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ELECTRON MICROSCOPE IN NEW FIELDS

By DR. V. K. ZWORYKIN. From "Radio Craft."

Few innovations in the scientific world have made a place for themselves as quickly as the electron microscope; and no wonder. While for centuries previous to this remarkable contribution of radio, research men had been able to enhance the range of the visible world only by small steps, gradually perfecting the light microscope to its present high stage of excellence, the electron microscope almost at once revealed detail of structures up to a hundred times as fine as that visible with the earlier instruments. Within the past year the electron microscope, having been made commercially available has increasingly proved its value in the fields of biology, chemistry, and metallurgy. Its utility has been greatly enhanced by the development of new methods of observation.

OPERATION EXPLAINED

As the name implies, the electron microscope utilises electrons in place of light to form a magnified image of the object to be examined. As these minute charged particles, even when possessing a velocity comparable with that of light, do not readily traverse matter, the electron microscope must be carefully evacuated, i.e., freed of air. Furthermore, the electron rays cannot be focused in the usual fashion by material lenses or pass through a glass slide supporting the object. Finally, they cannot be observed directly by the human eye.

Under these conditions it is not surprising that the electron microscope presents an appearance differing greatly from that of the light microscope. Nevertheless, the basic arrangements of the two instruments are quite analogous. In the electron microscope electrons emitted by a hot filament are accelerated by a carefully stabilised difference of potential of about 60 kilovolts and concentrated by the "condenser lens"—the magnetic field between suitably shaped pole pieces of an electromagnet—on the object, which is usually supported by a collodion film about a two-millionth inch in thickness. After passing through the object and being partly scattered by the latter, the electrons are focused under the influence of a second "magnetic lens"—namely, the objective—into an intermediate electron image of the object. This is then further magnified by the magnetic "projector lens," which throws it on a luminescent screen so that it becomes visible to the eye. When the screen is replaced—by means of a simple turn of a knob—by a photographic plate, the image is recorded on it permanently. To facilitate the exchange of object and photographic plates, airlocks are provided at both points, making it unnecessary to evacuate the microscope anew after each exchange.

To further the application of the instrument in the field of biology, an RCA Fellowship for electron microscope research was established under the auspices of the National Research Council, and Dr. Thomas F. Anderson, of the University of Wisconsin, was appointed to the post. Collaborating with a large number of prominent scientists, Dr. Anderson has investigated numerous bio-

(Continued on page 12.)

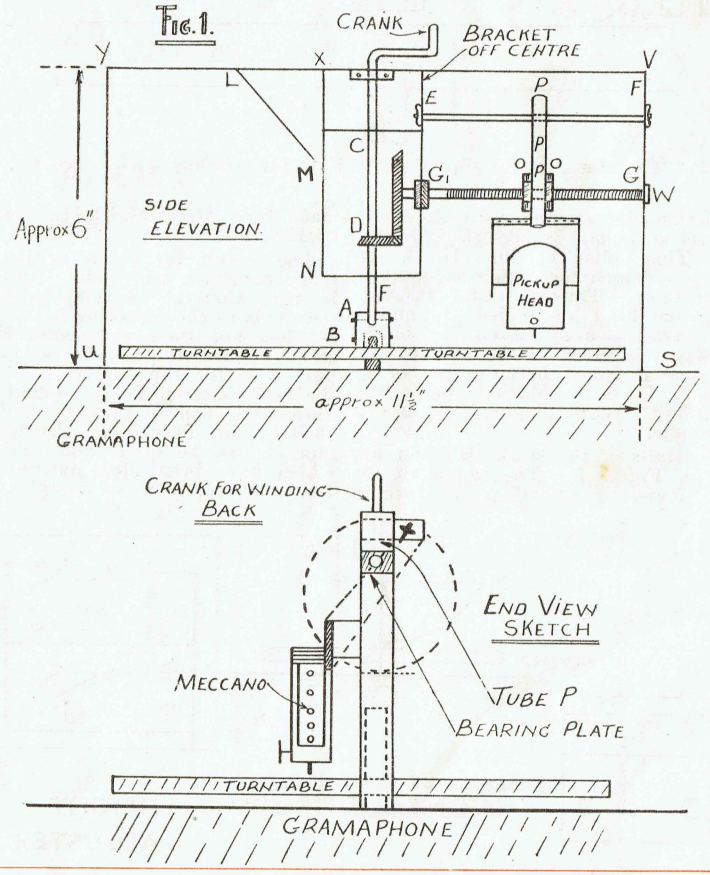
THE HOME RECORDER

ADAPTABLE TO A GRAMOPHONE

(BY RAHOB 9390). (Original).

This is a small unit using a pickup and can be constructed, without any involved craftsmanship, for a negligible cost. Many will find that old Meccano strips are ideal for most of the metalwork. Figure 1 gives a general elevation of the unit which is fixed to a gramophone, from which the tone arm has been removed. All sizes are variable. They can be altered to suit each different constructor, and gramophone.

A word about the parts comprising this. In Figure 1 UVYS comprises the main frame which may be made of brass, iron, or Meccano strips. XN and the corresponding strip, are a bracket also made of the frame material and LM is a brace. The main shaft F (coloured red) is driven from the sprig on the gramophone, AB. (This is shown in detail in Figure 2. This shaft drives the 2:1 ratio bevel gear, also Meccano, labelled CD. This rotates the threaded shaft G1G at half the speed of the turntable. This shaft is threaded with either 32 or 40 turns to the inch, and



so the nuts O, O (attached to the tube P) are drawn in 1-64th or 1-80th of an inch for each revolution of the turntable. This threaded shaft bears in W and is held by collars at G1.

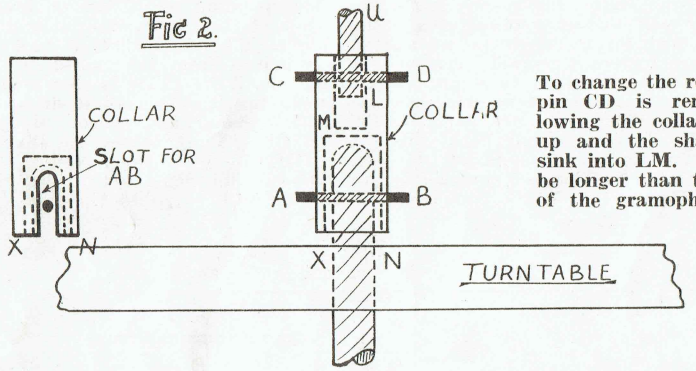
EF is a rod wing-nutted at each end. This slides in a curved slot (shown in Figure 3) and controls the raising and lowering of the head. The tube P must be able to slide easily along this rod.

which the stylus is to move, through the bearing and on the slot plate. Thus the arc M1 N1 is found from MN. And the slot lies along M1 N1.

The bearing-plate can be made by drilling a hole the correct size, halfway through a piece of metal as in Figure 3.

The bearing-plate for the main shaft with the crank is shown in Figure 4. The collars for the threaded shaft are

Fig 2.



To change the record, the pin CD is removed allowing the collar to slide up and the shaft U to sink into LM. LM must be longer than the height of the gramophone sprig.

Note: The crank at the top of shaft U is for winding back. See Fig. 1.

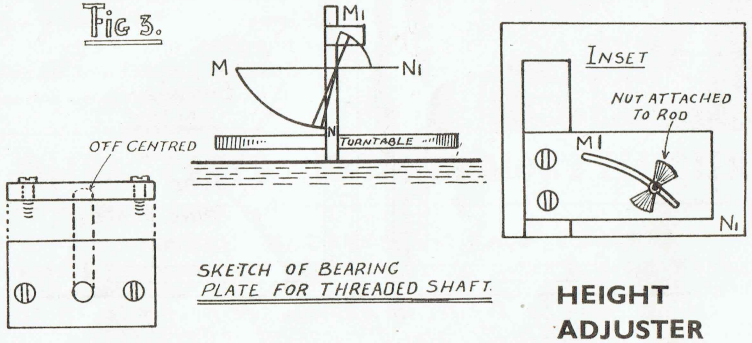
In action, the rotating turntable drives the bevel gears and rotates the threaded shaft. This pulls the nuts O, O, in 1-64th of an inch for each revolution of the turntable. Thus the tube P, supporting the head is pulled in and a stylus engraves a spiral on the blank. This stylus is fitted in the pickup and the pickup is fed with the output of an amplifier. Thus the blank is made into a recording. When playing-back, use a fibre needle.

The details of the height adjuster are found in Figure 3. The radius of the slot is found by extending the arc in

made from Meccano wheels, also shown in Figure 4.

The circuit for recording is an ordinary amplifier with mike and tuner inputs. Connect the extension speaker terminals to the recording head. If your set has not these terminals, Figure 5 gives the circuit. A is for push-pull output, B is for single valve. For blanks the best material I have found is light fibrous cardboard thickly coated with shellac and allowed to harden. Aluminium can be used and old records which have been filed smooth will do. Use a sharp, hard steel stylus, or else

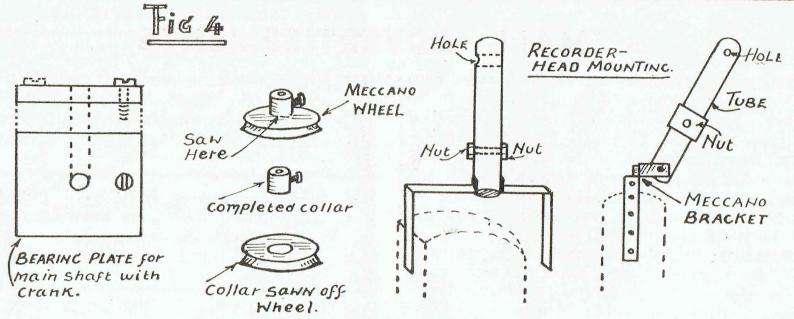
Fig 3.



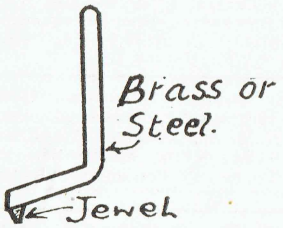
SKETCH OF BEARING PLATE FOR THREADED SHAFT.

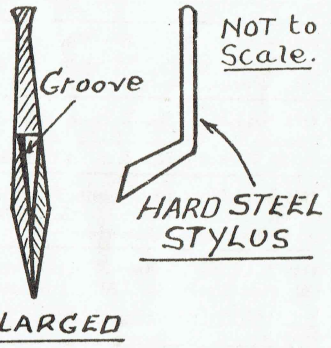
HEIGHT ADJUSTER

Fig 4



a jewel stylus as in Figure 5. When the record is made, lift the drive collar and raise the head. Take the completed record off and rotate the crank, thus winding back the head. The completed record will stand seven or eight playbacks if a fibre needle is used. Although these recordings are not absolutely perfect they give a moderately good playback.





