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Printed by Blundell Bros., Ltd., Willis Street, Wellington.—August 1, 1944, E.P. 14295.

The New Zealand RADIOGRAM

6D

Volume 11, No. 8. WELLINGTON, N.Z. AUGUST 1, 1944.

(Registered as a Newspaper). Published in Wellington on the first day of every month

AIDS NATIONAL ECONOMY

THE REALM OF ELECTRONS

(H. VERNON WHEATLEY.)

If the electron had never become the subject of intense research, Fleming, in all probability, would never have experimented with vacuum tubes, and this is indeed an alarming possibility, because the science of radio would never have made the progress it has. So, when you think kindly of Fleming, give a thought also to Millikan, Richardson, Compton and others, who were the real pioneers who paved the way for Fleming, de Forest and company.

Richardson produced the law of thermionic emission after experiments of more than a decade, to prove his theory of the emission of electrons from hot filaments. He also covered practically every field which deals with electrons, and thus was responsible for the spade work which gave the world the X-ray and photoelectric devices.

Millikan was the man who measured the charge of the electron. Rough estimates indicated that "cathode rays," which appeared when an electric current was passed through rarefied gas consisted of minute particles carrying electric charges, which were approximately the same value as that carried by a hydrogen ion when water is dissociated by an electric current. Further research suggested that all electricity was probably divided into such "electronic units." Thus was later born the terms electrons, protons and photons. The measuring of electrons and so forth was attained by making a tiny drop of oil from an atomizer catch or lose an electron, and its motion was watched when between two parallel electrified plates. From the rate of motion, the size of the electric charge could be calculated. Many drops of oil of varying sizes, charged in diverse ways, were measured, and oil was substituted with mercury. Always the charge on the drop was a small whole multiple of a certain unit. Taking an average of all the readings, the unit charge could be measured to about one part in a thousand.

It seems to the average man a shocking waste of time, energy and money just to learn this constant precisely, but the fact is that the electron is one of the three fundamentals of which it appears the world is made (electrons, protons and photons). The electric charge carried by the electron is its most characteristic property, and hence is one of the true basic facts of nature. Then, if the electric charge is definitely known, the number of things one is able to calculate with pecision are legion. Such calculations cover the number of molecules in a cubic centimetre of air, the weight of atoms, the distance between layers of atoms in a crystal, and other things which seem highly scientific, but have a very real influence on industry and our everyday life. Therefore, the charge of the electron is a quantity which is second only to the velocity of light as a fundamental constant of nature.

Other people have studied this field, but Millikan's findings have been the

(Continued on Page 5)

A SIMPLE WHEATSTONE BRIDGE

PRACTICAL DETAILS FOR THE CONSTRUCTION OF A SIMPLE BRIDGE FOR THE MEASUREMENT OF RESISTANCE.

(From Australasian "Radio World.")

Last month we discussed various methods of resistance measurement, some based on Ohm's Law (I equals E/R, therefore R equals E/I), others using the balancing of potentials in a Wheatstone network. The latter method is the more accurate in practice and the simple device described here enables comparisons to be made to within one per cent. if care is taken. Under good conditions, an accuracy of one part in a thousand may be obtained. The apparatus consists of four parts:

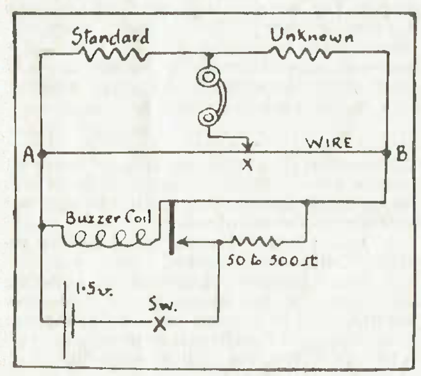
1.—A current source.
2.—The Bridge.
3.—A Standard Resistor.
4.—A Detecting Device.

If a battery is used as a source of current, the detecting device must be sensitive to D.C. and a galvanometer is suggested. A good quality O — .1 milliameter is quite suitable.

For those people not lucky enough to possess such an instrument, we suggest that an A.C. source be used and that the detecting device be a pair of earphones. A really good A.C. source may be made from a buzzer and a dry cell, the buzzer being enclosed in a soundproof box and preferably shielded. Anyway, we'll have more to say on these points later on.

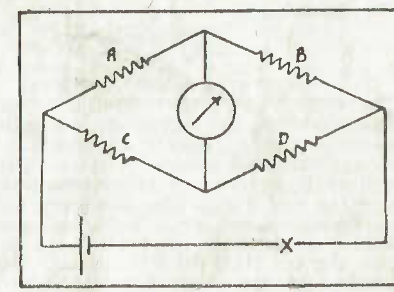
DESIGN OF THE BRIDGE

The bridge consists of a length of uniform resistance wire, together with



a slider or movable tap. A scale divided into either 100 equal parts or divided according to a "bridge" scale, is fastened beside the wire. The parts of the wire on each side of the movable contact form two resistances in the Wheatstone net. The other two resistances consist of the "standard resistor" and the resistance to be measured. The accuracy of the result depends on the accuracy of the standard resistor. Resistors correct to within 2 per cent. are usually obtainable at a price only slightly more than for an ordinary plus or minus 20 per cent. resistor. Resistors correct to one-half of one per cent. are also easily obtained. Further accuracy is not necessary for most radio work, and, in any case, would be useless, as the bridge itself introduces some error.

The resistance wire must be uniform, as we are going to take the ratio of its lengths as the ratio of its resistances (measuring in each case from the mov-



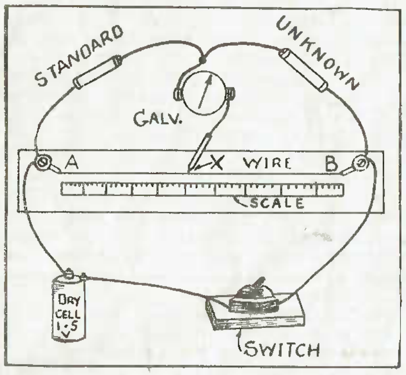
able contact). The careful unwinding of a 30 ohm rheostat or a 100 ohm wirewound potentiometer will provide a good length of suitable wire.

CONSTRUCTION

Having obtained the length of resistance wire, the actual usable length must be decided. This should be either one metre (the scale is then one metre long and is divided into cm and millimetres) or 20 inches (the scale is marked off in inches and tenths of inches. The wooden baseboard to carry the wire must be about 6 inches longer than the usable length, and 4 to 6 inches wide. It must be quite rigid and quite dry. A coat of shellac varnish is a help. The wire is tightly stretched between two solder lugs which must be spaced so that the length of wire between the lugs is correct. The pieces of wire embedded in the solder on the lugs are not counted in the length. At each end a pair of flexible leads, each fitted with a good quality alligator clip should be soldered. The movable contact may consist of a piece of brass rod or thick copper wire. One end is rounded so as to form a "smooth point." To the other end are soldered three insulated wires with alligator clips. The scale must be close to the wire and may be underneath it.

USING THE BRIDGE

The ends of the bridge (A and B in the diagram) are connected to the cur-



rent source (the dry cell or the dry cell-plus-buzzer). The standard resistor is connected between one end (A) and the unknown resistor which is connected to the other end (B). The detecting device (galvanometer or phones) is connected between the movable contact, which for the time being is left off the wire and the junction of the standard and unknown resistances. The movable contact is touched lightly on the wire and a current is registered by the galvanometer (or phones). The movable contact is now moved along the wire until finally a position is found at which the galvanometer (or phones) does not indicate a current. (Position X in the diagram.) The distances AX and BX are measured and the unknown resistance is calculated as follows:

Unknown equals Standard res. × BX ÷ AX, i.e. the ratio of the unknown to the standard is the same as the ratio of BX to AX.

It is advisable to have several standards, as the nearer BX and AX are equal, the more accurate is the Bridge. If "balance" is obtained very close to one end of the wire, then it is a sign that the standard resistor value is far too low or too high.

THE GALVANOMETER

If a galvanometer is used, it should be "shunted" by a length of copper wire (say a foot of 30 gauge) until balance is nearly obtained. Otherwise the unbalance of potentials will send sufficient current through the galvanometer to ruin it. When the balance is nearly obtained, the "shunt" may be removed. A quarter-ohm filament resistor may be used as a shunt.

PHONES

These should be standard good-quality radio phones wound to about 2000 ohm D.C. resistance. Ear-pads of sponge rubber are a help, as they keep out extraneous noises, including sound from the buzzer, besides making the phones more comfortable to wear.

BUZZER

If a buzzer is used as a source of A.C. voltage, it must be in some sound absorbing container. A good way is to mount it in a close-fitting cardboard box which is in turn mounted in a cardboard box with a layer of cotton-wool in between. The second box is then placed in a wooden box and the outer gap filled with sawdust. The two cardboard partitions and the wood reflect back part of the sound, whilst the cotton wool and the sawdust absorb most frequencies to a large extent.

The buzzer (and sound-absorbing box) can be enclosed in a metal case which is earthed, thus helping to prevent A.C. being picked up directly by the phones via induction. If there is a direct pick-up of A.C., there is no position on the wire for zero sound, only a minimum position is found. Connecting a resistor between the contacts of the buzzer improves the note, but may tend to stop it from working. Best results were obtained with a special buzzer using carbon contacts (actually a simple type of microphone!) with a 50 ohm resistor across the carbon contacts.

INCREASING THE SENSITIVITY

Interchanging the position of current source and detector sometimes improves the sensitivity and allows a sharper balance to be obtained.

A high-pitched buzzer gives better results than a low-pitched one.

A large number of standards covering the range to be measured is also very helpful. It is a good idea to make not one, but a dozen measurements, and take the average, thus reducing "experimental" error.

THE REALM OF ELECTRONS

(Continued from Page 1)

most reliable. Millikan's notable "firsts" were the precision measurements of the speed of electrons in photoelectric cells, and the record he once held for having obtained the shortest wavelength ultra-violet light that had been observed. To Millikan also must go the credit that he was responsible for giving the evidence which led to the scientific world focussing its attention on those mysterious messengers from interstellar space, the cosmic rays.

Compton's work showed us that in the world of the atom we deal practically with pure chance. This gentleman concerned himself a great deal with X-rays, and, in partnership with Mitchelson, they proved themselves to be the "big shots" when it came to measuring light. We are still led to believe that light travels in waves through a medium called ether. The long waves are called red, the shorter blue and violet and so on. Beyond the red are heat waves, which we feel but do not see, and beyond the violet are the ultra-violet and X-rays, which are invisible. Professsor Planck proved that the ether is not always like a carpet which can be shaken at one end to produce the waves that we see as light. Planck argued that there were no waves—light came in particles, or, as he called them, "quanta." This is the Quantum Theory, and illustrated that light came in jerks, like a spray of projectiles that follow one another so rapidly that the effect of continuity is obtained.

