is of little value unless it is of substantial thickness, and thin, iron plate is the minimum thickness which can be really recommended.

Referring to Fig. 2 it will be seen that the magnetic field of A, say a low-frequency transformer or choke, cuts the circuit of B, which may be another transformer or choke. A voltage corresponding in frequency with that of the current in A will therefore be induced in B. When, however, an iron screen is interposed between A and B as in Fig. 3, the magnetic flux due to A is concentrated in the screen and does not reach B.

Screening Devices

It is now necessary to deal in detail with the principal screening devices which are available. The simplest form consists of built-up partitions of aluminium or tin plate arranged between the circuits it is desired to isolate from each other. This was the first type of screening to be employed and proved reasonably efficient with the older types of components.

Usually a metal sheet covering the baseboard, with transverse shields between the H.F. stages and a metal panel, gave a fair measure of shielding. It must be admitted, however, that a certain amount of interaction was still possible with such an arrangement, and it is an interesting conjecture as to what proportion of the "liveliness" of some of the 3-valve and 4-valve sets of the 1928-1929 era was due to the magnetic leakage of the individual components. A typical example is illustrated in Fig. 5.

- Allied to the canned cell is the question of metalized valves. All H.F. and detector valves can now be obtained with bases which have been sprayed with a metal coating, this, in turn, being connected to one of the filament pins in the case of directly-heated valves, or to the cathode pin for indirectly-heated types.

This metal coating serves the same purpose as the effective screening of waveforms of metal-covered sleeving (Fig. 7). This metal coat serves the same purpose as the effective screening can.

In order that all screens and cans shall be at the same (earth) potential, it is usual to mount the filaments upon a metal base. This may be achieved by placing a sheet of metal plate or metal strips on the top surface of the baseboard, or a chassis of metal sheet may be used instead of a baseboard.

Other Cases

An excellent and convenient alternative that has come greatly into favour during recent months is the wooden base or chassis, and covered over-all in one of the many forms of metal sheeting (see Fig. 7). These metalized bases are quite easily worked with ordinary wood working tools, and good electrical contact is provided by ordinary wood screws.

Mention must now be made of methods for shielding individual wires. It frequently happens that a single wire should be screened—for example, the connection to the anode cap of a screening grid valve (see Fig. 6), or the connection from the aerial terminal to the first H.F. grid, or some other wire carrying signal current. Various forms of metal-covered sleeving are available, but in making a choice it is wise to remember a few points:

1. The actual wire must be insulated, and the screening metal earthed, while to avoid losses the metal cover must be of large enough cross-section to prevent appreciable losses of signal current. Probably the best combination is a thin, flexible, metal-coated wire enclosed in fairly wide bore systoflex and covered over-all in one of the many forms of metal sleeving (Fig. 7).

2. Handy makeshifts for the metal sleeving can be devised by means of a wrapping of metal foil, or even by winding bare wire closely over the systoflex. Finally, mention must be made of the practice of using metal-braded flex for the heater circuits of A.C. mains sets. Obviously, with the usual tin-plate, copper braiding, no magnetic shielding is obtained. Only the very effective effect of the braiding is to keep the wires twisted cores as close together as possible, and thus to restrict the magnetic leakage. Until this braiding is employed, both metal-braded and ordinary twin twisted cores are used, and have never found any noticeable difference in performance between the two.

Prepare a circular scale as in method No. 1. Connect an ohm-meter across the potentiometer at points "a" and "b" of the circuit and adjust the potentiometer so that the potential at "a" shall be at the same (earth) potential, it is necessary to see that the oscillator note is obtained on the scale and adjust the potentiometer to the desired capacity or by substituting the desired capacity for "X". The resulting value for "X" can then be obtained on the same scale by printing the capacities, etc., from the mains to the oscillator. It should be emphasised that the value assigned to "X" must be reasonably near that of the condenser to be measured, otherwise the resistance "X" on the scale will be too near one end of the scale to obtain a true silent point.

Connect a pair of high-resistance headphones and the low-voltage winding of a bell transformer, or other source of oscillations, to their appropriate terminals. Join the condenser under test to the terminals labelled "Capacity" with short lengths of wire (not twisted flex), and insert the Clix plug into one of the sockets. Switch on the oscillator and adjust the potential of the oscillator with care until the note heard in the headphones is clear and definite. It should then be possible to find a point which is quite silent, but where a slight movement of the oscillator will make the oscillator note audible again.

If no silent point can be obtained, transfer the Clix plug into each of the other sockets in turn and repeat the process.

It is desirable, therefore, to use a high-note oscillator in preference to the A.C. mains when using the low-capacity range. This is principally because the low-frequency hum from the mains does not appreciably pass the small-capacity condensers used in the circuit.

The simplest oscillator, incorporating a buzzer, which the writer has used with success, is given in Fig. 5.
A Cheap and Novel Speaker

The components required for the novel speaker illustrated are: 4 lengths of 2BA threaded rod and 8 2BA nuts; 2 pieces of thin plywood, 18in. square, and a pair of 'phones.

The phone magnets are removed in their entirety from their cases and mounted in the centres of the plywood squares, so that when placed together the magnets attract each other. If they do not reverse the magnets (quite a distinct pull can be felt). A hole is then drilled in each corner of the squares. Replace the leads to the earpieces, screw two 2BA nuts on to each rod and assemble the parts as shown. Thread on the outside the remaining 2BA nuts, and, by means of the threaded rod, adjust till the magnets are practically touching. Lock with the outside nuts and, except for a coat of varnish on the squares, the speaker is complete.—P. Tsarrin (Hull).

A Simple Protective Device for Gramo. Records

A protective device for gramophone records is shown in the sketch. The record is placed on the 'board', and on completion slips into the chamfered slot and retained by the small vertical portion. The groove and is then raised off the record "board," and on completion slips into the slot having a soft side could be covered by felt or velvet touching the recording surface by the chamfered slot and retained which would act as a brush.

Protective Device for Gramophone Records

In operation the needle is placed against the "board" and on completion slips into the groove and is then raised off the record surface by the chamfered slot and retained by the small vertical portion.—D. Jones (Deptford).

Removing Broken Terminals from H.T. or L.T. Accumulators

Sometimes happens that accumulators with good plates in them cannot be used because a terminal has broken in (generally the positive). A quick and easy method of removing the broken part is to pour a little killed spirit on the terminal stump and then press on it with a hot soldering iron for a few seconds, keeping the iron flat and completely covering the stump. The iron expands the lead stump of the plate and the killed spirit runs inside and sends all corrosion and sulphation, which previously held the terminal stump fast, to the top. With a sharp-nosed pair of pliers it is then an easy matter to remove the stump. Care must, naturally, be exercised with celluloid accumulators.—H. Kay (Royton).

Centring M.C. Speaker Speech Coils

An easy method of centring the speech coil of a moving-coil loud-speaker.

First loosen off the screw holding the spider to the centre pole, then insert three pieces of cigarette cardboard or paper (according to the size of the gap) about 1in. wide, at equal distances round the centre pole, and on the inside of the spider. Tighten up the screw and remove cards, when the speaker will be found to be correctly centred. If the spider is damaged a temporary repair may be effected by lightly packing cotton-wool in the gap, to prevent chatter.—L. R. Tyler (Oswestry).

Centring a Speech Coil in an M.C. Speaker

The following method of calibrating and marking of dial readings for a two-knob tuner will prove very simple and effective. First, cover the degree markings on the condensers with a piece of cartridge paper cut out to shape. Having switched to the earpieces, screw two 2BA nuts on to each rod and assemble the parts as shown. Thread on the outside the remaining 2BA nuts, and, by means of the threaded rod, adjust till the magnets are practically touching. Lock with the outside nuts and, except for a coat of varnish on the squares, the speaker is complete.—P. Tsarrin (Hull).

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Centring M.C. Speaker Speech Coils

An easy method of centring the speech coil of a moving-coil loudspeaker.

First loosen off the screw holding the spider to the centre pole, then insert three pieces of cigarette cardboard or paper (according to the size of the gap) about 1in. wide, at equal distances round the centre pole, and on the inside of the speech coil. Tighten up the screw and remove cards, when the speaker will be found to be correctly centred. If the spider is damaged a temporary repair may be effected by lightly packing cotton-wool in the gap, to prevent chatter.—L. R. Tyler (Oswestry).

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A Simple Band-pass Filter

Having on hand a two-way Bulgin snap-switch, I devised the switching arrangements shown in the accompanying sketch, whereby the S.G. valve of my set is cut out and at the same time a small capacity condenser is brought into circuit across the fixed terminals of the tuning condensers. An efficient band-pass filter is thus formed which will bring in the locals and many of the more powerful foreigners at excellent quality, at the same time saving the current that the S.G. valve would have consumed.—J. H. Wylde (Marsden).

Automatic Delay Switch

Some A.C. set builders will perhaps welcome a simple alternative to the thermal-delay switches which are on the market. The device illustrated, which is fairly easy to construct, has the advantage of saving the current that the S.G. valve would have consumed.—J. H. Wylde (Dublin).

A Universal Bench

It is often difficult to find room for a bench in the house, and the accompanying sketch shows a detachable one which can easily be fitted to any table. It merely consists of a board about 8in. wide and 4ft. or 5ft. long, fixed to the top of a table as in sketch. One end has a lower piece about 8in. long fixed at an angle to the top and held by two or four coach or countersunk bolts. The bench is then pulled on to the table until this end is tight. Then the lower part of the other end is pushed up on the bolt, which may be placed in the most convenient of the holes provided, and the wing nut tightened. Since all the wear and tear comes on the front of a bench, this "makeshift" will be quite wide enough. A piece of newspaper should be placed on the table before the bench. It will protect the table and serve to collect dirt.—James H. Rowe (Dublin).

A Nut-locking Hint

Most amateur constructors find soldering a rather difficult job, but here is a simple method of securing nuts without resorting to the soldering iron. First, a piece of thin twine in shellac, and then pass the twine through the nut (as in sketch) and screw the nut on with the twine between. This method will effectively lock the nut if the shellac is wet when the nut is screwed on. The ends of the twine may then be cut off.—F. H. Lovell (Hemphire).

Trimming Ganged Condensers

I recently acquired a ganged condenser assembly on which the trimmers were adjusted by means of hexagonal-headed nuts the size of ordinary terminal nuts. With the condenser mounted it was most inconvenient to adjust the trimmers with ordinary spanners in such a manner as to effect proper adjustment, so I detached the ganged unit and removed the adjusting nuts. From a broken alarm-clock I secured two brass gear-wheels of equal size and removed the bushes, thus leaving a hole in the centre of each. These I sweated on to the ends of the adjusting nuts, the holes being concentric. On replacing the nuts-cum-gear-wheels, trimming became simplicity itself, the wheels being moved round either way by means of a long wooden rod with one end flattened.—T. D. Ramsay (Sterkspur, South Africa.)

Slotting Ribbed Coil Formers

For those who are desirous of matching home-made coils on a six-ribbed ebonite former, the following dodge will ensure that the windings are identically spaced on each coil. It is usual to wind the long-wave section in slots in the bottom part of the coil, and the medium wave winding as a plain solenoid. A reaction winding will also be required on the same coils, and possibly a small aerial coupling winding for the medium waves. A few scraps of oak are all that are required. It is advisable to leave a space of about half an inch at the bottom of the former to accommodate terminals or soldering tags. A flat piece of oak therefore, ¼in. thick, is screwed to the bench, and the former held firmly against this and resting on the bench. A slot is then cut in each rib with the edge of a flat file. The file resting on the piece of wood whilst it is cutting. The file should be about ¼in. thick, which will give a suitable cutting space for as many as a hundred turns of, say, 34 enameled wire, if each slot is cut to half the depth of the rib. For the second series of slots, a piece of ½in. oak is now screwed on top of the first one so that the front faces are flush, and the cutting process repeated, keeping the file riding flat on the wood. If more slots are required, additional pieces of ½in. wood are screwed on the top of the preceding ones.—L. Pitchford (Normanton).

