THE AUSTRALASIAN

Radio World

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VOL. 9 . . . . . NO. 3

AUGUST 15 1944

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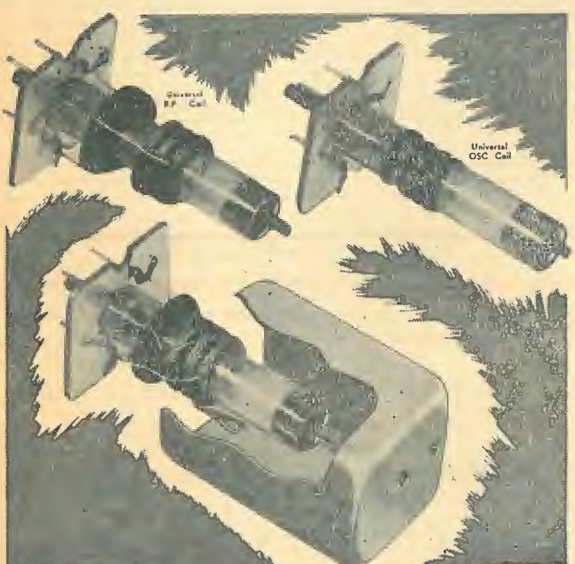

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EDITORIAL

The war effort has called upon the radio industry to supply huge quantities of equipment. Radio receivers and transmitters are required for fitting to practically every tank, plane, and boat. Hundreds are required for the maintenance of communications between various groups of men in action.

The demand is being met in a marvellous way, considering the problems of production, but sometimes it is found that schedules cannot be maintained. Almost universally the explanation is that sufficient manpower is not available.

Quite unofficially, we happened to go into this problem with a well-known factory executive and immediately formed the opinion that the problem was not really so much a matter of shortage of hands as the inefficiency of those employed.

This was due, primarily, to the fact that the executives of the organisation were themselves overloaded with work.

In this particular case the production was three times what would have been a rush in peacetime, yet there were fewer executives on the job. Needless to add, these executives were not in fit shape to get the best out of the employees.

No one seemed to have the time to spare to see to the proper up-grading of the more intelligent "unskilled" workers, yet we feel sure that such time would not have been wasted. In fact we suggested that an intensive schooling of a few of the better-type staff, in this case especially senior females, would eventually lead to improved quality as well as quantity of production by removing a severe bottle-neck in the testing department.

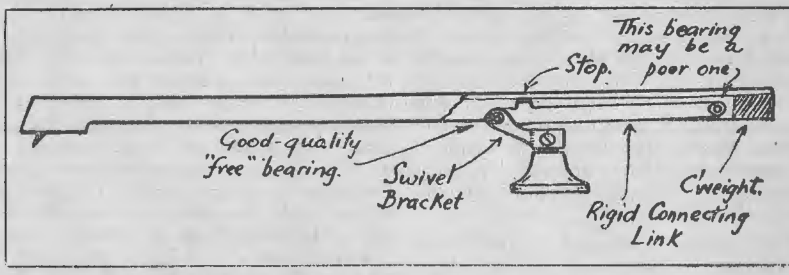
At any time, the overworking of executives does not lead to efficiency in the long run.

—A. G. HULL.

HOME-MADE HI-FI PICK-UP

IN the January issue of "Australasian Radio World", there was described a two-pole "Hi-fi" magnetic pick-up in which the steel needle alone formed the armature. This pick-up was comparatively simple in design and very light on records but suffered from one big disadvantage: the output was very low—much less than a twentieth of a volt, and even lower after compensation for the lack of bass. That pick-up required an extra high gain amplifier resulting in excessive amplification of noise and hum. With the improved designs described below, much less gain is required—the output of the pick-up after equalisation being about that of a medium-level crystal microphone.

By
J. W. STRAEDE,
A.M.I.R.E. (Aust.)*
7. Adelaide St., Preston, Victoria



Suggested mounting arm for the home-made pick-up.

Increasing the Output

The output of the pick-up has been increased in three ways—the greatest increase coming from the use of four poles instead of merely two. This doubling of the number of poles much more than doubles the output. The extra pole pieces are placed under the coil-bobbin and decrease the reluctance of the magnetic circuit which goes through the armature every time it is displaced.

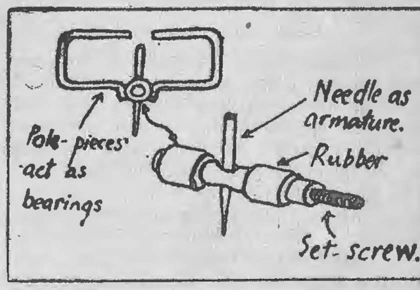
Another way in which the output is increased is by placing the upper pole pieces closer together. Normally this would result in odd-harmonic distortion on the peaks, especially in the lower frequencies, but this is reduced by having the armature lower down, so that its tip does not approach the pole pieces closely at full amplitude.

Finally the bass resonant frequency is made somewhat higher so that less compensation is required. The actual resonant frequency depends on the type of needle suspension and is lowest in the rubber-friction-grip type. A resonant frequency of 30 to 50 cycles per second is of no importance whatever as ordinary records contain little of those frequencies (many of the **cheaper** magnetic pick-ups cut off sharply below a resonant frequency of from 80 to 110 c/s!!).

Suspension Methods

The first suspension system tried was that described in "Australasian Radio World," for January, 1944. Strange to relate, it was not found very satisfactory when used with ordinary steel needles. The grip of the rubber was insufficient after the needle had been changed a few times; besides it is suspected that the needle and rubber do not maintain contact at all times, thereby producing discontinuities in the output and resulting in whiskery reproduction. When miniature long-playing needles are used, the rubber block system is quite o.k., though best results were obtained by surrounding the upper half of the needle by a tightly fitting rubber tube which was then cemented in the bobbin.

A second suspension system was a miniature version of conventional mag-



An alternative suggestion for the needle mounting.

netic pick-up suspensions, the needle being clamped half-way in a long tubular pivot rod which was threaded to take a clamping screw. The first of these pivot-cum-needle clamps was made by filing off the armature and lowest portions of a Garrard pick-up and considerably lightening the result. Using the second system all went well except that the needle frequency (scratch frequency) was in the audible range of the average record and a low-pass filter with a cut-off of about 6,500 c/s. was needed if worn records were to be played.

Copper-Torsion Suspension

A third system was tried. A midget armature was built up from the tip of a "permanent" needle, a very short length of thin iron wire (about gauge 24) and some thin copper wire (gauge 28). The piece of iron wire acts as the actual magnetic armature while the copper wire which was doubled and twisted acts as a sort of tor-

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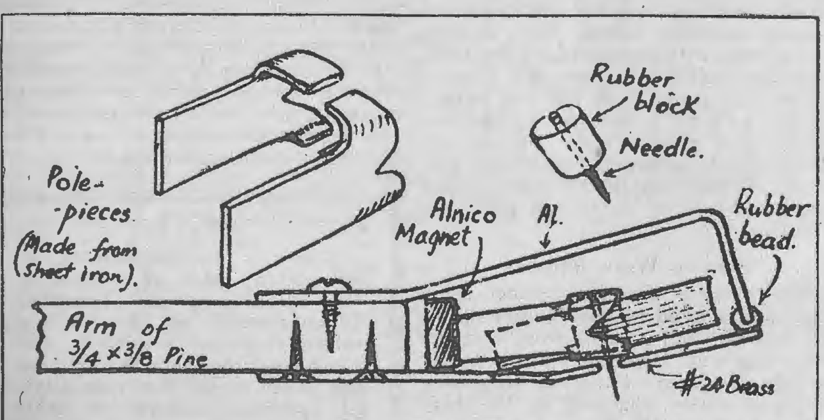


A rough sketch of the pick-up assembly, with illustrations of the pole pieces and the suggested needle mounting.

* Proprietor of Straede Electronic Laboratory and Lecturer in Electronics at Melbourne Technical College.

HI-FI PICK-UP
(Continued)

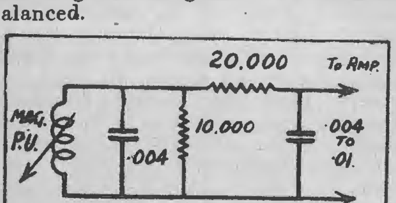
sion-bar suspension. After twisting the two long strands of copper wire together, the iron wire (then about 2 inches long) was pushed through; the copper wire was then hard-drawn by pulling it near to breaking point and the junction of iron and copper soldered. Finally the wires were trimmed to length and the needle tip (a piece of platinum-iridium embedded in copper) soldered on.

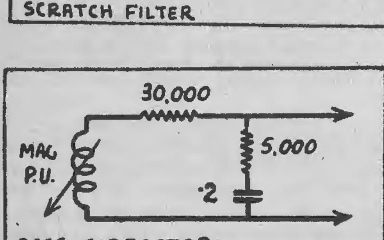
The twisted copper wires were splayed out at each end and cemented to the underside of the bobbin with celluloid cement. This cementing is the hardest part of the process and will be replaced in future pick-ups by soldering to the tips of the polepieces or to projections from them.

Damping of the movement was carried out by smearing rubber solution over the armature and halfway up inside the bobbin and by pushing in a small ring of rubber (cut from a piece of thin tubing) between the top of the armature and the top of the bobbin.

Coils and Magnets

Pick-up bobbins are difficult to procure these days and larger bobbins such as those in headphones and old magnetic speakers may be used instead, providing ordinary large size needles are to be employed. Loudspeaker bobbins generally provide a higher output, and, due to their lower D.C. resistance require a lower value of D.C. load. If a loudspeaker bobbin is to be used, or if a little bit of the output can be sacrificed, electrical damping can be obtained by winding three turns of 20 gauge wire around the outside of the bobbin and short-circuiting it. This electrical damping helps to reduce the peak at the needle (scratch) frequency. A heavy magnet is quite an advantage so long as it is counter-balanced.





Suggested circuit arrangements for a suitable bass corrector and a scratch filter to allow worn records to be played.

Pick-Up Arm

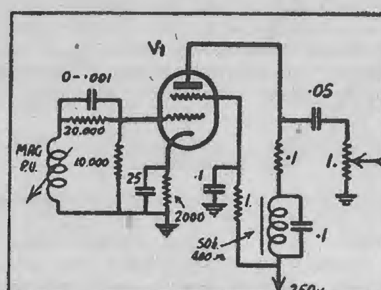
Resonance in the pick-up arm itself is of comparatively small importance. Several types of arms were tried: One consisted of ½ × ½ hardwood with a large number of cross cuts one-quarter of an inch deep. These cuts were filled with soft wax, because the velocity of vibration through wax is different to that through wood. Another pick-up arm was made of two sections of quarter inch brass tubing each fitting freely over a steel rod. The junction between the two brass tubes was made by a tight binding of adhesive tape.

Finally an arm with a swivel joint was made so that the pick-up head could be rotated for easy needle loading, the presence of the necessary counter-balance preventing the direct lifting of the arm.

A suitable balance weight can sometimes be obtained from the pole of an old dynamic speaker.