Compton stepped into the breach and produced the experiment that proved that light sometimes, but not always, acts as though it were composed of bullets. X-rays are light rays, so he shot them under conditions that scattered them. (Hold a piece of thin, translucent paper against a lamp, for an illustration of this scattering.) These scattered X-rays increased in wavelength, if they had a wavelength, and this phenomenon was theoretically impossible if X-rays were waves. It was only possible if we supposed X-rays to be composed of minute particles, as Planck predicted. The Quantum Theory therefore has done away with cause and effect, simply because chance takes a hand when light corpuscles shoot around, so we now have the "principle of uncertainty."

The popular model of an atom was a nucleus of protons around which revolved negative electrons, like an ultra-microscopic solar system. It was then shown that the outer electrons would in time fall towards the nucleus. In other words, all the matter in the universe itself, and therefore the whole universe, should have collapsed long ago. Since the universe is still with us, it was necessary to revise things. So intead of revolving round the nucleus in definite orbits like a well-behaved solar system, the electrons wandered at will within the atom. It cannot be stated definitely where an electron is in an atom. The result is that physicists can merely indicate the probable positions of atoms.

Whether this is or is not so much mathematical misrepresentation puzzled Compton, who turned X-rays on a gas. He made the rays collide with electrons and photographed the result. The electrons proved to be wanderers, as previously stated. An atom "radiates" and an electron has to do something in order to make itself visible, and by that time it is somewhere else.

This shook the foundations of physics, and a new way had to be acquired of looking at such things, for instance, as a glowing electric lamp. The new views cannot be expressed in every-day language, but only in a way that is understood by people with an education in higher mathematics. This is not meant to indicate that the cosmos is a sealed book to the average man. Ask a friend whether the earth revolves around the sun or not, and he will undoubtedly answer that it does. Ask him to prove it, and he will flounder helplessly. The point is that everyone accepts the solar system with its central sun, without knowledge of celestial mechanics. So it is with Compton's newer theories. The average man is unable to grasp the mathematical reasoning upon which they are based, and therefore must accept them as part and parcel of their thinking habits.

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THE REGENERATIVE DETECTOR

A COURSE FOR EXPERIMENTERS AND CONSTRUCTORS OF ONE AND TWO VALVE RECEIVERS.

(By A. J. Wooding (Rahob 7513).

INTRODUCTION

Regenerative receiving sets had their greatest popularity in the early days of broadcasting, when an entire broadcast receiver often consisted of a regenerative detector and audio amplifier feeding into headphones or a horn-type loud-speaker. Although this type of set was superseded by the neutrodyne, T-R-F and superheterodyne receivers for broadcast reception, regeneration still survives, especially with experimenters and radio enthusiasts. It is more popular than ever, now, with radio parts in short supply and with so much interest centred on short-wave reception.

New regenerative circuits are constantly appearing in magazines and periodicals, but a description of how such circuits work is rarely found. The purpose of this article is to give the radio hobbyist an idea of what is happening in his one or two-valve set, and how, by skilful construction and adjustments, to obtain the maximum performance of which it is capable. It will be found helpful for beginners to study the "Radio Beginners' Course" in the 1943 "Lamphouse Annual" before reading on.

GENERAL CONSIDERATIONS

Though regenerator detector circuits are many and varied, they all work on the same basic principle. This consists in feeding some of the energy in the plate circuit of the detector valve back into the grid circuit, thus increasing the strength of the original signal and increasing the gain of the detector stage. Several types of detector may have this principle applied to them, but in all cases the detector valve must work as an amplifier, as this is the characteristic which provides regeneration. Now let us look at a few detector circuits and decide which type is the most suitable for the task.

Firstly, the diode detector cannot be used, for, although it has excellent tone quality, it does not amplify. Secondly, high-level grid and high-level plate power detectors require an r-f amplifier, as they only work with a large input voltage, and reaction has very little advantage except to increase selectivity. Therefore, we require a detector which amplifies, and which operates with a weak signal on the grid, as reaction can be used to build this signal up to a fairly large volume. There are two circuits which fulfil the above requirements. One is called the grid-bias, or anode-bend detector, and the other is the low-level grid-leak detector.

Reaction may be applied to either of these, but there is a disadvantage in the case of the anode-bend detector. When the input signal voltage increases, the gain of the valve increases. If the detector is being operated at a point just below oscillation, in order to obtain maximum sensitivity and selectivity, the increase in feedback voltage due to increased gain may cause it to break into oscillation, which will often continue when the signal returns to normal. Regenerative anode-bend detectors are therefore unstable in operation.

For the grid-leak detector, on the other hand, the reverse is true, the gain of the valve decreasing as the signal voltage increases. This gives an AVC effect, and the regenerative grid-leak detector, if properly designed, is quite stable to handle. This type has been popular for many years—from the early days of radio broadcasting, in fact—and its method of operation will now be discussed in detail.

THE GRID-LEAK DETECTOR

First of all, let us consider the grid-leak detector by itself (i.e., without regeneration). A simplified circuit is shown in Fig. 1, and the various com-

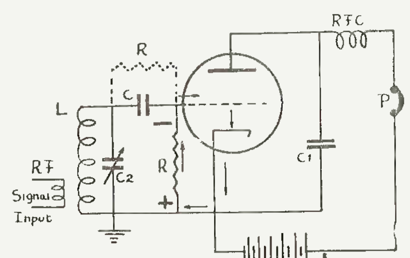


Fig 1

ponents are: C, grid condenser; R, grid leak; C1, plate r-f bypass condenser; C2, tuning condenser; L, radio-frequency transformer (coils); RFC, radio-frequency choke; and P, headphones. There are two possible positions for the grid-leak resistor R, one of these being shown in dotted lines.

Although the grid of the valve is connected through the grid-leak resistor R to the cathode, thus bringing the grid to zero voltage with respect to earth, a very small grid current still flows, due to the grid collecting electrons from the "spacecharge" or negative field of electrons around the cathode. The grid electric current flows round the grid circuit in the direction indicated by the arrows (Fig. 1) and in flowing through the grid-leak resistor produes a voltage drop across it, according to the formula

$E = IR,$

where E = voltage drop in volts.
I = grid current in micro-amperes,
And R = resistance of grid-leak in megohms.

If the grid resistor is one megohm and the grid current is .25 micro-ampere, the voltage drop will become

$E = .25 \times 1$
$= .25$ volt, or $\frac{1}{4}$ volt.

The voltage drop across the grid-leak R has its negative end towards the grid (see Fig. 1), so that the bias voltage applied to the grid under "no-signal" conditions is — .25 volt.

Let us now look at Fig. 2. Here we have a graph, called a "grid-voltage,

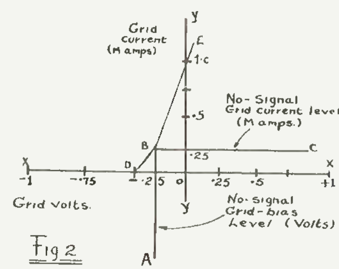


Fig 2

grid current" curve. It is so named because it is plotted between the grid-bias volts, on the horizontal line XX (called the "X-axis") and the resultant grid current on the vertical line YY (called the "Y-axis"). The point O where the two lines cross is called the "origin." The actual curve is the line D E, and it is obtained by applying fixed voltages to the grid and then measuring the grid current that results each time with a sensitive micro-ammeter or galvanometer. These results are plotted as points on the graph, and they are then joined by means of a smooth curve running through them. Graphs of this type are essential to radio engineers, and any Rahob who is interested in the theory of valves will find how useful they are.

In Fig. 2 the grid-bias voltage of — .25 volts and grid current of .25 micro-amp. under "no-signal" conditions are set at the point B on the curve. The stage is now set for the entrance of the radio signal.

When the aerial is connected and the detector is tuned to an unmodulated radio signal, the signal current in the aerial coil induces a similar current in the grid coil by "transformer action." The r.f. signal voltage is developed across the tuned circuit, and since the grid condenser C has very low opposition to radio frequencies, nearly all of this voltage is applied to the grid. However, there is already a negative d-c voltage on the grid, so that the incoming signal is super-imposed on (i.e., applied on top of) this negative bias. The total grid voltage will therefore follow the radio-frequency curve which is shown on the line A in Fig. 3.

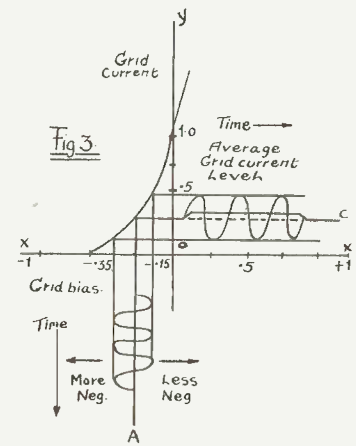


Fig 3.

Since the amount of grid current depends on the grid voltage, the grid current also varies at radio frequency, and it would have the same waveform as the grid voltage, if the grid-voltage, grid-current curve were straight.

But it is not straight, and a careful study of Fig 3 will show that the INCREASE in grid current when the grid voltage becomes LESS negative, is greater than the DECREASE in grid current when the grid voltage becomes MORE negative. Thus the average grid current is increased.

In Fig. 2, when there is no signal on the grid, the grid bias is —.25 volts and

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

the grid current is at the .25 micro-ampere level. In Fig. 3, an r-f signal having an alternating voltage of .1 volt (1-10th volt) is applied on top of the grid bias. The total grid voltage then varies between —.15 volt (—.25 + .1) and —.35 volt (—.25 — .1), and the grid current varies between .14 and .46 micro-ampere. The average level of grid current is now about .30 micro-amperes.

You can see what has happened. When the detector is tuned to the 1-10th volt signal, the level of average grid current has increased from .25 to .30 micro-ampere. This represents an increase of 1-20th micro-ampere.

If a stronger radio signal were applied, the level of average grid current is increased still further. In fact, as the strength or amplitude of the r-f signal varies, the average level of grid current varies with it, and if the detector is tuned to a modulated r-f carrier, the average grid-current level will follow the audio modulation, as shown in Fig. 4.

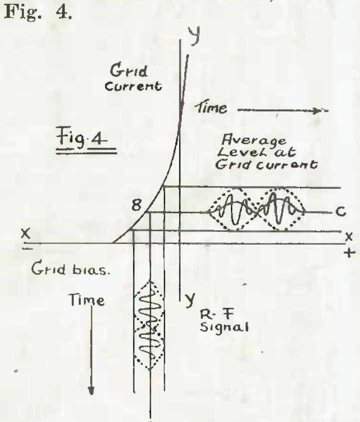


Fig 4

Now here is a problem. We have succeeded in making the average level of the grid current follow the modulation envelope of the carrier, but what is really required is some way of making the grid voltage vary with the modulation, in order to control the plate current of the valve. How may this be done?

The answer is, by means of the grid leak. When the grid current, which flows through the grid resistor, increases, the voltage drop increases and thus the grid bias becomes more negative. In this way, the application of a modulated r-f signal to the detector causes the grid bias to vary up and down in successive dips, as shown in Fig. 5. This in turn controls the plate current.