A Nut-locking Hint

Most amateur constructors find soldering a rather difficult job, but here is a simple method of securing nuts without resorting to the soldering iron. First, a piece of thin twine in shellac, and then pass the twine through the nut (as in sketch) and screw the nut on with the twine between. This method will effectively lock the nut if the shellac is wet when the nut is screwed on. The ends of the twine may then be cut off.—F. H. Lovell (Hemphire).
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DYNATRON OSCILLATORS AND THEIR USES

An Interesting Explanation of the Dynatron Principle with Some Practical Information in Regard to the Construction and Use of Dynatron Oscillators.

By K. E. BRIAN JAY

If the electrons emitted by the hot filament of a valve strike the plate sufficiently hard they will knock electrons out of the metal of the plate, and so set up a secondary electron stream in the opposite direction to themselves. By raising the grid of the valve to a higher D.C. potential than the plate, as in Fig. 1, the speed of the filament or primary electrons is accelerated, so that they knock more electrons from the plate and increase the stream of these secondary electrons, which are attracted to the grid. The result of this is shown in the plate volts-plate current curve of Fig. 2. As the plate voltage is increased, the plate current (measured by the milliammeter M) increases until it reaches the point A, at which secondary electrons begin to be liberated. Beyond A an increasing number of secondary electrons are set free which return to the grid and so reduce the total plate current until the point B is reached at which the plate voltage approaches that of the grid and the potential difference is no longer sufficient to draw the electrons to the grid. We see then that over the part of the curve between A and B the valve has the unusual property of passing less current the more the voltage is increased, a condition called negative resistance. This effect was first described in 1918 by A. W. Hull, who gave the property of passing less current the more it is increased, the plate voltage is altered and the negative resistance is equal to the reciprocal of the curve AB, so that decreasing the slope increases the negative resistance, and from Fig. 2 it is clear that the slope of the curve is decreased when the control-grid bias is made more negative.

A practical version of the arrangement is shown in Fig. 3; C1 and C2 are 1 mfd. bypass condensers, Pi 50 to 10,000 ohm variable potentiometer to provide fine control of the control-grid bias, C3, a variable condenser of .0005 mfd. or less, depending, like the coil L1, on the wave-length range required. A six-volt grid bias battery is used and for the preliminary tests the slider of R1 should be set at the positive end. 50 volts H.T. on the screen grid will suit almost any valve, but the voltage on the plate is rather more critical, although it will probably be between 10 and 30 volts. To test whether the dynatron is working, a coil covering the 200 to 600 metre broadcast band should be placed at L1 and the broadcast receiver tuned to the local station; C3 is then rotated until a heterodyne whistle is heard in the loud-speaker; if there is no whistle the plate voltage is altered until it appears. Most mains or battery screen-grid valves work satisfactorily, high conductance valves being the best, but pentodes are quite useless because the third grid has been introduced for the express purpose of removing the dynatron kink.

For Comparing Coil and Condenser Efficiencies

When the valve is oscillating, increasing the negative grid bias by moving the slider of R1 to the negative end increases the negative resistance, which approaches the impedance of the tuned circuit L1C3 until, when they are equal, the oscillations cease; decreasing the negative bias should cause the oscillations to restart immediately; if they do not, backlash is present and may be removed by adjustment of the plate voltage. When properly adjusted the oscillator provides an excellent means of testing the relative "goodness" of coils and small condensers. To compare two coils one is connected in place of L1 and tuned by C3 to give a beat note with a station tuned in on the receiver; the grid bias is then increased by adjusting R1 until the valve just stops oscillating, when the bias voltage is read on the voltmeter shown dotted at L1 in Fig. 3. The second coil is then put in place of the first and the
PRACTICAL WIRELESS

FILTERS AND FUSES

ALTHOUGH at first sight there appears to be no objection between filters and fuses, it can be seen on closer consideration that fuses should be fitted to mains filters. The type of filter referred to is shown in Fig. 1, and is for reducing hum and interference. This filter should be placed as close as possible to the point at which the mains enter the house if the trouble is to be reduced to a minimum. From Fig. 1 it can be seen that the condensers C1 and C2 are connected directly across the mains, the centre point being earthed. This is a very effective method of reducing the interference due to the mains, and it is essential that fuses of low current-carrying capacity should be connected in the circuit as shown.

House Mains Fuses

At this point the practical wireless man will be thinking of the main fuses in the house. If the mains fuses are relied upon, any trouble which does occur to either of the condensers will cause the house fuses to blow. If extra fuses of low current-carrying capacity are in circuit these should any breakdown occur. These fuses will have no effect on the filters which are required to bypass the high frequency currents and to steady the voltage swing in the case of direct current mains. Any light fuse rated at .5 amp or so may be fitted. We shall thus have a fully protected filter.

The wireless engineer always tries to avoid fuses where possible, and although this is quite all right on some circuits it is advisable to be on the safe side when using the mains. The "heavy" electrical engineer does not leave things to chance, as can be seen from examining the usual house switch and fuses; this is shown in Fig. 2, which should be of interest to readers. First of all comes the mains switch and fuses; then the main switch, and lastly the usual house switch connected in the circuit as shown.

Fig. 1.-Wiring of house mains filters and fuses. The way in which the fuses are connected in the circuit as shown.

Fig. 2.-Mains filters and fuses, the main switch, and the usual house switch connected in the circuit as shown.

March 3rd, 1934

TOPICAL TECHNICALITIES

Wattage Dissipation

When current is passed through any circuit or component having resistance, a voltage drop occurs across that circuit. In other words, a certain amount of voltage is dissipated. It is one of the laws of science that nothing can be created, or "destroyed" but, as the voltage drop across the resistance multiplied by the current flowing represents "power," it would appear that in the case under consideration nothing can be lost or destroyed. This is not actually the case, however, since the electrical power is simply converted into energy of another kind - heat.

The plant will be evident that the energy which is in the form of heat is "wasted" or "destroyed," and it is this which gives rise to the general concept of "wattage dissipation," due to the fact that the power (in watts) found when multiplying the voltage across the resistance by the current) is changed into heat, and is then "destroyed."

Knowledge of these facts is essential when choosing resistances and other components for use in wireless circuits, because if these are not capable of dissipating sufficient energy they will heat up undesirably, and damage will result.

A Dynatron Wavemeter

In addition, it makes a good wavemeter because, as long as the total space current drawn by the valve (measured by a milliammeter inserted at X in Fig. 3) is kept constant, the wavelength of the circuit is very little affected by changes in the
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**DISTORTION IN AMPLIFIERS**

**Notes On Its Cause And How It Can Be Overcome.**

By E. C. ROWE, B.Sc. (Hons.), A.C.G.I.

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**Amplitude Distortion**

The third type of distortion is known as amplitude distortion in which the amplitude of the output variations is not linearly related to the amplitude of the input variations. By “linear relation” we mean that if the instantaneous input and output currents were plotted against each other the graph would be a straight line, showing that the output varied as the input. This is shown in Fig. 2. It can be shown mathematically that this non-linear relationship introduces harmonics, or high multiples, of the fundamental and condensers can be so chosen that for the operating range of frequencies the total impedance is not unduly affected by the frequency.

With low-frequency amplifiers both frequency and amplitude distortion are serious, but with high-frequency amplifiers it is frequency distortion that causes the most trouble.

The distortion in high-frequency amplifiers, while generally the same as in low-frequency ones, has several distinctive features. Frequency distortion, as before stated, is the more serious because any modulation of the high-frequency signal is frequency distorted, but, however, it must be recognized that when radio frequency amplifiers are generally tuned it is only frequencies in the neighbourhood of the resonant frequency that pass through the amplifier — thus a common form of high-frequency distortion occurs when the difference in frequency between two high-frequency carrier waves approaches the resonant frequency. Then again, a deeply modulated carrier wave, which acts on the amplifier at the same time as a second carrier, to which the amplifier is tuned, is being received, is liable to cause what is known as cross-talk.

In conclusion, we may sum up distortion as consisting of two principal kinds:

1. That set up when currents of different frequencies are not amplified by equal amounts. This is overcome by good design.

2. That due to the amplification not being independent of the input voltage. To ensure freedom from this fault the working characteristic must be linear over the operating range of voltage, which demands the correct choice of valves and a high external output impedance.

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**Poznan’s New Transmitter**

Better signals from Poznan (Poland) are now being picked up on 345.2 m., as since the beginning of February the new 17-kW transmitter has been gradually taking over the broadcasting. According to a Polish paper, Poznan will be endowed later with more powerful plant; in fact, it is possible that this will be a bigger station than the old one.

---

**Fig. 1.** A graph illustrating the alteration in shape of signal waveforms.

**Fig. 2.** Relation between input and output.
The best results from the 'Leader Three' can be obtained only by using the designer's specified components. These Varley components are not merely a first choice for this remarkable set—they are the solus specifications! An essential part of the 'Leader Three'—you cannot afford to use any other components.

1 VARLEY NICLET L.F. TRANSFORMER
The result of extensive research coupled with a long and varied experience in the winding of transformer coils. Niclet 1:5 L.F. Transformer
D.P.22 7/6

1 VARLEY ELECTRONIC RESISTANCE
20,000 ohm. 1 watt. C.P.201 9d.

1 VARLEY ELECTRONIC GRID LEAK
2 meg. 1 watt. C.P.201 9d.

Both these are tubular resistances with metal end caps and short protruding lengths of wire which make direct contact with the resistance material.
Short Wave Section

SPECIAL AERIAL SYSTEMS FOR SHORT-WAVE RECEPTION.

The Short-Wave Enthusiast Will Find Ample Scope for Practical Experiments in the Various Types of Aerials Described in This Article

By ALF. W. MANN

There are various types of short-wave aerials, the majority of which are of simple construction, and which may be used in conjunction with any type of short-wave receiver. As a rule, the magnitude of aerial experiments undertaken by the average amateur is governed by the amount of space in which to erect alternative aerials and the particular site of his house.

It is, of course, well known that almost any aerial, either long or short, will do for short-wave reception. It does not follow, however, that the results obtained will do justice to the capabilities of even the most ordinary receiver; therefore, if at all possible, the construction and erection of a special aerial suitable for short-wave reception should be considered.

In placing the suggestions outlined in this article before readers, the writer has taken into account the circumstances under which the majority of short-wave enthusiasts carry out their DX and experimental work, and has confined his suggestions to those where unlimited space is not the ruling factor. Fig. 5 is, of course, given as an interesting example only, as very few enthusiasts will be fortunate enough to have the amount of open space at their command which is necessary to erect the type of aerial shown.

In many instances, aerials consisting of a length of insulated wire laid behind a picture rail are in use. Whilst no doubt moderately satisfactory for broadcast reception, such an aerial leaves much to be desired so far as short-wave reception is concerned.

Aerials Under the Roof

If the experimenter lives in a private house, and wishes to use the short-wave receiver at will leaving the broadcast receiver coupled to its own aerial, the possibilities of an inside aerial zigzagged between the rafters under the roof should certainly be considered. The writer uses an aerial of this type strung from corner to corner with the down-lead from the far end. The total length is 65ft. of insulated aerial wire, and the results obtained are quite satisfactory.

The flat dweller in the cities and large towns has a difficult problem to solve, especially if his flat happens to be about half-way between the top and bottom of the block, for it is certain that those above him will have availed themselves of the roof facilities, whilst those below will take advantage of the back space available at ground level.

A commercial idea known as the "Fishing Rod Aerial," shown in Fig. 1, provides a solution to this problem, as it is mounted in a vertical position by means of two wall brackets. Whilst specially applicable to the circumstances outlined above, the idea is commendable to anyone who requires an additional aerial, or, for instance, an aerial for broadcast reception which may be erected with the minimum of trouble.

Vertical Aerials

As vertical aerials are under consideration, details, as given in Fig. 2, may be of interest. As the sketch is self-explanatory, further comment is unnecessary. It should be noted, however, that providing it is possible to use supporting brackets which will allow the aerial to hang at least 2ft. from the wall, there is no reason why this type of aerial should not be used when there is sufficient height available.