TWO TYPES OF STYLUS

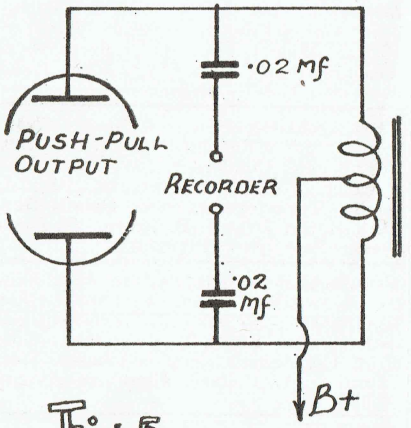
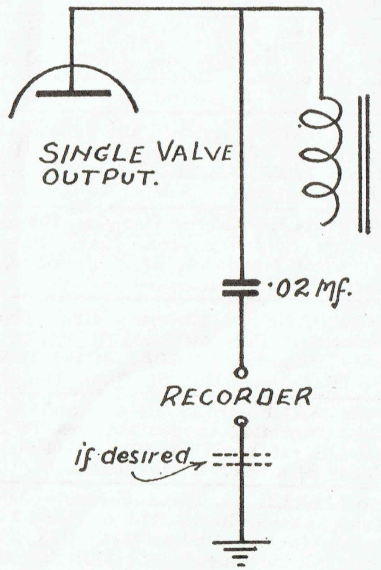


Fig 5.



SMALL ADVERTISEMENTS

An advertisement in the Radiogram will quickly dispose of your surplus radio parts. Hard to obtain goods are often brought to light through a small Radiogram advertisement. Advertising on this page costs 2d. per word payable with instructions. To ensure inclusion, your instructions should be received by us on the 15th of the month preceding date of publication. Advertisements addressed c/o "Radiogram" or "Lamphouse" can not be accepted. Address instructions to "The Radiogram," 11 Manners Street, Wellington, C.1.

FOR SALE—Hiker's Two, £5. G. S. D. Heather, 5 Hill St., Hamilton.

FOR SALE—1 3 gang Variable Condenser. What offers. A. Biland, Te Rapa R.D., Frankton Junction.

FOR SALE—1 12in. Rola P.M. Speaker (Special); price £8 10/-. Rahob 11055, c/o 90 Forbury Road, St. Clair, Dunedin.

FOR SALE—One 3 Gang Variable Condenser. What offers? A. Biland, Te Rapa, Frankton Junction.

FOR SALE—Steam Engine, good as new, had little use, £1 or nearest offer. D. Wagener, P.B., Awanui (Rahob 12265).

FOR SALE—1 10in. Plessey P.M. Speaker, in new condition, £6 10/-. Rahob 11055, c/o 90 Forbury Rd., St. Clair, Dunedin.

FOR SALE—Hiker's One, in neat Cabinet, Batteries, Phones. Offers. Apply B. Woodham, 3 Carey St., Wellington, W.1.

FOR SALE—Crystal Microphone, on stand, with 35ft. Flex and Plug, £9 10/-. Rahob 11055, c/o 90 Forbury Rd., St. Clair, Dunedin.

FOR SALE—Electric One-valve Set, £2; Electric Soldering Iron, 15s; Shaw's Electrical Handbook, £1. J. Ward, 8 Gorrie St., Nelson.

FOR SALE — Electric Gramophone Motor and Pick up (modern outfit), in first-class order, £10 10/-. Rahob 11055, c/o 90 Forbury Rd., St. Clair, Dunedin.

FOR SALE—Gram. Motor and 11in. Cast Turntable, tapped voltages, 50-250 AC/DC, £6. M. Riddle, 66 Calabar Road, Miramar, Wellington.

FOR SALE — Three Ferranti Audio Transformers. Ratios 1/3, 1/7 and Output. Also one Philips Ratio 1/3, 12/6 each. J. A. Patrick, 86a Hill St., Wellington.

FOR SALE—Swan Audio Transformer, 3-1, new, 12/6; .0003 Variable Condenser, 3/-; Akrad Kodagraph, hardly used, 17/6. A. H. Dally, Makotuku, Hawke's Bay.

FOR SALE—Crystal Set, with phones, 35/-; High-grade Buffs, as used by leading electro-platers, 4. 5 and 6in. x 1in. thick, 3/9, 5/6, and 8/- each. Rahob 8845. 14 Alba Rd., Epsom.

FOR SALE—Wright De Coster 14in. P.M. Speaker, heavy duty type; will handle 35 watts. Price £20. Rahob 11055, c/o 90 Forbury Rd., St. Clair, Dunedin.

FOR SALE—Universal Velocity Microphone on adjustable stand, nickel plated, with 35ft of flex and plug, in new condition; price £27 10/-. Rahob 11055, c/o 90 Forbury Rd., St. Clair, Dunedin.

FOR SALE—Hiker's Two New Batteries, Metal Chassis Cabinet, 4 Plug-in Coils, Vernier Dial, £6; Phones, 15s. A.C. Oscillator, three Valves, Speaker, Volume Control,. Cabinet, £4 10/-. Key 15/- Arnold, Box 279, Hawera.

FOR SALE—Quantity New and Used Valves, 0/1 Milliameter, Universal scale, 1000 O.P.V. Meter, 5-valve Amplifier, Typewriter. Particulars to Brown, 24 Pompalier Terrace, Ponsonby, Auckland.

FOR SALE—"Ferranti" Audio Transformer, 3-1, 10s; I.C.S. 3-in-1 Tuner, 30s; Two Gang Condenser and Trimmers, 10/6; Midget Portable Gramophone, measures 6in. x 5in x 7in., £1 10s. Rahob J. Wells, Box 7. Milton.

FOR SALE—385-volt Power Transformer, 2.5 Filaments, practically new, 35s; 3 gang Condenser, 15s; Small Horn Speaker, 15s; New 53-valve, 10s; 4.1 Audio Transformer, 10s; Small 6-volt D.C. Meter, 7/6. J. B. Rowe, 359 Devon Street East, New Plymouth.

FOR SALE — Hiker's Two in Cabinet 21½in. x 10in. x 9in., with or without headphones; no batteries; excellent condition; also Small Carbon Microphone, Ford Coil, single gang condenser. What offers? A. Pollard, Chalmers Avenue, Ashburton.

FOR SALE—Parts of Amplifier, complete with Celestion 10in Speaker, 3 6V6GTG Valves (No. 6J7 or 6C5), £7 10/-. Also, Parts for 6-valve Broadcast Radio, complete Valves and Speaker (6.3v. Valves), £9 10s; 1 12in. Majestic Speaker, 1,000 Field Coil, no tranny, £1 10/-. R. Gardner, Denniston.

SMALL ADVERTISEMENTS—Continued

FOR SALE—Valves, 6K7, 42, 12A7, 7/6 each; 80, 2/6; 2 gang Condenser, 7/6; Single Gang, 5/-; 6 x 6 mfd., Electrolytic, 5s; Power Transformer 6v., 5v., 385v., 100 M/A Windings, 25s; 2 465 K.C.I.F.'s, 7/6 each; 200,000 ohm Potentiometer, 2/6. M. Downey, 53 Wallace Street, Wellington.

FOR SALE—Powerful 16 Valves Beam Power Amplifier, 80 watts output and separate power supply. Incorporated with 4 pre-amps, input channels and pick-up with twin magic eyes as volume indicator. Has enough volume for the largest dance hall in N.Z. and wonderful outfit for public addresses. First in gets this one, £85. Rahob 11055, c/o 90 Forbury Rd., St. Clair, Dunedin.

WANTED TO SELL, Phillips B and C Eliminator. What offers? Rahob 8662, 9 Alma Street, Dannevirke.

WANTED TO SELL—30 Watt Inverse Feedback Amplifier, with 2 speakers, microphone; modulate 150 watt, 2 valve, electric, complete. N. Martin, 29 Cockayne Road, Wellington, N.5.

URGENT SALE—One Dualwave (19-50M & B.C.) coilkit, wired and tested, with AVC and 1RF Stage. Complete with matched 3 Gang Condenser and two Iron-core I.F.S. All brand new condition, £5 10/-. Particulars from J. Jackson, Hotel Esplanade, New Brighton, Christchurch.

CRYSTAL PICK-UPS and MICROPHONES—Limited stocks arriving. Order yours now. Write R. C. Walker, 252 Willis Street, Wellington.

WESTINGHOUSE, ¼ h.p. Split Phase Electric Motors, £6. The Lamphouse.

WORKING MODEL STEAM ENGINES, 37/6 each. The Lamphouse.

SUPREMACY, the great war game, 19/6 per set. The Lamphouse.

RAHOBS—Spare Club Badges can be obtained from the Secretary, 9d. each.

HIGH PRICE offered for G12 Permanent Magnet Speaker, in good condition. S. C. Cummins, Pokuru, Te Kawa.

SWAN ½ amp. 6-volt Battery Chargers, 80/- each. The Lamphouse.

ELECTROSHINE — The silver plating liquid, 2/3 per bottle. The Lamphouse.

TRANSFORMER and Armature Rewinds. Send for price list, quotes given for special jobs. M. J. Begley, c/o A. Zeinert, Mangamutu, Pahiatua.

WILL PAY GOOD PRICE for Portable Gramophone, with or without records. Rahob 7202. M. Karipa, c/o Patea Freezing Co., Ltd., Patea.

WANTED—Midget, 5 or 6in. P.M. Speaker, Edwards, Box 12, Waiuku.

WANTED—Pea Lamp, complete. Apply R. J. Toxward, Rectory, Gisborne.

WANTED—Electric Hikers One. Rola G 12in. Speaker and 5in. P.M. J. Ramsay, Pokeno.

WANTED — Small Comutator Type Electric Motor, for Gramophone. G. S. D. Heather, 5 Hill St., Hamilton.

WANTED — Two good 1S4 Midget Valves. G. Rigg, 16 Devon Street, Masterton. (Rahob 6487).

WANTED—0-1 M.A. Meter, or Pifco Rotometer or Radiometer. Write R. Young, Manaia. (Rahob 4529).

WANTED, a Pair Good Headphones, about 2000 ohms, 30s. Write D. Akrigg, "Elgin," Exeter, New South Wales.

WANTED—100 to 150 ft. of Tinned or Plain Copper Aerial Wire. G. W. Young, Tahuna Road, Morrinsville.

WANTED—Small Modern 2-volt Radio Set, 4, 5, valves; pay good price. Write D. Herbert, Waieurua P.B., Dannevirke. Rahob 10951.

WANTED—One Pickup (not too expensive), also an Electric Motor for a gramophone. R. S. Wilberfors, Box 434, Wanganui.

WANTED — Slow-motion Instrument Knob. For Sale, Oxford Voltage Reducer, 230, 6 volts; good condition; offers. J. Norris, Grey St., Whangarei.

WANTED—a copy of the "Radio News" of September, 1935. Will pay 5/- for a good copy. T. H. Bransgrove, 211 Devon St., New Plymouth.

WANTED—Two Midget Variable Condensers, 23 Plate, .0001 and one 13 Plate, .0003. Write Chas. Soufflot, No. 2a Flag Staff Hill, Wellington, C.1.