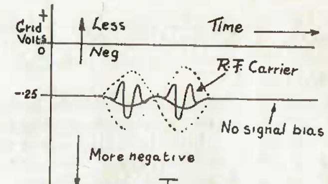


Fig 5

There are two components in the plate current (see Fig. 6). One is the amplified r-f carrier wave, which is not

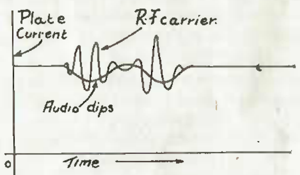


Fig 6

wanted and is therefore by-passed to earth through the bypass condenser C1 in Fig. 1, and the other component is the audio due to modulation, which passes through the R-F choke to the headphones to be converted into audible frequencies.

APPLYING FEEDBACK

Now for the regeneration. Instead of bypassing the r-f component of the plate current directly to earth, as in the ordinary grid-leak detector, it is made to flow first through a small feedback or reaction coil which is coupled to the grid coil, in the regenerative detector.

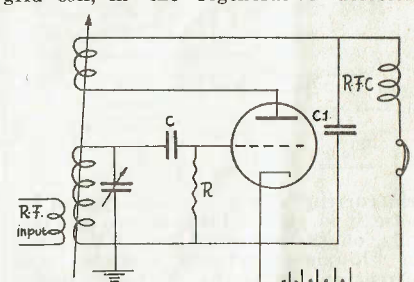


Fig 7

Fig. 7 is the circuit of Fig. 1, but with a feedback coil introduced into the plate circuit, so that the r-f component of the plate current flows from the plate, through the feedback coil, through the bypass condenser C1, to cathode.

Now it can be seen why a detector which amplifies is essential. In regeneration, the valve has two jobs to perform. Firstly, it must work as a detector, as described before, and, secondly, it must work as an R.F. amplifier with the output coupled back to the input.

This feeding back of the input voltage produces a "vicious circle" effect, in which the original radio-frequency signal at the grid is amplified, fed back to the grid, re-amplified, fed back to the grid again, and so on. Such a process cannot go on indefinitely because of circuit losses, but it is sufficient to give very high gain when the input signal is small. Also, the amount of feedback must be limited, because too much reaction overcomes the losses of the circuit and oscillation results.

In order to obtain the maximum gain possible, which is obtained at a point just below oscillation, a regeneration control is essential. In Fig. 7, the amount of feedback is controlled by moving the reaction coil towards or away from the grid coil, the arrow indicating that coupling is variable.

The amount of regeneration is also dependent on the phase relations of the original input voltage and the feedback voltage. For instance, if the feedback voltage applies positive voltage peaks to the grid at the same time as the positive peaks of the original signal occur, the voltages are in phase and regeneration is maximum. On the other hand, if the feedback voltage lags or leads the original signal voltage, regeneration is greatly reduced.

Now this has a very important bearing on the operation of the regenerative detector. When such a detector is properly tuned to a radio station (that is, when the tuned circuit is at resonance with the carrier frequency of the station) the carrier feedback voltage is in phase and reaction is at a maximum. On frequencies above and below the carrier frequency, however, phase-changes in the tuned circuit cause the feedback voltage to be out of phase with the signal voltage, and regeneration falls off on each side of the carrier. Thus selectivity is increased. The amount of selectivity depends on the amount of regeneration, and if the detector is operated at a point just below oscillation to obtain maximum reaction, and therefore maximum sensitivity, selectivity is so sharp that the higher frequency sidebands of a station are completely cut out. Audio reproduction suffers accordingly.

Selectivity is also controlled by the strength of the incoming signal. A strong signal applied to the grid of the detector increases the negative bias on the grid, reducing the gain of the valve as an R.F. amplifier and reducing the amount of feedback accordingly. As a result, selectivity is decreased, so that the stronger the radio-frequency signal, the poorer is the selectivity of the detector. Poorer selectivity means a wider "pass-band," or band of frequencies allowed to pass the grid.

Another point to be noticed regarding selectivity is that the current taken by the grid "damps" the circuit, making selectivity even poorer. Grid-current damping is neutralised by regeneration, but in the case of the strong signal mentioned above, regeneration is cut down and grid-current damping once again reduces the selectivity.

When the detector is tuned to a weak signal which is close to a very strong one, the strong undesired signal will "ride through," by decreasing the regeneration and making the pass-band wide enough to admit it. The only remedy in such a case is to reduce the pickup of the aerial, say by means of a volume control in the aerial circuit (aerial condenser). This reduces the strength of both the desired and undesired signals, but the desired signal strength may be increased by more regeneration.

A PRACTICAL CIRCUIT.

Now here is a practical one-valve receiver circuit which will give satisfactory results on broadcast and short-waves. It is shown in Fig. 8. The heavy lines represent wires carrying radio frequency, and these should be made as short as possible in practice by careful lay-out of the parts. A screen-grid valve is used, as this type is the most sensitive for regeneration. As the plate load is a pair of headphones, which is a comparatively low-impedance load, a valve having a fairly low plate resistance is preferred, such as types 49 or 33.

In battery valves, grid current does not start unless the grid is made slightly positive, so the grid leak is connected to the "A +" side of the filament. This may be done as in Fig. 8, or, if it is desired to have the grid resistor connected across the grid condenser (in parallel with the condenser), the A + side of the filament is earthed. A good example of the latter method is the well-known "Hiker's One," and it explains why the A-battery of the "Hiker's One" should be connected with A + earthed. However, there is no particular advantage with either method of grid-leak connection, and the constructor may choose the one which suits his fancy.

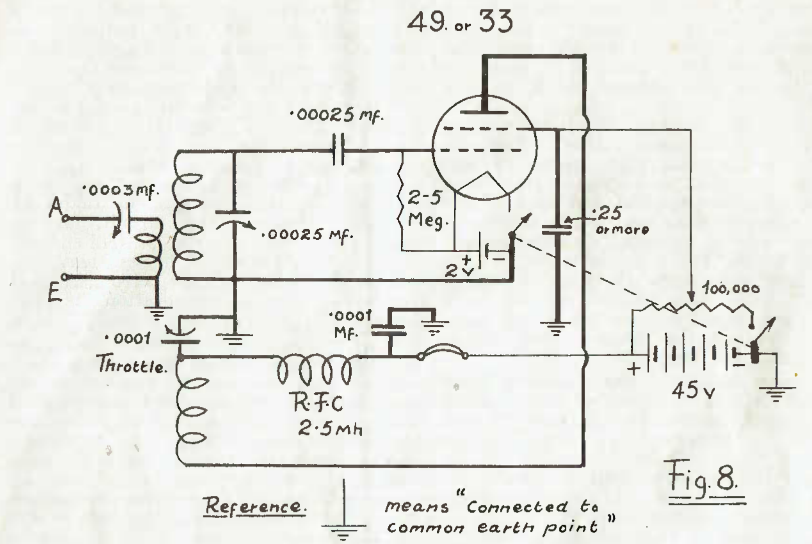


Fig. 8.

A characteristic of the regeneration control is that when it is varied it also varies the tuning of the detector. This is definitely undesirable, and since certain controls have less detuning than others, the effect may be taken into account when choosing the type of control to be usesd. One of the best reaction controls, for smoothness and minimum detuning, is the "throttle" condenser in the plate circuit. It is used in Fig. 8, the .0001 mfd. variable condenser being the throttle condenser. The principle of operation is as follows:—An increase in the capacitance of the throttle condenser decreases its reactance (opposition) to radio frequencies, so that the r-f component of the plate current which flows from the plate through the reaction coil and through the throttle condenser to earth, is increased. And since the r-f current through the reaction coil is increased, feedback to the grid circuit is also increased.

A decrease in the capacity of the throttle condenser, on the other hand, increases its reactance, and the r-f component of the plate current which flows through the reaction coil is decreased. Feedback is therefore decreased.

Thus regeneration may be controlled by varying the capacity of the throttle condenser.

Another control in the circuit of Fig. 8 is the 100,000-ohm potentiometer, which controls the positive screen voltage. A screen-grid valve has a critical value of screen voltage, generally around 30 volts, at which the valve is most sensitive for detection, and the potentiometer may be used to select this point.

DESIGN OF COILS

Much care should be given to the design and construction of the r-f transformer, as it is upon this unit, more than any other, that the success of the set depends. Even when the receiver appears to be functioning correctly, further adjustments to the reaction coil or aerial coil may succeed in bringing in more distant stations. There are certain fundamentals which must be observed in winding coils. Firstly, wind all coils in the same direction on the former, so that the voltages will be properly "phased." Secondly, wind the reaction coil at the earthed end of the grid coil, as shown in Fig. 8. This avoids instability due to capacitive feedback from plate to grid. Thirdly, when wiring up the coils, use the connections shown in Fig. 8. A careful winding without overlapped turns also improves performance.

The first coil to consider is the grid coil. On broadcast it is usually close-wound, while on short-waves it is often space-wound to reduce the distributed capacitance between turns. As it is the tuning coil, its inductance is determined by the frequency range to be covered, and may be very conveniently determined from the "Capacity, Frequency and Inductance Chart" in the 1942 "Lamphouse Annual." Obtaining the right number of turns to give the desired inductance is not quite

so easy, as it is necessary to work out a formula. For a single-layer coil, close-wound, of the broadcast-band type, the formula is

$$L = \frac{r^2 N^2}{9r + 10l},$$

where N = number of turns,
L = inductance of coil in micro-henries,
r = the radius of the coil in inches,
And l = the length of the coil in inches.

When we wish to know the number of turns for a given inductance, the formula becomes

$$N = \frac{\frac{10L}{rt} + \sqrt{\left(\frac{10L}{rt}\right)^2 + 36rL}}{2r}$$

where N, L and r have the same meanings as before and t is the turns per inch of the wire. There is a wire table giving turns per inch in the "N.Z. Radiogram" for August, 1943, on page 22.

A most useful formula is the one which is used for space-wound short-wave coils. This formula is

$$N = \sqrt{\left(\frac{9}{r} - \frac{1}{5l} + \frac{10l}{r^2}\right) \times L},$$

where the symbols have the same meanings as before. It looks a large formula, but it is very easy to work out.

As an example let us apply the last formula to a coil on a one-inch diameter former, with the turns spaced so that the coil is one inch long. It is to have an inductance of 5 micro-henries. Then, in the formula, L will be 5, r will be ½ (since radius is half the diameter), l will be 1, and then

$$N = \sqrt{\left(\frac{9}{\frac{1}{2}} - \frac{1}{5 \times 1} + \frac{10 \times 1}{\frac{1}{2} \times \frac{1}{2}}\right) \times 5}.$$

Working out the numbers in brackets first,

$$N = \sqrt{\left(18 - \frac{1}{5} + 40\right) \times 5}$$
$$= \sqrt{57\tfrac{4}{5} \times 5}$$
$$= \sqrt{289}$$
$$= 17 \text{ TURNS.}$$

When the number of grid coil turns has been calculated, the grid coil may be wound on its former, leaving sufficient room at each end of the former for reaction and aerial coils and mounting brackets.

(To be continued in next month's "Radiogram.")

STAMPS

Thanks to the following Rahobs who have donated used postage stamps to the Club:—11085, 9697, 11125, 11837, 10765, 11119, 11388, 5910, 11847, 11,588, 5989, 11487, 11368, 12018, A130, 11324. —Rahob 1.

Unusual Items

From OHMITE NEWS

It is claimed that a synthetic textile filament is now the finest filament produced by man or nature. It is so fine that it is only one-eighth the weight of the finest silk filament and 20,000 miles of the filament weighs one pound.