In Fig. 3 we have a variation of the above idea, and, whilst eminently suitable under certain circumstances, the possibilities of swinging signals, due to the swaying of the broadcast aerial in the wind, should not be overlooked, as under these circumstances tuning in and holding signals even on a stable and trouble-free receiver is apt to be difficult.

A Divided Aerial

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A Divided Aerial

The details concerning the arrangement shown in Fig. 4 were forwarded to the (Continued on next page)
writer by a New Zealand enthusiast who is highly satisfied with the results obtained. The fundamental principle is that each flat top is half a wave length, i.e., if the listener wishes to receive a particular station, for example, on a wavelength of 25 metres, the individual flat tops must be 12½ metres long. Unfortunately, details as to whether the feeders F are tuned in order to bring each half in resonance is not stated. The writer has not sufficient space available to try out the idea, but it may have an appeal to listeners abroad who hear one or more of the British Empire Transmitters regularly.

As previously stated, the transposed aerial arrangement shown at Fig. 5 is included as a matter of interest. The advantage of this type is, that whilst it is not a complete eliminator of outside interference, such as that caused by electric signals, lifts, car-ignition, and other systems, it is effective in cutting down the interference to such an extent that the improvement is at least half in resonance. The advantage of this type is that whilst it is not a complete eliminator of outside interference, such as that caused by electric signals, lifts, car-ignition, and other systems, it is effective in cutting down the interference to such an extent that the improvement is at least half in resonance.

### Oscillation Complaints

At one time, for instance, complaints of oscillation preponderated. Programme time was seriously jeopardized by S.O.S. messages from local stations, asking residents of various streets to look to their sets lest they be causing interference. A huge map at broadcasting headquarters, studded with pins, enabled the engineers to see how far any complaint was correct. The advantage of this type is that whilst it is not a complete eliminator of outside interference, such as that caused by electric signals, lifts, car-ignition, and other systems, it is effective in cutting down the interference to such an extent that the improvement is at least half in resonance.

#### How the B.B.C. Looks After Listeners.

By HAROLD A. ALBERT.

### Electrical Interference

Electrical interference, that other bugbear, is also rectified whenever possible. If a listener is getting noises in his set from electric signs, X-ray apparatus in a neighbouring hospital, or a dynamo in an adjacent cinema, he has merely to tell the B.B.C., and assure the engineers of the genuineness of his complaint by taking the trouble to fill in their questionnaire. The G.P.O. will send out experts with apparatus which will probably cure the trouble.

#### Difficult Cases

Only in those cases in which trams or electric railways are concerned do the engineers find themselves unable to attack the difficulty.

#### Interference from Electric Trains

If you live near overhead wires, or have trolley buses passing by, or a train going through your back garden, you can expect some amount of electrical interference. The same is true with regard to the third rail system, but trolleys and trolley buses usually cause more trouble than they are worth. In frosty or rainy weather, or perhaps after a sandstorm has passed, electric noise may be the worst form of interference. The usual earth system is not used.

### Heterodyne Interference

Heterodyne troubles—that is, interference between stations due to the shortage of wavelengths—are another matter. They can only be dealt with internationally. The B.B.C. representatives at international meetings are kept fully aware of the engineers' difficulties in this regard. The B.B.C., it will be seen, really are as keen on perfect reception of their transmissions as they are on the perfection of the transmissions themselves.

#### Complaints of Interference by Means of the Telephone

There are also hundreds of letters from listeners who want to get the best out of their sets, or who are suffering from mysterious breakdowns for which they are unable to account. Many a listener may write to say that the reverberation period of a certain engine transmission on such-and-such a night was so-and-so, whereas it is usually something-or-other, and that he found it better or worse.

Such letters supply a great deal of information concerning listeners' opinions on the quality of the transmissions which otherwise would be lacking. Many a listener has been advised from headquarters as to the best place to stand his loudspeaker for good results, and the articles in the "Technical Section of the B.B.C. year books are based largely on the type of inquiry made by listeners!"
This latest production of The Gramophone Company is somewhat of an experiment in one direction, although there is nothing of doubtful efficiency in its make-up and performance. The experiment is in regard to the price—12 guineas—which undoubtedly sounds far too low for a high-grade instrument having four valves and bearing the hall-mark of perfection bestowed by the name "H.M.V." As a matter of fact, the makers have a very good and sound reason for offering such amazing value. It is their intention that an instrument capable of giving the best possible reproduction should be within the reach of every household.

It need scarcely be pointed out that this latest set, which has only just become available to the public, upholds the high standards which have always been held by "H.M.V." products. It is, as the name suggests, a four-valve (plus rectifier) superheterodyne receiver, and can be obtained for payment from all 50-cycle A.C. mains supplies.

The Cabinet and Controls

This set is beautiful to look upon besides being pleasing to the ear. It is housed in a remarkably attractive modern—walnut cabinet which has been specially designed and made in the "H.M.V." factories to eliminate all resonance and "boom." The front is attractively veneered and has a square speaker opening which is in very good taste. There are four controls symmetrically arranged about a rectangular tuning scale opening. The scale is illuminated when the set is switched on and is marked off in wavelengths from 200 to 500 metres and from 900 to 2,000 metres; it can be altered by the volume control. The makers themselves were careful to observe that there would be no sudden "blast" when tuning past a powerful station; the wave changes are uniformly smooth and effective manner, the volume and tone controls being "graded" in such a form that it can be fitted almost exactly to suit all "taste" and every type of reproduction. All the controls are very accessible and work in a particularly smooth and effective manner, the volume and tone controls being "graded" in such a form that it can be fitted almost exactly to suit all "taste" and every type of reproduction.

A Modern Circuit

The circuit of the "Superhet Fourforty" is on very efficient and up-to-date lines, and comprises a non-radiating screen-grid frequency-changing valve having cathode coupling, a 125 kc variable-mu intermediate-frequency amplifier, a power-grid second detector, and power pentode output valve fed by a special L.F. transformer and giving an undistorted output of 11 watts. The rectifier for H.T. supply is a full-wave with an output of 325 volts at 120 milliamperes, which is obviously a very generous one for a four-valve set.

To ensure high-quality reproduction a new type of "H.M.V." energized moving-coil loud-speaker is employed, and this is mounted on an open baffle so that there is no wooden fret to act as an obstruction to the sound waves. Other special features of the receiver under review are: the fitting of an effective whistle suppressor; the circuit is so designed that there is no sudden "blast" when tuning past a powerful station; the set can, if desired, be operated in any room without the necessity for an aerial and earth; reproduction is not marred by the presence of images. These are just a few of the points which are very apparent and which are worthy of particular attention.

Tests of Standard Receivers

Our first test of the "Superhet Fourforty" was under rather unfavourable conditions, since the set was used without either aerial or earth some twelve miles from Brookmans Park. Despite such a handicap we found no difficulty whatever in bringing in no less than twenty stations at "programme" strength. The question of selectivity simply did not exist, and no transmission occupied more than a fraction of a division on the tuning scale. Production results from an "H.M.V." instrument—as near to perfection as possible under present conditions (and that is really saying a lot). The "Crampless" control was found most useful in obtaining the maximum pleasure from listening to foreign stations whose transmissions are not always of such high quality as those of our own stations. A commendable feature of the tone control was that it did not affect volume to a very marked degree, as is usually the case, and it was found remarkably well in every way. The volume control was equally useful and effective; it had to be made good use of when receiving a number of stations in order to prevent overloading, so the reader may judge what a high degree of amplification is afforded.

Crampless Controls

A point which should be stressed in regard to the "Superhet Fourforty" is that it is not appear to have the very slightest effect upon the quality, with a result that volume could be turned down to almost inaudibility without music sounding "thin" and lacking in "body." A feature of all the control knobs which is well worthy of mention is that they are "crampless," having been designed in conjunction with anatomical experts—this is surely a sign of the times and a point of importance. It should be mentioned in respect to the volume control that it was found to be really accurate.

After the rather unfair preliminary test we tried the set on a moderately good outside aerial and connected an earth lead. Results were truly astounding, and there was apparently no limit to the number of stations which could not only be received, but actually enjoyed for their entertainment value. In every case the quality was all that could be desired, and we could find no item upon which to criticise adversely. Every reader who intends to buy an up-to-date set of marvellous quality and at an almost unheard-of price should not fail to consider the merits of the "H.M.V." "Crampless" Fourforty. The set can be obtained for D.C. operation at 13 guineas, or as a complete and attractive radio-gramophone in console cabinet at 20 guineas (A.C.) or 21 guineas (D.C.).
GRID DECOUPLING—

A Number of Lesser-known Points in Respect of L.F. Amplifiers are Dealt With in this Article

The general subject of grid bias, automatic and otherwise, has been dealt with in these pages on more than one previous occasion, so it is not proposed to repeat any information which has been given before, but rather to touch upon points of a rather more specialized kind. The following notes have been prompted very largely by readers' queries and by incidents which have arisen in carrying out experimental work, and in designing various forms of L.F. amplifiers. My remarks may appear somewhat disjointed, because I shall attempt to cover as much ground as possible in reasonably few words. Moreover, I shall try to deal with all those points which have been known to puzzle readers whilst designing amplifiers and receivers for their own use.

Grid bias and grid decoupling are not always associated one with the other, but in most cases they are so closely bound up that they should be considered jointly; this is especially true in the case of many receivers where two or more L.F. amplifying stages are employed. In order to make this point quite clear, it might be well to commence by considering a battery-operated amplifier having a push-pull output stage something like that shown in Fig. 1. In this case a centre-tapped input transformer is employed and the negative G.B. connection is made to the centre tap of the secondary winding. It is known that the two valves in push-pull output stage are of similar types, however, excellent results can generally be obtained anywhere between 50,000 and 100,000 ohms and is not critical. If they are not alike there will be a loss in amplification and a danger of parasitic reactions which have just been produced, but it is equally satisfactory, and rather less expensive, to employ a single decoupling resistance only, this being incorporated in the G.B. negative lead at the point marked X. The resistance in this case should generally have a value between 100,000 ohms and 150,000 ohms. At this juncture I might refer to a query which came my way recently. An amateur had made up a Class B amplifier using two L.F. valves of low impedance, and these were connected after a correct Class B transformer. The arrangement should have functioned reasonably well, but it was found that it distorted terribly—why? Well, this particular constructor was well aware of the advisability of decoupling grid circuits, and he had inserted resistances in the grid leads of the two valves. In other words, he had done what has been advised above, and yet he was wrong. The explanation is that valves connected in Class B pass a comparatively high and widely-fluctuating grid current when functioning correctly, but if there is a high resistance in their grid circuits grid-current fluctuations are strongly opposed. This applies with equal force when a proper Class B valve is employed and is an exception to the general rule given above, and which should be followed in every case excepting that of Class B.

Fig. 1.—Showing how grid decoupling resistances are connected in the case of a battery-operated push-pull amplifier.

Fig. 2.—Grid decoupling resistances are very desirable when two valves are wired in parallel.

Fig. 3.—G.B. and decoupling resistances in a battery-operated output stage. R1 is for decoupling and works in conjunction with the electrolytic condenser C.

Fig. 4.—This shows grid-bias decoupling arrangements when two battery-operated L.F. valves are automatically biased.

Fig. 5.—This shows how grid-bias decoupling can be employed in the cathode of a detector in order to ensure correct "balance"; this is shown in Fig. 2. It might be argued that, there is no point in connecting two output valves in parallel these days because a greater output can be obtained by using a Class B. This is not quite true, though, because it is often wished to make use of two valves which are on hand without having to buy special transformers and a new Class B valve. Besides, parallel working is very satisfactory indeed when the output stage is preceded by a high-amplification L.F. valve and an efficient detector. Particularly this is true when the set is operated from an eliminator which is unsuitable for Class B purposes.