WANTED—0-1 M.A. Meter, with or without rectifier. Whiting, "Willowbank," Mayfield. Mr. R. Whiting, 74 Middle Road, Allerton, Ashburton. (Rahob 4795).

WANTED—Pair of Bagpipes, suitable for beginner; also Latest Records, must be in good order. Price and particulars to B. C. Bain, Hukerenui, North Auckland.

WANTED TO BUY—N.Z. Listener, containing photos of N.Z. members of Parliament. Write W. W. Sides, c/o R. A. Hayman, Esq., Willowbridge, R.M.D., Waimate.

WANTED TO BUY, or donations of Used Postage Stamps, or Collections, large and small lots appreciated. Rahob No. 12603. H. F. Mitchell, Services Hospital, Rotorua.

Slips at The Mike

One shilling paid for every "slip" published; 5/- for particularly good ones.

2ZB, September 8, 1944, 9.18 a.m.: Aunt Daisy: "If you have a pocket with two aprons in . . . ."

2ZB, September 15th, 1944, Aunt Daisy describing her experiences in Hollywood: "Then there are the tables you sit under . . . . . "

2ZB, September 19th, 1944, 7.55 p.m.: "I didn't think he would ever put a woman round his arm—er. . . . . "

2YC, September 16th, 1944, 7.15 p.m.: "When My Dream Goat Comes Home."

An American Station. Stock market report: "Pigs have gone up by 3 cents."

2KY, 28/9/44, 8.30 (N.Z. time), in "Fostard's Shoes" session: "Equipped with hot and cold shadows."

THE MEASUREMENT OF RESISTANCE

By J. W. STRAEDE, B.Sc.

(From the Australasian Radio World)

Maybe it's a speaker field, or just a resistor with colour chipped off. How do you measure its resistance?

Resistance is **invariably** measured by the voltage drop across it when a certain current flows. Invariably. The basic principle is Ohm's Law, one form of which states that the voltage drop across a resistance is equal to the product of the current in amperes and **the resistance in ohms.**

SIMPLE METHOD.

This leads to a very simple, but not very accurate method. A 1½-volt dry cell is connected in series with a milliammeter and the resistance to be measured. The meter reads the current flowing and the voltage drop is assumed to be nearly all of the 1½ volts. Suppose the meter reads 25 ma.. or .025 ampere. Then E equals 1 × R and R equals E/I where E is voltage drop, I equals current in amperes and R equals resistance in ohms.

R equals EI/
= 1½ divided by 0.25
= 1½ × 40 = **60 ohms.**

NOT ACCURATE.

This method is not very accurate because the voltage drop across the unknown resistance is not 1½ volts. Part of the voltage (electrical pressure) is used up across the cell itself and across the meter. Besides, if the resistance happens to be too small, then too much current will flow and burn out the meter, or at least bend its pointer.

The accuracy may be considerably improved by using a separate meter, a voltmeter, to measure the actual voltage drop across the resistance, but again inaccuracy must occur, because a small part of the current goes through the voltmeter instead of through the unknown resistance.

In ordinary "multi-meters" and "volt-ohm-meters," only one meter, a milliammeter is used. To make up for the drop in voltage across the meter and cell or battery, a large resistor is inserted in series with them and adjusted until the total resistance of battery (or cell) meter and resistor is equal to some fixed value, usually such that the meter gives full scale deflection with zero external resistance. As the resistance to be measured increases, the meter reads less and less. (The meter is said to be backward reading.) Finally the deflection of the meter needle is too small to be measured, thus setting an upper limit to the resistance that can be measured. The resistance of the battery or cell changes with age so that there is another reason why an adjustable resistor is required in the multi-meter.

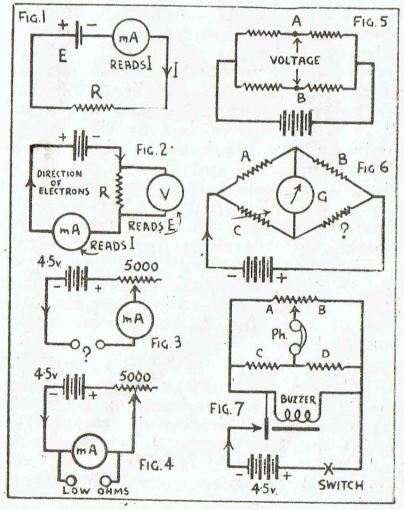
LOW OHMS.

For low resistances the unknown resistance may be connected in parallel with the meter, thus bypassing some of the current. As the resistance to be measured is made less so more current is bypassed and the meter read less. The higher the meter reading, the greater the resistance. Such "low-ohm" meters are therefore "forward-reading."

All the methods considered so far depend on the accuracy of calibration of the meter (s). Small commercial meters may be calibrated to within 2 per cent., but even 1 per cent. is sometimes too much variation, so more accurate methods must be considered.

BRIDGE METHODS

Resistance may be compared with the resistance of some "standard" (which may have been measured by a University



to, say, one part in 100,000). A simple method is the "Wheatstone Bridge" invented by a man named Christie. If four resistors are connected in series parallel to a battery, then a voltage may be found between the resistor junctions not directly connected to the battery. If all the resistors are equal in value, or if they have values according to a certain rule, then this voltage disappears.

The disappearance of the voltage may be found by a sensitive galvanometer. The rule for this disappearance of voltage, or "balancing" of the Wheatstone Bridge is:—

A/B equals C/D

where A and B are the resistances in one arm of the bridge and C and D are the resistances in the other arm.

In practice, A and B are made equal, or in some convenient ratio such as 1:10 or 100:1. They are, therefore, called the "ratio arms." C is an adjustable resistance which is calibrated i.e., has a scale giving its values, whilst D is the unknown resistance to be measured. C is adjusted until the galvanometer G reads zero.

Then D equals value of C, multiplied by B and divided by A;

or D equals C $\times$ B/A

This "bridge" method is most accurate as the galvanometer does not have to be calibrated.

A.C. CIRCUIT.

If the circuit is supplied with A.C. instead of D.C. then an A.C. meter, a loudspeaker, or even a pair of phones may be used in place of the galvanometer. In fact, an excellent "bridge" may be wired up using a buzzer and cell in a soundproof box as the current supply and an earphone in place of the galvanometer. A and B may consist of a length of resistance wire and C can be a good quality resistor that has been accurately checked by some friend with a meter, or a specially accurate one obtained from the factory. Next month we hope to give constructional details of a "Metre Bridge," so called because the piece of wire for A and B is exactly a metre long.

Because A.C. will "pass through" a condenser (actually what really happens is that the condenser permits the current to keep flowing back and forwards) an A.C. operated bridge can be used to compare capacities of condensers. Inductances may also be compared.

Weather and U-S-W

From "Wireless World."

Some interesting facts regarding the influence of weather on the propagation of ultra-short waves emerge from a study of the records of signal strength variations in the Post Office radio telephone link between Guernsey and England from 1937 to 1939.

The path between stations was about 85 miles in length over sea, of which 36 miles was outside the optical range; the wavelengths employed were 5 and 8 metres. Continuous records taken by the Post Office were analysed by Dr. R. L. Smith Rose and Miss A. C. Strickland, M.Sc., to show correlation between signal strength and atmospheric conditions. The results are given in a paper recently read before the I.E.E.

It is clearly established that weather has an influence on the variations of signal intensity. During periods of high barometric pressure, often accompanied by temperature inversions, signal strength was at a maximum, but there was much fading of the slow type. Low-pressure conditions with very little temperature inversion gave the steadiest signals though of rather low level. Snowy and foggy weather also gave a steady signal even when the atmospheric pressure was high.

The authors conclude: "It seems clear that the main agencies causing variations in signal intensities on these wavelengths are the variations in refractive index of the air in the lower atmosphere, due notably to changes in moisture content, and in addition the presence or absence of temperature inversion layers from which the waves can be reflected at heights of from a few hundred to a few thousand feet."

DRILLING GLASS

This is done very readily with a common drill by using a mixture of turpentine and camphor. When the point of the drill has come through, it should be taken out and the hole worked through with the point of a three-cornered file, having the edges ground sharp. Use the corners of the file as a reamer. Great care must be taken not to crack the glass or flake off parts of it in finishing the hole after the point of the drill has come through. Use the mixture freely during the drilling and scraping. The above mixture will be found useful in drilling hard cast iron.

Electron Microscope

(Continued from Page 1)

logical problems. In the field of bacteriology many of the disease-producing micro-organisms have revealed a wealth of internal structure which heretofore could only be surmised. In some cases chemical changes within the individual germs—for example, the formation of metallic tellurium crystals in diphtheria bacilli—could be observed.

STUDY CHROMOSOMES

Even more striking has been the success of the electron microscope in the field of the viruses, disease-causing agents beyond the range of the ordinary microscope. A micrograph shows a fan of tobacco mosaic disease virus "molecules" cohering in characteristic fashion. Numerous other plant viruses and the effect on them of immunizing materials have been studied, yielding valuable information for the eventual control of diseases caused by them.

Simultaneously work has gone on to determine the structure of chromosomes the entities within every living cell which determine the inheritable characteristics of the organism. These studies, which require extraordinary skill in the preparation of the specimens, indicate the great complexity of these basic elements. Other investigations have concerned themselves with revealing the delicate forms of insect life. Micrographs have been made showing a breathing tube of a mosquito larva, magnified 7500 times. These, like the scales of butterfly wings and the irridescent covers of beetles, have shown structures of great beauty and regularity.

APPLIED TO METALS

In the field of industry the electron microscope found almost immediate applications in the study and control of all types of matter in finely divided form—powders, suspensions, dusts and smokes, the characteristic states of pigments, insecticides, ceramic materials, medical preparations, and many other substances where the individual particles are too small to be identified by the light microscope. The electron microscope, with its much greater resolving power, not only makes it possible to count the particles and to classify them with respect to their size, but also shows their characteristic shapes which are found to differ widely. A good example of this are micrographs which show the characteristic cubic form of magnesium oxide smoke particles and the minute thin plates which make up an arsenate insecticide powder. Size, shape and size distribution of the particles are all of them characteristics of vital importance for the physical and chemical behaviour of the material studied.

The electron microscope cannot be applied directly to the study of bulk matter, such as the polished and etched metal specimens from which metallographers seek to gain information regarding the constitution of the metal in question. However, a method has been worked out for the preparation of collodion replicas of the surface which are only about a millionth of an inch in thickness, and which serve as the object in the electron microscope. In a micrograph of a particular etched steel specimen of "pearlite," obtained from such a replica, the dark portions of the picture represent iron carbide ridges embedded in pure iron in characteristic manner. This replica technique has enabled metallographers to extrapolate the validity of important laws relating to the physical properties of steels and their etch patterns far beyond the limit imposed by the light microscope. The same technique proves useful in the study of non-metallic bulk materials, such as ceramics, quartz, glass, etc.

Other advances in the application of the electron microscope have resulted from a modification of the equipment. An electron microscope has been adapted for use with extremely high voltages up to 300 kilovolts. As the penetration of matter by the electrons increases rapidly with their kinetic energy, it is possible herewith to see details in objects, e.g., the larger bacteria and fine sections of organic tissue, which appear totally opaque at the lower voltages.