Bass Compensation

There are two chief ways of making up for the lack of bass in an ordinary record when pick-up resonance is not being used. Either a "loss" network can be connected between the pick-up and the first stage of the amplifier to reduce the response at the frequencies

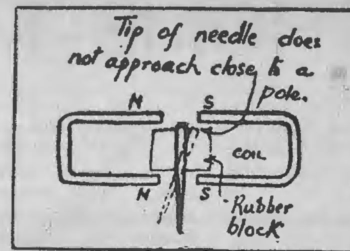


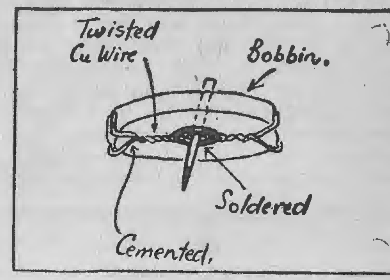
Another method of arranging bass correction by using a tuned choke in series with the plate load of the first amplifying valve.

above the bass or a tuned circuit with a low resonant frequency (e.g. 90 c/s.) can be connected in series with the anode load of one of the pentode voltage amplifier valves. Both circuits are shown, with valves found by trial. The loss method is the best from a theoretical standpoint, but the output of the pick-up is lowered. Complete shielding is necessary for the pick-up leads, filter network and first two stages in the amplifier. The volume control should be connected **after** the first valve.

Playing Worn Records

New records are hard to get these days and a good pick-up shows up all the defects! For playing worn records, the frequency response should be reduced—gradually at the low frequency end and fairly abruptly at the high frequency end. This frequency restriction can be obtained by means of a double pole single throw switch and a





Further suggestions for the needle fixing.

condenser and resistor. When the switch is closed, the condenser is shunted across the pick-up thereby reducing the highs while the resistor goes across the bass-boost condenser, reducing the amount of bass compensation. The actual sizes of these components must be found by trial, the condenser varying in capacity from .2 to .003 mfd. and the resistor varying from 1,000 to 10,000 ohms. Sometimes better results are obtained by interchanging the positions of the components, a 5,000 ohm resistor being connected across the pick-up and the bass-boost condenser being shunted by a .5 or 1 mfd. condenser.

Motor Precautions

A good pick-up reproduces low-frequency rumble from the motor. Even if this low-frequency vibration is itself inaudible, it may modulate the output thereby producing an unpleasant warbling effect. Cures are, of course, the better, mounting of motor and pick-up on a heavier motor-board, weighing the turntable and removing non-linearity in the amplifier. Finally a suggestion: If you can get your amplifier-plus-pick-up calibrated for frequency response, you will get an idea of what your resonant frequencies are and you can compensate accordingly.

NOTE

Owing to an inadvertence, in last month's issue we referred to Mr. Straede as our Technical Editor. Actually, Mr. Straede is a valued technical contributor, but is not connected with the editorial and is not in any way responsible for opinions expressed by other contributors.

—Editor.

WIDE-RANGE AUDIO FREQUENCY OSCILLATOR

IN all phases of audio frequency work it becomes essential to have some quency source, which is dependable. free from distortion, has good output waveform, and an output which is free from voltage variation throughout its range. Although many reputable firms making test instruments seem to prefer the beat-frequency type to that

By

CHARLES MUTTON,

1 Plow Street, Thornbury, Vic.

of any other, when it comes to the home constructor, it is extremely unlikely that he would be able to obtain anywhere near the stability obtained in the commercially-built job. Beat frequency oscillators commonly known as B.F.O. are also rather pricy, i.e., the better class ones, and as the inferior types are far from reliable it serves one much better to do without than have an instrument which cannot be relied upon.

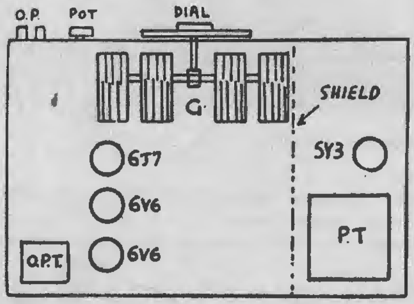
However, one particular firm in U.S.A. which is starting to make a name for itself in the matter of making test gear is the Hewlett-Packard Co. This firm gets away from the conventional B.F.O. and is turning out a resistance-capacity tuned type of audio oscillator, a similar type to the one we are about to describe. A glance at the circuit diagram will reveal the complete lack of inductances, a feature which has many points to recommend it.

Principles of Operation

The circuit consists of a 6J7 tube used in a Wien Bridge type of circuit, the oscillation constants of which depend of the selection of resistance capacity combinations selected by the two-gang switch. Continuous variation of the frequency range is governed by the four-gang condenser. The operation of the oscillator depends on the automatic adjustment of the ratio between the regenerative and degenerative feedback between the output and input circuit. The regenerative feedback is fixed and thence fed back to the grid of the 6J7 through the resistance-capacity input circuit. The degenerative feedback is coupled through the 2,500 one-watt resistor shown in the diagram, through the two lamps in the cathode circuit of the 6J7. These lamps are two 6-watt 120 volt tungsten Mazda-type and were obtained from A.G.E. Co. This type of lamp possesses a positive resistance temperature characteristic, hence the amount of feedback voltage increases more rapidly than the current through the lamps. The audio current which is fed from the plate circuit of the first 6V6-GT tube causes a varying voltage drop across the lamp resistor circuit.

Buffer Stage

The oscillator proper is isolated from the output stage consisting of another 6V6 GT tube. This prevents the output stage from reacting back on the oscillator stage resulting in better stability under varying loads. It will be noticed that the output load is placed in the cathode circuit, which has the advantage of an extremely



A suggested layout plan.

high input impedance while having at the same time a very low output impedance, also due to degenerative action. The circuit covers an extremely wide band of audio frequencies.

Range Covered

The complete range of the instrument is from 16 to 85,000 cycles. Each set of resistors covers a frequency range of approximately 10 : 1. The coverages being as follows 1.—16—150 cycles. 2.—150—1,150. 3.—1,150—10,000. 4. — 10,000 — 85,000 cycles. These figures form the extremities of each range. Continuous coverage is afforded from 16—85,000. The voltage available from the low-impedance output is variable up to about 1.25 volts up to about 25,000 cycles. The other output impedance provides 18-20 volts.

The tuning condenser consists of two two-gang Stromberg-Carlson broadcast condensers, one standard and one reverse action connected up as a four-gang condenser utilizing an old drum dial from an Emmco trade-in receiver. The frame of the condenser is at grid potential above ground. For this reason it was found necessary to shield the entire oscillator portion of the instrument from the power supply. The dial also had to be insulated from the shafts of the condensers with insulating bushes, in order to get away from hand capacity effects. The gang condenser is shielded its entire length and the power supply is kept up one extreme end of the chassis. The entire instrument is also placed in a metal screening box. The instrument should not be operated out of its box, failure to stick to this point will result in excessive A.C. pick-up on the low frequency range.

Capacity Balance

The purpose of C2, which is a 75 mm F fixed condenser, is to maintain a capacity balance between the two gang sections, as the lower section has a higher capacity to ground than the top section. The trimmers on the lower section of the gang can be removed and the trimmers on the upper section are varied until smooth oscillation is maintained over all bands. This adjustment is not very critical, hooking the instrument up to a C.R.O. will determine the best setting. The maximum capacity of the gangs was found

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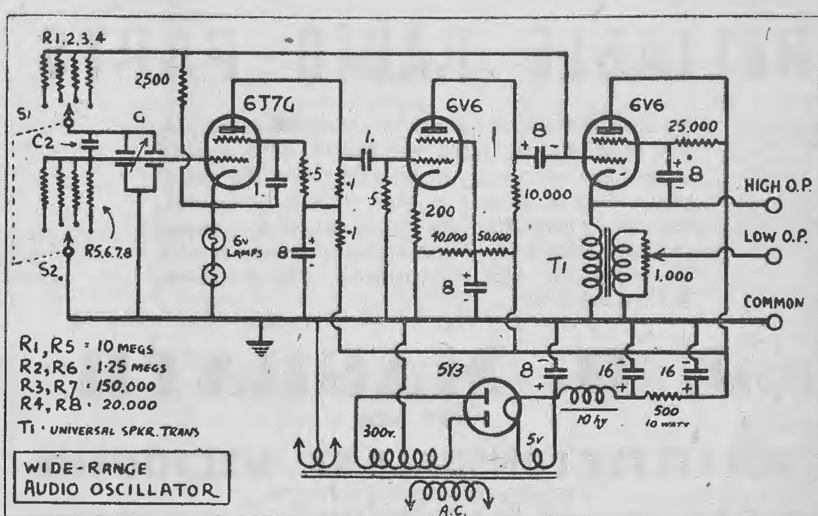

Circuit schematic for the handy audio oscillator.

AUDIO OSCILLATOR
(Continued)

too high, only 365 mmF being needed. Removing two moving plates out of each section did the trick.

Calibration of the Instrument

There are two methods that can be used to calibrate audio oscillators. The first and most simple being the beat frequency method, used in conjunction with another audio oscillator of known accuracy. The other method used is to calibrate the unit against the linear sweep oscillator in a cathode ray oscilloscope having a range from 10 to 5,000 cycles, and using the 60 cycle power line frequency as a base from which to start. However, it is extremely unlikely that any of our readers are fortunate enough to have either of these pieces of equipment, the only other alternative being to try and borrow either of the above instruments or pay to have the job calibrated by a reputable sound engineering firm who would have the necessary facilities.

Calibration is by no means essential and for most laboratory work it is possible to test amplifiers, speakers and other equipment after "calibrating" the oscillator "by ear."

SOLDIERS' OWN STATION

One of our readers writes as follows:—

Dear Sir,

With reference to the paragraph at top of column 3, page 26, of your 15th June, 1944, issue, headed "SOLDIERS' OWN STATION"; an A.I.F. station known as "THE VOICE OF THE DESERT" was on the air with programmes of music and speech from records and flesh and blood in April, 1942. There was a registered list of 42 listeners and many unregistered ones. It was operated on fleapower on 200 meters, but it had a very useful range of entertainment value. It included amongst its listeners troops of various nationalities who made the acquaintance of many well-known transcription series of the "Dad and Dave" type for the first time. The station operated under a military experimental licence and was also licensed by the Palestine Broadcasting Commission. One of the operators broadcast from 2SM on the activities of the station, March, 1943. As a first-class licensed radio station with a regular twice daily programme of good entertainment value the "VOICE OF THE DESERT" antedated the W9YH station by many months. To the very great sorrow of the members of the original station the Army has applied the title "the Voice of the Desert" to a mobile public address system van.

Yours truly,
JOHN KINGLEY.
(VK2A.C.F.).

THE ACCURACY OF OHMMETERS

EVERY radioman has frequent occasion to determine resistance values. If he has access to an ohmmeter, the problem is simple. For those with a milliammeter, a battery and a known resistance, the problem should be no more complicated, since basic ohmmeter circuits can be duplicated readily. However, an understanding of the principles involved and of the limitations which restrict the use of the ohmmeter is important if miscalculations are to be avoided.