Q.P.P. and Class B

An arrangement similar to that shown in Fig. 1 is useful in the case of Q.P.P. (which, incidentally, looks like becoming very popular again in view of the new valves which have just been produced), but it is generally lie anywhere between 50,000 and 100,000 ohms and is not critical. Output Valves in Parallel

A precisely similar thing applies when two valves are connected in parallel to handle a greater output, and in this case grid decoupling is generally even more important. Provided that the valves are of similar types, however, excellent results can nearly always be obtained by including a fixed resistance in the grid circuit of each; this is shown in Fig. 2. It might be argued that, there is no point in connecting two output valves in parallel these days because a greater output can be obtained by using Class B. This is not quite true, though, because it is often wished to make use of two valves which are on hand without having to buy special transformers and a new Class B valve. Besides, parallel working is very satisfactory indeed when the output stage is preceded by a high-amplification L.F. valve and an efficient detector. Particularly this is true when the set is operated from an eliminator which is unsuitable for Class B purposes.

Automatic G.B. in Battery Sets

When automatic grid bias is used in a battery set, grid circuit decoupling is often extremely important, for if it is omitted...
AND GRID BIAS

By FRANK PRESTON

all kinds of troubles are likely to be experienced. The method of fixing a decoupling resistance in a set having a single H.T. transformer is given in Fig. 3, where the resistance in question is marked R.1, and the bias resistance, R.2. It will be seen that the decoupling resistance is inserted between the H.T. negative terminal and the G.B. terminal on the L.F. transformer, and also that a decoupling condenser is connected between the latter terminal and the earth line. The resistance (R.1) may have a value of about 50,000 ohms, whilst the condenser should preferably be of the electrolytic type having a capacity of about 20 to 50 mfd, and a working voltage of 20 or so. Notice the polarity of the condenser, and that the positive terminal goes to earth. When automatic bias is provided for two L.F. valves the arrangement will be something like that shown in Fig. 4. A single L.F. valve circuit is decoupled, but it would be sufficient to decouple one only in most instances unless automatic bias were also taken for an H.F. valve. At the same time it is slightly safer—from the point of view of perfect stability and good quality—to decouple both valves.

Biasing Indirectly-heated Valves

The method of applying automatic grid bias to indirectly-heated mains valves (either A.C. or D.C.) is slightly different from that shown in Figs. 3 and 4, because the bias resistance is included in the cathode lead as shown in Fig. 5. In this case the grid-bias voltage is that developed across R.2, and R.1 serves for decoupling in conjunction with the electrolytic condenser marked C. If decoupling were omitted, R.1 and C would not be used and the G.B. terminal on the L.F. transformer would be connected directly to the earth line. It should be mentioned that grid-bias decoupling is particularly useful in a mains set, not only on the score of L.F. stability, but also because it tends to remove any residual hum, especially if a really large-capacity electrolytic is employed. In practice it is nearly always worth while to use a condenser having a capacity of 100 mfd, or so when such a condenser can be obtained with a sufficiently high working voltage. It should be noticed that the condenser is “returned” direct to the cathode of the valve instead of to earth as one might think would be correct. The point in this is that there should be the least possible resistance to alternating currents between the actual cathode and the G.B. end of the transformer.

Decoupling in the Pick-up Circuit

As a further example of G.B. decoupling a circuit is given in Fig. 6 which shows a detector valve (with radio-gram. switch and pick-up connections) followed by two resistance-capacity coupled L.F. stages which feed into the loud-speaker through a choke-capacity feed system. This is a circuit which would be used for “quality” reproduction when a high-tension voltage of about 300 was available. Automatic grid bias is obtained for every valve by including a suitable resistance (R.2) in the cathode return lead, and every grid circuit is decoupled by means of a second resistance R.1. It is perhaps not very common practice to decouple the pick-up circuit, but it is certainly an excellent idea which makes for perfect stability, and it is one which should be tried when there are signs of slight L.F. oscillation when the pick-up is in use.

When Using a Directly-heated Output Valve

A somewhat different grid-bias arrangement has to be made when an output valve of the directly-heated type is employed in conjunction with others with indirectly-heated cathodes, and one very simple system is illustrated in Fig. 7. Here it is assumed that there is only a single heater winding provided on the mains transformer, and this has to supply the cathodes of both directly- and indirectly-heated valves. It will be seen that the bias is applied to the output valve by means of the usual resistance (R.2), but that this is connected between the centre point of a 30-chm potentiometer (P) in parallel with the filament and the main H.T. negative lead. A decoupling resistance is again used, and this time it is wired between the lower end of the grid-leak (G.L.) and the earth line, a condenser being connected as before.

An Important Point

Another very important point illustrated by this circuit, which is that the choke-capacity speaker-feed circuit is returned, not to the earth line, but to the centre point of the potentiometer. As a matter of fact, this applies to all circuits where an automatically-biased output valve feeds a speaker through a choke-capacity circuit, because if that circuit were returned to H.T. negative there would be a fairly serious loss of signal energy across the bias resistance, which would form a part of the total valve load. This point is very often overlooked, with a result that the maximum output of which the last valve is capable is not realized.

Another way of biasing a directly-heated output valve which is used in conjunction with other valves of the indirectly-heated type is shown in Fig. 8. This is very similar to the battery circuit shown in Fig. 1, and has the disadvantage that the bias resistance passes the total anode current of all the valves in use. The resistance must therefore be of a comparatively high value rating if overheating is to be avoided. Another objection is that if the anode current of preceding valves is varied over wide limits (such as would be the case when several variable-muf stages were included in the receiver) the bias voltage would be varied at the same time and this might lead to distortion.

Where separate heater windings are provided on the mains transformer there is no difficulty whatever in using a directly-heated output valve with others of the indirectly-heated type. Bias is obtained by inserting a suitable resistance between the centre tap of the winding which feeds the output valve and H.T. negative, as shown in Fig. 9.
Once Again We Take the Lead, this Time in Demonstrating that Low Price and Efficiency CAN be Combined in a Home-Constructed Receiver. Our Latest Set, Dealt With Here, is Designed to Cover the New Lucerne Wavelengths, It Costs Only 60', is Ultra-Selective, Backed by Our Guarantee, and has Ample Power Output

A MODERN SET FOR 60'-

The Price Problem
Our policy has been sincere, and we have not hesitated to spend many thousands of pounds to give effect to it. Quite naturally without guarantee. We felt that the home constructor was entitled to free advice and to the assurance that the receivers described in our pages would live up to our claims, and also he should be able to feel that he could build a receiver with the same confidence and assurance of service as he would obtain were he to purchase one of the better class of receivers. Notwithstanding the extremely low price at which it is possible to buy a receiver to-day, it is still necessary to pay a fair sum of money if satisfaction is to be obtained.

Cheap Receivers are Seldom Satisfactory
A large proportion of our correspondence is received from readers who complain in the bitterest of terms of their experiences with some of these cheap receivers, and from those who have failed to obtain the service to which they were really entitled from the manufacturers concerned. The policy of some of these manufacturers, we make bold to assert, is always to blame failure on the purchaser, and then to offer to service the receiver for a certain sum. Now we have taken the trouble to investigate some of the complaints of our readers on this score, and in every case we have found that no blame attaches to the reader concerned. In every case we have found that the set has been badly made, wrongly connected, has had components left out, has arrived with parts broken, has defective valves, and in a large majority of cases the receiver could not possibly have been put through any test before its despatch to the retailer.

This is a somewhat tragic state of affairs, but it is none the less true. We appreciate that price has a great appeal, and that readers may think in terms of price and to their sorrow consider the question of results and efficiency after the purchase, when it is too late to get their money back. Particularly is this
LOW PRICE AND EFFICIENCY COMBINED!

Although only a few components appear to be utilised, the results are in no way insignificant.

Use these parts for the LEADER and so make certain of excellent results.

One "Metaplex" Chassis, 12in. by 10in. with 12in. runners (Peto-Scott).
One Double-Gang Condenser, "Nugang" Type A.,00005 mfd. (C1 and C2) (Jackson Bros.).
Two "Universal" Screened Coils (Wearite).
One .00015 mfd. Differential Reaction Condenser (C5) (Graham Farish).
One .0002 mfd. Fixed Condenser, Type 665 (C4) (Dubilier).
One 1 mfd. Fixed Condenser, Type 9200/B.S. (C3) (Dubilier).
One .2 mfd. Tubular Fixed Condenser (C6) (Graham Farish).
One "Niciet" 5:1 L.F. Transformer (Varley).
One "Junior" On-off Switches, Type S.38 (Bolgin).
One Grid Bias Battery Clip Type No. 2 (Bulgin).
One Fuse Holder and Fuse Bolt, Type F5 (Bolgin).
One .2 mfd. Tubular Fixed Condenser (C6) (Graham Farish).
Two Terminal Socket Strips, one marked "A" and "E" (Duxbelin).
Two "Junior" On-off Switches, Type B. (Bolgin).
Six Solid Plugs (for use with terminal strips) (Clix).
Three Component Brackets (two long and one short) (British Radio-Scott).
Three Valves: one S.G.215; one 210 Det., and one 725P. (Cassor).
One High-Tension Battery (Lissen).
One 9volt G.B. Battery (Lissen).
One 2volt Accumulator (Lissen).
One "Junior" On-off Switches (Bolgin).

Another view of the Leader ready for the valves and batteries to be connected.

The Circuit
As was mentioned in the preliminary notes last week, circuit simplicity is the keynote, and as is so often the case (in wireless in particular) the simplest arrangement is conducive to the best results. Thus we have utilised a screen-grid valve of the ordinary type for H.F. amplification. Tuning has been accomplished by ordinary air-core coils in preference to those of the iron-cored type, and although selectivity would naturally have been higher with the latter type of coil, the principal consideration here was the accommodation of coils designed since the Lucerne Plan was put into effect. The very best may therefore be obtained from the reorganized wavelengths, and it will be noticed that the tuning range extends down to 150 metres.

(Continued overleaf)
TONE CONTROL

THERE are many receivers in use to-day which, possess what is known as a tone control, but in many cases this term is erroneously applied. For instance, practically every circuit which employs a pentode output valve gives undue prominence to the higher notes in the musical scale and to prevent a certain amount of shrillness it is customary to connect a fixed condenser with a resistance in series across the output circuit of the pentode. This is known as a tone control, but it does not actually control tone. What it does do, however, is to limit the high notes and thus enable a better balance of reproduction to be obtained. It has absolutely no effect on the lower notes and cannot, for instance, adjust the bass, or balance up the strength of the reproduction of both treble and bass.

Tone control, to live up to its name, should enable the listener to adjust the reproduction so that any required degree of balance of tone is obtained, and the control should permit the bass to be strengthened, the treble notes attenuated, or the upper notes strengthened at will, and should at the same time, permit this to be carried out in a perfectly smooth manner, with one control which would not have to be turned through more than one complete revolution. The Multitone tone control transformer is one example of a complete tone control, and is designed for the purpose by a firm who have specialized in this type of work. The other four terminals on the transformers are connected in the orthodox manner. The high resistance permits the reproduction to be varied over the complete range, giving reproduction which at one extreme is extremely deep, and at the other a high-pitched tone. Obviously, it is seldom normally necessary to carry the control to these extremes, but between them there is a complete variation which enables the reproduction to be adjusted so that the deficiencies of the receiver, the particular characteristics of the loud-speaker, or the personal prejudices of the listener may all be taken into account and the resultant reproduction will be perfectly balanced. The inventor of this system, Mr. Poliakoff, has spent many years in investigation, sound research, and, in addition to this special tone control transformer, he has also carried out some interesting experiments with regard to assisting the deaf to hear the wireless programmes, and the result of his experiments is embodied in a receiver which is being produced by Messrs. Multitone. This receiver is a five-valve one; in two models, one a five-valve self-contained battery receiver which requires no aerial or earth. It costs 20 guineas. The other model is for A.C. mains operation, and costs 24 guineas. In both of these receivers the circuit arrangements permit of the use of the apparatus in the standard manner, a loud-speaker being fitted to reproduce the programmes in the ordinary way. In addition, however, a special attachment is provided, at the inclusive cost, which permits the deaf to listen at any required degree of volume to suit their particular comfort, without, however, affecting the volume required by others from the ordinary loud-speaker. In addition, the wireless receiver may be used by the deaf person to enable him to hear the conversations of friends, etc.
**PILOT AUTHOR KIT**

**EXACT TO SPECIFICATION**

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**AVOMONOR TEST METER.**

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...from the Range of WEARITE H.F. CHOKEs

The H.F.P.J. CHoke (as illustrated)
Effective impedance 100-2,000 metres
Self-capacity 2 m.mfd.
Inductance 220,000 mh.
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The H.F.P.J. 2/-

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Self-capacity 45 m.mfd.
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The H.F.P. CHoke
Similar in characteristics as the H.F.P.A. but without Pigtail Connection... 3/6

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THE BEGINNER'S SUPPLEMENT

THE TRANSFORMER SIMPLY EXPLAINED.