Another application for which the electron microscope is especially well suited—due to its remarkable depth of focus—is the preparation of stereoscopic or three-dimensional microscope pictures. For this purpose two pictures of the object are taken in sucession, the object being tilted in a special object holder at a fixed small angle with respect to the instrument axis, first in one direction and then in the opposite. When the two pictures so obtained, after developing and printing, are placed in an ordinary stereoscope, the object appears, greatly magnified, in its proper space relationship. The result is very striking. A stereoscopic pair of pictures of zinc oxide smoke, when viewed with a stereoscope reveals beautifully how the individual particles are supported by one another, pairs of opposite spikes of each "star" being bent in opposing directions out of the plane of the centre of the star.

This glimpse of a year's progress with the electron microscope may serve better as an indication of future possibilities than as a record of past accomplishments. Considerable as these may be, they are bound to be outdistanced in a very brief time by the concerted effort of the many workers who, even at the present moment, are applying the electron microscope to the solution of their problems.—"R.C.A. Radio Age," N.Y.

WITTIQUIZ ANSWERS

1.—Because there is sufficient internal resistance in the grid condenser to act as a leak, and also some resistance is apparent across the socket and tube base.

2.—B. 3.—A.

4.—D:—F—G, F—P, G—P, F—SU, SU—P. G—SU.

5.—No. Heat causes element expansion. Therefore the distance between them is altered; thus the capacitance is altered slightly.

PEN FRIENDS WANTED

Rahobs wishing to contact other readers may have their names, addresses and interests published at a cost of 1/- for each announcement, which must not exceed 25 words.

Rahob A404, Thomas J. Williamson, 40 Isaac Street, Spring Hill, Brisbane, Australia, would like to enter into correspondence with some other members to exchange ideas, etc.

Rahob A124, Godfrey Robb, Box No. 16, Portland, Victoria, Australia, wishes to exchange Australian Magazines for New Zealand Magazines.

Rahob A232, J. Hughes, 14 Fairview Grove, East Malvern, Victoria, Australia, would like to meet or correspond with any Rahobs interested in the construction of Mains and Battery Sets. (Short-wave, fairly advanced).

RAHOB LIBRARY

The donation of a book from Rahob 7246.

Several other books have been received from various Rahobs, who have not included their names or numbers. If we have not written to you, Rahobs, please accept our sincere thanks.

RAHOB LIBRARY DONATIONS.

Rahob No.	Donation. £	s.	d.
A364		2	0
12008		10	0
9111		2	2
11696			5
12793		4	0
7113		14	3
12610		5	0
11085		5	0
7555		2	6
9094			3
12820	1	10	0
8296		4	0
5962		2	0
11143			6
8141		4	0
10650		1	6
7675		1	6
	4	9	1
Lamphouse Donation .	4	9	1
	8	18	2
Previously acknowledged	95	16	6
Total	104	14	8

Books purchased £19/3/1.

MASTERTON.

The first meeting was held and was a great success. Officers have been elected and plans made for the future meetings.

Rahobs in Masterton and the surrounding districts who would like to join the Club are advised to get in touch with the Secretary, G. J. Brogden, 49 Worksop Road, Masterton.

HAMILTON.

Meetings are now being held regularly and interesting talks have been given by some of the more advanced members. It is hoped to arrange for a permanent home shortly, and in the meantime Rahobs wishing to join the club should get in touch with the Secretary, A. D. Nelson, 12 Ulster Street, Hamilton.

DUNEDIN.

Y.M.C.A. RADIO HOBBIES CLUB.

Dunedin held its second Radio Exhibition Window Display last month, and once again the club is to be congratulated on its splendid effort. The list of entries was larger than that of last year, and a much higher standard of work was shown to the Dunedin public. This club also celebrated its second birthday last month, and Mr. A. R. White and Master A. MacLachlan were the guests of honour. Other activities for last month, included a broadcast by the club members over 4ZB, Dunedin. A surprise night and a social evening. A photograph was taken of the club and its members. Unfortunately owing to our notes arriving late in Wellington, all radio articles for August and September were cut out. I am sorry, Rahobs. My apologies to Wellington also. Owing to busy arrangements of activities we shall sign off now, wishing our sister branches all the best.

A. R. WHITE,
Instructor and Organiser.

STAMP COLLECTION.

Used postage stamps have been received from the following Rahobs:—12041, 11388, 12386, 8475, 9437, 7202, 12835.

MOTUEKA.

Meetings of the Motueka Radio Hobbies Club are held fortnightly in the St. Thomas's Hall. Attendances have been excellent and members are very keen.

Mr. Kelly donated some old Sets and Speakers and we are going to do some experimenting with these.

Subscription rates have been fixed at 25/- for Seniors and 12/6 for Juniors p.a., or 6d, a meeting.

The Club hopes to arrange for a visit to 2YN in the near future and to purchase an A.C. Oscillator for Morse practice work.

Rahobs who have not joined the local Club are requested to come along and bring their friends.

B. F. MACKAY, Secretary.

AUCKLAND.

We have to report that the judging of our present competition has been extended till the end of October, due to several reasons.

Club membership is still on the increase with 122 at the time of writing. We regret that one of our keenest members, Ron Rhodes, is at present in the Auckland Hospital, and we all wish him a speedy recovery to his former good health.

To the following we extend our sincere thanks for their kind donations:—

Radio 1936, Ltd.,
S.O.S. Radio,
J. F. Henderson,
R. R. Gatfield.

On a recent evening we had an auction sale of parts and some very keen bidding resulted. Nearly everyone had bargains to carry home and more equipment to play about with.

To intending members and anyone interested, you will find us at the Clubrooms, 5 Abbotts Chambers, Karangahape Road, every Friday evening. Supper is provided for all.

J. FORREST, Secretary.

GIRDLING THE GLOBE

DX observations of the month by Arthur T. Cushen, 105 Princes Street, Invercargill, DX advisor to the Radio Hobbies Club, and Short Wave Editor of the New Zealand DX Club's bulletin, "New Zealand DX-TRA." All communications to the above address will receive prompt attention.

BROADCAST.

North America.—These are the best North Americans signals at 7 p.m.:—

KFBK (1530), KGA (1510), KSTP (1500), XESM (1470), KGER (1390), KIT (1280 off 7), KFVD (1020), KYA (1260), KFI (640), KOIN (970), KHSL (1290), KLX (910), KOL (1300), KOMO (1000), KIRO (710), KDYL (1320), KPAS (1110), KJBS(1100), and XEG (1050).

The best 250 watters are KTOH (1490, 7-8 p.m.), KFMB (1450), and KCKN, KFRE, both on 1340, the former being all night, and the latter best at 7 p.m. KLRA has the "Swing Shift" at 6.30 p.m. Sundays on 1010, and is well received, while WDSU now operates all night and is best at 7 p.m. KOMO has switched frequency with KJR, and is now heard on 1000, KJR now being on 950 kcs. KABC, at present a 250 watter on 1450 kcs., plans to purchase the equipment formerly used by XENT at the cost of £40,000, and hopes to operate on 680 kcs. with 50,000 watts.

November should find midnight reception near its peak, so here is a full list of the stations which should be received when conditions are good. (o) Indicates opens at this time.

8.30 p.m.—WWVA(o).
9.0 p.m.—WJJD(o), WDSU, WTAM(o).
9.15 p.m.—WCKY(o).
10.0 p.m.—KSTP(o), WSB(o), WLAC(o), KLRA, WSAI(o), KXYZ(o), KWKH(o), WAKR(o), KMA(o), KXEL(o), KMOX (o).
10.30 p.m.—CMCY(o), CMQ (o), WOW(o), KXEL, WHO(o), WWL, KTRH(o).
10.45 p.m.—KARK(o), WFLA(o), WOAI.
11.0 p.m.—KSCJ(o), KMMJ(o), WTCN, KOMA(o), WLS, KFH, WWL, WBAP, KVOO, WQXR, KRLD.
11.15 p.m.—WJBO(o).
11.30 p.m.—KMTR, CBM, KRRV.
12.0 p.m.—KPAC, KPRC, CKY, KGDM(o), KGMC, WBBM, KSL, KTAR(o), KFOX.
12.30 a.m.—KLO(o), KYOS (Spanish), WOC, XEMO, KGHL, KECA.
1 a.m.—KOIN, KTRB(o), KXL, CFCN, KYA (o), KGER, KOL, KARM(o), KFRC (o), KFWB, KECA, KMO, KPRO(o), KFAC, KERN.
1.5 a.m.—KFMB(o).
1.30 a.m.—CKWX(o), KSRO(o).
2 a.m.—KIEM(o).
3.30 a.m.—KGMB (o)
3.45 a.m.—KGU(o), KHBC.
4 a.m.—KTOH.

SHORT WAVE.

India.—The latest list from Delhi gives these frequencies and calls now in operation:—VUD4, 9.590 mcs.; VUD5 on 7.275, 7.300, 11.760, 15.190, 17.830; VUD6 on 11.830, 7.215; VUD7 on 6.190, 11.790, 9.630; VUD8 on 15.350, 11.870; VUD5 (15.190 mcs.) has news in England at 3.30 p.m., followed at 3.45 p.m. by a Chinese programme. At 7.30 a.m. news at dictation speed is now broadcast by VUD8 (11.87), VUD7 (9.63), VUD4 (9.59), VUD5 (7.30), VUD5 (7.275), VUD6 (7.215), VUD7 (6.190), and VUD2 (4.96). VUD8 (11.87) and VUD5 (15.19) test at 10.45 p.m.

United States.—Further additions this month include two more N.B.C. stations, WNRX and WNRA. WNRX on 7.565 mcs., broadcasts till 7 p.m., after which they move to the 520 metre band, being heard on 14.57 mcs. at 11 p.m. WNRA on 601 closes at 7 p.m., and re-opens at 7.15 p.m. on 9.855 mcs., being heard till 8 p.m., when KWIX comes on, blotting them out till 10.30 p.m., after which they are again heard till closing at 11 p.m. WNRI in the 23 metre band, 13.05 mcs. is good in the morning, while in the evening WNRA uses this frequency at 11 p.m. WCBN, New York, carries baseball broadcasts at 8 a.m. on 11.145

(Continued on page 17)

SHORT WAVE—New Stations of the month

Megacycles	CALL	LOCATION.	ITEMS OF INTEREST.
15.190	VUD5	Delhi, India.	News in English, 3.30 p.m.
15.130	KGEI	San Francisco.	Opens 8 p.m. with news.
14.570	WNRX	New York.	News 11 p.m., heard also 7 a.m.
13.050	WNRA	New York.	News 11 p.m.
13.020	WLWR	Cincinnati.	Heard at 8 a.m.
12.960	WLWR	Cincinnati.	Better signal, news 8 a.m.
11.840	VLC7	Shepparton.	To North America, 5.10 p.m.
11.730	KGEI	San Francisco.	Opens 5 p.m., poor signal.
11.680	——	Port Moresby.	Dispatches to U.S.A., midnight.
11.145	WCBN	New York.	Baseball 8 a.m., European service, 9.30 a.m.
9.897½	WLWL	Cincinnatti.	News at noon.
9.855	WNRA	New York.	7.15-11 p.m.
9.590	DXU9	Berlin.	News 5.30 p.m.
7.275	VUD5	Delhi.	News 7.30 a.m.
7.215	VUD6	Delhi.	English 7.30 a.m.
6.425	——	Berlin.	News 5.30 p.m.
6.130	VPD2	Suva, Fiji.	Sundays 5.55-9.30 p.m., daily 8.10-9 a.m.