* * *

Add to the many new uses for glass reported in this column the marvellous use of glass springs for stresses up to 2000 lbs. per square inch. In many respects glass is better than steel for this purpose. It is more truly elastic, retains its elasticity over a broader temperature range, is immune to acids and apparently to fatigue also. One glass spring showed no signs of failure after 8,000,000 deflections in a sulphuric acid mist.

* * *

A new and very valuable use for high-frequency heating may result from research now being conducted for the purpose of preventing a $250,000,000 yearly stored grain loss due to insects. In the experiment the grain was passed between two electrodes and subjected to an electrostatic field of 3.5 megacycles. In 50 seconds the temperature of the grain was raised to 130° F. and all four life stages of the insects were killed.

* * *

The famous soap that is 99.44% pure has nothing on the mercury that is 99.99995% pure and is being produced in a certain laboratory at the rate of half a ton daily.

Big Reduction in Price!

OLD BATTERIES LIKE NEW

"TARMAG"—THE BATTERY TONIC.

Tarmag dissolves the Basic Sulphate of lead crystals which prevent the electrolytic contact, and enables the battery to function as new. Tarmag will bring your old battery up to full strength — will increase the life of new Batteries up to 50 per cent. For better lighting and split second starting try Tarmag. Tarmag is a liquid which is simply poured into the cells.

Complete with instructions.

Cat. No. JA70, for 6-volt Battery **2/9**

Cat. No. JA70a, for 12-volt battery **5/6**

MINIATURE SCREW HOLDERS

Bakelite Lampholders, miniature screw thread which takes torch and similar lamps.

Cat. No. JS223— **1/8** each

Just the thing for your radio cabinet and other fine furniture. 6 oz. bottles.

Cat. No. JU306 .... **1/5**

Other C.O. Products include:—

C.O. Waxshine (Floor Polish)—Cat. No. JU300	1/4½
C.O. White Canvas Cleaner—JU301	1/5
C.O. Grease Chaser (Soft Soap in Jars) JU302	1/8
C.O. Black Shoe Polish—JU303	7½d.
C.O. Brown Shoe Polish—JU304	7½d.
C.O. Lusta Polish Cream—JU305	1/8
C.O. Disinfectant—JU307	1/2½
C.O. Metal Polish—JU308	1/2½
C.O. Woodwax (Stain Polish)—JU309	1/5

ELECTROSHINE

Just rub on your taps, door handles, knobs, nameplates, etc. It will give them a gleaming silver finish. Gives new beauty to brass, copper and similar metals.

Cat. No. JU1 .... **2/3** bottle

OSRAM LAMPS

All the Popular Types available at the Lamphouse.

40 Watt, 2/2	100 Watt, 4/-
60 Watt, 2/3	150 Watt, 7/-
75 Watt, 3/3	200 Watt, 10/3

ADAPTORS

For end of cords to fit into light socket for extensions, etc.

Cat. No. JG210 .... **1/3** each

INSUVARN

QUICK DRYING INSULATING VARNISH

Fresh stocks just on hand. Insuvarn is a fast-drying moisture-proof Coil Dope. Painted over Coil Windings it will hold them rigidly in place and prevent the atmosphere getting at the windings. Excellent for coating Coil Formers before they are wound, and for impregnating wood panels so as to ensure they do not absorb moisture. Insuvarn can also be used for mending Speaker Cones, and a hundred and one other Radio jobs requiring a first-class insulating varnish or cement.

Insuvarn is also sold under the trade brand "Stucka" as a liquid glue, and can be used for mending Wood, Bakelite, China, Glass, etc., etc. Every serviceman and home experimenter should have a jar of Insuvarn on hand.

Cat. No. JU159 **2/3** jar

LAMPHOUSE CIRCUIT BOOK

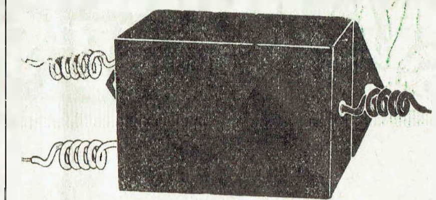
Contains 80 pages, with about 200 different circuits. This book has been prepared in response to hundreds of inquiries which we receive for a publication containing a comprehensive range of Radio circuits. All the circuits have already appeared in various numbers of the Lamphouse Annual or the "Radiogram," and no claim is made that the book contains new circuits.

Radio enthusiasts will find the book of great use for reference purposes. Circuit diagrams only are given, there being no constructional details. The circuits include Electric Fences, Power Packs, S.W. Converters, Wave Traps, Testing Equipment, Code Oscillators, Aerial Systems, Amplifiers, Crystal Sets, and Electric and Battery Sets of every description.

LAMPHOUSE RADIO CIRCUITS—PRICE 2/6. Postage 3d.

Cat. No. JB100.

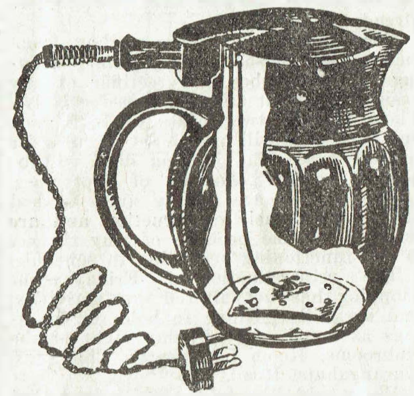
NOTENNA AERIAL ELIMINATOR



Equally successful on both broadcast and short-waves. Replaces aerials of all types. Very compact size. No lighting arrestor required. Reduces noise, interference and man-made static. Simply attached between aerial and earth terminals on your set and to earth wire. Money back if you are not more than satisfied. Dimensions 4in. x 2¼in. x ¾in.

Cat. No. JA310 .... **8/5**

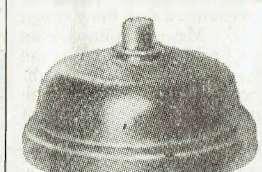
THE "WIRELESS" JUG ELEMENT



Cannot burn out! This Element is made on an entirely new and patented principle. Having no element wire, cannot burn out. Easy to fit.

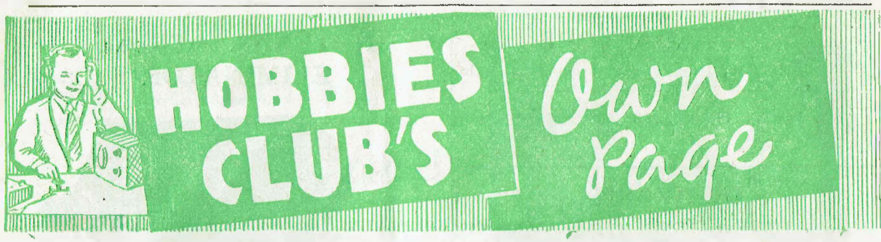
Cat. No. JE517 .... **9/6** each

BELL PUSHES



Good quality Brown Bakelite Push; 1¾ in. diameter.

Cat. No. JG334— **1/7** each



AUCKLAND.

(A. Walker, President).

June 30 was an outstanding night for many of our members, as it brought us exactly an even century (100) in membership for 15 months of existence. The foundation members considered it an occasion they had been looking forward to with pride, and congratulations were plentiful.

Mr. G. Munro was the fortunate member to even our score.

Now, then, sister clubs, we would be interested to hear when you reach the first century, as we are looking forward to our second one and have two starters already.

For the senior members we have commenced a super-het competition, consisting of three tubes and rectifier of any design or circuit and entrance fee is 1/-. There will be two prizes of 10/6 each and the judge will have a set of rules for judging to. The judging date will be decided at the beginning of September.

The juniors are having quite a deal of fun with their construction and are now solving the problem of why the set is not functioning according to schedule.

The reintroduction of Friday night shopping has not altered our activities, and we will continue to hold our meetings as usual every Friday night at the clubrooms, Room 5, Abbott's Chambers, Karangahape Road.

We would like to make it clear that members are not obliged to belong to N.Z. Radio Hobbies Club to be a member of our club.—J. Forrest, Secretary.

MOTUEKA

This is Motueka, calling all Rahobs. There was a fair attendance at the first meeting, and all present were very keen to form a Branch. Mr. Mackay was elected to the chair, and explained some of the advantages of forming a Branch. The following were elected to the executive:—Patron, Mr. F. H. Cooper; President, Mr. J. H. Robertson; Vice-President, Mr. Holmwood (subject to consent); Secretary and Treasurer, Mr. B. F. Mackay; Auditor, Mr. P. T. Driver; Committee, Messrs. M. McNabb (subject to consent), I. Holdaway, J. Stevenson and S. Waters.

The meeting was not in favour of holding meetings in private houses, but the matter was left in the hands of the President and Secretary to arrange. It was also decided to hold a dance at some future date, and that the music should be supplied by amplified recordings. The meeting then closed with supper.

All Rahobs who have not joined, please get in touch with either the President or Secretary, who will tell you when the next meeting will be held. New members are urgently needed; don't let your Branch down, come along and help us.

This is Motueka signing off, with an appeal for more members and an appreciation for the help of the many people who have helped us to get going.

B. F. MACKAY, Secretary.

HAMILTON.

Rahobs interested in joining a local Radio Club please get in touch with Rahob 7793, S. Andrews, c/o Mrs. Town, Mitcham Avenue, Forest Lake, Hamilton.

The first meeting was advertised in the "Waikato Times" and was held on July 12. Meetings will be held at 7 p.m. every fortnight thereafter.

MATAMATA.

Rahobs interested in forming a club please get in touch with H. J. Bathe, c/o R. Clark, Box 37, Matamata.

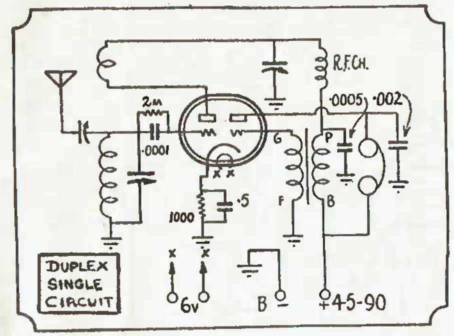
DUNEDIN.