This Article Explains in a Clear and Interesting Manner the Theory of the Transformer and Describes the Construction and Use of the Various Types.

If a wire carrying a fluctuating electric current is placed near another wire it will create an electric current in the second wire in spite of the fact that there is no electrical connection between the two wires. This fact is illustrated in Fig. 1. A wire is connected to a battery and a switch as shown, while another wire, which is placed near the first, is joined to a sensitive galvanometer (current-measuring instrument). As soon as the switch is closed current from the battery commences to flow through this wire which is connected to it. In a fraction of a second the current rises from nothing to its maximum figure, after which it continues to flow at a steady rate until the circuit is broken by opening the switch again, when, of course, it ceases as suddenly as it commenced.

The Principle of Induction

Now if you watch the galvanometer while you make and break the connection between the first wire and the battery, you will notice that the pointer of the galvanometer gives a "kick" each time the switch is opened or closed, thus showing that at those moments a current also flows through the second wire.

This experiment is a simple demonstration of the principle of induction and is the principle underlying all transformers. The reason why the current flowing through the one wire can produce a current in the other, is because whenever an electric current flows through a wire it produces what is called a magnetic field round the wire; that is to say, the wire exhibits properties similar to those of a magnet. Now, so long as the current flowing through the wires remains steady, the strength of the magnetic field will also remain constant; but if the current varies in strength, then, naturally, the intensity of the magnetic field will also vary. It is this variation in the strength of the magnetic field which is able to produce an electric current in any other wire which comes within its influence.

Lines of Force

Fig. 2 clearly shows how the magnetic field extends round a wire when a current is passing through it. The field is represented by lines of force, which are, naturally, closest together (showing the greatest intensity of the field) nearest to the wire. At the instant represented the current is flowing at a steady rate. Should the current suddenly increase, however, then the lines of force will expand outwards, followed by others which are still closer together until the field becomes correspondingly weaker, as shown in Fig. 3. A decrease in current will have the opposite effect, and the lines of force will contract inwards until the field becomes correspondingly stronger, as shown in Fig. 4. Now suppose another wire be placed near this wire, say, at the point X, you can see clearly that a rise and fall in the current through the first wire, as shown in the three diagrams, will mean that the lines of force, in moving outwards and inwards, will pass through the second wire. In doing this they create a current in the second wire. When they move outwards they produce a current in one direction, and when they move inwards they produce a current in the opposite direction.

It should be clearly understood that no current is produced in the second wire unless the current through the first is flowing steadily. It is only when it varies and so causes a movement of the surrounding lines of force that a current is produced in the second wire. This explains why, in the experiment just described, there was no movement of the galvanometer needle, except when the current through the first wire was started or stopped; that is, at the moments when the lines of force expanded outwards, and in doing so, passed through the second wire, and again when they "collapsed" inwards and once more passed through the wire.

However, if instead of passing a steady direct current through the first wire and making and breaking the circuit with a switch, we use one which fluctuates all the time, such as an alternating current, then a similar fluctuating current will be produced in the other wire.

(Continued overleaf)
A Simple Transformer

Now the magnetic field round a wire can be greatly intensified by making the wire into a coil, as in Fig. 5. Here you see how the lines of force, surrounding one turn, link up with those surrounding the next, and so produce an intense magnetic field whose centre or axis is down the middle of the coil.

One of the simplest forms of transformer consists of such a coil with another coil of wire placed inside it, as in Fig. 6. If a fluctuating electric current is passed through the first, or “primary,” coil, then a current will also be obtainable from the “secondary.”

Now the current through the primary bears definite relationship to that obtained from the secondary, and this relationship is dependent on the number of turns of wire in the primary coil as compared with that in the secondary coil. Thus, if there are ten times as many turns in the secondary as in the primary, then the voltage (or pressure) of the current from the secondary will be ten times that of the primary. Conversely, if there are less turns in the secondary than in the primary, say, half as many, then the voltage of the secondary current will be less than that of the primary—in this case, half the voltage.

Step-up and Step-down Transformers

A transformer having more secondary than primary turns is called a step-up transformer, while one having less secondary than primary turns is known as a step-down transformer. It must not be concluded from the foregoing that a transformer is a miraculous appliance which will give any desired increase in the power of a current by merely using sufficient turns of wire for the secondary. It is true, of course, that the voltage can be stepped up to almost any desired figure by this means, but this does not mean that the transformer is a creator of power or energy, for every increase of pressure (voltage) is accompanied by a corresponding decrease of current (amperage).

Step-up and Step-down Transformers

If the secondary turns are increased to 10 times the number of primary turns, say, to 100 turns, then the current will be reduced to 0.1 amp. On the other hand, using less turns on the secondary will give a decrease in voltage, but an increase in amperage. Thus, 100 turns on the secondary will give 5 volts, but a current of 16 amps. The point is that the power given out by the secondary in each case equals that put into the primary, namely, 80 watts (vols x amps.).

Of course, these figures are those that would apply in the case of a perfect transformer, but since no transformer can be 100 per cent. efficient the power output is always slightly less than the input.

The Object of the Iron Core

To the radio enthusiast the most familiar type of transformer is the L.F. (low-frequency) intervalve transformer. This instrument has primary and secondary coils, but it is also fitted with an iron core.

A simple iron core is shown in Fig. 7, and consists of an iron rod pushed through the middle of the coils.

Its object is to concentrate the magnetic lines of force round the coils so that the maximum number of lines cuts each turn of the secondary winding. The type of core used in an L.F. transformer is, however, more elaborate and completely surrounds the coils as in Fig. 8. The concentration of the magnetic lines of force within the core is shown by the dotted lines.

The core is not made of solid iron, but is composed of thin layers or laminations. This is to prevent the formation of electric currents called “eddy” currents which would otherwise circulate within the iron itself, due to the magnetic field. Such currents are merely a waste of energy and represent a loss in the efficiency of the transformer. Details of how the core of an L.F. transformer is built up are given in Fig. 9.

The coils of the transformer consist of many thousands of turns of insulated wire wound on a fibre bobbin. Usually one winding is wound on first with a layer of Empire tape or waxed paper as an insulating covering round it, and then the other layer is wound on top. Sometimes a layer of paper is also used between each layer of wire, apart from the layer separating the two windings.

Intervalve Transformers

L.F. intervalve transformers are usually of the step-up type and are used to...
Renowned for their complete efficiency and advanced design—J.B. Precision Instruments. Used by all leading set designers. To ensure the very best results with your "Leader Three" follow the solus specification of the designer:

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Low Prices. Tinned soldering tags or screw terminals for same price. Guaranteed for 12 months.
PRACTICAL WIRELESS

SOUND ENERGY

The Acoustic Output of a Gramophone

By F. W. LANCHESTER

In approaching this subject it is necessary to adopt certain conventions. From the standpoint of the record we take as a basis the record of a pure tone, in which the form of the engraved needle track is a sine curve. The second is that we assume (from inspection of a number of records) a maximum permissible lateral force. The third is that we take some definite velocity \( V \) as representing the velocity of the record under the needle point; actually this varies from 4 ft./sec. at the periphery of a twelve-inch record to about 2 ft./sec. at the centre. We shall take a mean value \( V = 3 \) ft./sec. The fourth is that the amplitude of movement of the needle is maximal, namely, assumed \( = 0.005 \) in. Thus, the fifth is that the frequency is consistent with the foregoing; thus:

\[ f = \text{frequency} \]
\[ V = \text{velocity of record under the needle point} \]
\[ l = \text{the length of an undulation} = \frac{2\pi}{f} \text{inches} \]
\[ \theta = \text{max. angle of track} \]
\[ \theta = \frac{l}{V} \]
\[ f = \frac{V}{2\pi} = 3 \times 0.166 = 380 \text{cycles per second} \]

That is to say, the frequency 380 is that which accords with the given values of \( V \) and \( \theta \).

There are two lines of approach open. The first is that we may compute the maximum permissible lateral force from the needle, the limit being reached when the needle jumps the track. This will give an upper limit. The second line of approach is to base our calculation on the amplitude of the acoustic wave in the throat of the horn, using the equation:

\[ \text{Watts} = \frac{(af)^2}{8} \]

For the first we require to know the limiting lateral force the needle can exert without leaving the track. By a simple experiment in which a weight is supported on three needle points on the face of a record, and the record tilted till the needles no longer hold, it is established a needle point will sustain a lateral force at least equal to its dead load; thus it is usually possible to tilt the record to 45 deg. or over before the needles lose their hold, for the present investigation equality will be assumed. A fair average figure for the weight borne by the needle is 4 oz., so we shall assume 4 oz. or 0.25 lb. as the maximum permissible lateral force.

According to the data already given, the maximum lateral velocity of the needle point is \( = V \tan \theta = 36 \times 0.166 = 6 \text{in./sec.} \).

The downward velocity of the needle is \( 0.25 \times 32.2 = 8.1 \text{in./sec.} \). That is the rate of doing work on the steepest part of the sine curve. The mean value is half this \( = 0.0625 \text{ ft. lbs./sec.} \).

Converting this into electrical units, the limiting value of the power output is:

\[ \text{Power} = \frac{(af)^2}{8} = 50 \text{milliwatts.} \]

This is well within the limiting value 84 milliwatts determined by the other method of computation.

On test the instrument was found to carry its load quite comfortably, and in order to explore the possibilities a new sound-box with a larger diameter piston was fitted. Before discussing this it is of interest to check the foregoing on the basis of diaphragm pressure.

Now \( af = 12 \), therefore pressure = \( \frac{12}{210} = 0.057 \text{ pounds per sq. in.} \) and pressure force on piston = \( 0.057 \times 3.8 = 0.216 \text{ pounds.} \) This gives: \( 2.3 \times 0.210 = 0.483 \text{ pounds lateral force on needle point, or well within the permissible value.} \)

The data relating to the second sound-box are as follows:

**Fig. 2.—1 is an acoustic duct, leading to 2, Duct in laser arm forming first part of acoustic tube. 3, Main casing. 4, Conical guard (perforated metal) held by 5a, Screwed ring. 5, Conical diaphragm or "piston." 6, Conical piston extension. 7, Piston rod, connecting to 8, Needle holder, and 9, Needle. 10, Pithon skirt, supported by 11, India-rubber rolling ring or obturator.**

**Fig. 3.—1 is a duct, leading to 2, Acoustic tube, leading to 3, Taper section, communicating with 4, Final flare, or horn. 5, Conical diaphragm or piston. 6, Piston extension. 7 and 8 are Ligatures forming centring means. 9, Field gap with moving coil within. 10, Electro magnet (core). 11, Electro magnet winding.**

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BEGINNER'S SUPPLEMENT

(Continued from page 1102)

SOUND ENERGY

(Continued from page 1103)

Do you realize how much time is wasted if your Speaker is not correctly matched to the output value of the transformer? With any Set, the W.B. MICROLODE model P.M.4A gives amazing volume, because by a simple switch adjustment you can permanently match the transformer to the speaker, no matter which of the hundred different output values can be put out by the transformer. The speaker is responsible for the volume, and the transformer does the work. A revelation awaits the listener who has never used a transformer.

One such transformer is the Mains Transformer, as used by all the best manufacturers. It is designed to give the best sound quality and to save on the expense of wiring. The transformer must be selected to suit the power supply, as well as the service of the house. It is a common practice to install a transformer of 20VA with a 100VA receiver, and of 100VA with a 300VA receiver. The transformer should be selected for the service of the house.