GIRDLING THE GLOBE

(Continued from page 16)

mcs. in chain with WBOS on 15.21 mcs. WCBN opens its usual European service at 9.30 a.m. WRCA has been heard opening at 7.14 a.m. on 11.89 mcs., while WBOS operates till 9.30 p.m. on 9.57 mcs. On the West Coast, KWID uses 7.23 mcs. from 9.15 p.m., and KGEI is on 15.13 mcs. from 8 p.m. KGEI can be heard in the afternoon from 5 p.m. on 11.73 mcs., but at poor strength.

Australia.—VLC7 Shepparton, carries the North American transmission, 5.10-5.40 p.m., together with VVLG3. A special service to the Far East is broadcast by VLG4, 15.315 mcs, and 11.88 mcs., at 11 a.m., during which messages are broadcast for prisoners of war and civilian internees in Japanese hands.

New Guinea.—Special dispatches from the South West Pacific are broadcast nightly for the Blue Network, San Francisco, by a Port Moresby transmitter on 11.67 mcs., from midnight.

Syria.—FBU, "Radio Levant," Beirut, broadcasts a special service for troops from 3-3.45 a.m. Verification letters received have been signed by the Officer Commanding, Captain M. R. L. Bazalgette, FBU, Forces Broadcasting Unit.

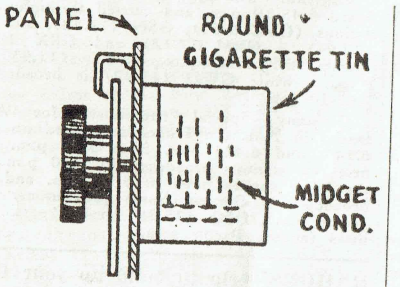
England.—The B.B.C.'s Pacific service is now heard 5.45-10 p.m. and carried throughout on stations (GVZ 9.64), GSN (11.82), and GRV (12.04). GRM (7.12) and GRX (9.69) operate till 7.30 p.m., GVY (11.955 till 9 p.m., while GWD (15.42) is broadcasting 7.45-10 p.m.

Germany.—Special broadcasts for Allied troops in Northern France are heard on 9.59, 6.145, and 6.425 mcs. from 5.30 p.m. The first two stations broadcast till 6.40 p.m., but the latter carries news at 5.30 p.m. and then broadcasts a German home programme. At 10.30 p.m., DJQ (15.28) has a session on news for the Pacific area.

RAHOBS, help to build up your Club; try to get ONE more member.

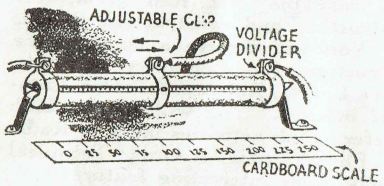
HINTS AND KINKS

The following Hints and Kinks hav e been sent in by Readers. Rahobs, help your Club by contributing to this column.



HANDY CONDENSER SHIELD.

A round tin as used to pack 50 cigarettes is ideal for shielding midget condenser in short-wave receivers. Drill a hole in centre of lid large enough to admit condenser spindle. Fasten lid to panel by means of two small nuts and bolts. A small slot in tin will allow the lead from the fixed plates to pass through.

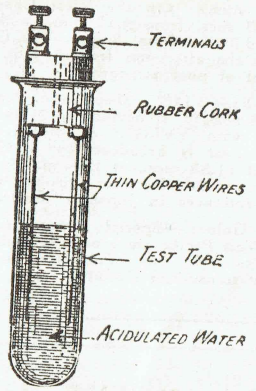


Handy scale for variable voltage divider does away with voltmeter checking each time clip is changed.

A SIMPLE POLARITY INDICATOR.

When charging accumulators it is always necessary to know which terminal of the mains is positive and which is negative.

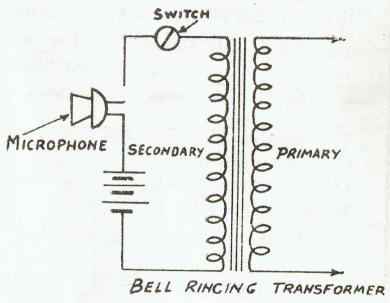
This may be determined very simply by placing two leads from these terminals in water. The wire on which most gas is formed is the negative, and should be connected to the negative terminal of the accumulator. The reaction is increased if a little sulphuric acid is added to the water. Vinegar will do in the absence of other acid.



A POLARITY INDICATOR.

A neat form of indicator may be constructed in a glass test tube. A rubber cork is fitted to the tube through which two small terminals pass. These each have soldered to their ends a length of thin copper wire. The accompanying sketch will make the construction clear. It is advisable to drill a small hole through the stopper to allow the gas to escape.

SUBSTITUTE MIKE TRANSFORMER.



A bell ringing transformer can be pressed into service as a microphone transformer. The primary (240 volt winding) is connected to the amplifier, the secondary (6 or 8 volt winding) to the microphone.—Rahob A143.

RADIO WITTIQUIZ

By H. VERNON WHEATLEY.

JUNIOR WITTIQUIZ.

(Answers on page 25).

Five questions with a value of 20 points each. Using both hands and taking off our boots to make counting easier, we find that five right gives you a top score of 100 points. Consequently four right gives you 80 points and this isn't bad at all. 60 points means that you should try harder, and under this score, you should try harder still.

1. Our first question deals with a popular theory, and, at a first glance we seem to explode this theory very noisily—but we don't. If we remove the grid leak from a detector tube circuit, it should "blot itself out," or, in other words, stop operating, as there is no component to return the grid to "zero." But in quite a lot of cases, the tube goes merrily along, even though the regeneration is impaired. Why?

2. A comparatively simple action allowed the science of radio to make tremendous strides. This concerned the internal geometry of a vacuum tube, and was (a) the construction of a carbon plate to dissipate heat easier; (b) the introduction of a grid into a diode; (c) the perfection of a cathode element to give us better a.c. tubes; (d) the use of thorium coated filaments; (e) the insertion of an extra grid into a triode; (f) ditto, pentode.

3. This one is easy. If you had a variable condenser whose moving plates were half circular in shape, you'd know that the type was (a) straight-line capacity; (b) straight-line frequency; (c) straight-line wavelength; (d) compression.

4. You have heard the term "inter-electrode capacity." This denotes the small capacity which exists between the elements in a tube. If a diode tube has only one inter-electrode capacity, a pentode has (a) three; (b) four; (c) five; (d) six; (e) seven; (f) two.

5. Is this interelectrode capacitance constant in all cases when the tube (any type) is in an operating condition? Yes or no. Be careful during the 10 seconds allowed to think it out.

TELEVISION

By Rahob 6792.

Somewhere in London in the year 1925 there sat a young man named John Logie Baird, looking at the image of a puppet which was being televised from another room. From the hard work of this man has risen one of the most marvellous inventions—the power to relay moving scenes from one place to another by radio. John Baird often sacrificed his meals to buy more parts for his experiments in the attic where he lived. For years he experimented with a mass of wires, batteries and bicycle parts until he obtained his goal. In 1928 he transmitted the first picture across the Atlantic. Admittedly it was only the size of a postage stamp and very distorted but it was marvellous considering that the practical range of television so far is only 30—50 miles. It has been said that unless some entirely new way of television transmission is discovered, its range will never be very great. At present one has to be within about 30 miles of the station. Regular programmes are already being transmitted.

HOW A SCENE IS TRANSFORMED INTO WIRELESS WAVES.

Television was originally transmitted by means of selenium cells but these are now considered out of date.

In order to transmit a scene it is not sent as a whole, but it is split up by a process known as "scanning." These little pictures are transmitted in a certain order at the rate of 25 per second. "Why 25?" you ask. There are two reasons for this.

1. Motion pictures are projected at 24 per second and may be projected at 25 without the error being noticeable.

2. The frequency of the modern a.c. supply is 50 cycles so that it is convenient to scan at 25. Scanning is now done by electron guns but was originally done by means of a disc with holes arranged in a certain way punched in it, which is spun round between the scene and the seleniom cell.

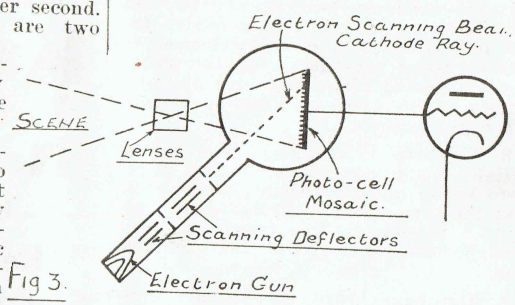


Fig 3.

There are two commonly used types of scanning.

1. **Sequential.**—This process starts from the top left hand corner of the pictures, and traverses a path roughly like Fig. 1.

Actually it only shows 5 scansion lines, in reality there are 250 and now more common 441. You realise that the more lines there are, the greater detail there will be.

2. **Interlacing.**—See Fig. 2. As is seen the scansion does every second line then starts again and does the others. This reduces flicker to a negligible amount.

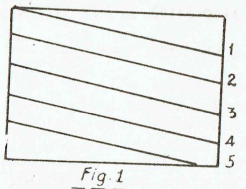


Fig 1

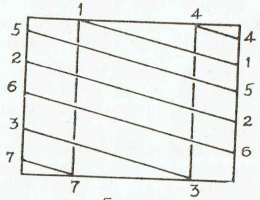


Fig 2

So much for scanning. Now I will explain the apparatus which converts light into electrical energy—the heart of the transmitter. Two types of cameras are used nowadays. The "emitron" and the "Baird Electron" camera.

The Emitron.

The Photocell mosaic is the secret of the Emitron. It consists of a thin flat mica plate about 4in. x 5in. covered on the side remote from the lens by a continuous layer of some good conductor such as silver. This is connected to the grid of the first amplifier. On the other side of the plate is a mosaic of silver globules completely isolated from one another and have a density of hundreds of thousands per square inch. The silver globules are slightly oxidised and covered with a coating of some photo-active metal such as caesium or rubidium. The mosaic thus consists of millions of microscopic photo-electric globules forming condensers with a mica dielectric, the second plate on the other side being common to all. When light is thrown on to the screen, different condensers in different parts acquire different charges, depending on the intensity of the light. The main feature of the emitron is that the whole screen is illuminated, being very sensitive so that the light required is not any more than for the modern photographic studio. The most complicated part of the tube is the scanning system. The cathode ray beam is deflected by means of the plates to the paths over the screen as required by the types of scanning previously described. The ray neutralises the charges on the condensers as it passes over them and thus a minute quantity of current flows off the other plate to be amplified, its value depending on the intensity of the light which fell on to the mosaic. To enable the receiver of television to reassemble the pictures in the correct order at the other end, synchronising signals are sent along with the carrier. These are made by the apparatus which makes the time base for scanning. Their separation will be explained later.