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

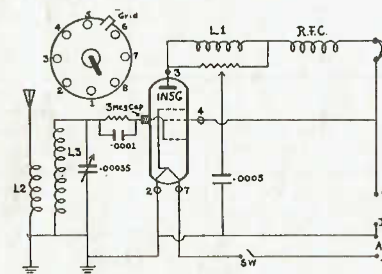
Dunedin calling all Rahobs. I would like to take this opportunity to say a few words on the operation of our branch. We have two classes on radio each night, with an Instructor in charge of each class, instructors being A. R. White and G. Halliday. It is hoped

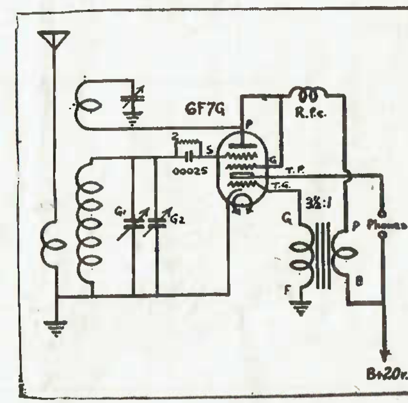
(Continued on page 28)

CIRCUIT REVIEW



Six Simple Singles

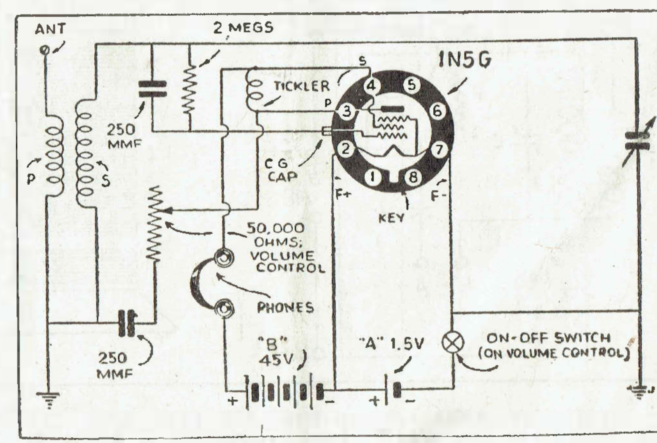


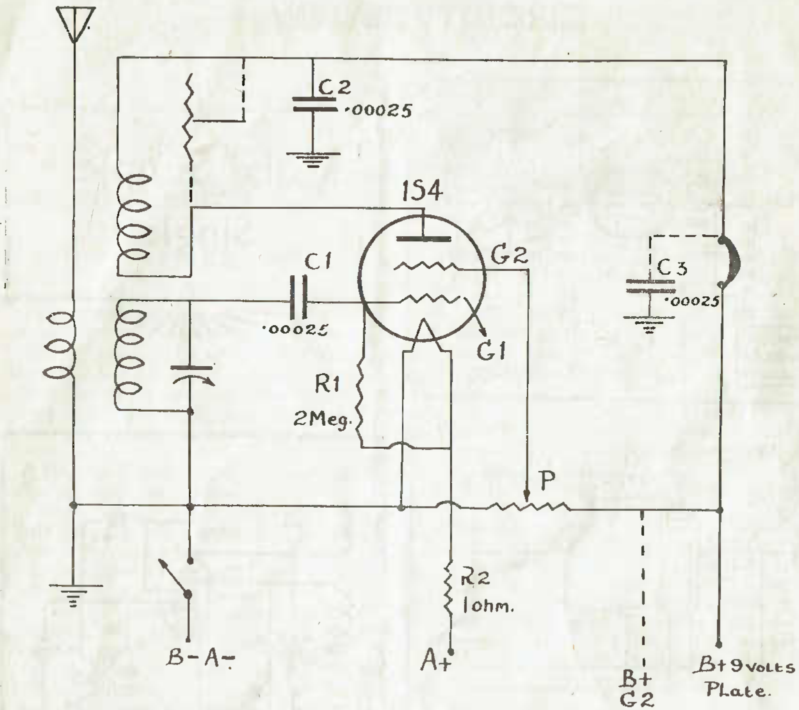


Above—SINGLE 1N5G

Right—A.C. DUPLEX

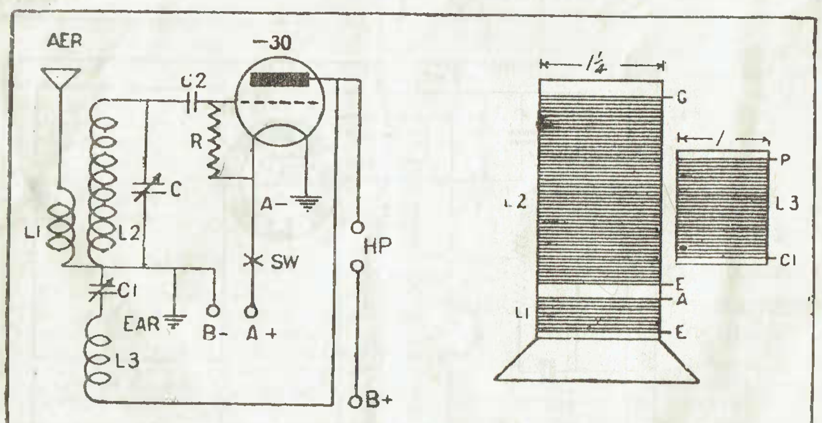
THE RAHOB SINGLE





THE SINGLE 1S4

P = 100,000—1 megohm.
P + Plate = 9-18 volts.
B + G2 = 9 volts.



CIRCUIT AND COIL DIAGRAM FOR THE "ONE-DER."
L1 — 10 turns. L2 — 100 turns. L3 — 30 turns.

VALVE PRICE LIST

All prices are subject to alteration without notice.
Many types are still unprocurable.

Valves.	s.	d.	Valves.	s.	d.	Valves.	s.	d.
OA4G	17	10	1V	8	6	6F5GT	9	6
OZ4	12	8	2A3	14	1	6F6	10	6
OZ4G	12	2	2A4G	—		6F6G	9	3
OIA	9	0	2A5	9	5	6F7	13	2
1A4-P	12	8	2A6	9	5	6F8G	11	10
1A5-G	14	2	2A7	11	1	6G5/6H5/6U5	12	0
1A5-GT/G	14	2	2B7	11	1	6G6G	12	8
1A6	11	11	2E5	12	0	6G8G (Aus.)	12	6
1A7-G	14	3	2X2/879	19	6	6H6	9	0
1A7GT	12	11	3Q5GT	13	0	6H6G	8	6
1B4-P	13	9	5T4	13	6	6J5	9	5
1B5/25S	10	0	5U4G	8	8	6J5G	8	3
1C4 (Aus.)	12	0	5V4G	13	6	6J5GT	9	6
1C5G	13	11	5W4	9	6	6J7	10	6
1C6	12	0	5W4GT	10	0	6J7G	9	11
1C7G	13	9	5X4G	8	6	6J7GT	9	11
1D4 (Aus.)	12	8	5Y3G	6	0	6J8G	12	2
1D5G-P	12	0	5Y4G	6	4	6K5G	9	6
1D5GT	—		5Z3	8	2	6K6G	9	4
1D7G	13	1	5Z4	12	1	6K6GT	9	6
1D8GT	20	5	6A3	16	6	6K7	10	6
1E5G-P	12	6	6A4	11	6	6K7G	9	5
1E7G-V	18	6	6A6	12	2	6K7GT	9	11
1F4	12	0	6A7	10	0	6K8	12	5
1F5G	13	0	6A8	12	8	6K8G	13	6
1F6	13	3	6A8G	10	5	6L5G	9	6
1F7G-V	14	4	6A8GT	10	0	6L6	16	6
1G4G	11	6	6AB5/6N5	12	9	6L6G	14	6
1G5G	11	6	6AB7/1853	18	0	6L7	12	5
1G6G	11	6	6AC5G	10	0	6L7G	11	6
1H4G	7	3	6AC7/1852	20	0	6N5 (see 6AB5/6N5)	12	9
1H5G	13	5	6AD7G	12	0	6N6G	18	0
1H5GT	13	1	6AEG	12	6	6N7	12	0
1H6G	12	0	6AFG	10	0	6N7G	11	6
1J6G	10	5	6AE7GT	—		6P5G	9	4
1K4 (Aus.)	11	6	6AF6G	10	0	6Q7	11	0
1K5 (Aus.)	12	3	6B4G	10	0	6Q7G	9	5
1K5G	11	6	6B5	17	6	6Q7GT	9	10
1K6 (Aus.)	12	8	6B6G	11	6	6R7	11	6
1K7G (Aus.)	13	3	6B7	11	7	6R7G	10	4
1L5G (Aus.)	12	6	6B7-S	11	0	6S7	12	0
1M5G (Aus.)	12	9	6B8	13	0	6S7G	11	10
1N5G	12	9	6B8G	11	9	6SA7	9	6
1N5GT	13	0	6C5	9	10	6SC7	11	0
1N5GT/G	12	6	6C5G	10	0	6SF5	9	6
1P5GT	14	5	6C6	9	3	6SF7	9	6
1Q5GT	13	9	6C8G	12	0	6SJ7	9	10
1R5	12	6	6D6	9	3	6SK7	9	9
1S4	12	6	6D8G	12	7	6SQ7	10	10
1S5	12	6	6E5	12	0	6SR7	11	0
1T4	12	6	6F5	10	10	6T5	16	0
1T5GT	16	6	6F5G	9	4	6T7G	12	1

Valves.	s.	d.
6U5/6G5	12	0
6U7G	9	10
6V6	13	0
6V6G	10	6
6V6GT	10	0
6V6GT/G	10	0
6W7G	12	6
6X5	12	0
6X5G	10	6
6X5GT	10	6
6X5GT/G	10	10
6Y6G	13	6
6Z7G	13	6
6ZY5G	13	0
7A5	13	0
7A6	13	0
7A7	13	0
7A7-LM	13	0
7A8	13	0
7B4	—	
7B5-LT	13	0
7B6-LM	13	0
7B7	13	0
7B8-LM	13	0
7C5-LT	13	0
7C6	13	0
7C7	—	
7Y4	13	0
10	19	6
12A5	14	0
12A7	14	4
12A8GT	10	0
12B8GT	13	9
12C8	13	0
12F5GT	10	3
12J5GT	9	6
12J7GT	10	0
12K7GT	9	6
12K8	13	0
12Q7GT	9	9
12SA7	10	6
12SC7	10	6

Valves.	s.	d.
12SF5	9	6
12SJ7	9	6
12SK7	9	6
12SQ7	9	6
12SR7	10	6
12Z3	9	6
15	16	4
19	10	6
20	19	0
24A	9	5
25A6	13	10
25A6GT/G	10	9
25A7G	13	6
25A7GT	12	6
25B6G	12	6
25B8GT	13	6
25L6	12	6
25L6G	10	0
25L6GT	10	3
25L6GT/G	10	5
25Y5	19	6
25Z5	8	9
25Z6	11	6
25Z6G	9	6
25Z6GT	9	6
25Z6GT/G	10	0
26	6	2
27	6	0
30	6	11
31	7	6
32	11	9
33	11	7
34	11	6
35	9	3
35A5	13	0
35A5-LT	13	0
35L6GT/G	10	2
35Z4GT	9	6
35Z5	13	0
35Z5-LT	13	0
35Z5GT	9	10

Valves.	s.	d.
36	9	5
37	9	4
38	9	0
39/44	9	5
41	8	10
42	8	10
43	9	0
45	7	2
45Z6GT	9	6
46	11	2
47	9	11
48	21	0
49	10	2
50	20	9
50L6GT	11	9
53	13	0
55	9	6
56	6	5
57	8	11
58	8	6
59	13	0
70L7GT	15	6
71A	8	9
75	8	9
76	6	4
77	9	5
78	9	5
79	11	2
80	5	8
81	18	2
82	10	6
83	10	0
83V	13	8
84/6Z4	9	2
85	9	0
89	9	5
112A	9	6
117N7GT	—	
117Z6GT	15	0
117Z6GT/G	15	0
302	13	6

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 A124, Mr. R. Henderson, 18 Madden Grove, Burnley, Melbourne, Australia, would like to correspond with members of the Club, particularly interested in DX and Photography.