Basic Principles

By means of the circuits shown in Fig. 1, it is possible to measure an unknown resistance by comparing it with a standard or known resistance. First, the current, I, is measured with only the standard or known resistance, R, in the circuit of Fig. 1-A. Next, the unknown resistance, Rx, is inserted in the circuit, as shown in Fig. 1-B, and the new current, I-1, is read. The current with both known and unknown resistances in series will be less than with the known resistance alone. From these two readings the unknown resistance can be calculated by the following equation:

$$E = IR = I_1(R + R_X) = I_1R + I_1R_X$$
$$I_1R_X = IR - I_1R = R(I + I_1)$$
$$R_X = R\left(\frac{I - I_1}{I_1}\right)$$

This equation is derived from Ohm's Law, as follows:

$$R_X = R\left(\frac{I - I_1}{I_1}\right) \qquad (1)$$

The value of the unknown resistance is calculated by multiplying the known resistance in ohms by the difference between the two readings and dividing the product by the current reading after insertion of the unknown resistance. The readings may be directly in amperes or milliamperes, or simply as fractions or percentages of full-scale meter deflection.

The equation is conveniently solved by means of a slide rule or long-hand arithmetic. If, for example, with a known resistance of 5,000 ohms the current, I is 0.87 milliampere, and with the 5,000-ohm and unknown resistances in series the new current, I-l is 0.30 milliampere, substituting in equation (1) and solving will give:

$$R_X = 5{,}000\left(\frac{0.87 - 0.30}{0.30}\right) = \frac{(5{,}000)(0.57)}{0.30} = 9500 \text{ ohms.}$$

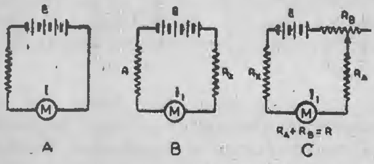

Fig. 1 — Basic ohmmeter circuits. The current first is measured with the known resistance, *R*, in the circuit of 4. The unknown resistance, R_X, is then connected as shown at B and the new current noted. The unknown resistance may then be calculated by the formula given in the text. C shows the addition of a variable resistance, R_B, to compensate for battery deterioration.

Series Circuits

The ohmmeter circuit of Fig. 1-C has provision for adjusting the current to full scale with the known resistance. In this case the known resistance, R,

By

DR. TRUMAN A. GADWA

(Reprinted from "Q.S.T.", U.S.A.)

consists of Ra and the portion of Rb in the circuit. Then, if insertion of the unknown resistance, Rx, causes the meter reading to fall from full scale to one-half scale, we know that the circuit resistance has been doubled and that Rx = R. If the reading falls to

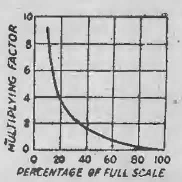

Fig. 2 — Characteristic curve of a series ohmmeter circuit, showing the factor by which the known resistance is multiplied to obtain the unknown resistance value corresponding to any percentage of meter deflection.

one-third scale, the resistance has been tripled and Rx = 2 R. Similarly a drop to one-quarter scale means that the circuit resistance has been multiplied by four and that Rx = 3 R. Thus a curve, such as that shown in Fig. 2, may be drawn from which may be obtained the factor by which the known resistance, R, must be multiplied to give the unknown resistance for any percentage of the original full-scale reading. If, for example, the known resistance is adjusted so that the meter reads full scale with R short-circuited and the insertion of the unknown resistance causes the meter reading to drop to 40 per cent of full scale, the curve of Fig. 2 shows that the unknown resistance is 1.5 times the known resistance.

If desired, the meter may be fitted with a scale of the type shown in Fig. 3-A, which permits the meter to be read directly in ohms, the calibration being obtained by the use of Fig. 2. The scale is not linear, of course, and it is reversed from the normal milliammeter current scale, since zero resistance occurs at full-scale current while infinite resistance is indicated by a zero-current reading.

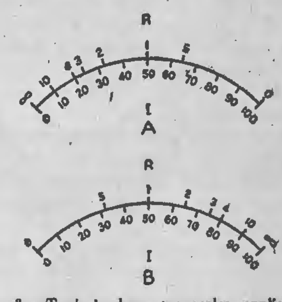

Fig. 3 — Typical ohmmeter scales applied to a milliammeter. The reversed scale at A occurs when the unknown resistance is connected in series, while the scale at B is of the type which results when the unknown resistance is connected in parallel with the meter.

Measurement of resistance by means of the circuit of Fig. 1-C is subject to increasing error as the battery deteriorates, because the adjusting resistance, Rb, which is unavoidably part of the calibrating resistance, must be reduced to compensate for the reduction in battery voltage if a full-scale reading is to be maintained with zero resistance at Rx.

An Improved Circuit.

A circuit which makes the measurements practically independent of battery voltage is shown in Fig. 4. It is similar to the circuit of Fig. 1-C except that the compensating resistance, Rb, is connected in shunt with the meter. The circuit operates on the principles previously set forth for the circuit of Fig. 1-C insofar as resistance measurement is concerned. It has the important advantage, however, that

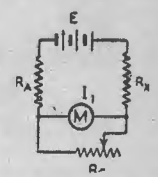

Fig. 4 — Circuit for measuring high resistances. The battery compensating resistance, R_B, is in shunt with the meter, varying its sensitivity. R_A is the standard, and its value must be known. The unknown resistance, R_X, is connected in series.

adjustment of Rb to compensate for battery age has a negligible effect upon the total circuit resistance. So long as the circuit is adjusted first with the Rx terminals short-circuited, the accuracy will not be affected, for all practical purposes, regardless of the value of Rb. The formula for determining the unknown resistance value from the meter reading is equation (1), where Ra is substituted for R. The value of Ra in this circuit should be known as accurately as possible. With a 1-ma. meter and a re-

(Continued on next page)

OHMMETERS
(Continued)

sistance of 2000 ohms for Ra, a reading of 1/100 ma. will indicate a resistance of 198,000 ohms, while a reading of 99/100 ma. will indicate a resistance of approximately 20 ohms. The measurement of still higher resistance values will require the use of a higher resistance at Ra, and a correspondingly higher battery voltage to obtain the initial full-scale deflection.

Measurement of Low Resistances.

The circuit of Fig. 5 is more suitable for the measurement of low resistances. In this arrangement the unknown resistance is connected in parallel with the meter instead of in series, the meter resistance serving as the standard. Before the unknown resistance, Rx, is connected, the circuit current is adjusted to full-scale meter reading by means of Rb. Then, when Rx is connected, the total circuit current will be divided between the meter branch and the Rx branch in inverse proportion to the resistance of the branches. Thus, if a 1 ma. meter with a resistance of 30 ohms (an approximate figure for a meter of this type) is used and Rb is adjusted so that the meter reads full scale, connection of a 30-ohm resistance at Rx will cause the meter reading to fall to half scale. Other values of unknown resistance will give a meter reading above or below half scale, depending upon whether the values are respectively above or below 30 ohms. A 1-ma. meter can be read with fair accuracy down to about 1/100 ma. Since the circuit current has been set initially at 1 ma., a meter current of 1/100 ma. means that 99/100 ma. must be flowing through Rx. Therefore, the resistance of the latter must be 1/99 of the meter resistance, or 30/99 = 10/33 ohm. This value represents the minimum value of resistance which can be measured by this system with reasonable accuracy. At the other end of the range, a meter current of 99/100 ma. means that the current through Rx is 1/100 ma. and therefore that the resistance of Rx is 99 times that of the meter, or 99 × 30 = 2970 ohms. The resistance for any meter reading may be determined from the formula

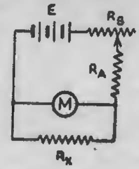

Fig. 5 — Circuit for checking low resistances. The resistance of the meter, *M*, serves as the standard, R_B compensates for battery deterioration with negligible effect upon the calibration, while R_A (exact value not critical) assists in setting the initial full-scale current. R_X is the unknown resistance.

$$R_X = \frac{I_1 R_M}{I_1 - I}$$

where I is the full-scale current before Rx is connected, I-1 the new current with Rx connected and Rm is the resistance of the meter. It will be noticed that a resistance scale for the milliammeter will run in a direction opposite to the scale for the circuit in Fig. 1-C, minimum resistance now coinciding with the minimum current reading, as shown in Fig. 3-B.

A battery voltage should be chosen which will permit the sum of Ra and Rb to be at least 100 times the resistance of the meter. Then the meter resistance forms a negligible portion of the total circuit resistance and the total circuit current remains essentially constant regardless of the value of Rx connected across the meter. For this reason, the exact value of the series resistance is not important so long as it is initially adjusted to give full-

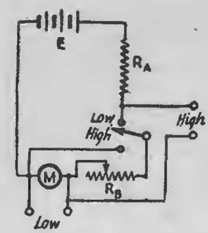

Fig. 6 — Combination circuit for measuring high or low resistances. With a battery voltage of 3 and a 1-ma. meter, suggested values are an accurately known resistance of approximately 2000 ohms for R_A and a variable resistor of 1000 to 1500 ohms for R_B.

scale deflection, and Rb may be changed to compensate for a drop in battery voltage without affecting the calibration of the meter. With a 3-volt battery and a 1-ma. meter, Ra and Rb should each have a resistance of about 2000 ohms.

A combination of the circuits of Figs. 4 and 5 for measuring high and low resistances is shown in Fig. 6. For the ranges mentioned in connection with those corcuits, Ra should

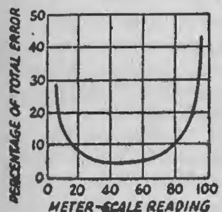

Fig. 7— **Curve showing resulting inaccuracies in resistance measurement when an error of as little as one per cent is made in the meter reading.**

be adjusted as accurately as possible to 2000 ohms, while Rb may be a variable resistor of 1000 to 1500 ohms with a current-carrying capacity of 2 or 3 ma. The battery should have a voltage of 3 and the meter a scale of 1 ma.

Accuracy of Measurement

In the determination of resistance by this method, the accuracy of the result will depend upon the accuracies of the following:—

(1) Standard or known resistance.
(2) Meter calibration.
(3) Initial setting of meter to full-scale.
(4) Meter readings with known and unknown resistances in circuit.
(5) Voltage regulation during test.

The tolerance of a cartridge-type resistor can be ascertained from the R.M.A. colour band, a gold band indicating an accuracy of 5 per cent., silver 10 per cent., and no colour 20 per cent. Standard resistors suitable for voltmeters are available with even closer tolerances. Meters can be calibrated against precision standards for high accuracy. Care in the adjustment of the initial setting as well as in observation of readings will reduce the error to a minimum.

If any error is made in reading the meter, the resulting error in resistance determination will not be constant at all points on the meter scale. It will be minimum at half scale when the current with the known resistance alone produces a full-scale reading. The total error increases as the current readings with both resistances in the circuit approach either end of the scale. The curve of Fig. 7 illustrates how the resulting error varies at different points on the scale for an error in reading of as little as one per cent of the full-scale reading. It is obvious that errors in readings of the meter affect the accuracy of measurement least when the known and unknown resistances are equal. Where greater accuracies are required, the Wheatstone bridge principle must be utilised.

SCREENING BY METAL SPRAY

AN important requirement of radio apparatus is the screening of electric wires, motors, etc., which would otherwise interfere with clear reception. Sometimes parts of wireless receivers themselves are screened by tinfoil or thin aluminium sheets. Screening can now be done by plyboard, paper or glass fabrics, the surfaces of which are coated with finely divided metals by a special process. According to a report by the National Physical Laboratory, in which these metal-coated products were examined, the electromagnetic screening properties were equal with those of tinfoil having a thickness of 0.2 mm. An important feature is the continuity of the metal coating which has to be connected to earth. Further, it cannot be pulled off, and paper board with a thickness of $\frac{1}{64}$ inch can be folded without upsetting the continuity of the coating.