THE BAIRD ELECTRON CAMERA.

This operates very differently to the Emitron. It consists of a cylindrical high vacuum tube and contains a normal photo-cathode at the end remote from the lens.

The accelerator electrode is a thin film of silver on the inside of the tube. The photo-electric cathode is continuous like an ordinary photo-cell, the image being televised focussed on to this and the photo-electrons leave the plate, the density being proportional to the intensity of the light. As a result of the accelerator and deflector plates the electrons leaving the plate trace a vertical path down the tube. The electron image thus formed is scanned in an extraordinary manner. The scanning aperture remains fixed, the small hole in the electrode being in the focal plane of the image. By means of special coils the whole image is deflected from side to side up and down across the aperture moving forward and passing into the aperture in their turn. They are collected and amplified. The scanning aperture leads to the electron multiplier in which the signal is intensified. If this was not there, the noise to signal ratio would make this camera impracticable.

A special camera combining both these cameras has been developed and is called the "Super Emitron." Also a double-sided mosaic is being tried.

After the currents from the cameras have been amplified, they are modulated and together with the synchronising signals are applied to the R.F. Carrier. The wavelength used for television is about seven metres. This does not explain such unwanted things as secondary emission and other hinderances which are cut out by special apparatus such as "tilt and end controls."

TELECEIVERS.

The teleceiver somewhat resembles the audio receiver in the first stages but of course the final stage is totally different. The main part is the cathode-ray tube from which one sees the images. These are of the high-vacuum type and require plate voltages from 1500—2000. The line synchronising signals are removed from the signal just prior or just after detection, the latter being more common. Teleceivers are of superhet type and have

(Continued on next page.)

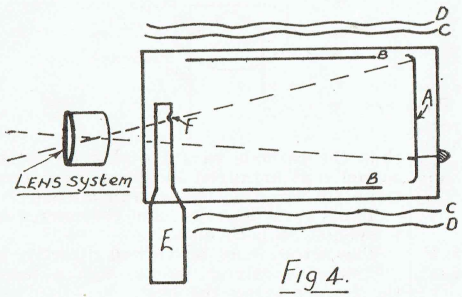


Fig 4.

A. Photo electric cathode.

B. Accelerator.

C. Magnetic Focusing Coil.

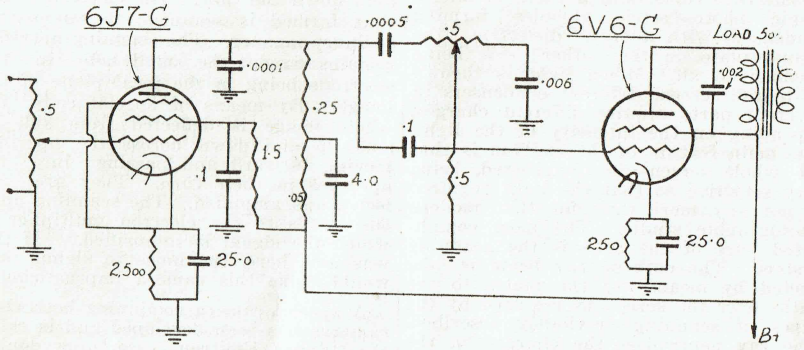
D. Deflector System.

E. Electron Multiplier.

F. Scanning Aperture.

THE LAMPHOUSE, 11 Manners Street, Wellington, C.1.

CLASS A AMPLIFIER



I have just built a Class A Amplifier, and have had good results with it. According to a Valve Chart the output should be 4.25 watts. The chassis is 6in. x 4in. x 2in. and made of aluminium, while the power pack I built for it is 8in. x 6in. x 2in. and made from steel. I am enclosing the Amplifier circuit.—Rahob 7827.

Television

(Continued from page 21)

about 16 valves to drive a 5in. or 7in. cathode ray tube. Typical valves complement for a teleceiver is:—

1851 R.F. Amplifier 6K8 Mixer

1851 1851 1851 — I.F. Amplifiers. — 6H6 Detector.

1851 1st Video Amp. — 6V6G 2nd Video. — 6H6 Synchronising Signals Rectifier.

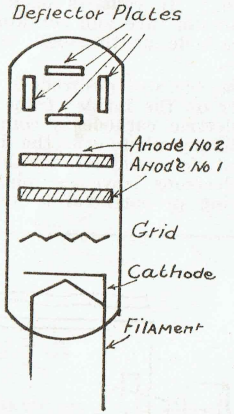
6L7G 6F8G — 2 Pairs H.F. and L.F. sweep amplifiers.

(The 1851 is a special television tube).

The video frequency corresponds to the audio frequency in an audio set. The two pairs of 6L7G and 6F8G feed directly into the cathode ray tube, which in this case is 5in. with a plate voltage of 1500. There are nine controls on this set, but only three are used to any extent.

I.F. Channel Gain; Bias Adjust; L.F. Synchronis; H.F. Sweep tuner; L.F. Sweep tuner; Cath. Ray beam intensity; Cath. Ray Focus; Horizontal beam shift; Vertical beam shift.

The amplified signals are applied to the grid and the high plate voltages to Nos. 1 and 2 plates. Synchronising voltages are applied to the deflectors and



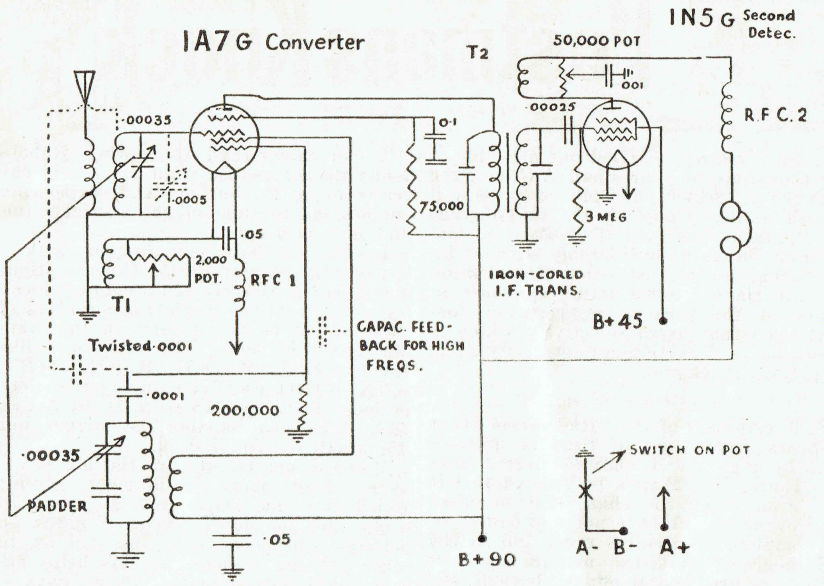
thus the cathode rays are shot on to the screen and arranged in the correct positions just as they were transmitted.

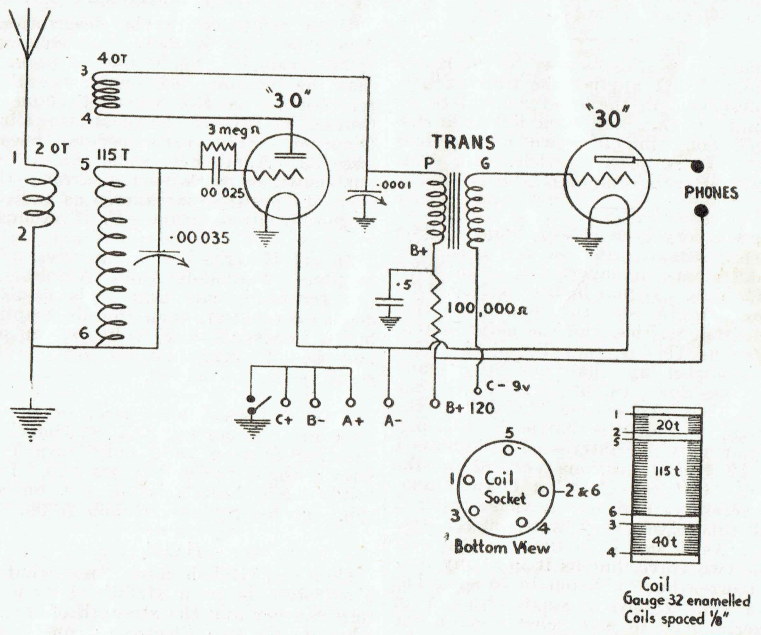
Thus cathode rays are the secret of television at both ends.

The screen may be viewed directly, by means of a mirror, or through a lense, the former being the best.

CIRCUIT REVIEW

TWO GOOD TWO-VALVE CIRCUITS.





I have recently carried out a couple of modifications to your small A.C. set, the "Eaglet 2," which have proved quite well worth while. Coupling the audio stage by parallel-feed 3-1 Transformer, increased the gain considerably without introducing undue distortion. Substitution of a variable .0001 mfd. condenser in place of the present regeneration control gave that extra selectivity which is desirable in a station-crammed city area. —F.F.G., Auckland.

The criticism of the "Radiogram" that appears from time to time is quite a healthy sign as it shows interest, and the Editor can always be trusted to sift the grain from the chaff, and so effect improvements. I have not had cause yet to complain of needless repetition in the "Radiogram," and the articles by contribution are not stretched beyond the point of general interest. I started radio 18 years ago when we had to make nearly everything but the tools.—Oamaru, Rahob 6459.

Some of the Rahobs may be interested to know that I applied the Salving process described in the 1943 Annual to an accumulator that had been left in a discharged condition for two and a half years. It restored it with quite some success.—Paraparaumu, Rahob 7040.

I am a very keen DX-er, using a 1938 7-valve Ultimate, and in my good city locality I have an inverted L aerial 90ft. x 45ft. high. If you looked at N.Z. DX-er you would see the extent of my broadcast activities, and the point of telling you all this is, that I find the Ultimate (bottled up) has not very many advantages for straight-out DX over my Hikers Two. Of course, the dial of the Ultimate is half the battle in DX-ing, but you may be interested to know I have 12 U.S.A. stations verified on the Hikers. I logged CJOC a 1 kw. Canadian recently, and the next morning I heard this catch very well on the two valve. As I say I do not have to rely on the two valve, but as it is at my bedside I often have a listen in to see what it can get. I have a small trimmer in the aerial lead to give selectivity on the locals, but when the locals go off the air, I switch over off the trimmer and the Hikers really "goes."

I can understand that other Rahobs really do not realise what small sets can really bring in, but my D.X experience enables me to tune in at the right time and dial position.