Rahob 7215 wants a Pen-friend interested in motoring and farm work in Australia to exchange magazines, etc. Address, C. P. McDonald, Rewa, via Feilding.

Rahob 9143, A. N. Sims, Fenton Street, Thames, wishes to contact some Rahob who can assist him with information regarding magnetising, using a motor field.

Rahob 7984, Alex. Pollard, 92 Chalmers Avenue, Ashburton, requires pen-friends, 16-17 (of either sex), interested in Ball-room or Tap-dancing, or Swing Music.

RADIO WITTIQUIZ

(By H. VERNON WHEATLEY)

WITTIQUIZ— SCORES

100%—You are wasting your time here. Professor Einstein needs an assistant.

75%—still clever.

40%—Just normal.

Get below this and we would advise you to forget you ever attempted the question. Don't brag about it to your friends.

---

1. If you had a red powder (and it could take two other forms, too) and found it was soluble in carbon bisulphide, you'd be fairly sure it was one of the following elements or substances. A clue—it is allied to sulphur. Your choice—(a) sal-ammoniac; (b) selenium; (c) haematite; (d) manganese dioxide; (e) a sulphuric acid derivation; (f) caustic potash.

2. A Daniel cell makes use of two electrolytes. One of these is a diluted solution of sulphuric acid. Although these cells are practically museum pieces these days, can you give the name of the other liquid used? The dilute sulphuric acid is in a porous pot, and the other solution is in a glass jar, in which the porous pot stands. (a) Carbon-tet; (b) sal-ammoniac; (c) copper sulphate; (d) brine; (e) pure undiluted sulphuric acid; (f) distilled water.

3. If we had a circuit "conductively coupled" we would know that it was (a) indirectly coupled; (b) magnetic coupled; (c) not regenerative; (d) direct coupled; (e) conventionally coupled.

4. Just what is an aperiodic circuit? (a) Untuned; (b) possesses a low resistance; (c) encourages oscillation; (d) definitely oscillatory; (e) tuned.

5. Radiosondge has become something of an art and the correct use of it is invaluable. People who use the system are called (a) artillery officers; (b) meteorologists; (c) tank commanders; (d) pilots; (e) spiritualists; (f) astrologists.

6. When two dissimilar metals touch in free air, one becomes positive and the other negative. Strange, but true. This effect is called the (a) Peltier effect; (b) Maxel effect; (c) Volta effect; (d) Leyden effect; (e) Farad effect; (f) Ohm effect; (g) Ampere effect.

7. Professor Weber was honoured by having a unit named after him. This unit was (a) pole strength; (b) inductance; (c) polarity; (d) poundal; (e) dielectric constant; (f) decibel.

8. If you decided to put an alkaline cell into commission you would use for an electrolyte (a) dilute sulphuric acid; (b) dilute caustic potash; (c) bicarbonate of soda; (d) manganese dioxide; (e) ammonia; (f) chloride.

(9) This is a trap for the unwary. If you had an alternator to overhaul, would you give a great deal of attention to the commutator, polishing it up and so forth, and also cleaning between the segments?

10. If you built a smoothing choke, using no specifications whatsoever, and then found that the gap in the core was too small, just how would you expect the choke to act? (a) Ready saturation and loss of inductance under load; (b) no saturation point and increased inductance under load; (c) eddy currents very apparent and internal resistance increases under load; (d) no saturation point and loss of inductance under load; (e) the inductance would be smaller than anticipated either with or without load.

(See Page 28)

Motueka, 10th June.

I am not worrying about a prize in your competition, but on seeing it in the June "Radiogram" on page 23, it gave me an idea. You see, Radio has a big part to play in life these days, and electricity is used by everyone, and everyone should know a little more about it. I would suggest that you publish circuits or diagrams on Sound on Film. As I do a bit of amateur movies, and I understand that the 8 mm. film now produced in the States (U.S.A.) has a sound track, and lots of N.Z. movie fans will want to build and fit a Photo Electric Cell Amplifier and Speaker to their outfits.—Rahob 6280.

Whangarei, June 13th.

Just a few lines to say how much the "Radiogram" is appreciated in this home. My boy of twelve, who is really the Rahob, as I entered the membership in his name to get him interested in Radio, is very keen on looking through the "Radiogram." Needless to say, I run him a close second; we often both desire it at the same time. Boy-like, he looks first of all for "Slips at the Mike," then "Hints and Kinks," while I find enjoyment in every page, although nearly every other page is in the nature of being "double Dutch" to me, despite my intense interest in Radio and what makes it go. However, it is worth the small fee of 6/- to learn even how much I don't know, so here is wishing your paper and all the various activities that it has inspired the very best of wishes. Please find enclosed my boy's subscription for the ensuing year.—For Rahob 9740.

That Notenna Aerial Eliminator I got some time ago is very good and saves a lot of bother. I am satisfied with same. —Rahob 11679 (26/6/44).

Motueka, 10th June.

May I suggest that in your pages of the "Radiogram" (6 and 7 in June issue) it would be much more to readers' advantage if you were to put all the "For Sale" together—say on page 6—and the "Wanted to Buy" on page 7, instead of having them all mixed together.—Rahob 6280.

I am writing you these few lines to tell you how pleased I am with the Club. It is a good 6/- worth, and I am glad I joined up now. I have received five "Radiograms" so far, and I find them very interesting. Please find enclosed some New Zealand stamps which I have hunted up to add to the collection. Here's wishing the Club well for the coming year.—Rahob 11119 (28/6/44).

I wish to acknowledge receipt of goods sent to me. They were all in good condition and I am well satisfied with them. The new "Annual" is very interesting, especially the article "Getting Started." I think more can be learned from material arranged in this manner than the straight technical way of putting it. I thank you for the great deal of pleasure I have derived from radio through belonging to the Hobbies Club. In answer to your letter after the last order, I had paid my subscription at the end of May and have my card, etc. Hoping you are having all the best.—Rahob 9256 (25/6/44).

For a chap like myself who is only studying Radio in his spare time, the "Radiograms" are certainly wonderful little magazines.—Rahob 7626 (Timaru).

I have to acknowledge receipt of the 1944/45 "Lamphouse Annual" and to extend my sincere congratulations to the Lamphouse in being able to produce such an outstanding number in these hard times. To my mind it is the best yet.—Rahob 8955 (Greymouth, 27/6/44).

Ardmore.

As a Wellington Rahob now in the R.N.Z.A.F., I have an important question which has been in my mind for some time and one for which so far I have found no answer. How is it that Wellington, the capital and headquarters of the club, has no clubrooms and meetings, etc., as have various other towns and cities throughout the country? Surely headquarters is setting a very poor example in not attempting to get something going. What's wrong with Wellington Rahobs that they should be

(Continued on page 26)

GIRDLING THE GLOBE

BROADCAST.

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.

Solomons.—"A.E.S., Bougainville," a new station for troop entertainment has been heard opening at 7 a.m. on 670 kilocycles. This station is operated for American Servicemen in the South Pacific. Schedule is 7 a.m.-11.15 p.m., and this station is also a member of the "Mosquito Network."

China.—XPRA, Kumning, China, 690kcs., a station operated by the National Government, has been heard at 2.30 a.m. broadcasting American Special Service programmes, including "Personal Album."

North America.—Reception of the early morning programmes from this continent have been heard this month from 10 p.m. till 1 a.m., which means that we are to have a long DX season through the summer from these stations. Strength is still only fair from most of the transmitters, and only the powerful ones have been heard with any regularity. Here are those noticed: KGO (810), KARK (920 opens at 10.45 p.m.), WOAI (1200), KSTP (1500), WLAC (1510), KOMA (1520), WCKY-KFBK (1530), KXEL (1540), WQXR (1560), XEMC (1590), all heard at 11 p.m.

NORTH AMERICAN BROADCAST STATIONS.

New Ones and Alterations.

Here are some additions for your log in the "Annual," and some corrections:—

New—

790 kcs.—WEAU, Eau Claire, Wisc.	1,00	C
1400 Kcs.—KSJB, Jamestown, N.D.	250	C
1490 kcs.—KPLC, Lake Charles, La.	250	C
1490 kcs.—KXO, El Centro, Calif.	250	P

Frequency Change—

820 kcs.—WTBO, Cumberland, Md. (from 1450 kcs.)	250	E
1450 kcs.—KCMC, Texarkana, Tex. (from 1230 kcs.)	250	C

Call Corrections—

790 kcs., KVAS to KVOS; 900 kcs., WSEA to WSBA; 980 kcs., WGRG to WGBG; 1400 kcs., KLUE to KLUF; 1490 kcs., KBRK to KBKR.

State Corrections.—

770 kcs., WEW, St. Louis, Mo. (not Minn.).

1260 kcs., KGGM, Albuquerque, N.M. (not N.).

1340 kcs., WGAA, Cedartown, Ga. (not Go.)

1420 kcs., WOC, Davenport, Iowa (not la).

1450 kcs., WCHV, Charlottesville, Va. (not Ca.).

SHORT WAVE.

United States.—KGEX, General Electric, Fairmont Hotel. San Francisco, was opened on July 1, and broadcasts programmes to the Philippines. Can be heard till 5 p.m. on 15.33 mcs., and broadcasts 9 p.m.-1 a.m. on 9.53 mcs., suffering interference from WGEA till midnight. Many other changes have taken place as from July 1st, and these include: KROJ, 17.76 mcs., broadcasts to Australia 1-3.45 p.m.; KWIX, 9.85 mcs., now opens at 8 p.m.; KGEI, 15.13 mcs., opens 5 p.m. in chain with KES2 and KROJ. WGEO has taken over the 7.25 mcs. frequency from KGEI for the European transmission, and can be heard till signing at 7 p.m. An interesting verification from CBS, which enclosed the engineer's schedule for the 24 hours' operation covering 17 pages, shows the amount of work behind the operation of a system like CBS, which now operates six stations, WOOW, WOOC, WCBX, WCRC, WCDA, and WCBN.

Australia.—The new transmitters of General MacArthur's headquarters, VLC-4, VLC-5, and VLC-3, have all been put into service this month. VLC-4, 15.315, is used to Western States of North America from 5.12 p.m. in chain with VLG-3, 11.71 mcs. VLC-6 on 9.615 mcs., is also used to the Western States at 3 a.m., in chain with VLG-3. VLC-5, 9.54 mcs., broadcasts to Asia from 10.15 p.m., an English period is heard at 10.30 p.m., this service being also heard over VLG-4, 11.84 mcs., and VLI-3, 15.315 mcs.

Mediterranean.—JCJC, Army test transmitter in this area has moved to 7.22 mcs., a frequency recently vacated by Rome Radio, and can be heard at good strength signing at 5 p.m. The schedules are 3-5 p.m., 10 p.m.-2 a.m., 3-7 a.m. A list of news sessions from stations in the Middle East is broadcast at 6.30 a.m. on Mondays. Times are given in GMT and Cairo time.

India.—Delhi now broadcasts on the announced frequency of 15.35 mcs. at 1.45 p.m., when news in English is presented. English again heard at 2.30 p.m. in a message service to the Far East.