Easy To Make

It will be readily understood that metal coated laminated boards are stiff compared with thin metal sheets, while being much more easily made up into screening enclosures, especially by amateur makers of wireless apparatus, as the boards can be screwed or nailed together. Standard sizes of boards measure 20 by 40 inches and have thicknesses of $\frac{1}{64}$th, $\frac{1}{32}$nd, $\frac{1}{16}$th and $\frac{1}{8}$th inch. Standard metal coatings are zinc on one side or on both sides, or aluminium on one side or on both sides, or aluminium on one side and zinc on the other, but coatings of other metals can also be applied.

For Glass Fabrics

Another application of these metal coatings is to glass fabrics which were described in these columns for January, 1943. This product is said to retain all the desirable advantages of glass with the addition of excellent screening properties. Limp and flexible as cloth and porous enough to allow "breathing", such fabrics yet have the electrical qualities of thin metal foil. They are available in sheets and tubes, the latter being particularly useful for screening wires and cables.

TECHNICAL GLOSSARY

A new and enlarged "Glossary of Terms used in Telecommunications" has recently been issued by the British Standards Institution. Many new definitions have been added and many others have been revised to keep pace with recent developments. Well over half the terms are current in wireless, though there are sections for land-line telephony and telegraphy. The purely wireless sections are headed Radio-communncation, Television and Radio Direction Finding.

Among new terms defined is radiolocation: "Determination of the position of a distant object or reflecting surface by a method involving the use of reflected waves."

What seems to be one of the less happy innovations is the word "omniaerial" as a preferred alternative to "omni-directional aerial." The extension of the term "radio broadcasting" to cover sound, vision or facsimile transmission for general reception, though logical enough, runs contrary to accepted usage and seems likely to make for confusion. On the other hand, everyone will approve the complete omission of "static"—a quite incorrect but still popular designation of interference. "Antistatic aerial" is given, but its use is deprecated. The same applies to "demodulation" as a synonym for "detection." One could wish that the unnecessary "video-frequency," given as a second-choice synonym for "vision frequency," was also deprecated.

Perhaps the most drastic substitution is "sender" as a preferred alternative for "transmitter." We know that the word is used in the Services, but except for purely official purposes, it does not seem to have made much headway. But one feels that we ought to like the shorter word "sender"; most authorities urge that an English word is always more natural and forceful than a Latin derivative.

Though prepared primarily as a guide for the standardisation and coordination of technical terms, the Glossary should interest a much wider readership than most publications of its kind. Issued as B.S.204:1943 by the British Standards Institution, 28, Victoria Street, London, S.W.1, it costs 3/6.

IMPROVED CORES

A new kind of steel, developed by Westinghouse, which can be rolled to a thickness of 2 mils is being used for cores of transformers for application in radio detecting devices. The cores, weighing from one-fifth of an ounce up to seven pounds, are wound from a continuous ribbon of the ultra-thin steel by a process which is much faster than the old one of laboriously stacking punched laminations by hand.

—From an American magazine.

A USEFUL A.C. BRIDGE CIRCUIT

THE following is a description of a simple type of Wheatsone Bridge which will be of inestimable value to the amateur, serviceman, or home builder and providing care is taken in its construction, it will repay its intended owner a thousandfold, and will enable many checks to be made on component parts with a degree of accuracy, impossible to obtain with the best ohm meters and capacity meters we have seen to date.

Ranges Covered

Resistance

.1 ohms to 10 ohms
10 ohms to 1,000 ohms.
1,000 ohms to 100,000 ohms.
100,000 ohms to 10 megohms.

Capacity

.1 mmfd. 90 mmfd.
10 mmfd. 1,000 mmfd.
.01 mfd. .1 mfd.
.1 mfd. 10 mfd.

Before starting the description of this instrument one important fact must be realised and that is this instrument is not a toy, and the writer

By

CHARLES MUTTON,
1 Plow Street, Thornbury, Vic.

would not advise the novice to tackle the job. A working knowledge of a Wheatstone Bridge is essential and more important still, the resistors and condensers which are used as standards internally must be beyond reproach and must be accurate to at least 1 per cent. Neglect of the latter will result in serious inaccuracies which become cumulative.

General Description of Circuit

This instrument consists of low voltage A.C.-fed bridge circuit, known as the slide-wire type, the slide wire consisting, in the writer's case, of a specially-made 1,000 ohm potentiometer, which is 3 inches in diameter. The use of a large potentiometer assists in spreading out the calibration points with resultant greater calibration accuracy. Attached to the spindle of the potentiometer is the main dial, which consisted of a 5 inch circle of ⅛ inch brass sheet, which was turned on a lathe.

The switch consisted of a 2 bank 12 position Yaxley switch which serves the purpose of switching in the various standards to one pair of the output terminals.

A small power transformer with the following voltages was pressed into service to meet the power supply requirements:—200, 220, 230, 240v. primary, high tension—250/250 secondary. The usual 5v. rectifier winding constituted the A.C. source for the bridge circuit and by using an ordinary 6X5 indirectly-heated rectifier, meant that the 6J7 amplifier tube and the 6G5 magic eye null indicator and the rectifier filaments could all be supplied from the one remaining 6.3 filament winding on the transformer. The heater to cathode voltage using this method is questionable, but to date, has not given any trouble. If, however, a transformer is available which has two 6.3 windings, then the rectifier heater can be separated from the other two heaters with less risk. The filter system consists of the resistance capacity type, a 10,000 ohm resistor (5 watts) and two 8 mfd. electrolytics. Seeing that the current drain is extremely small, two 20,000 ohm 1 watt carbon resistors in parallel will suffice for the filter resistor. Incidentally the filter is in the negative lead of the high tension supply.

Extremely Sensitive

The 6J7 tube is used purely as an amplifier and as such makes the instrument extremely sensitive. The remaining tube, the 665 magic eye, serves to replace the usual galvanometer in other bridge applications, but has the advantage that the null indication is much more definite and damage to the indicator is impossible. The sensitivity of the null indicator is governed by the 1 megohm potentiometer in the grid circuit.

Having covered the simple points in the instrument it may be necessary to explain the inclusion of several other components in the circuit. In the case of R3 in the circuit this resistor is used as a safeguard should a short circuit occur across the output terminals which could happen if a short circuited component be connected to the measuring terminals, in which case this resistance will prevent the transformer winding burning up by limiting the current through the winding.

Balanced Resistors Needed

R10 and R11 are inserted as limiting resistors in each end of the slide wire, to prevent the bridge from measuring from zero to infinity with a resultant overcrowding of calibration points at each end of the scale. Here we come to a very important point. On position 3 of the switching arrangement, R4 and R5, both 100 ohm resistors, are switched in both legs of the bridge circuit. It is absolutely essential that these resistors should be accurately matched, also the two resistors of 80 ohms each—R10 and R11. Unless this is so it will be almost impossible to get both sides of the bridge in balance.

To make this clearer, the dial is calibrated from .1 to 1 in the centre, and from 1 to 10. Now it will clearly be seen that with the slide wire forming one part of the bridge circuit and the internal standard plus the external component to be measured the other, then when the arm of the potentiometer is exactly set halfway, the pointer should correspond to 1 on the main dial. This is half scale and the bridge should be in balance. The balanced condition will be indicated when the shadow of the eye is narrowest.

Self-Checking Calibration

Returning to reistors R4 and R5 we should now be able to see that they form an internal check, always

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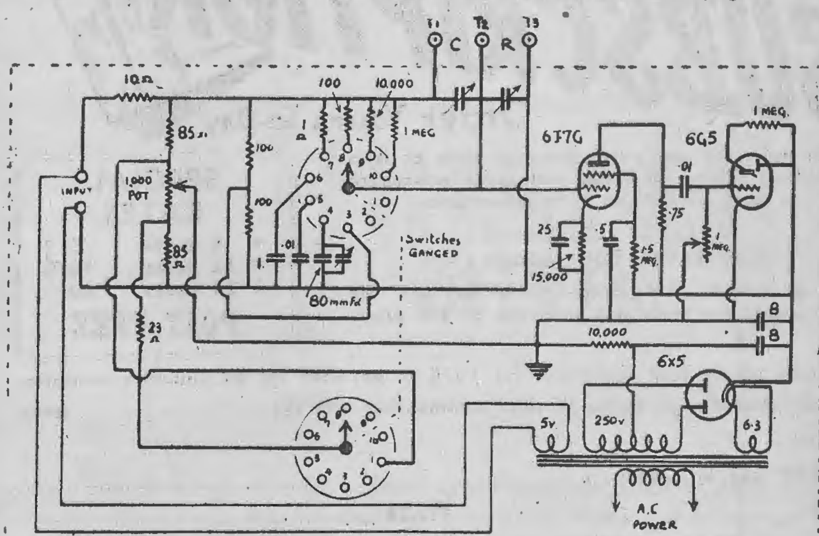

Schematic of the bridge for testing resistances and condensers

A.C. BRIDGE
(Continued)

on hand, to check the calibration of the dial. Thus before using the bridge, we can turn the switch to position 3, turn the dial until balance is indicated and if all is well the pointer should indicate 1 on dial, showing us that at half scale the bridge is in balance. Hence the stress on the fact that these resistors should be accurately matched.

Checking To Percentages

Looking at R17 in the schematic we will find by tracing the circuit, on switch position 1 this 23 ohm resistor is shunted across the 1,000 ohm potentiometer. This has the effect of greatly broadening out the null indication. In this case the scale was calibrated in percentage values—25 per cent. to the left of centre scale and + 25 per cent. to the right of centre scale. Here the bridge performs the useful function of going through a whole lot of resistances which have to be checked for tolerance. By using position 1 we select a resistor of known accuracy, connect it to one pair of terminals and by placing all our other resistances to be checked across the remaining terminals, the dial at balance will indicate directly in percentage how much each resistance is plus or minus from the accurate known one.

Position 1 and 3 on the switch have been covered, positions 4, 5, 6 up to 10 merely switch the various internal resistance capacity standards in circuit and, in consequence, what-

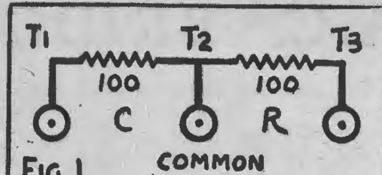

FIG. 1

ever range is in use, the dial reading multiplied by the range used gives the exact value of the external component being measured. The scale holds good for both resistance and capacity. There remains, however, position 2 to be explained. This can be termed the open bridge circuit, and in this position no internal connections are made to the bridge. The purpose of this connection is to make available a condition whereby an external standard may be connected to one side of the bridge and then a number of other components of unknown value may be compared against the external standard, balance being indicated in the usual manner.

Heavy Wiring Desirable

In the original instrument which the writer constructed, all the wiring was carried out with heavy tinned copper bus, 14 guage to be exact. All leads to the switch were made as short as possible and everything was made rigid in order that the calibration would hold good. The power supply was kept well away from the other components in order that external field of the transformer would not effect the bridge operation. The magic eye was mounted horizontally to the front panel and was completely encased in a valve shield.