I will not bore you further with a list of fifty regular Pacific Coast stations heard on the Hikers. In a country locality away from the locals I'm sure lots of these would be heard early in the evening, and I've heard the large ones like KVOO, KSL, KWKH, KMOX, WBT, KNX, KIRO, and KFI during the silent period. I still use 18 volts B, 1½ A and 33's. These valves chew the current, but it's worth the fun indeed.

When I am DX-ing on the big set, I have a lead from the filament circuit which gives me ample light to read call books and jot down reception notes, so perhaps you could pass this tip on to other DX-ing Rahobs, as this helps ensure electricity greatly these days.—Auckland, Rahob 10450.

SHORT-WAVE MIDGET TWO.

With reference to the description of the above receiver in the September "Radiogram," I would like to point out that the biassing resistor for the 1S4 is referred to as R5, when it should, of course, be R6, as shown in the Circuit Diagram. This error occurs twice on page 22. Another point is that C8 was not shown in the wiring diagram. However, its position is exactly as indicated in the circuit diagram.—F. H. Adams.

In my Hiker's Two I am using a 1B4 in place of the 49 Audio Amplifier. I can truthfully say that it is easily as good, even better, than the 49 Amplifier, but it needs up to 45 volts on the plate and 1½-volt grid bias to get the best results.—Rahob 11449.

Two articles I have read in the Annual are "Reporting DX Stations" and 'Getting Started" and only wish I had known about the club years ago. I certainly have been missing out on somthing good.—Sydney Rahob A390.

S.O.S.

Can any Rahob advise me what the Electrolyte is in a Balkite ½ amp battery charger and the strength of it? Also what do the two Electrodes consist of.—Rahob 5256. H. Walsleben, Songer St., Stoke.

Rahobs! Please let me know whether Postman's Knock pages interest you.—Rahob 1.

I notice in the prizes of £1 that V. H. Wheatley's name is mentioned. How is it that he receives the first prize and a £1 prize? I hope he keeps the good work up with his articles. They are very interesting.—Rahob 11143.

* * *

Rahob Wheatley submitted many entries to the recent competition, and it was only because there were so many good entries from other Rahobs that he only received two prizes. He was rather unlucky.—Rahob 1.

I have, for some time now been interested in Radio as a hobby and as a career and it was in the hope of gaining a little useful knowledge that, this year I was foolish enough to pay 6/- for the year's "Radiograms." Since the beginning of the year I have discovered practically nothing of use to me. Most of the circuits printed were extant when Adam wore rompers and the only part of the book that seems up to date is the DX Corner, run of the N.Z. DX Club—and the advertisements, which are **always** up to date. Now, I ask you to wake up a little bit. I would like to see the "Radiogram" produce something like the "Australasian Radio World" or some articles like Morse in "Radio News" and for goodness sake, scrap that half-page heading on the front. What about something modern? A few circuits of modern superhets, and what about a characteristic chart for all Philips and Mullard Tubes—you could probably borrow them from a serviceman if you tried. Now, I don't expect any sort of an answer to this letter and I don't suppose you'll take any notice of it either, but just in case you should happen to—shoot H. Vernon Wheatley and replace your worn down Editorial Staff with some live-wire Radio Fans.—Rahob 11328.

P.S.—Please don't think this missile at all personal. If you should, please forgive me.

* * *

Talking about being up to date, Rahob 11328 apparently does not know that the "Australasian Radio World" has ceased publication.—Rahob 1.

I wish to acknowledge receipt of the "Lamphouse Annual" and the "Radiogram." I might say I am by no means disappointed and consider the "Radiogram" one of the greatest little books I have ever read, and the Annual is a mine of information. Here's wishing the Club the very best.—Rahob A344, Australia.

A letter received from a bored Rahob No. 11048 (Auckland).

Among other uncomplimentary remarks he states that the "Radiogram" is a mouldy piece of paper that clutters his letter box.

While we endeavour to publish all criticism of a fair or constructive nature, we have no intention of publishing letters of the type forwarded to us by Rahob 11048.—Rahob 1.

REALM OF LIGHT.

Reference your correspondent, Mr. H. H. Taylor, who commented on my article "The Realm of Light" in your columns.

I stated that Miller was the colleague of Michelson for the very good reason that he was. My authorities for this statement, together with both my article and this letter in general, are: H. G. Gale, F. R. Foulton, Kaempffert, Heisenberg, and in a minor way, Perot, Benoir, Fabry, Compton, and various members of the Case School of Applied Science and the Ryersan Laboratory.

Dayton C. Miller was the original associate of Michelson in the early experiments with the two light rays, and it was Miller who found that the "race" between the two rays was not quite a tie. Professor E. W. Morley entered the picture at this stage to supplant Miller. At a later date Michelson was not satisfied, and he made more precise experiments, and the minute difference was put down by him and Morley to be an experimental error. This was accepted by most bodies, but not all. As yet, however, Miller's own experiments with regard to this minute difference are not accounted for and until this happens, who can give a final and correct verdict.

The partnership of Miller and Michelson did not receive the publicity of the Michelson-Morley team, so therefore the former was little known. Mr. Taylor was perhaps justified to query this particular statement.

I used the expression "distant stars are receding." The average man invariably describes all bodies in the universe as stars and as the article was written for the layman, the term used to generally indicate all bodies was completely justified.

I trust that this information will be of value to both Mr. Taylor and your readers.—H. Vernon Wheatley.

HOW THEY WORK

TRANSFORMER COUPLING METHODS

By H. VERNON WHEATLEY.

A transformer is simply a device for changing electrical power at one voltage and current, to power at another voltage and current. A step-down transformer performs as its name implies; it delivers a lower voltage but more current at its secondary winding, after a **higher** voltage and **small** current has been applied to its primary winding. With an audio or radio frequency transformer, the same action takes place, but in this case the components handle microscopic currents and higher frequencies.

Your three winding coils (aerial, grid and reaction) in your favourite "super-blooper" is in reality a transformer, as a transferrence of energy takes place between the windings.

Dealing with power transformers, the laminated strips of "iron" around which are the windings, play an important part in transformer construction. The cores appear in several styles, the most efficient being the closed core H type. The sketches given show three styles, one bad, one fair and the H type.

The ideal transformer would be a closed core "H" type, pie wound. Pie wound indicates that the primary and secondary windings are wound in sections in slots alternating with each other.

The closed core type as depicted could be improved considerably by winding the secondary over the primary winding and even more so by winding half the primary on one side and the other half on the other side, doing the same with the secondary. However, this is not a transformer constructional article, so we'll leave the headaches to the designers.

The primary and secondary windings act in a very peculiar way. If we place a resistor in either winding, the same effect will occur in the other winding, and the secondary voltage is always 180° out of phase with the primary volts, whether or not a resistance has been inserted in either winding.

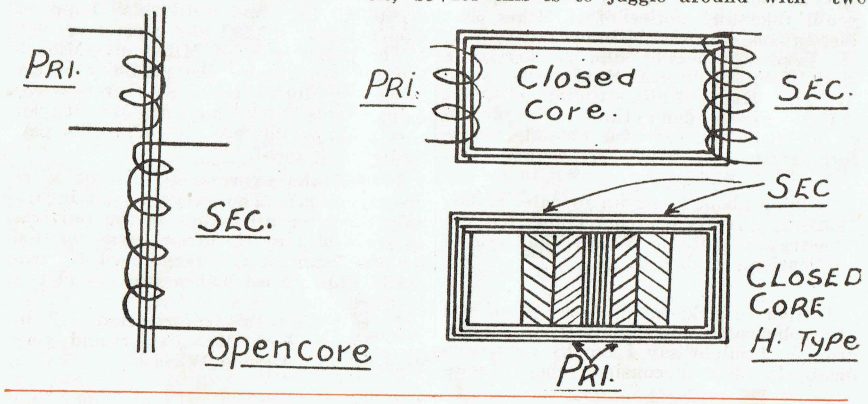
The principle losses to be found in a transformer may be tabulated as follows:

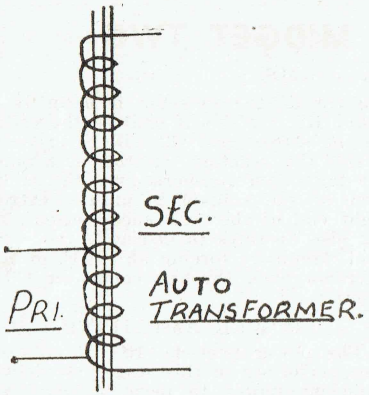
1. Magnetic.
2. Copper (resistance and skin effect).
3. Eddy currents.
4. Hysteresis.

The leakages in the primary and secondary windings are individual. Flux is lost because the hysteresis in the iron core causes heat. So you can see that there are plenty of losses to take into account.

Before we leave this section I'd like to introduce the Auto transformer which is regaining a little of its one-time popularity, principally in the R.F. application. The auto transformer comprises of one winding only, but this winding is tapped, to give a primary and secondary winding as shown in the sketch. Used for a power transformer, this type is limited to a small ratio and the disadvantages are:—

1. Circuits are not isolated.
2. The wire has to be heavy enough to stand heavy primary current and sufficiently insulated to stand higher secondary voltage. The obvious cure for this is to juggle around with two

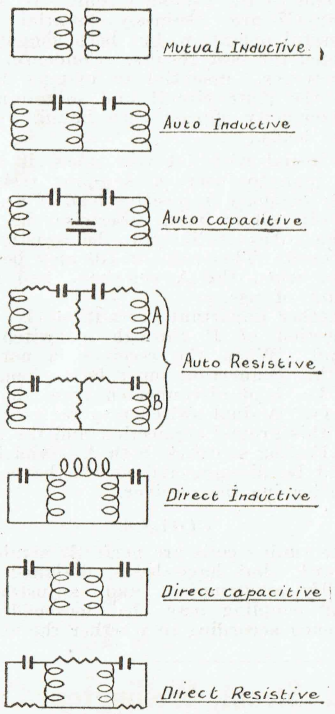




different gauges of wire, but by the time this is accomplished, it would have been just as well to build the normal type.

3. If the primary becomes open circuited, the secondary is automatically broken also. The advantage is that there are less copper (resistance, skin effect, etc.) losses.

R.F. transformers act in precisely the same way as their power and audio brethren, and to improve their efficiency some I.F. transformers make use of an iron core. This does not mean that the core consists of slabs of stalloy as in the case of power and audio transformers. The core of an I.F. transformer is composed of dust, perhaps impregnated in the former itself or some other such method.



To give you a better idea as to how transformers work, I intend to conclude this discussion with forms of coupling. There are seven principal methods of coupling and all these are shown.

You will probably recognise some of the above skeleton circuits. In the Auto resistive bracket, A is not the true auto resistive coupling. B is the absolutely correct form, although some publications gave diagram A. A couple did have the grace to make a correction, but others let it stand, which misled a few people.

The ratio marked on an audio frequency transformer gives a direct indication as to the nature of its windings. For example, a 1 to 3 ratio transformer has exactly three times the number of windings on the secondary than the primary has, and so on.

A transformer both transforms and transfers in a single action.