(1) Maximum possible estimate of power based on 4-oz. load on the needle point on assumption that ideal speaker may not exceed the dead load ... 84

(2) Author's special design of "sound box" with acoustic tube and 2.25in. piston 50

SECONDARY WINDINGS are each connected to the grid of one of the valves, while the third point or "centre tapping" is connected to grid ground. The usual way is by using the valves in the usual manner twice the signal strength can be obtained.

The largest winding supplies the H.T. mains into one of suitably voltage and amperage for working the receiver. The stages of the transformer are each tested, and using the wave-form of the convertor as a basis, it was easy to see what happens. When the theoretical figures could be realized, a good modern mechanical gramophone might be expected to give a power output in the region of 20 milliatts, which allowance is made for losses not taken into account in the calculation; the author would propose to credit a higher figure than 10 milliatts as that actually reached.

Comparison with a low-power radio or electrical gramophone, having a power valve with an A.C. output of say, 150 to 180 milliatts, would suggest that either the same amplitude of the drum or the efficiency usually given for the moving coil speaker on the basis of laboratory measurement is low. Both by theory and experiment the efficiency of a moving-coil speaker of the open cone type is not more than 5 percent. That is why the subject awaits further investigation.

Mains Transformers

Apart from the coupling valves, one of the most important uses of transformers in receiving sets is that of transforming the current supplied by the electric light mains into one of suitable voltage and amperage for working the receiver. Mains transformers are very similar to transformers, but are larger. They usually have two or more windings instead of two or three secondary windings. The largest winding supplies the H.T. mains to the valve. The next one has fewer turns of heavier gauge wire, and supplies a comparatively large current at low voltage for heating the filament of the valve, while a third winding is fitted when a valve rectifier is used. It provides the current for the filament of the rectifier.

Other iron-cored transformers are used to connect the last valve in a receiver to the loud-speaker. Usually the transformer is fitted to the speaker itself. It transforms the high voltage (but small current) from the transformer into a lower voltage, but larger current suitable for working the loud-speaker.

SOUND ENERGY

(Continued from page 1103)

Milliatts

(3) Ditto, ditto with 3-in. piston and 6 oz. dead weight, certainly not realized ... 250

(4) Corrected value for the foregoing based on highest possible lateral force on needle ... 60

(5) Computation of H.M.V. "Exhibition" sound-box ... 22

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TELEVISION SWITCHING SYSTEMS

In this Article a Number of Methods of Switching Over from the Loud-speaker to the Television Receiver are Described

**Series Feed**

One of the simplest methods of connecting a disc-type machine is that shown in Fig. 1, where the neon and synchronizing coils are wired in series between the anode of the output valve and high-tension positive. There is a very appreciable voltage drop across the neon and therefore it becomes necessary to provide an H.T. voltage well in excess of that actually required by the valve. Thus, if a switch were arranged simply to change over from the primary winding of the loud-speaker input transformer to the machine, an excessive voltage would be applied to the anode of the output valve, probably with disastrous results.

In the case of a mains-operated receiver this difficulty can be overcome most conveniently by including a resistance in series with the speaker transformer, as shown at R. Clearly, the value of the resistance must be such that the same anode voltage is applied to the valve whether the speaker or apparatus is in circuit. In other words, the value of the resistance must be approximately equal to the resistance of the neon; the resistance of the synchronizing coils can be ignored since it will not be very much different from that of the primary winding of the speaker transformer. A suitable value for the resistance is about 8,000 ohms, and such a value will nearly always produce the required effect. But if a high-resistance voltmeter is available the exact value can be found quite easily by using a variable resistance of about 15,000 ohms for R. First of all, the voltage between the anode and cathode of the output valve can be measured with the machine in circuit, after which the resistance can be adjusted until the same reading is obtained when the switch is turned to the "speaker" position.

**A Pentode Precaution**

There is another point to bear in mind when the output valve is of the pentode type; this is that the set should always be switched off before changing over from speaker to machine, or vice versa. The reason for this is that when the anode load is suddenly removed from a pentode, and when the suppressor grid is still positively biased, a high-voltage surge occurs which is often sufficient to ruin the valve. Of course, a multiple-switch could be employed that would automatically break the mains circuit when changing over, but the complication involved would not generally be justified.

Fig. 2 shows a similar arrangement to that already dealt with, but in respect to a battery-operated receiver where a separate voltage source is employed to supply the necessary "striking" voltage for the neon. A two-pole Q.M.B. switch is employed in this case, so that the normal H.T. voltage is applied when the speaker is in use, the additional voltage only coming into circuit on television. When the output valve is a pentode the same rule applies as was previously referred to.

**Switching with Transformer Output**

An entirely different method of switching is called for when the apparatus is fed through a 1:1 output transformer and the receiver is mains operated. Upon switching over to the speaker the high-tension load is reduced by the amount of current consumed by the neon, and therefore the supply voltage is increased; and, assuming an H.T. voltage of approximately 250, the load would be reduced by as much as some 25 milliamperes, which is fairly considerable in proportion to the output of, say, a Class A rectifier. In order to maintain a uniform load a shunt resistance can be placed across the H.T. supply when the speaker is in use, and the method of providing for this is shown in Fig. 3. Here, the resistance R is in parallel with the H.T. supply during the time the speaker is in circuit. It will be obvious that R must have the same value as the neon and synchronizing coils, so that approximately 8,000 to 10,000 ohms will again be correct.

(Continued overleaf)
As before, it might be desirable to employ a variable resistance and to find the correct setting under working conditions. This could be done by measuring the anode voltage, as before, but a greater degree of accuracy can be obtained by measuring the total anode current with and without the apparatus in circuit. The resistance should then be adjusted so that the current reading is the same in both cases. The rule in regard to pentodes again applies, of course.

Switching in Push-pull Circuits

When a push-pull output circuit is employed, the system of switching over from speaker to machine is not greatly different from that just dealt with, and the connections are shown in Fig. 4. In this case it is assumed that a choke-capacity output feed is employed, whilst it can be seen that a double-pole change-over switch is used. When the switch is in the "television" position, the neon and synchronizing coils are fed with audio-frequency currents through the two fixed condensers, and the "striking" voltage is obtained from the normal high-tension supply. Changing over to the "speaker" position connects the loud-speaker to the two condensers and also brings the "balancing" resistance R into circuit between H.T. positive and negative, so maintaining a uniform load on the H.T. source. The method of determining the correct value for the resistance is precisely the same as was previously explained.

In the case of a battery-operated receiver, it will be obvious that the resistance is not required, and, in fact, must not be used, since it would merely cause a waste of current, and produce no good effect.

When a Separate Valve is Used for Synchronizing

The switching arrangement becomes somewhat different when a separate synchronizing valve is employed, due to the fact that there are more circuits to consider. Fig. 5 shows one of the simplest arrangements, and this is entirely suitable for use with a receiver where the high-tension supply is from 350 to 500 volts. The circuit can more easily be followed if it is compared with Fig. 1, of which it is a rather more complicated form. Only a single-pole switch is employed. It is evident, for instance, that when the speaker is connected in circuit the voltage dropping resistance R1 is in series with the primary winding of the transformer, whilst the shunt resistance R3 absorbs a certain amount of current from the H.T. supply. The value of R1 is similar to that of R in Fig. 1; in other words, it is equal to the resistance of the neon. R3 must pass the same amount of current as the synchronizing valve V2 and the synchronizing coils. Its resistance can, therefore, be found by calculation when the normal anode current passed by V2 is known, or it can be found by inserting a milliammeter in the H.T. positive or negative lead and adjusting the value until the total current load is the same when the speaker is in circuit as when the apparatus is switched on. The resistance marked R2 is for the purpose of reducing the H.T. voltage to the correct value required by the synchronizing valve; the value can be found by calculation.

The arrangement shown is only suitable for use with a mains receiver, and in the case of a battery set R3 would not be needed, and it would be more economical to provide for the filament circuit of the synchronizing valve V2 to be "broken" when the loud-speaker was in use. Thus, a two-pole change-over switch would be required and should be connected as shown in Fig. 6.

It might appear that a similar arrangement would also be better even with a mains set, but there is a little difficulty which would have to be contended with. When the heater circuit was "broken" the load on the L.T. winding of the transformer would be reduced, so that there might be some danger of applying an excessive voltage to the heaters of the other valves. It is true that this difficulty would only appear when the "regulation" of the mains transformer was not all that it might be, but where any doubt exists it is always wise to "play for safety."

Another little point which should be considered in dealing with the arrangement shown in Fig. 5 is that if a pentode valve is used for synchronizing, the H.T. supply to its suppressor grid should be disconnected at the same time as its anode voltage; this can easily be provided for by employing the connections shown in broken lines.
Many have voiced the suggestion that it should be possible to record the television signals broadcast by the B.B.C. on some permanent or semi-permanent device which could be used to furnish images in the home at any convenient time. In other words, why is it not possible to duplicate for vision what the gramophone has done for sound?

It will therefore come as a surprise to most readers to learn that the principles and practice of such a method were established about six years ago, Baird being the particular pioneer in the work. Unfortunately, the scheme, while practicable, is full of difficulties, as I will explain after I have dealt with the arrangement.

Making the Record

Our first concern, then, is the making of the record. From details which have been furnished in earlier issues of this journal the reader will remember that the subject or object to be transmitted is scanned by a regular and rapidly-moving spot of light, the reflections from the areas illuminated being made to operate photo-electric cells. This produces current effects which are proportional to the varying light effects, and being minute in character they are amplified in the normal way. These are the signals which are broadcast, but for our "bottled" images (phonovision is the name which has been applied to this section of television work) we vary the process slightly. This will be made clear by a reference to Fig. 1. The scanning device (either a

Fig. 1.—Pictorially illustrating how a record of a television transmission can be made in the studio.

mirror-drum or disc, the latter being shown in Fig. 1 for simplicity) is driven from a motor which in turn is coupled to a turntable through reduction gearing. On this turntable is placed the blank record, and the vision signals, after amplification, are passed to a recording or cutting needle run in the plain record grooves. This makes indentations corresponding to the vision signals, and if it is desired to make the transmission a dual one, then a synchronized record can also be made of the accompanying sound produced by the subject before the transmitter. An alternative to this is to have a double recording track made on one record, one recording needle handling the sound and a second one the vision.

Fig. 2.—A dummy's head acting as the subject for making a test phonovision record, this latter process being visible in the foreground.

Playing the Record

A completed vision record made in this fashion is illustrated in Fig. 3, and differs from an ordinary sound record by having a characteristic wavy appearance. At the receiving end the process is reversed and this will be seen by studying Fig. 4. As before, one motor drives the scanning device (mirror-drum or disc) and turntable through a reduction worm gearing of exactly the same ratio as that employed (Continued overleaf)
by the transmitter (this should be marked on the record face itself to prevent error). An electrical pick-up "plays" on the record in standard fashion and the resultant signals, after amplification, pass to the light source and modulate it so that the images can be built up with the aid of the scanning device, which in Fig. 4 is again shown as a disc. The means adopted for reproducing the accompanying sound (if any) will depend upon whether a double-track record is used or one separately synchronized.

Fig. 5 represents some of the original experimental apparatus used in "playing back" these Phonovision records. A particularly interesting illustration is that of Fig. 6, for it depicts how the resultant television images appear when built up from "canned" signals, the section of the receiver shown, of course, being one of many types which can be made up to suit individual taste.

Difficulties

Now why are supplies of such records, which would prove a boon to the experimenter, not available for general use? Well, first of all, one of the prime objects in employing these records is to test out home-constructed television apparatus at one's own convenience without being dependent on the B.B.C. It is, therefore, essential that the vision records were made, they have not reached the stage of perfection demanded by television signals. Added to this, we have the fact that if an ordinary pick-up is employed to play back the record when carrying out tests at home, the results will fall short of those required for impartial investigation. The pick-up may be quite satisfactory for sound work, but the imperfections are not evident when "looked at" on the television screen. These, then, are the prime reasons why, at the moment, records are not made for re-sale, but this should not in any way prevent anyone from carrying out their own experiments, provided they appreciate that the results to be expected will not live up to "one hundred per cent."