It might be advisable to point out that the lowest resistance range, which measures from .1 ohm to ten ohms is extremely critical as to lead resistance, switch contact resistance, etc. This is understandable when such low resistances are involved. Intending constructors should see that the leads on this section of the switching arrangement are run with half inch copper braid, covered with a large diameter piece of spaghetti sleeving to prevent short circuits. It is also important that the internal capacity of the wiring be as low as possible. All leads must be kept away from the chassis as far as possible. Wherever a lead enters the chassis through a hole, make the hole 4 or 5 times the diameter of the wire.

There are four terminals used in all, one for earthing the case of the instrument and of the other three, one is common to both resistance and capacity terminals and forms the middle connection. The other two are spaced about ½ an inch from the centre one. These are all placed in the front of the instrument at the most convenient spot in order that components to be measured can be easily connected and disconnected. It is advisable to use large screw top terminals for the purpose rather than the push in type as the latter usually requires the use of two hands, besides being rather flimsy in a lot of cases.

Now we come to the most important point of all, the calibration of the instrument. The entire usefulness of a bridge depends on the accuracy of the internal standards but more still on the calibration.

Calibration By Comparison

In the writer's case it was extremely fortunate that he was able to borrow a laboratory standard decade resistance box, variable in 1 ohm steps from .1 ohm to 10,000 ohms and a ratio arm box with accurate laboratory standard fixed resistors therein, consisting of two arms of 10,100, 1,000 ohms in each leg.

The method used to calibrate the bridge was as follows:—

The first thing to establish is the position of 1 which corresponds to half scale setting on the dial. To determine this the writer connected the ratio arm box in the following manner. The open bridge position was selected, and by placing an accurate 100 ohm resistance to each pair of the output terminals as shown in Fig. 1. The pointer knob attached to the 1,000 ohm potentiometer was then turned until balance was indicated by the eye null indicator; this balance point then indicated that the electrical centre of the 1,000 slide wire potentiometer was accurate. A corresponding pencil mark was made on a white cardboard panel affixed to the front panel of the instrument. Disconnecting the external laboratory standards and turning the switch to position three connected the two internal 100 ohm balance resistors in circuit which, in effect, duplicated the original set up. This meant that the balance point should have been unchanged, however there was a slight change which showed that either one of the 100 ohm internal resistances was off value, so that it was a case of cut and try until the balance point on number 3 switch position was the same as that obtained with the two external standards connected to the open bridge position, e.g., position 2. Similarly position one was checked again with the external standards. As would be expected due to the 23 ohm shunting resistor, the balance point was quite broad but was sharpened up appreciably by adjusting the 1 megohm potentiometer in the grid circuit of the magic eye. Now having a starting off point the writer proceeded with the rest of the calibration.

Marking The Dial

It was deemed advisable to calibrate the dial markings on the intermediate range rather than the extreme high or extreme low range. The calibration is simplified in that the one scale holds good for all ranges, both resistance and capacity. On the extreme low range, however, a slight inaccuracy from .1 to .6 of an ohm will be noticed, which is hard to eradicate due to the fact that it is impossible to get zero resistance in the switch and leads, plus the leads to the decade box when calibrating. To reduce this error the connecting leads to the decade box were run in one-inch tinned copper braid. For minimum error the standard resistor in the decade box plus the connecting lead would have to equal exactly one ohm. Then the one ohm internal bridge standard plus switch contact resistance, plus the lead to the switch, would also have to equal one ohm. Obviously this scheme is not practical, and as the error only occurs on values below one ohm and is such a small percentage it can be neglected for ordinary purposes.

We are now all set to calibrate the intermediate range which, as has been stated, we do first. This range uses an internal 100 ohm resistor as a standard and measures from 10 ohms to 1,000 ohms with 100 ohms appearing at the centre of the scale. It was deemed necessary to check our internal standard 100 ohm resistance against the accurate 100 resistance in the decade box, so we then switched in our 100 ohm standard in the instrument by using switch position 8 and connected the 100 ohms from the decade box to the resistance terminals, and as the balance point came at our original mark on the scale, 1 at half scale, we knew that our internal standard was o.k. Leaving the switch untouched we then set the decade box at 10 ohms, swung the dial for balance and put a pencil mark opposite the pointer and marked this position as .1 not 10. We must remember that we are using one scale for all calibrations. Therefore on the range we are at present calibrating, the .1 dial reading is multiplied by 100 to give a true reading. We now have the starting point for the scale. We then increased the decade box in 10 ohm steps, rebalancing the bridge for each step and putting a corresponding pencil mark opposite the pointer at each balance point, this was done up to 100 ohms, which brings us to half scale which is already marked as 1. We now have ten calibration points .1, .2, .3, .4, .5, .6, .7, .8, .9 and 1; there remains the other half of the scale to be calibrated which is done the same way and is calibrated as 1.5, 2, 3, 4, 5, 6, 7, 8, 9, 10. However, as on this range which we are using, actual dial figures are multiplied by 100, the dial on this half of the scale indicates from 150 ohms to 1,000 ohms.

Intermediate Calibration

It can be seen from this that the intermediate values are not directly read because there are not enough calibration points, there being only 20 in all. It was then necessary to go over the complete scale again, and on the first half, as the points were each 10 ohms increase. This was reduced to steps of 1 ohm so that from .1 to 1 on the scale there were roughly 100 calibration points. Similarly the rest of the scale, instead of only indicating every 100 ohms to 1,000, intermediate points were marked between these

(Continued on next page)

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(Continued)

points in steps of 10 ohms. All this may seem rather tedious to the reader, but if a job is worth doing it's worth doing well. Thus the more calibration points on the dial, the more accurate our readings and in addition we increase the usefulness of the finished instrument. It actually took the writer practically one whole day to complete the job, but the final result was worth the time and effort spent.

We come now to the percentage scale, which may or may not be deemed necessary. For production purposes it is extremely handy. This percentage scale is brought into use by turning the switch to position 1 where the slide wire is now shunted with 23 ohms resistance.

The method used to calibrate this scale is almost self explanatory. The writer used an accurate fixed resistance of 100 ohms in one side of the bridge, and set the decade box to 100 ohms and connected it to the other side of the bridge. The decade box was then increased in 5 ohm steps in excess of 100 ohms, each step representing 5 per cent. change until a value of 125 ohms was reached. The decade box was then returned to 100 ohms and then decreased in 5 ohm steps until 75 ohms was reached. We thus have the inner scale calibrated to indicate plus or minus, 25 per cent. of whichever accurate standard is used externally. For example, we wish to check a batch of resistors which must be within 5 per cent. plus or minus of their marked value. We select one of known accuracy, connect it to one side of the bridge, turn to position one, and then check through our batch, rebalancing where necessary. We can quickly reject the ones which are off value as our scale will tell us immediately whether they are over or above value and also the percentage error directly.

Low Capacity Range

There remain one or two points to be cleared up. It will be noticed that, across the measuring terminals, are connected two variable trimmer condensers. In the writer's case there were two Stromberg Carlson air-dielectric trimming condensers, with some of the plates removed, these values approximate to 5 mmF. These only become important when measuring small value condensers on the lowest range. It will be realised that we cannot build up any instrument which has no wiring capacity, so that we must start off with some known value, in this case approximating to a total of 10 mmF, which will have to be subtracted from the read value on the scale when checking condensers of low values. However on all other capacity ranges this extremely low value of internal capacities becomes relatively unimportant, forming such a small percentage of the condensers

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FREQUENCY-CONTROLLING CRYSTALS

THE piezo-electric properties of quartz crystals were first discovered and investigated by the Curies, of radium fame, in 1880.

The three crystals exhibiting strongest piezo-electric properties are quartz, tourmaline, and rochelle salts.

Structural Features

Rochelle salts has about ten times the piezo-electric effects of quartz but is very fragile, hard to manufacture and must be handled with great care to avoid damage. These crystals are adversely affected by hot climates. Rochelle salt crystals is not mechanically strong enough to stand up to the vibration of being used to control the frequency of valve oscillators except for very low inputs. If this power is too great the crystal will return to a liquid state. However, rochelle salt crystals are used extensively in crystal michrophones and pick-ups where its strong piezo-electric properties outweigh its disadvantages.

Tourmaline being a semi-precious stone is too expensive to be used extensively.

Quartz or silica (Si02) occurs in nature and is found extensively in Madgascar and Brazil. Its structure is technically known as "hemihedral with inclined faces".

Very High "Q"

When quartz is used to control the frequency of a valve oscillator a "Q" of tens of thousands may be obtained compared to about 300 of a tuned LC circuit.

If a thin plate of quartz is placed between two metal surfaces and an alternating voltage is applied to these two metal surfaces the crystal will be found to expand and contract with the alterations of the applied potentials.

Now, if the reverse process takes place and the crystal is caused to contract and expand, lengthen and shorten by alternating pressure and

By

CHARLES ASTON,

21 William Street, Double Bay, N.S.W.

tension it will be found that an alternating current will be generated across the two metal surfaces.

At a certain frequency this action will be found to be most pronounced and this is the natural frequency of the crystal and is the one that the crystal will oscillate most readily.

The true natural shape of a quartz crystal is hexagonal with an apex at each end. But owing to rough handling is seldom in this shape when it reaches the cutter.

Investigation has shown that three axes of symmetry exist, the optical axis Z, electrical axes Y and mechanical axes Y.

The X axes are directions of greatest piezo-electric effect and are three in number.

The Y axes are also three in number.

Crystal sections are cut in the shape of plates or bars. Possibly the still most used cuts are the X and Y although the special cuts are beginning to be widely used, some of these cuts being known as AT, B5, LD2, etc., and have a temperature coefficient approaching zero. These slabs, unlike the X and Y, are not cut parallel to the Z axis but at an angle to it. These special cuts require extreme accuracy in cutting and grinding if the required characteristics are to be obtained and most of these methods appear to be regarded as trade secrets.

Before the crystal is cut an accurate means of locating the axes must be used and specialised equipment is required to cut crystal blanks.

Grinding may be done by rotating the slab of crystal on a piece of plate glass smeared with a mixture of fine carborundum powder and water until it is found by experiment and measurement that the crystal is operating at the required frequency. Care must be taken to see that the two surfaces are parellel and level.

Critical Grinding

It is a comparatively simple process to grind crystals to a frequency of 3 megacycles, above this the plates become critical, the power capacity drops and grinding becomes more exact.

As the piezo-electric crystal is a mechanical vibrator the molecular friction of the crystal plate when vibrating at the rate to produce R.F. oscillations is sufficient to develop heat. This heat will cause slight alterations in the characteristics of the crystal and thus effecting the frequency generated.

A Y-cut crystal usually has a positive temperature coefficient so that as the temperature increases so will the frequency of oscillation.

Y-cut is also known as "parallel" or 30 degrees cut and its piezo-electric out-put is greater than but not as reliable as the X-cut. This cut is also more liable to oscillate at more than one frequency although these spurious peaks do occur to a lesser extent with the X-cut. A change in temperature can cause a Y-cut slab to jump to another mode of vibration (frequency).

The X-cut or otherwise known as, Curie, Zero or Perpendicular cut as its larger surfaces are perpendicular to an electrical axis. The temperature coefficient is negative.