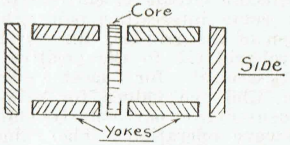
For those sufficiently interested in the construction of a home-made audio transformer.

Bobbin:—§in. in external diameter; §in. internal diameter; 1¾in long; flanges 1¾in. diameter. (Bobbin may be round).

Primary winding:—3,500 turns of 40g. S.S.C. copper wire.

Secondary winding:—17,500 turns of 47g. enam. copper wire.

The core is built up of narrow strips of stalloy to form a closed H core (see a previous diagram). Fifteen strips are required for the core, eight strips for each of the two sides, and 16 yoke strips, 5/16in. wide.



Each lamination is separately enamelled.

Candidly the trouble taken to make this component is worth ten times the price of an audio transformer, but some of you may care to have a shot at making one.

You will see by the number of turns contained in both the primary and secondary work out that ratio will be 1 to 5. If you get weary winding the secondary, you can stop at 10,500, alter the stalloy, etc., before assembling, and call it 1 to 3 and a hard job finished.

THE DUAL WAVE MIDGET TWO

By F. H. ADAMS.

Employing two 1.4 volt midget tubes in a resistance-capacity coupled circuit, this receiver will provide speaker reception of local broadcast stations, and phone reception of the more powerful short-wave transmitters.

The use of resistance-capacity coupling facilitates construction of a very compact receiver of small physical dimensions, particularly if the parts are mounted on a board and a small condenser is used for tuning. A solid dielectric type condenser would be suitable if carefully tuned. If the battery leads are soldered to a plug or a valve base and a suitable socket is mounted at the receiver, the usual assembly of straggling leads may be eliminated, and the batteries enclosed in a separate box. Or the receiver may be built up on a regular chassis with all small components mounted underneath. Whichever plan is adopted, it is a good scheme to leave space for an extra valve in case it should be later desired to add an audio amplifier.

Before considering constructional details it is proposed to briefly run over the circuit, as familiarity with the electrical circuit helps tremendously when the actual building is undertaken.

DETECTOR.

For this service the R.F. Pentode 1T4 was chosen. Used as a regenerative Grid-leak Detector in the old, reliable Reinartz circuit with plate tickler-coil, plenty of sensitivity was obtained. The tube, however, will not oscillate if the aerial coil L1 is too close to the grid coil =L2. A regenerative detector will usually perform best when loosely coupled to the aerial by reasonable spacing between aerial and grid coils.

The detector circuit is entirely orthodox, but some interesting points arise. Connection of the grid-leak directly from the control-grid G1 to the positive filament is essential for most efficient operation, and the values for grid-leak and condenser are particularly suitable for dual-wave operation. The value of the plate load R2 was assessed at 100,000 ohms rather than the usual 250,000 ohms on account of excessive drop in plate voltage occasioned by the higher value when operating from a 45 volt supply. If R2 is connected close up to the valve socket plate lyg, C2 will operate to by-pass radio frequencies from the plate circuit. Additional R.F. filtering did not appear to be necessary in the original receiver. An important feature of the detector hook-up is resistor R3. If this is omitted the voltage on the screen grid G2 will be excessive. When the reaction control is advanced for maximum regeneration, the sliding arm of the control is at the extreme right end of the resistance element, and R2 also operates to de-couple the screen grid circuit by forcing any R.F. or A.F. currents back through condenser C3 to ground.

POWER AMPLIFIER.

The power pentode 1S4 is an excellent performer in this stage. It delivers sufficient power to drive a small permanent magnet speaker if the incoming R.F. signal is strong enough, and to provide a healthy wallop in the phones for short-wave work. It will be noticed that the usual C bias battery is not employed. Instead, the voltage drop across resistor R5 is used to bias the control grid of the 1S4, thus eliminating one battery and two leads. A further advantage of this scheme is that the bias is self-adjusting and need not be adjusted as the batteries run down. The electrolytic condenser C6 must be connected exactly as shown, with the positive end to the ground circuit. Neither it nor C7 are absolutely essential for successful operation, but both should be included for best results. Condenser C5 is, however, essential to by-pass R.F. from the plate circuit and so minimise hand-capacity effects when handling the phone leads.

As usual with 1.4 volt tubes, it is a good plan to insert a dropping resistor in the common A positive lead if a new 1.5 volt cell is used, otherwise the life of the tubes is likely to be drastically shortened. This resistor R6 may be removed when the A cell has had fair amount of use.

Another important precaution is the connection of P through a switch to ground. When the receiver is not in use this connection must be broken, or the B— lead disconnected from the B battery. A dual switch may be used for both this ground connection and the A— lead. Failing switches, both A— and B— should be disconnected at the batteries, when leaving the receiver.

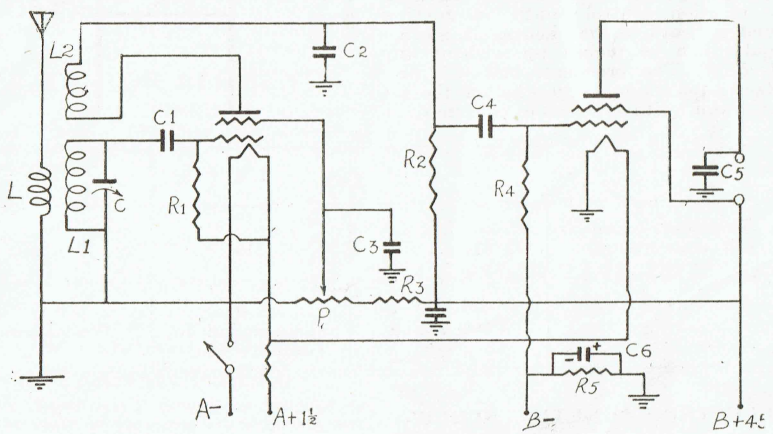
COILS.

The tuning coils are perfectly straightforward, but have been designed to simplify construction and adjustment. Aerial coupling may be loosened or tightened according to whether the aerial coil is pushed farther away from or closer to the grid coil. If the tube will not oscillate with ¼in. spacing between the two coils, additional turns may be added to the reaction winding, but even with a very run-down B battery not more than 12 turns should be required for the short-wave coil. Sometimes a big aerial will prevent the detector from oscillating. The remedy is to connect the aerial through a variable condenser to the aerial coil. As the condenser capacity is gradually decreased an adjustment will be found where the detector commences to oscillate. This adjustment will vary on the different bands, and also provides a means of roughly tuning the aerial circuit. Selectivity is always a problem with a regenerative detector and an aerial 25 to 30 feet long and as high as possible is the best type to use.

Adjustment of the reaction winding may be readily effected by winding on an extra turn or two for a start and then removing any excessive turns from the bottom of the winding. A Hikers or any similar coil should be suitable for broadcast. When winding the short-wave coil, the bottom end of the reaction winding may be scraped and cleaned, and then wound tightly around the top end of the appropriate former pin. The coil may then be plugged in and tried. Starting off with 12 turns, if necessary, remove the end of the reaction winding from the former pin, unwind one turn, cut, and attach again to the former pin. With a new B battery 8 turns should be sufficient, but each receiver will need individual adjustment on account of the many variable factors. If it is finally desired to solder the end of the winding, the method will depend on the type of former used. For instance, if a valve base and cardboard former is used, a short piece of 18 or 20 gauge wire may be soldered to the correct pin and brought out through a hole in the side of the base to serve as a soldering point. Coil adjustment, however, is not at all difficult on account of the action of the reaction control whereby the screen voltage may be varied from zero to maximum voltage, thus providing a very wide range of control.

CONSTRUCTIONAL.

The first job is to mount the coil and valve sockets, tuning condenser, switches, and reaction control. A four-pin valve socket may also be mounted to serve as a terminal for the battery leads. Even if a battery plug is not used, the socket makes a convenient terminal for connecting up the internal and external power leads. The battery leads may each be threaded through the socket directly from their respective lugs.



C—.000385 mfds.
C1—.00025 mfds.
C2—.00025—.0005 mfds.
C3—.25—.5 mfds.
C4—.01—.02 mfds.
C5—.001—.005 mfds.
C6—10—25 mfds.
R1—2 megohms.
R2—100,000 ohms.
R3—100,000 ohms.
R4—500,000—1 megohm.
R5—750—1,000 ohms 1 watt.
P—100,000 ohms for preference.

THE LAMPHOUSE, 11 Manners Street, Wellington, C.1.

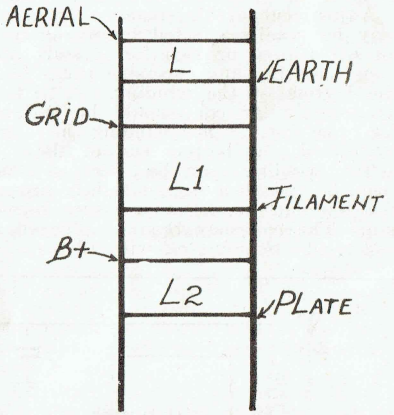
Commence the wiring by installing the ground system. A length of tinned aerial wire or solid bus wire may be run from the earth terminal across the chassis close to the condenser rotor connection and the coil. All coil and detector ground connections may be made directly to this wire. Another length of wire run across to the second valve socket, and soldered to the first wire at the point of intersection will serve for all ground connections for the 1S4. This method of earthing simplifies wiring and ensures efficient operation. The remainder of the wiring is detailed in the wiring diagram. Aerial and earth terminals are not shown, but may be mounted on the back wall of the chassis if desired.

The most important wiring precaution is to treat the condensers with consideration. If the ends of the connecting wires are well cleaned up before soldering it will help towards doing the job with a minimum of hot iron.

TESTING.

When the wiring has been completed, look the entire receiver over carefully, taking particular care to identify the battery leads. If everything appears to be in order, plug in the broadcast coil and valve, and connect up the phones, aerial, and earth. Leave the batteries till last and be sure you are not connecting the B voltage to the filaments. When the set is switched on, advance the reaction control until a rushing sound is heard in the phones. A station should then be picked up without any difficulty. The broadcast coil will provide a good guide as to whether the set is working with reasonable efficiency, as plenty of headphone volume should be available from the more powerful broadcast transmitters. The short-wave coil should be tried out at night. Slow, careful tuning will be necessary with the detector maintained just on the verge of oscillation. A little experience at the controls will teach the operator how to get the most out of his set. There should be plenty of short-wave stations to be heard at reasonable volume, and the operator will soon locate the different bands, and become acquainted with the best times to listen for particular stations.

Note:—The electrolytic condenser C6 may be switched to ground. Breaking this connection will prevent any possible leakage from the batteries when the receiver is not in use.



		L 1	L 2
Broadcast Coil (all close-wound)	L 15 (32 g.)	110	25.30
Short-wave Coil	3 (24 D.C.C.) Close-wound	5 Space-wound to occupy ½in.	8.10 Close-wound

ELECTRO-MAGNETIC SCREW-DRIVER

If the shank of your screwdriver has about 50 turns of wire wrapped around it and connected to a 4-volt battery it will become magnetised and hold metal screws and bolts.