Algiers.—"United Nations Radio," Algiers, can be heard on 6.025 mcs. in chain with the 6.04 mcs. outlet, with news at 8 a.m. Strength of this new outlet isn't as good as the signal on 6.04 mcs.

South America.—Peru: OAX4W, Lima, on 5.955 mcs., puts in a fair signal till closing at 5.05 p.m. OAX4Z, Lima, relaying OAX4A, received at fair strength on 6.082 mcs. till signing at 4.30 p.m. Chile: CE1180, 11.97 mcs., located in Santiago, has a news service in Spanish at 11.30 a.m., and can still be heard at very good strength when they sign off at 4 p.m.

Argentina.—LRE, 6.085 mcs., relays LR3, "Radio Belgrano," opens at 10.50 p.m. in a programme of early morning music and news.

Germany.—DXU9, Hilversum, the former PCJ, carries the feature "News of the Day" broadcast by "Lord Haw Haw" (William Joyce), at 8.30 a.m. This same session is rebroadcast to America at 1.15 p.m. on many frequencies, 10.54 and 9.67 mcs. are the best received.

England.—The latest list of B.B.C. frequencies totals 76, making the B.B.C. the greatest broadcasting system the world has ever known. The present world conditions mean that trans-

(Continued on page 28)

HINTS & KINKS

1/- paid for every one published and 5/- for especially good ones. Send yours in.

VEST POCKET TEST PROD

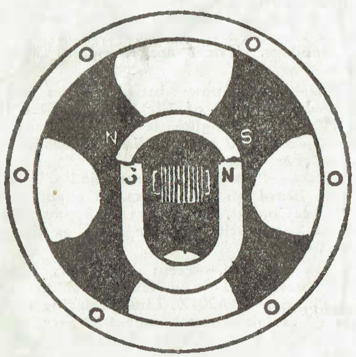
Secure a flashlight of the small, fountain-pen variety, preferably with a fibre or bakelite insulating case. Substitute a small insulating disc for the lens and reflector. Clamp a threaded metal rod, about three inches long, to the disc by means of a nut on each side. The open end of the rod should be pointed, in prod fashion, and the rod itself adjusted so that the other end makes contact with the positive terminal of the flashlight battery.

Mount a "featherweight" telephone receiver on the other end of the holder, connecting one terminal to the negative cap on the battery and the remaining post to a short length of flexible wire ending in a small test clip.

In servicing, the clip is connected to the chassis, or ground, and the prod is used for exploring the circuit, a loud click on disconnecting indicating a closed circuit.

REMAGNETIZING SMALL MAGNETS

This kink is to show how to remagnetize the small magnets in earphones.



Remagnetizing Phone Magnet

First of all remove the magnets from the phones and place them across the poles of a P.M. speaker and leave them there for approximately a half-hour, occasionally giving them a sharp tap with some small object.

I have found that this completely rejuvenates the old earphones, which otherwise might be discarded.

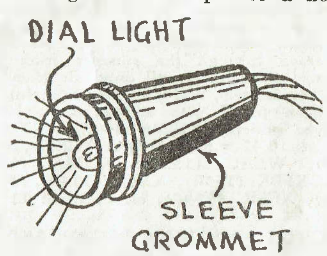
METHOD OF MOUNTING SPEAKER CONES

One of the greatest difficulties many service men experience when re-assembling a speaker is in holding the outside rim of a cone in place on the speaker frame while the cement is drying. The method employed at our shop never fails to line up the cone perfectly.

After shims are placed on pole pieces of the speaker, the cone is lined up around the outer rim of the cone and cement applied on the speaker frame. The rim of the cone is then pressed in place carefully and held with several spring-type wood clothes pins. For small cones six or eight pins are required, but for larger cones ten or twelve are required to do a good job.

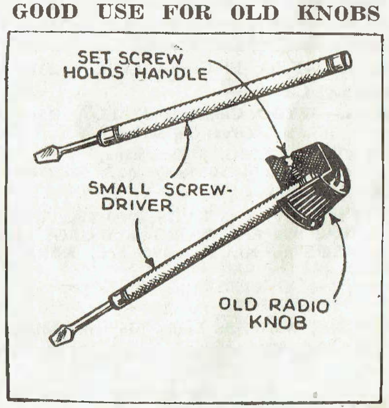
TROUBLE LIGHT

A handy trouble light is simply made by screwing a dial lamp into a holder,



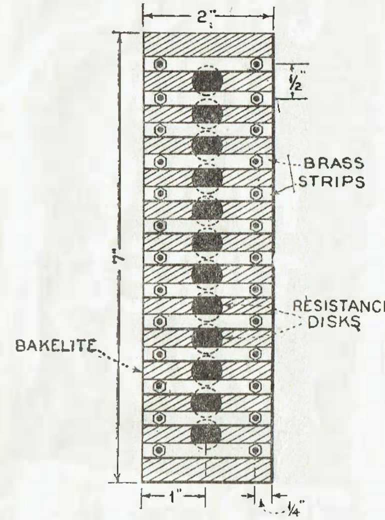
connected to a length of flex, and then sliding the whole assembly into a rubber sleeve grommet. The grommet concentrates the beam and protects the lamp.

GOOD USE FOR OLD KNOBS



A HOME-MADE VOLTAGE-DIVIDER

A good voltage-divider for use in B eliminators can be made from an old carbon-pile type variable resistance unit such as the Bradleyohm. Made as



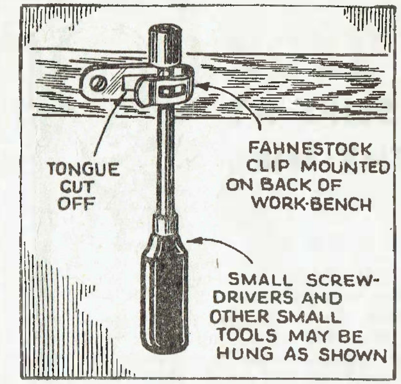
shown in the accompanying drawing, the voltage-divider will prove to be a handy resistance unit.

A strip of bakelite two by seven inches is used as a support for the twelve carbon-discs. Thirteen holes are drilled along each edge, one-half inch apart and one-quarter inch in from the edges, with a number 28 drill. Thin strips of brass two inches long and one-quarter of an inch wide hold the discs in position. Each brass strip has a hole drilled one-quarter of an inch from each end with a number 28 drill. The unit is assembled, as shown in the drawing, with 6/32 machine-screws and nuts.

The insulated portion of a sparking plug when removed can be used as an excellent stand-off insulator if a piece of threaded rod with a couple of nuts is placed in the hole in the porcelain. Also, the subdivision wall in a car battery makes useful insulating strips and small panels. The casing of batteries if melted can be moulded into desirable shapes.—Rahob 11002.

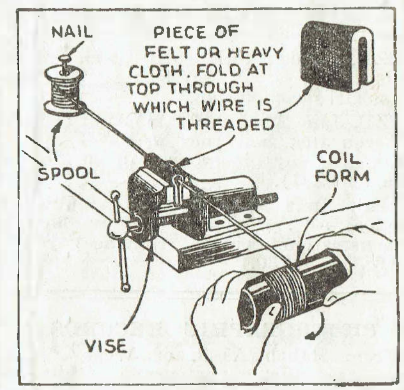
NEW USE FOR WIRE CLIP

Here is another use for the old standby, the Fahnestock clip, of which every experimenter has quite a collection. As the accompanying sketch



shows, they may be used to keep the usual arrangement of socket wrenches and other small tools off the bench and within easy grasp.

COIL-WINDING KINK



It is always difficult to prevent the wire from kinking when winding a coil. Usually three hands are needed. The arrangement shown in the drawing simplifies matters considerably.

CUTTING BAKELITE TUBING

In winding coils on various sizes of bakelite and hard rubber tubing I ran up against the difficulty of cutting the tubing straight. Previously I would saw it to the best of my ability as governed by arm and eye. Results in many cases were not so good, and quite often necessitated additional work of filing or sawing. I found the remedy in simply pasting a straight-edged piece of paper around the form to provide a guide line for the entire circumference of the tube.

SLIPS AT THE MIKE

2ZB, 2.29 p.m., June 28, 1944.—"You've been listening to the gold cream guards."

3YA, 9.0 p.m., June 15.—" ——— and the Allies behind them with sticky bombs."

2YA, 3.19 p.m.—"The Army forwards are rolling up behind the ball."

1YA, 7.18 p.m., July 6, 1944.—"When the motor cow came in . . . ."

War news, 6.15 p.m., July 2, 1944.—"Hitler has spoken for the first time in five months."

2ZB, June 16th, 9.5 a.m. Aunt Daisy: "You just soak it in paper—er—water."

2ZB, June 16th, 9.10 a.m. Aunt Daisy: " . . . the soap with the schoolgirl's complexion."

2ZB, June 22nd, 9.10 a.m. Aunt Daisy: "If you just boil your heads—I didn't mean to say it—your fish heads."—(Rahob 9291).

1ZB, June 21st, 12.12 p.m. (Philco Radios).—" . . . and let an honest demonstration convict (convince) you."—(Rahob 11730.)

PHOTOGRAPHIC RECORDS

From Rahob A143, of West Footscray, Australia, a photograph of himself outside his house.

We acknowledge receipt of and thank Rahob No. 7215 (C. P. McDonald, Rewa, via Feilding), for his photograph.

POSTMAN'S KNOCK

(Continued from page 22)

content to read of other clubs' activities without making any endeavour to start something themselves. Come on chaps (or is it headquarters?) What's holding you back? Let's get cracking and show the other branches that Wellington is truly headquarters in every sense of the word. You can't all be in the armed forces, so what about it?—Rahob 7042.

THE LAMPHOUSE ANNUAL

1944 - 1945

CONTENTS

RADIO STATION LOG, brought right up to date Contains the Wave Length, Power, and the best time to listen (N.Z. time) to New Zealand, Australian and American broadcast Stations, and the world's Short Wave Stations.

"GETTING STARTED"—An instructional article for those who know nothing of Radio, but who wish to take it up for their hobby or as an interest.

DOUBLET AERIALS—a special feature article dealing with all types of Doublet and noise-reducing Aerials.

VALVE CHART—includes characteristics and base connections of practically all types of American Valves.

THINGS TO MAKE—full particulars of how to make Wave Traps, Shocking Coils, Electric Motors, Electric Fences, Fire Alarms, Crystal Sets, Microphones, Pickups, and many other useful articles.

FOR THE LISTENER—Station Log, Instructions for DX Listening, World Time Chart, Short Wave Reception.

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NAME ....

ADDRESS ....

....

Radiogram, Aug. 1944.

GIRDLING THE GLOBE.

(Continued from page 23)

mission time of the B.B.C. is taxed to the utmost time of the B.B.C. is taxed to the Pacific Service are being received at entertainment strength, and to advise them of transmitters which have faded out at certain times, thus being withdrawn for service to a nearer area, they have arranged with me to cable them weekly, even daily, if necessity should arrive, on reception in this location. Such a service by a DXer is something unknown before the war, and shows what a great help we can be to stations, the Security Department, and the next of kin in the passing on of messages from our prisoners of war.