Home Recording

I have done this work several times myself, using one or two of the home-recording devices which have been on the market from time to time. The first criterion is to use a good low-frequency amplifier in conjunction with the recorder, preferably one embodying resistance-capacity coupling with low gain per valve stage. This same amplifier can also serve as the television signal amplifier when playing back the records after they have been mechanically indented in the disc.

A suggested circuit is given in Fig. 7, the method of connecting the amplified signals from the output valve naturally depending upon the type and nature of the recording pick-up, but this information is always furnished by the maker. A variable-mu high-frequency pentode stage will obviously feed the received television signals into this amplifier. Although the arrangement of the unit required will be dependent upon the average reception conditions of the London National station, in the district in which the experiments are being conducted, as a general rule, within the service area of this Brookmans Park station, one variable-mu high-frequency pentode stage, followed by an anode bend detector valve, without any form of reaction, will be suitable.

Whereas, in the case of studio-produced records, there is complete control over the synchronizing, as was indicated earlier in the article, when reliance has to be placed on the broadcast signals to be "bottled" for further use, difficulties creep in. Turntable speed must be dead steady, both when records and signal are played back, and even then, in the case of the latter an extra stage of low-frequency amplification, for feeding the superimposed synchronizing signals is advisable.
March 3rd, 1934

PRACTICAL WIRELESS

WILL THE PENTAGRID REVOLUTIONIZE THE SUPERHET?

(Continued from page 1078)

a section of which has a five miles per hour speed limit; even if the road is the same width throughout its length it will be obvious that the speed limit portion will have more vehicles per yard upon it than any other part where speed is normal.

A very brief consideration will show that this theory is quite untenable: electrons will pass through the grid “OG” at a very fast rate, and as soon as they enter the field of the positively grid Si they will accelerate to a speed of at least 25,000 miles per second due to the terrific pull of Si. This being so, how can the electrons possibly slow down? There is absolutely nothing to cause it; even the grid “TG” is positive, what little there is due to the pull of Si.

This will accelerate to a speed of at least 25,000 miles per second, which is the maximum speed that the electron reaches in a valve. The true explanation of this valve runs quite rational lines and is very easy to follow. Fig. 1 shows the electrodes referred to while Fig. 2 shows how such a valve could be constructed. Reference to the drawing will show that there are five grids and the heater, cathode and anode.

The heater “H” performs the usual function of warming the cathode “C.” Next comes the second grid “OG,” which is the maximum speed that the second grid “OG” can accelerate the electrons to.

The working may be more readily understood if the incoming signal is a carrier wave only, and it is visualized in the following manner. The incoming signal swings up and down the characteristic curve of the valve, and at another speed the oscillator alternately makes the characteristic curve steep and flat. The anode current is controlled by the signal, but the degree of control is decided by the oscillator grid.

It is now evident how the pentagrid mixes the two waveforms by means of the electron stream that is the only thing common to both portions of the valve.

Turn to pages ii (cover) and 1073 for Special Offer relating to our famous Tool Kits.

Graham Farish—products for the ‘Leader Three’

Graham Farish—the LEADING Components, are specified for the “Leader 3”—the more you use the better the results and the more money you’ll save. Every Graham Farish product is guaranteed to be efficiency itself. Write for full catalogue containing many interesting new items.

LITLOS DIFFERENTIAL CONDENSER

A highly efficient condenser, similar in general construction to the Lit-Los Variable type, but having two sets of fixed vanes, enabling the user to engage differentially between them. The terminals are somewhat differently disposed, but otherwise the instrument is identical in construction with the Lit-Los and Reaction types. All capacities up to .0005 mfd. (500 cems.)

PRICE

DISC CHOKE . . . . 2/-
TUBULAR CONDENSERS . . . . 1/-
SLOT AERIAL FILTER . . . . 2/-

Advertisement of GRAHAM FARISH LTD., Masons Hill, Bromley, Kent.
We go to a lot of trouble to make the contents of Practical Wireless understandible to the beginner and expert alike. Now and again, however, we receive a letter from a reader who, without investigation of our information, jumps to conclusions. I had one the other day—Ah! here it is, from W. R. Cuming, of Dumfries. "The theoretical diagram of the Reader's Wrinkle," p. 988 of February 10th issue, entitled 'An Electric Bell Relay'. It is wrong, for several reasons. Obviously if the theoretical diagram were used, it would be possible to arrange the bell battery in such a way that the resonances of the receiver might be either in parallel with, or in opposition to, the receiver. In the first case, a premature discharge of the bell battery would occur; and in the second case, damage might be done to the receiver battery, since the resistance of such a bell circuit is normally negligible. The practical circuit then correct only up to a point, as the contacts will chatter, unless the frequency of the trembler is normally such that it vibrates synchronously with that of the bell. The result would be the reverse of the quietness suggested, which, it is stated, would allow the bell to be heard. A far simpler, cheaper, and more effective scheme is to run a lead from the bell circuit near the aerial terminal through a small fixed or adjustable condenser, having a value in the vicinity of .0001 mfd. to .0001 mfd., when it is usually possible to hear the 'Burring' note above the loudest passages of music. This latter method is well known and is very effective. With regard to 'A New Use for Old Transformers,' the secondary of one of the transformers is wired in opposition to the primary of the receiver, or if this does not produce a loud enough warning note for the speaker, then the lead may be connected to the aerial terminal through a small fixed or adjustable condenser, having a value in the vicinity of .0001 mfd. to .0001 mfd., when it is usually possible to hear the 'Burring' note above the loudest passages of music. This latter method is well known and is very effective.

It seems necessary to point out to my critic that the theoretical and the practical circuits, as well as the text relating to this wrinkle, are quite correct and in order, but, as he is apparently unable to understand the scheme, may I say that he is quite wrong.

Finally, no mention is made of a bell battery, simply because such is not required. Instead, the Low Tension accumulator is employed in the bell-wiring system, and if the circuit is examined it will be found that the customary make-and-break is not employed as in the usual bell system. Instead, the bell magnets are wired in series with the push, bell and accumulator. This means that when the push is operated, current will flow through the magnet system and the armature will be attracted and held in contact with the poles of the magnet. The accumulator is fed to the valves of the receiver, via the armature and the contact-breaker, which means that in the position of rest current may flow, and the switch on the receiver will enable the circuit to be broken at will.

When, however, the armature is attracted to the magnets this current is broken, and therefore, as stated in the text, when anyone presses the bell push the set is switched off. If the striker is left on the armature this would give a blow on the bell gong as the set was disconnected, and although no continuous ringing of the bell is obtained this is unnecessary, as warning that someone is ringing the bell is obtained by the cessation of signals from the loud-speaker.

With regard to the second criticism, this reader may not know that transformers are capable of carrying quite a fair amount of current through the secondary winding. I have had some tests made in our laboratories and I give below the results of these tests:

Transformer No. 1 (5/6 List Price). Secondary resistance 8,000 ohms. At 12 m/A temperature rise only just perceptible. At 30 m/A temperature did not exceed 80 degrees C. after one hour's use, and showed no signs of breaking down.

Transformer No. 2 (30/- List Price). Secondary resistance 32,500 ohms. At 12 m/A temperature rise appreciable but
no ill effects apparent after one hour's use, the sealing compound remaining set and the taping round the windings remaining unaltered in appearance. At 30 m/A breakdown occurred after 15 minutes.

It is obvious that the above treatments are absurd, as in the first case the voltage drop at 30 m/A would be 240 volts, and this obviously prevents the average user from applying sufficient H.T. to the output valve to draw this magnitude of current. It is safe in this case, therefore, to adopt the scheme of connecting the two transformers in series as the total voltage of 240 volts would be restricted to a safe figure. Incidentally the output valve of the average battery receiver does not pass current which in any way approaches this figure.

In the second case, 30m/A at 32,500 ohms gives a voltage drop of over 900 volts, and we cannot visualize any listener connecting this transformer in the anode of a Marconi magnet of equal weight. The demand for these reputed " slack " months has repercussions throughout various trades in Great Britain. The buying of the raw materials and the manufacture of the instruments known as the " Marconi Lucerne Specials." The demand for these instruments is truly astonishing, and the attitude of the buying public towards them ensures full production for some time to come.

The customary January rise in unemployment does not apply to Marconiphone. Additional operatives taken on at the beginning of last season to cope with the seasonal rush are being kept on, and further employment in all the associated industries, and it is from beginnings like, that February has been regarded as the month of February has not been crossed. It is obvious that the above treatments do not show these absurd, as in the first case the voltage drop at 30 m/A would be 240 volts, and this obviously prevents the average user from applying sufficient H.T. to the output valve to draw this magnitude of current. It is safe in this case, therefore, to adopt the scheme of connecting the two transformers in series as the total voltage of 240 volts would be restricted to a safe figure. Incidentally the output valve of the average battery receiver does not pass current which in any way approaches this figure.

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PRACTICAL WIRELESS

March 3rd, 1934

RADIO CLUBS AND SOCIETIES

Club Reports should not exceed 300 words in length and should be received. First-Publish Monday morning for publication in the following week's issue.

SLADE RADIO

A lecture to Mr. F. N. Swift, of the Marconiphone Co. Ltd., was given at the meeting held recently. In this he described the radio section of the works at Hayes. At the conclusion of the lecture a demonstration was given of the Model 262, which is a 3-valve A.C. apparatus. It includes 110, Hilliards Road, Gravell Hill, Birmingham.

GOLDERS GREEN AND HENDON RADIO SCIENTIFIC SOCIETY

On Wednesday, January 24th last, a talk was given to this society by Mr. J. Hill, R.E.S., on "The Design and Testing of Home-Constructed Radio Receivers."—Mr. A. E. Whitcomb (President), 60, Ponson Road, London, N.W.2.

THE SIDDUP AND DISTRICT RADIO AND TELEVISION SOCIETY

An interesting lecture, "Metal Rectifiers," given by Mr. D. Ashby, B.Sc., of the Westinghouse Brake and Saxby Signal Co. Ltd., proved a great attraction at the last meeting of the above society. Mr. Ashby began by describing the construction of the Westinghouse metal rectifier and how it works. He then discussed the different resistances at the junction of a metal and an oxide, and he then explained in detail the various ways of using these rectifiers when it is necessary to convert alternating current into direct current.—Hon. Secretary, Mr. W. J. Smith, 9, Ordinary Avenue, Bishop, Kent.

THE CHATBURN AND DISTRICT RADIO SOCIETY

"Modern Radio Practice" was the title to a very interesting lecture given before the above society on the 9th inst. by Mr. Deal, of Moulard, Mulard, Ltd. The lecturer dealt in a very lucid manner with the basic functions of a radio valve. The society extends an invitation to all practical radio craftsmen in the district.—J. Holden (Hon. Sec.), Downham Road, Chatburn, Lancs.

INTERNATIONAL SHORT-WAVE CLUB (LONDON)

An interesting discussion, entitled "Is Short-Wave Listening Worth While?" took place in the London Chapter meeting held at the R.A.C.S. Hall, Wands- worth Road, S.W.8, on Friday, February 1st. Mr. A. E. Bear, in opposing the motion, said that short-wave listening was definitely worth while. Short-wave stationers were increasing in number, and such stations as W3AX, W3SKK and the Empire stations were certainly giving service.

Mr. F. G. Sailer, in support of the motion, said that one could not listen on short waves with any degree of pleasure. A Canadian member said what a boon short-wave stations were to one whose nearest broadcasting station was over 500 miles away.—A. B. (Sec.), 40, Mary's Place, Rotherhithe, London, S.E.16.