An X-cut crystal has three possible frequencies of operation, the strongest corresponding to the thickness, the second to the length and the third

(Continued on page 19)

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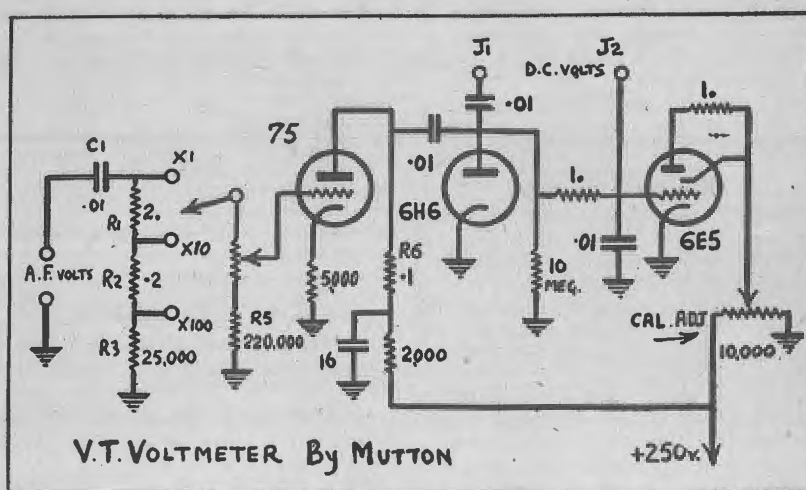
(Continued)

being measured.

Another point which crops up is the use of a variable trimmer across the internal standard which would normally be 100 mmF for the lowest condenser range. In the writer's case an 80 mmF was used here with a variable trimmer across it. The reason for this being that, if we use a 100 mmF condenser internally, the internal wiring capacity plus the capacity across the bridge terminals, would mean that our internal standard would be far in excess of 100 mmF with a resultant big error in readings on the lower capacity scale. If we use an accurate external 100 mmF condenser on one side of the bridge and then balance our shunting condenser internally to bring the balance point at half way on the calibrated scale we then know that the internal standard approximates the external one. At the same time we must remember that whatever reading we obtain 10 mmF must be subtracted to get a true reading when we are using the bridge on the lowest capacity scale.

After all the calibration was completed and adjustments made, the scale was neatly drawn in Indian Ink and sent to a commercial firm who made a photostat of the original and transferred the markings on the cardboard scale to the brass dial made for the purpose. Credit for the design of this instrument must go to the Philips people who produce a somewhat similar instrument commercially. The main difference is the different tubes used and a different bridge voltage. If obtainable, greater sensitivity may be obtained by using the Philips EM1 as the null indicator. This requires a voltage of only 6 volts to close the shadow in place of 22 in the case of the 6G5.

V. T. VOLTMETER FOR AUDIO WORK



V.T. VOLTMETER By MUTTON

IN these hard times of short supplies, meters are particularly hard to find, so that any test instrument which can be pressed into use without using a meter should please many of our readers. It is proposed to describe an audio frequency V.T. voltmeter which uses a 6E5 "magic eye" tube as the indicating medium. The response is uniform over the audio band from 20 to 10,000 cycles.

To describe the instrument briefly it is composed of a resistance coupled stage using a type 75 tube which is a high-mu triode (similarly a 6B6G could be used with equal result). One diode of this tube rectifies the output voltage, which is then applied to the 6E5 grid through a resistance capacity filter.

Wide Coverage

The range covered is from .1 v. to 100 volts, and the instrument is provided with a gain control and attenuator, both being calibrated in terms of voltage required to close the shadow of the eye.

The attenuator, which is located in the input circuit, consists of a multiplier controlled by S1 and the calibrated potentiometer R4. By means of the multiplier switch the input voltage may be adjusted in steps of 10 over a range of 1 to 1,000. The potentiometer R4 permits a continuous coverage over a range of 1 to 10 on any range set by S1.

Provision is made in the output of the rectifier circuit so that the rectified voltage can be measured by means of an electronic or D.C. V.T. voltmeter. Where the range of this V.T. voltmeter is very low it will then be possible to measure voltages as low as .02 volt since most D.C. V.T. voltmeters are capable of measuring below .1 volt, which on the lowest range of our instrument is sufficient to close the shadow of the 6E5.

Resistor R5 should be adjusted so that it has a resistance equal to 1/9 the resistance of R4. This value will approximate 220,000 ohms as indicated in the circuit. When R5 has the correct value only 1/10 of the input voltage will reach the grid when the control is rotated counter clockwise; because R.S. will then be 1/10 of the total resistance.

Calibration By Adjustment

The R.M.S. voltage required to completely close the shadow will be .1 volt. There will be some variations due to different tubes and circuit constants. To obtain the greatest accuracy the voltage to the target should be adjustable above or below 150 volts. To do this a known voltage of .1 volt is applied to the eye and the target voltage is varied until the shadow just closes. If the shadow does not close increase the target voltage and vice-versa if it overlaps.

For Signal Tracing

Provision is also made to utilise the instrument as an amplifier, by bringing out a connection from the output circuit at jack J1. This connection is useful when used as an audio frequency signal tracer. To prevent distortion of the positive peaks of the output voltage a high load resistance is used in the diode rectifier circuit. Thus the 10-megohm load R8 limits the diode current so that the loading effect on the positive peaks is negligible.

It is necessary to provide the 1 to 10 level control R4 with a direct reading scale so that the instrument will read in terms of volts required to close the eye. By feeding voltages from 1 to 10 into the input circuit, with the multiplier switch on × 10, R4 is thus calibrated directly. Before this calibration is done R5 should be adjusted so that a 1 to 10 range is covered. If the range is greater than 1 to 10 R5 is too small if less than 1 to 10 R5 is too large.

Overloading Impossible

Damage to this meterless meter is impossible, since a heavy overload only causes the shadow to overlap. The calibration could be made more accurate still by using any standard A/C voltmeter.

Bias From Cell

In the original circuit it was necessary to earth the cathode of the 75 tube so that one diode was used as a rectifier, and a bias cell was used to supply the bias, as these cells are not obtainable in Australia it was necessary to revise the circuit and use a separate 6H6 rectifier and use self bias on the first tube. The power supply is not shown but consists of a standard type of small receiver power pack using a filter choke and a couple of 8 mfd. condensers.

If desired a low capacity shielded cable can be constructed and used for connection to the circuit under test. If possible keep this cable to a minimum length, certainly not more than 3 ft., microphone cable will do nicely.

Low Input Capacity

Should a low input capacity be needed for special applications the 75 could be replaced by a 6J7 penthode, the circuit constants, if this is done, are the same for a 6J7 as a resistance coupled amplifier. This handy gadget will save many hours of headaches, over amplifiers and the audio end of many of your receivers.

BRAVERY AT SEA

The latest list of awards of "Lloyd's War Medal for Bravery at Sea", which is given to officers and men of the Merchant Navy and Fishing Fleets for exceptional gallantry at sea during the war, contains the names of two radio officers: 1st R.O. Frederick R. Clark (deceased) and 3rd R.O. Neil M. Coleman.

When their ship, sailing alone, was torpedoed and set ablaze 1st R.O. Clark sacrificed his life by his devotion to duty, remaining on board to transmit messages which brought a ship to the rescue of the survivors. 3rd R.O. Coleman also displayed great courage and a high sense of duty. While the distress messages were being transmitted he held a broken connection in position and would not leave until the flames forced him to do so.

—"Wireless World" (England).

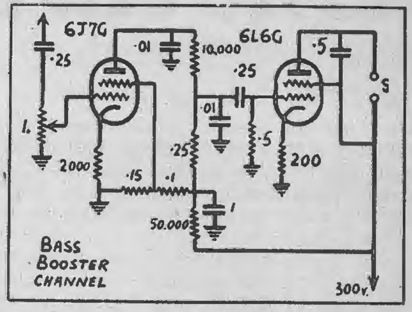
BASS BOOSTER FOR AMPLIFIERS

IT would be quite reasonable to suppose that many amplifier enthusiasts who are possessors of an amplifier, which normally in conjunction with either a gramaphone pick-up or a radio tuner is capable of reproducing some fine quality, but is lacking in true bass response. By true bass response we don't refer to those indefinable thumps which occur with monotonous regularity and often referred to as "the lows," but to a faithful rendition of low frequency sounds possessing the original timbre and negligible harmonics. It is also a recognised fact that the cone of a loudspeaker when trying to reproduce a note in the lower register, due to inherent faults in its construction, will modulate frequencies of sounds in the middle register, with resultant distortion of these higher frequencies. One cannot reasonably expect any single speaker to reproduce both ends of the audio spectrum with equal efficiency, without going to considerable expense.

It is the purpose of this article to describe a separate unit using an independent speaker with which it is possible to reinforce any existing audio amplifier, without making any changes to the main amplifier.

Looking at the circuit diagram in Fig. 1 it will be found that the unit fundamentally is a two stage resistance coupled amplifier with certain modifications. The power supply has been omitted for simplicity sake. The complete unit is thoroughly shielded in a steel box, the layout is not critical but follows the standard practice of working progressively from input to output.

From the outset it must be realised that this unit cannot be used for ordinary amplifier uses, in that it has a cutoff frequency approximating 75 cycles, which in simple language means, any frequencies above about 75 cycles are not reproduced in the speaker. This sharp cut-off effect is accomplished by means of a resistance



Circuit for an amplifier to handle only the lower audio frequencies.

capacity filter in the output circuit of the 6J7 tube. The fact that a .5 condenser is used across the output transformer may cause many to raise an eyebrow, but this merely assists the filtering action of the low notes and serves to resonate the output transformer primary to approximately 30 cycles. By omitting the by-pass condenser across the bias resistor in the 6LG stage we have a simple form of inverse feedback which keeps the harmonic distortion down to a low value. By repeating the process in the input stage we drop the stage gain by about half, but, in so doing, the linearity and frequency response is much improved. The screen feed for this stage uses a voltage divider system, however a series resistor of 1.5 megohms can be used with the same results.

Speaker Suspension

The speaker used is one which was specially selected for the job—in this case, a Rola K12 type with a heavy, soft cone, exceptionally free in the suspension, which is most necessary in view of the fact that the cone must have a large amount of excursion in order to reproduce the low notes efficiently.

Infinite Baffle Desirable

The unit is fitted with its own gain control which enables the amount of boost to be readily controlled, as it will be found that with certain types of recordings the boosting may be excessive. The amount of boosting may be excessive. The amount of individual taste. In the writer's case excellent results were obtained by constructing an infinite baffle to the specifications in a book called A.K. Box's Amplifier Handbook, which is now out of publication. The main amplifier consists of a 6J7 resistance capacity coupled to a 76 triode which is shunt fed transformer coupled to pushpull class A 2A3's with fixed bias feeding a G12 Rola speaker.

CRYSTALS

(Continued from page 17)

the coupling frequency which lies between the other two frequencies, and is dependant on the dimensions of the other two.

It has been found that rectangular shaped crystals are more robust than the round ones and are less expensive to manufacture.

As stated before special crystal cuts are used to reduce the temperature coefficient and when maximum frequency stability is required one of these cuts should be used in conjunction with a crystal oven. The oven will not have to operate within the fine limits required by the X- and Y-cuts.

There are other special cuts for higher power handling abilities, as the input with an ordinary cut crystal should not exceed a few watts as the excessive vibration is liable to crack the crystal.