SHORT WAVE—New Stations of the month

Megacycles	CALL	LOCATION.	ITEMS OF INTEREST.
17.76	KROJ	San Francisco,	1-3.45 p.m. to Australia.
15.36	—	Singapore,	1.30-2 p.m. to India, in English.
15.35	VUD	Delhi, India,	News, 1.45 p.m.
15.33	KGEX	San Francisco,	2-5 p.m. to Philippines.
15.315	VLC-4	Australia,	5.12-5.40 p.m. to Western U.S.A.
15.13	KGEI	San Francisco,	Opens at 5 p.m. for Pacific.
9.87	KMI-2	Dixon, Calif.,	Special broadcasts, 5 p.m.
9.85	KWIX	San Francisco,	Now opens 8 p.m.
9.615	VLC-6	Australia,	To Western U.S.A., 3-3.40 a.m.
9.54	VLC-5	Australia,	Directed to Asia, 10.15 p.m.
9.53	KGEX	San Francisco,	To Philippines, 9 p.m.-1 a.m.
7.25	WGEO	Schenectady, N.Y.,	European service, signs 7 p.m.
7.22	JCJC	Mediterranean,	3-5 p.m.
6.085	LRE	Buenos Aires,	10.50 p.m. onwards in Spanish.
6.082	OAX4Z	Lima, Peru,	Closes at 4.30 p.m.
6.025	—	Algiers,	News, 8 a.m.
5.955	OAX4W	Lima, Peru,	Signs 5.05 p.m.

HOBBIES CLUBS

(Continued from page 16)

soon that the services of our old friend, Mr. W. Dwyer, may be obtained. From 6.30 p.m. until 7.30 p.m. we have organised club games, such as table tennis, billiards, quoits, skittles, draughts, etc. 7.30 p.m. until 7.45 p.m. we have special talks, etc. 7.45 p.m. until 9.15 p.m. radio courses. At present and for the next few nights we are getting in some practical work. At 9.15 p.m. we have supper; club closed down at 9.30 p.m. That will give you all some small idea as to what an evening is like in our branch. Classes are well attended, and attendances are very steady, which I may say helps a lot in the teaching of radio as a hobby. By the way, Rahobs, our two classes are called as follows: The Coil Club and the Valve Club. Each club or class has two captains and two vice-captains, these being responsible for games, scores, etc. Plans are now being prepared for the Radio Exhibition Display, which will be held in October of this year. Last year the display was most successful, and it is hoped to have an even larger and better one this year. Last year the display was most successful, and it is hoped to have an even larger and better one this year. To all our new branches and also our old ones we extend to you all our greetings for your future success. After this date we shall be starting off with our new branch notes, which I regret to say we have been delayed with, owing to the competition we held recently on same. Our new notes will be brief, and it is hoped to provide regular radio items. In the meantime, friends, we thank you for your kindly interest. And this is Dunedin saying cheerio until next month. Mr. A. R. White, Instructor and Organiser, Headquarters, Moray Place, Dunedin.

WITTIQUIZ ANSWERS

(See Page 21)

1—B.
2—C.
3—D.
4—A.
5—B.
6—C.
7—A.
8—B.
9—No. Clean slip rings. Has no commutator.
10—A.

"MODERN RADIO DICTIONARY"

Many thanks to all those Rahobs who have sent in suggestions for the Modern Radio Dictionary. Further definitions will be published from time to time.—Rahob 1.

THE SERVICEMAN'S PAGE

"CRACKLING" AND INTERMITTENT FAULTS.

(Adapted from "Radio and Electrical Retailer," Australia.)

"CRACKLES"

Probably the most common and elusive faults in radio receivers are those which give rise to "crackling" noises, plus or minus variations. Before attempting to locate these faults in the receiver itself, the wise always check the aerial and earth system first, paying particular attention to ancient lightning arresters, joints, lead-in tubes and corroded earth clamps, sometimes tracing the cause of annoyance to this section. Once you have satisfied yourself that this part of the installation is beyond reproach, THEN start on the receiver.

The tubes and attendant shields should be moved and tapped slightly, doing the same with the chassis, to discover whether the fault can be produced at will. The knobs may be operated to see if they are working O.K., paying attention to the dial lamp and tuning drum cord (if metallic). A loose tube shield or corroded tube pin can produce a diversity of noises which were not apparent when the receiver was new. The same applies to an odd strand of a metallic dial cord caressing the chassis during its travels. Dirty or improperly adjusted switches, loose joints and dial lamp leads worn through to the bare wire are prolific producers of noise. If the trouble can be traced to any of these causes, the remedy is obvious, and in the case of a poorly fitting tube shield or a corroded tube pin, don't just do that particular tube—do the lot.

Should the chassis contain an undue proportion of dust and debris, etc., utilise the services of a bike pump or a vacuum cleaner in "reverse" (as a blower, of course). Dirt between the vanes of a condenser may be speedily removed by this method, but sometimes a pipe cleaner or feather may have to be laboriously applied to each plate. Dust and other small particles which somehow seem to gather inside a radio are notably hygroscopic. This last word may puzzle a few who have not been cursed with a classical education—simply it means "Capable of absorbing moisture from the air." Proof may be found by taking a dried flower petal, test with a "megger" or sensitive ohmmeter, wave the petal round in a cool damp room for a minute, and test again. You'll be surprised at the decrease in resistance. This is also applicable to dust, etc. So make a job of cleaning the chassis.

Still in pursuit of the noise, we try the slow-motion drive. This may cause a crackle when rotated. If so, clean and re-lubricate, and if it is of ball reduction type, refill with petroleum jelly. Earthing the condenser spindle by means of a pigtail often cures a receiver. Change the dial lamp or lamps, as sometimes a minute break in the filament will arc across, the lamps remaining alight, but an almost continual "roaring" sound issues from the speaker. The leads to the lamps should be reinsulated if the wire has become worn through because of contact with some moving part.

Having disposed of all these angles we now have to consider the components below the chassis. If a battery set, make sure the "B" battery fuse is clean. If the fuse clips and fuse ends are of dissimilar metals, a high resistance deposit forms in time, and often trouble may be traced to this point. "Dry" joints often occur and all wires soldered to a component should be waggled, and any doubtful ones can easily be resoldered. A crackle may also be localised by inserting a meter to read the various tube voltages and currents, a flickering of the needle often coinciding with a crackle. Similarly a meter in series with components through which D.C. is passing will often reveal a fault by a flicker. In the case of components, such as the secondary of an A.F. transformer, not normally carrying D.C., an ohmmeter will produce the required result in a similar manner.

INTERMITTENTS

These faults are a real headache at times. The fault is invariably capricious, only apparent when you are engaged elsewhere. It will not appear when desired, and perhaps only lasts a second, and when one attempts a test—it vanishes! Some of these intermittent faults occur regularly once the set has been switched on for a certain time, and so are comparatively easy to locate when compared with those of more irregular habits. The "will-o'-the-wisp" type occur rather frequently but vanish smartly once a meter is applied and frequently will not reappear for quite lengthy periods.

It is imperative that the technician obtain all the data he can from the client, and besides carrying out the check mentioned at the beginning of this article, he should closely inspect the adjacent A.C. power and light switches, etc., to make sure these are not faulty. Once the receiver is on the workshop bench, a few meters may be brought into action by inserting these in key circuits. A fault which appears at irregular intervals after switching on is located more speedily. Faults such as intermittent breaks in coils, transformers or speaker windings make contact when cold but become open-circuited when warm, come in this category. Resistors apparently in order when cold increase in resistance or become open-circuited when warm, are a considerable source of trouble, particularly grid-stopper resistances fitted inside the top cap shield of a power tube. These resistances often get abnormally hot and frequently are the culprits.

Should the receiver be tested outside the cabinet the fault may not appear, simply because the receiver is not operating under true working conditions. The parts are "running cooler," and the odd degree or so less temperature is often just enough to permit the component to operate normally. So, remove the knobs and shipping bolts, and when the trouble appears slip the chassis out quickly for continuity testing.

IRREGULARS

The irregular fault is best tackled by having a concentrated probe round the wiring, components, soldered joints, earthing tags, and so forth, using of course an insulated probe. Coil shields to chassis, metal cased condensers and variable condenser frames to chassis should be examined thoroughly. Dirty condenser bearings should be cleaned, and any other method of contact between condenser spindle and frame should have your close attention. A pigtail may be fixed to these two points to advantage. Should your tests be without result, it will be necessary to run the receiver for perhaps some hours, and maybe this would interfere with your other work. Some form of indication is necessary and a flashlamp bulb connected across the speaker transformer secondary is an admirable indicator. When signals are coming through, the lamp glows; and when they cease it fades out. The speech coil is disconnected, of course. A change from good to poor sensitivity and vice versa can also be detected. The input to the set should be steady and a modulated oscillator or "multivibrator" should be employed. Any change in the intensity of the light from the lamp, which should be in a prominent position, indicates that the fault has occurred, and you can get right on the job. If spare meters are available, they should be inserted at strategic points in the circuit, their readings noted as soon as the set is thoroughly warm and before the fault appears, and as soon as the indicator lamp warns you, the meters may be read without handling the set, and therefore without the risk of causing the fault to disappear.

Voltmeters could be used to check plate voltages first. If only one meter is available, then each tube must be individually tested. Any changes will indicate a probable clue in that particular circuit. Alternatively, a milliameter in series with the cathode of the tube will assist you also.

If a tuning indicator is fitted, this will often give an indication of the occurrence of the fault, but unless the fault is a high-tension failure or something of a similar nature, it will only indicate that the fault is in some part of the circuit that precedes it—anywhere between the aerial terminal and the A.V.C. rectifier.

When using the lamp as an indicator, there may be a little difficulty in connection with faults which do not affect the output considerably. The lamp will not indicate distortion unless this is accompanied by a change in output of the set. Also the fault just may happen to be in the speech coil, so check up thoroughly on this and its associated wiring.

If the fault produces bad crackling noises, the lamp will flicker with a corresponding movement on any test meters connected in the receiver.

In the case of intermittent faults a general rule cannot be applied. One has to eliminate certain sections, depending on the type of fault and its symptoms.

The power supply may have an electrolytic condenser suffering from internal corrosion, and smoothing chokes may have this complaint also, and because this has been mentioned last it is by no means least.

In conclusion, do not be led up the garden path by false clues. You may rotate the wave change switch and the fault goes. You clean the switch thoroughly—and the fault reappears. The rotation of the switch has caused a surge which removed or produced the fault. A wire or a tube moved here or there has the same result, and frequently the trouble is found far removed from your first point of suspicion. The moral is obvious.

RAHOB LIBRARY

ACKNOWLEDGMENTS OF DONATIONS

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9843		2	8
9859		1	8
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11600		3	0
9632		5	11
A129		2	6
2723		1	1
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P.W.D. REGULATIONS

AMERICAN CABLES AND FLEXIBLE CORDS.

Q.: There is at present on the New Zealand market a quantity of American two-core and three-core heater flexible cord with no means of identifying the cores other than one core of the three-core being varnished. Does this conflict with the regulations?

A.: Yes, but these cords may be used under a general modification provided care is exercised when connecting the cores to their respective terminals.

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