ARGO-AMERICAN RADIO AND TELEVISION SOCIETY

Readers, and others, in the Leigh, Lancashire, district are reminded that at the meetings of the Leigh Branch of the Anglo-American Radio and Television Society, which has just been formed by Mr. Harold Hughes, of 64, Siddow Common, Leigh, Lancs, from whom full particulars may be obtained. This branch is increasing in number, and such meetings as W3AX, W3SKK and the Empire stations were certainly giving service.

Mr. F. G. Sailer, in support of the motion, said that one could not listen on short waves with any degree of pleasure. A Canadian member said what a boon short-wave stations were to one whose nearest broadcasting station was over 500 miles away.—A. B. (Sec.), 40, Mary's Place, Rotherhithe, London, S.E.16.

CLITHEROE ROYAL GRAMMAR SCHOOL RADIO CLUB

At length a W.B. P.M.6 emerged triumphant in a challenge that of the Vice-President, whose instrument was at the last meeting. This was his 3rd. He was adapted specially by him and used 12 watts for energization. The Vice-President had entered a moving coil designed by him, on the basis of this principle.

At a length of 6.5 ft. P.M.S. emerged triumphant in a final in which an energized dual unit, and several permanent magnet speakers participated. Finally, the Vice-President was given the last word on all-caused "What?"—Hon. Secretary, E. L. Cumbers, May-cour, Compton Road, Clitheroe, Lancs.

CLITHEROE ROYAL GRAMMAR SCHOOL RADIO CLUB

This club was formed on February 3rd, 1934, and has since had seven meetings. The club's activities for February were those of the Elthamnia, Clitheroe, for a demonstration on sound apparatus, and tone-projectors. On the 28th ult., a visit was paid to the Whiteleas, at Moreton, Lancs. Further particulars can be obtained from the Secretary, E.L.Cumbers, Royal Grammar School, Clitheroe, Lancs.

INTERNATIONAL D'XERS ALLIANCE

Under date of March 1st, 1934, the following special transmission will take place as follows:—

1st March 4.30-6.30 a.m. G.M.T. H.B. San Domingo, D.R. 06.18 40°S or 45.70 metres. — F. B. Rawles, Publicity Director, Blackwater Corner, Newport, Isle of Wight.
Tests of the Latest Components.

Ordinary high-frequency pentode. The V.P.2 has the following characteristics:

-Filament voltage: 2.0 volts.
-Grid voltage: 2,000 volts.
-Max. anode voltage: 100 volts.
-Max. grid current: 0.05 ma.
-Max. anode current: 0.5 ma.
-Mutual conductance: 5 mmhos.

The S.P.3 has similar characteristics except that the mutual conductance is 12 mmhos. An important point about these two valves is that the auxiliary grid may have the same voltage as is applied to the anodes and this will enable the small voltage-dropping resistance to be dispensed with, or alternatively a potted one battery lead to be removed. Even with this high-grid voltage the anode current is still within reasonable limits being, in fact, approximately the same as that of a normal 6L6 valve. The standard 7-pin base will be fitted and the valves will be supplied with a metalized coating only. This coating is connected to one of the pins on the base so that it may be earthed if desired.

**WEARITE UNIVERSAL TYPE "A" COIL**

We recently reported on the Universal coil manufactured by Messrs. Wright and Wears and selling at 5s. 6d. This coil is now available in a second type, known as Type B, and it differs only in that a tapping point is now provided on the primary winding. This tapping point is brought out to Terminal No. 4 on the coil. This increase gives a higher degree of selectivity to be obtained where this is found necessary. Other advantages are that the tapping occurring will occur to the experimenter. The price will be the same, namely 5s. 6d.

**OSRAM H.T. BATTERY**

A combined frequency-changer of the heptode type is embodied in the U.O.C. This will be provided with the standard 4 volt 1 amp, battery, and will follow the lines of the heptode valve recently described in these pages. A standard 4 volt base will be fitted, and the reference number for the valve is M.C.400. The advantage of this valve over the normal H.F. pentode or tetode method of frequency changing is in that the selection of the line frequency is controlled by the grid bias. This makes the valve suitable in circuits which incorporate automatic volume control, where the maximum control requires the number of control valves is restricted.

**NEW EDISWAN VALVES**

The new valves are announced by Messrs. Ediswan Electric Co., and these are of the Universal A.C.-D.C. type. The first is the V.T.5, and this is of the in-line, direct-heated type with a rating of 13 volts 2 watts (200 mA max). The input is a pentode type, or triode by the grid bias. This results in the anode and 500 volts for the screening grid. The other valve is the V.T.500, and it is rated in watts 0.8, 1.6, and 2.4 watts (200 mA max). The grid is of the same type, and the number of control valves is restricted.

**BRITISH RADIOPHONE LINE DISCONTINUED**

Messrs. British Radiophone Ltd., announce that the Standard A type flat type variable ganged condensers (with the trimmers mounted at the side) is being discontinued and will not be available as from the 1st March.

**BATTERY H.F. PENTODES FROM MULLARDS**

Following our recent note of the issue of the 20B.2 valves, we are informed that the Mullard Company will shortly be issuing two H.F. pentodes, also for radio-valve purposes. These valves will be known as the P.V.3 and the S.P.2, the former having variable characteristics, and the latter an

**NEW EVER READY H.T. BATTERY**

A new type is announced from the U.O.C. This will be provided with the standard 4 volt 1 amp, battery, and will follow the lines of the heptode valve recently described in these pages. A standard 4 volt base will be fitted, and the reference number for the valve is M.C.400. The advantage of this valve over the normal H.F. pentode or tetode method of frequency changing is in that the selection of the line frequency is controlled by the grid bias. This makes the valve suitable in circuits which incorporate automatic volume control, where the maximum control requires the number of control valves is restricted.

**A USEFUL ALL-RANGE METER**

The meter illustrated above is a Pifco product and enables the user to read volts in three ranges—0 to 3, 0 to 15, and 0 to 1000 volts. The prices are 5s. 6d. and multiples up to 30. By using an external battery it is, of course, possible to take readings over a wide range. The instrument is of a high degree of accuracy and is quite insensitive.

**WHAT WE FOUND**

In our laboratory.

BULGIN RESISTORS

While constructing a Mains-operated receiver there was a demand for a number of fixed resistors having various wattage ratios. In the Bulgin range will be found resisters havin ratings from 20 watts downwards. The 20 watt type is found on a heat-resisting core which is provided with a spiral groove throughout its length, and the element is a special non-ferrous nickel-chrome wire. Although there are various standard ratings, the method of making connection enables various intermediate values to be obtained. Metal bands are clamped round the wire and are fitted with terminals, and the elements held in which are made into these bands, so that there need be no hesitation in making them for any desired value. This type of resistance may be obtained from 20 ohms up to 100,000 ohms leading to the price varying from 5d. to 60d. A smaller type of resistor is also available in ratings from 5 to 250 ohms, and these cost 6d. A special asbestos compound is employed for the former and insulation consists of nickel-alloy wire. Terminals connections are provided for the latter. Nickel-alloy wire may also be obtained by applying a resistive coating to it on the resistances in series or parallel. Resistor units may be obtained from 5,000 to 1,000,000 ohms. A glow worm has been fitted with the bridge wires for connect purposes are also available which may be obtained in 1 watt.

Two of the "Gerard" electric automobiles, which are ready for incorporation in a radio-grid. A model is also available with complete automatic resistance for the motor-board.

A block condenser manufactured by the T.M.C. Co., Ltd.
**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).

A Rival to "Q.P.P." - The accompanying rare woodcut of the period illustrates a dramatic moment in the development of my latest brain-child, "Quiescent Scratch-Scratch," and was recorded by an electrical storm through the infra-yellow haze. For obvious reasons, I cannot reveal too much of my new system, but I can hint that it is a remarkable modification of "Q.P.P." and that valves are unnecessary. The heart of the whole thing is the synthetic crystal "Chokite," a combination of the rare elements Nertzite and Aertite, fused by the Darkhouse's Curve method. Prodding-pegged, mounted on either side of the mounted crystal, do all the pulling and pushing; those are worked by hand, no electric mains being required. Further information I cannot give, at present, but when the system passes the experimental stage, and is in general use, valves, batteries, and the B.B.C. will be a thing of the past, and listening-in a meaningless function. My remarkable success is entirely due to the wonderful self-igniting "Inspirator," without which I should not have developed "Q.S.S." or anything else.-(Dr.) GASPARD HACKENOFF

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**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 both 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 encstact. The name and address of the sender should be addressed: THE EDITOR, PRACTICAL WIRELESS, 20, rue de St. Martin, Paris.

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STROBOSCOPE WANTED

"Re your article on 'Stroboscopes' in "Practical Wireless" last year. Could you please tell me if there is a firm which makes accurate gramophone stroboscopes, I would require one suitable for 50 cycle A.C. mains, with a speed of 78 r.p.m."—A. J. H. (Bristol).

A stroboscope suitable for your purpose may be obtained free of charge from Messrs. Claude Lyons, Ltd., 46, Buckingham Gate, Westminster, S.W.1. Kindly return this paper when writing for the Stroboscope.

SUP-HE T CONVERTER PROBLEM

"I am going to build a superheterodyne converter, and am rather doubtful regarding the correct valves to use. I have read in one book that it would be best to use an ordinary S.G. valve for the detector with a small 6A8 transformer and, a friend has a converter similar to the one I wish to make up, but he does not use the S.G. valve in the detector position. He tells me that the S.G. valve will not be worth while and that the ordinary medium-impedance type is to be preferred. Could you please help me out and give an explanation of the difference which does exist?"—T. Y. (Sheffield).

The valves you refer to may each be used, and the actual choice must be governed by the remainder of the circuit design. With an ordinary three-electrode valve you may find interference is difficult to eliminate, whilst the ordinary S.G. valve may result in doubtful tuning points. As you have not yet built the circuit we would suggest a medium-frequency frequency of the variable-null variety, as this will enable smooth tuning control to be obtained and will prevent cross-modulation. The small L.F. type of valve will serve quite well as an oscillator and is probably the best type of valve for this position.

SUPER-HET GANGING

"I had a lot of parts very similar to those used in the Premier Super, I had home-made L.F. transformers, and with a few new parts which I bought I assured a circuit on the lines of the Premier. I do not want to claim that I have built your set, but it is to all intents and purposes similar. I find, however, that when I set all trimmers on Fencam I get this station reasonably loud for home comfort, yet when I go up the scale the stations get weaker as I go up. London National is not too bad, but the Regional is much too loud for home comfort, yet when I set them as you describe in the magazine, I cannot get it. Can you tell me how to get this trimming so that it will remain for all stations?"—A. F. B. (Heywood).

The cause of your trouble is in the relation between the tuning coils and the tuning condenser. The coils are wound in such a manner that they require a tuning condenser having a certain "law." If this is attended to you will find that once adjusted the settings will remain at all parts of the dial. If, however, you employ a ganged condenser which does not maintain the correct ratio throughout the scale you will never succeed in obtaining the desired results.

L.F. OSCILLATION

"As you know, impairs the quality of the output valve only in view of the greater current if, however, you have apparently overlooked the fact that the bias resistance, when connected in the common negative envelope must carry double the current of the output valve. In view of the greater freedom which is passed you should have used at least a 5 watt resistor. The 1 watt resistor is not strong enough. The over-heating which this has resulted in, has altered the value of the resistance and you have not given sufficient bias to the valve. Thus you are damping the performance of the valve under these conditions. You require a 0.005 ohm resistance, and this should be of the 5 watt type.

BIAS RESISTANCE RATING

"I have a superhet receiver. It has no provision for controlling the bias resistance. Can you explain this point to me?"—G. B. (Peckham).

The difference lies in the fact that one transformer group intended to be connected in parallel to the output valve of your receiver, the other is intended for use with a push-pull valve. The total current of the output valve passes through the winding and obviously when a certain value is reached saturation will occur. This, as you know, impairs efficiency and therefore the rating is that which will be the maximum allowable current before saturation. In the case of the push-pull valves, however, the two valves work in such a manner that the currents flowing through the two halves of the primary are in opposition, and therefore they balance out. This means that the same amount of current is passed through the transformer winding, even for use with valves which pass a much greater current altogether.

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