The crystal holder has an effect on the resonant frequency of the crystal and advantage may be taken of this to vary the frequency generated. If one of the plates of the holder is fitted with a micrometer adjusting screw accurate adjustments may be carried out. If the size of the gap between the crystal and holder is increased the frequency becomes higher and decreased, lower. Care must be exercised to see that the crystal does not jump to another frequency. If the air-gap is increased too much it will cause considerable falling off in the piezo-electric out-put and brushing is likely to occur between the plates of the holder and the crystal this will cause excessive heat and the crystal will become discolored at the point of brushing and probably crack.

It can now be seen that crystals require care in manufacture and installation but owing to its many advantages it is used in many commercial installations. When operating correctly a good quality crystal will give trouble-free service and will keep a frequency stability of one part in a million over long periods.

DIRECT RECORDING OF FILM

One of the principal objections levelled against recording on film—the need for development and drying—is overcome in the system evolved by the Fonda Corp. of New York by embossing a track with a needle on plain cellophane strip. The machine makes use of a 320 ft. endless loop just over an inch in width and is capable of taking 60 parallel grooves. With a film speed of 40 ft. per minute a playing time of 8 hours is obtained at a cost of about 50 cents per hour.

The recording head and play-back pick-up are mounted on a rocker arm, and either may be brought into operation by movement of the lever seen projecting to the left of the coil of film. An essential feature of the mechanism is a resilient bed of felt under the recording needle which ensures a well-formed track without the risk of cutting through the film.

The apparatus is already in use by American Airlines for recording ground-air conversations.

Shortwave Review

CONDUCTED BY
L. J. KEAST

NOTES FROM MY DIARY—

"The Voice of America"

With justifiable pride the 'Frisco stations have since their big change on July 2nd, in frequencies, schedules and programmes adopted this slogan which until now was confined to the East Coast transmitters. I am sure most listeners will welcome the extra daylight hours provided by the introduction of KGEX and KGEI, by the change in beam of KROJ both in the morning and afternoon transmissions and most certainly by the splendid new programmes provided.

The opportunity to hear William Winter and Sidney Roger more often, Hary Wickersham and Robin Kincade almost daily, such features as "What's New?", "At Ease", "Health on the March", "As You Like It", "Saturday Serenade", and many others, to say nothing of the retention of many old favourites, gives just that fillup the Dx-er was waiting for and one can realise how the fighting forces, for whom it is primarily intended, will relish it.

Little Sir Echo

Several listeners have referred to the "echo" on the signal from VUD- on 19.54 metres.

This phenomenon which is peculiar to reception on wave-lengths around the 19 metre band has been noted on several occasions and readers will remember me mentioning it some year or so ago on a B.B.C. transmitter in this band. Only a few weeks back it happened on VLC-4 on the first day that General MacArthur's Headquarters used this station on 19.54 metres.

What actually happens is the signal has been reflected completely round the world. At one stage of its reflection portion of its energy was picked up by the receiver, but sufficient energy was still left for the signal to continue its reflections until it again reached the receiver, but some fraction of a second later than the first received signal.

BACK NUMBERS

We wish to advise subscribers who require back numbers of Australasian Radio World, that, with the exception of January and February, we have no stocks of 1942 issues. We can supply the complete set of 1941 and 1940 with the exception of July and August. These numbers are on sale at 1/- each.

Help Wanted

Mr. Alan Graham heard at 3 p.m. on approximately 6230 kilocycles what he thinks is a Peruvian station who close with Schubert's Serenade. Signal was weak and he missed most of the closing announcement.

NEW STATIONS

KGEX, 'Frisco, 15.33 mc, 19.57 m: From July 2nd this General Electric Station with a new call-sign has been putting in a great signal from 10.15 am till 3 p.m. At opening after brief station announcement they go into Eastern language and French till noon when a 15 minute news session is given. Programme details are then made known and they remain in English till sign off. Certainly a welcome addition to the Sunkist team, and like all 'Frisco stations announce as "The Voice of America".

KGEI 'Frisco, 15.13 mc, 19.83 m: Not a new station, but after testing last week in June (see "A.R.W.", July issue) under call KGEX, took on their old monnicker again and from 3 till 8.30 pm are beamed this way. Signal from opening till about 6 pm is great and on favourable nights can be copied till closing.

CE1180, Santiago, 11.995 mc, 25.01 m: "Radio Sociedad de Agricultura" on this frequency, 8 am till 2 pm. This is another advised by Mr. Howe of the Universal Radio Club, and confirms Dr. Gaden's suspicion that it WAS CE 1180 being heard on a new spot with good signal at 8.30 am but fading by 9.30.

WNRA, New York, 6.10 mc, 49.15 m: First heard at 5.09 pm on Tuesday, 18th July, giving wavebands for News in English. Sitting right on top of KROJ made it difficult to follow and I had to wait till KROJ signed at 5.45 before signal improved from R6, Q3 to R8, Q4. They were then talking in Italian, but at 6 pm announced: "This is WNRA, Boundbrook, New Jersey, operating on 6100 kilocycles by authority of Federal Communications Commission for Test purposes."—L.J.K.

COCU, Santiago, 7.175 mc, 41.81 m: Reported by Mr. Rex Gillett with an R4 sig. at 9 pm. And another mentioned by Mr. Howe. He says, "Cadena Orientale de Radio" appears to have replaced COKG Santiago.

HEO-4, Berne, 10.345 mc, 28.99 m: Still a further transmitter from Berne and directed to South America from 9.30 to 11 am is coming in at great strength according to Mr. Howe. Should be heard here, too.

RNB, Leopoldville 9.55 mc, 31.41 m: This new frequency transmits in French, Spanish and Portuguese, from 8 to 9.30 am.

——, Brazzaville, 9.439 mc, 31.78 m: Mr. Gillett reports having heard this new frequency as far back as June, but did not learn till the other day who it was. He hears them around 10 am and 3.15 pm The 3.15 session is heard well here and is in parallel with 25.06.—L.J.K.

VUD-, Delhi, 11.76 mc, 25.51 m: Still another outlet for All India Radio. My attention first drawn to it by a wire from Hugh Perkins. Heard at lunch time and until about 5.30 p.m.

COCL, Havana, 7.053 mc, 42.54 m: Reported by Mr. Edel as heard around 1.30 pm. Also reported by Mr. Howe of "Universalite", who says, "La Voz de la Democracia" relays CMCL. This station changed call from former CMZ1, relays CMZ.

KGEX, 'Frisco, 15.13 mc, 31.48 m: This is not a new spot for the General Electric Company but is for their 'Frisco transmitter, and I think the first time the G.E. have had two of their stations on at the same time on the same frequency. However,

(Continued page 23, col. 3)

ALL-WAVE ALL-WORLD DX CLUB

Application for Membership

The Secretary,
All-Wave All-World DX Club,
243 Elizabeth Street, Sydney.
Dear Sir,

I am very interested in dxing, and am keen to join your Club

Name..

Address..
(Please print both plainly)..
....

My set is a..

I enclose herewith the Life Membership fee of 2/- (Postal Notes or Money Order), for which I will receive, post free, a Membership Certificate showing my Official Club Number. NOTE—Club Badges are not available.

(Signed)..
(Readers who do no want to mutilate their copies can write out the details required.)

Shortwave Notes and Observations

OCEANIA

Australia

VLC-4, Shepparton, 15.315 m.c. Excellent until closing at 3.40 pm (Matthews).

VLC-6, Shepparton, 9.615 mc. Splendid at 1.30 a.m. (Matthews).

Perth was using 9.615 mc for a few nights but was back to VLW-6 on 9.68 mc again. (Matthews). (This clears up my remarks in June issue.—L.J.K.)

Fiji

VPD-2, Suva, 6.13 mc, 48.94 m: Heard at 6.30 a.m. on July 1st, with news at dictation speed (Gillett). (Yes, now on daily from 6.15—7 a.m., and on Sundays from 4—7.30 p.m.—L.J.K.)

New Caledonia

Radio Noumea, 6.208 mc, 48.39 m: Programme from 6 pm is "The Voice of The National Broadcasting Service in the Pacific." FK8AA, Noumea, opens at 7.04 pm. Noumea is 56 minutes ahead of Sydney.—L.J.K.

AFRICA

Belgian Congo

Leopoldville on 25.76 m heard at 3 pm, with R7 signal (Young).

French Equatorial Africa

Brazzaville has been heard on a new wave-length of 31.78 m, around 3.15 pm and 10 am (Gillett). Heard at 2 am after tune on Kissantzi. Gives station particulars and news in French. News in English at 2.05 am. Closes at 2.15 am (Matthews).

FZI, Brazzaville, on 15.595 mc. Still fair on opening at 8.30 pm (Matthews). (Not even a whisper, here.—L.J.K.)

EGYPT

SUV, Cairo, 10.05 mc, 29.84 m: Gives news in English at 4 am at good volume. (Gillett).

CENTRAL AMERICA

Costa Rica

TIPG, San Jose, 9.62 mc, 31.20 m: Has been packing a punch on several nights around 10.30 pm (Gillett). Good around 10.45 pm, and also heard very well one afternoon at about 2.15 . . . a surprise. (Graham).

TILS, San Jose, 6.16 mc, 48.66 m: Good volume from around 9.30 pm (Gillett).

Guatemala

TGWA, Guatemala, 9.685 mc, 30.96 m: Better signal than GRX on Sunday, until they closed at 3.30 pm (Gillett).

Panama

HP5A, 11.70 mc, 25.64 m: Weak at 2 p.m. (Graham).

HP5G, 11.78 mc, 25.47 m: Fair signal daily until blotted out at 1.45 pm by GVU (Graham).

U.S.A.

WRUW, Boston, 17.75 mc, 16.90 m: Heard well in Spanish programme around 10 am (Graham). (Gillett). (Can follow them most mornings till about 11 am.—L.J.K.).

WLWO, Cincinnati, 17.80 mc, 16.85 m: Fair at 8 am (Gaden).

WNBI, New York, 17.78 mc, 16.87 m: This is at call at 8 am, weak signal (Gaden).

KWIX, 'Frisco, 17.76 mc, 16.89 m: Heard conducting test "C" around 8.30 am, signal quite good (Gillett).

KGEI, 'Frisco, 15.13 mc, 19.83 m: Excellent signal from 3—6 pm. Can sometimes be copied till closing at 8.30 pm.—L.J.K. Signal fades out by 5 o'clock over here (Gillett). Excellent 3—7 pm (Matthews, Perth).

KROJ, 'Frisco, 17.76 mc, 16.89 m: Excellent signal daily from 11 am till noon (Graham). 100 per cent., and now gives a spot of news at noon before closing. (Gaden). (Now continues till 1.45 pm.—L.J.K.).

KGEX, 15.33 mc, 19.57—see "New Stations".—L.J.K. Very fine from noon and like programme, too, till 3 pm (Gaden).

KWID, 'Frisco, 15.29 mc, 19.62 m: Good in mornings from 8.30 (Graham).

WLWK, Cincinnati, 15.25 mc, 19.67 m: Only fair around 8.30 am (Graham).

KROJ, 'Frisco, 15.19 mc, 19.75m: Quite good in the mornings (Graham). (When closing at 10.45 am announce KRUJ on Aleutian and Chungking Beam now concludes.—L.J.K.)

WRCA, New York, 15.15 mc, 19.81 m: Not listed in your May issue, but heard several times between 9.30 and 9.45 a.m. (Graham(.

KGEI, 'Frisco, 15.13 mc, 19.83 m: Excellent signal from 3—6 p.m. Can sometimes be copied till closing at 8.30 pm.—L.J.K. Signal fades out by 5 o'clock over here (Gillett). Excellent 3—7 pm (Matthews, Perth).

WKRD, New York, 12.96 mc, 23.13 m: Best just before 10 pm (Graham). Very poor here at 9 p.m. (Cushen).

KKQ, Bolinas, 11.94 mc. A favourite of mine. Fair at 2 pm (Gaden).

WGEX, New York, 11.84 mc, 25.33 m: Heard at 10 p.m. Thought call was WGES. (Graham). New call, WGEX given at 10 pm (Cushen).

WCRC, New York, 11.83 mc, 25.36 m: This is the call at 9 p.m. (Gaden).

KGEI, 'Frisco, 11.79 mc, 25.43 m: Good at 8.30 pm, but interfered with by VUD-6 (Graham). (Think have now closed.—See KGEX, 15.33 mc.—L.J.K.)

WLWK, Cincinnati, 25.62 m: Terrific signal when closing at 10 pm (Graham). The best 25 m Yank. (Gaden) (Cushen).

Heard "V of A" on 25.77 m, with R4 signal, at 2.30 pm (Young). (This will be WKRX mentioned under "New Station" in July issue.—L.J.K.).

WCBN, New York, 26.92 m: Heard here at good strength when opening at 4.15 pm. Much better than any other Yank on that band. No interference noticeable (Cushen).

KWV, 'Frisco, 10.84 mc, 27.68 m: Good in late afternoon. (Graham, Perkins).

KES-3, 'Frisco, 28.25 m: Heard in afternoon (Graham, Perkins). (Very noisy here, seldom good enough to copy. Sister on 33.58 m at night much more chummy.—L.J.K.)

KROJ, 'Frisco, 9.89 mc, 30.31 m: Very strong around 8 pm (Graham, Perkins, Matthews, Graham, Hallett, Cushen, Edel).

KWIK, 'Frisco, 9.855 mc, 30.44 m: The undoubted favourite of all listeners as regards strength and clarity, although they now close at 8.30 pm. Certainly a welcome change from the Morse infested area of the 25 m band. —L.J.K.

Very strong 6 pm (Graham). Can follow right through (Perkins). "Pretty fine business" (Hallett). Certainly like new frequency (Gillett). Excellent all the time (Matthews). Great improvement (Walker). Splendid now (Gaden).

WKLJ, New York, 9.75 mc, 30.77 m: News at 8 pm. Good (Matthews).

WRUS, Boston, 9.70 mc. 30.93 m: Good with "V. of A." programme at 9 pm (Graham). (Splendid signal here, also.—L.J.K.)

WNBI, New York, 9.67 mc, 31.02 m: Good 8—9.30 pm (Graham).

WRCA, New York, 9.67 mc, 31.02 m: Very good at noon (Matthews).

WCRC, New York, 9|59 mc, 31.28 m: Becomes audible at 8.02 pm when VLI-6 closes. Good signal.—L.J.K.

KWIX, 'Frisco, 9.57 mc, 31.35 m: Signal quite good at 2.30 pm.—L.J.K. Fair, good after 9 pm onwards (Matthews). (Now open at 8.45 pm.—L.J.K.)

KGEX, 'Frisco, 9.53 mc, 31.48 m: Now on regular schedule from 7 pm—12.45 am.—L.J.K. Sorry, KGEX sits on top of WGEA (Gillett, Cushen). As good as the champions, KWIX and KRUJ, but blots out WGEA (Gaden). Suffers interference from WGEA (Cushen).

KRCA, 'Frisco, 9.49 mc, 31.61 m: One of the best Pacific Coast stations, especially late afternoons and evenings (Graham). (Now opens at 4 pm in parallel with KWV, till 7.15 pm. When KWV closes at 7.15, KRCA continues. The slight heterodyne at 5 pm is caused by WCBN on same frequency. —L.J.K.)

KES-2, 'Frisco, 8.93 mc, 33.58. Heard at night (Sanderson). (Now opens at 8.45 pm in parallel with KGEI.—L.J.K.)

WOOW, New York, 7.82 mc, 38.36 m: Usually marred by QRM at 5 pm (Graham).

WKRD, New York, 7.82 mc, 38.36 m: Heard well (Sanderson).

WRUL, Boston, 7.80 mc, 38.44 m: Good at 5 pm (Graham (Sanderson).

WRUA, Boston, 7.57 mc, 39.6 m: Excellent at 10 am (Graham) (Sanderson).

WLWO Cincinnati, 7.57 mc, 39.6 m: Best of 7 mc bunch, closes 6 pm (Gaden). Very good at 5 pm (Graham).

KWY, 'Frisco, 7.56 mc, 39.66 m: Heard opening at 10.30 pm, but Morse bad (Sanderson).

KGEI, 'Frisco, 7.25 mc, 41.38 m: Excellent in evenings (Perkins). (Now open at 8.45 pm.—L.J.K.).

WBOS, Boston, 7.25 mc, 41.38 m: See "New Stations."

KWID, 'Frisco, 41.49 m: Very good at night (Perkins). (Now open at 7.15 pm.—L.J.K.).

WGEA on 7.00 mc, 42.86 m: Open with a fair signal at 10 am (Graham). About the worst of the East Coast stations, like the 6 mc band better than 7 mc (Gaden). Very fair when closing at 5 pm.—J.L.K.

KEL, Bolinas, 6.86 mc, 43.7 m: Heard early evenings (Graham). Gave splendid coverage of news on "D" day. —L.J.K.

WGEO, 6.19 mc, 48.47 m: Splendid signal at 5 pm when closing (Gaden, Graham).

WCBX, New York, 6.17 mc, 48,62 m: Very good, 4—5. Closes at 5 pm (Gaden, Graham).

WBOS, Boston, 6.14 mc, 48.86 m: Very good at 6 pm (Gaden, Graham). Opens at 5.45 pm (Gillett). (Gives Wave Bands of News in English for 24 hours at 6.05 pm.—L.J.K.)

WOOW, 612 mc, 49.02 m: Note, call on this frequency at 5.30 pm is now WOOC.—L.J.K.

WOOC, 6.12 mc, 49.02 m: Heard well at 10 am (Graham). Closes at 5.30 pm (Gaden, Edel). Seems a new call to me (Gillett).

KROJ, 'Frisco, 6.10 mc, 49.15 m: Excellent signal 2—5.45 pm (Cushen, Gaden, Sanderson).

WLWK, Cincinnati, 6.08 mc, 49.34 m: Closes at 4.30 pm, would be the best of all Yanks only for morse. (Gaden).

WCBN, New York, 6.06 mc, 49.50 m: Shown in your list as WCDA, but am practically certain call is WCDN (Graham). (Think you will find WCDA closes at 4 pm and WCBN opens at 4.15 pm. See June issue under "New Stations". — L.J.K.). WCBN closes at 6 pm. O.K. except for morse (Gaden, Gillett, Sanderson).

WRUW, Boston, 6.04 mc, 49.66 m: Very good signal at 5 pm—usually bad QRM (Graham). Not a good sig up here (Gaden).

KROJ, 'Frisco, 49.15 m: Good when closing at 5.45 pm (Gillett, Edel). (Much better signal since they have been on the Chungking — Aleutian Beam.—L.J.K.).

SOUTH AMERICA

Argentina

LRS, Buenos Aires, 9.32 mc, 32.19 m: Good in am, not heard, or at least not recognised in afternoon or at night (Gaden). Pretty erratic . . . were good for a week but poor after that at 8 am (Graham).

LRE, Buenos Aires, 6.085 mc, 49.30 m: Better than LRM (6.18 mc) at 9 pm (Gaden, Cushen).

Brazil

ZYB-8, Sao Paulo, 6.095 mc, 49.21 m: Heard very strongly from 7—8.30 am (Graham).

PRA-8, Recife Pernambuco, 6.015 mc, 49.88 met: Heard several mornings quite well around 7 o'clock announcing as "A Voz do Norte" (Graham).

Colombia

HJCD, Bogota, 6.16 mc, 49.70 m: Was a lovely signal at 10.15 pm . . . copied a report (Gillett). Splendid signal . . . sometimes plays records till 10.30 with no English but location and call sign easily followed (Graham).

HJCX, Bogota, 6.018 mc, 49.85 m: Would be good but for Morse at 10.15 p.m. (Gillett).

CHILE

CE-1180, Santiago, 11.995 mc, 25.01 m: See "New Stations."

CE-970, Valpariso, 9.73 mc, 30.82 m: Have sent a report on their service heard at 8.45 am (Gillett).

Ecuador

HCJB, Quito, 12.46 mc. Heard daily at great strength throughout the morning (Cushen, Graham).

HCJB on 9.958 mc, very poor, but heard once or twice . . . best on Mondays around 11.30 am (Graham).

HC2ET, Guayaquil, 9.19 mc, 32.64 m: Better in afternoon than at breakfast time. (Gaden, Simpson).

HCIQRX, Quito, 5.972 mc, 50.23 m: Fair at 10.30 pm (Gillett).

Peru

OAX4T, Lima, 9.562 mc, 31.37 m: Heard O.K. in afternoon (Simpson).

OAX4Z, Lima, 6.08 mc, 49.33 m: Heard several afternoons closing at 2.30 with fair signal. Announces as "Radio National de Lima" (Graham).

THE EAST

India

Mr. Perkins, of Malanda, wires: Delhi on approximately 25.53 metres very good at 5.20 p.m. (Hugh is generally on the job when the newies are about. Think actual frequency is 11.76 mc, a wave-length of 25.51 m.—L.J.K.)

The new Delhi on 15.35 mc, 19.54 m: excellent at 3.30 pm (Matthews). Heard with news at 11.45 am, messages for internees at 12.45 pm. Signal R7, here (Cushen, N.Z.).

GREAT BRITAIN

GWR, 15.30 mc, 19.61 m: Is, as you say, a real winner around breakfast time (Gaden).

GRH, on 30.53 m, now continues till 2.45 pm in American service. Heard "The Old Town Hall" at 1.30 pm, Sunday, 16th July. Excellent show and some of the old time stuff is great. —L.J.K.

GWP is the correct call for BBC on 9660 kilocycles, according to Mr. Howe of "Universalite". This would appear to be confirmed, as Mr. Cushen has sent me a list he received from the BBC, and GWW does not appear but GWP does, and on 9.66 mc.—L.J.K.

GVZ, 9.64 mc, good in Pacific service (Matthews).

GWU, 6.625 mc, news at 3.30 am . . . good (Matthews).

GSB, 9.51 mc. Terrific at 9.30 am, also good at 6 pm (Matthews).

On account of the poor reception of the BBC after 6 p.m., here, the report from Mr. Matthews, of Perth. will come as a surprise, and, incidentally, create a little envy when he says GWE, 15.435, GSP, 15.31, GSU, 15.19 and GWC, 15.07 mc, all good at 8.30 p.m. (Sydney time).

WEST INDIES

(Havana, unless otherwise mentioned)

COBH, 11.805 mc, 25.41 m: This

Cuban referred to by Mr. Lindsay Walker last December, is now said by Mr. Howe to be on from M/N to 10 am, having replaced COGF Matanzas.

COCM, 9.83 mc, 30.51 m: Heard at 8 am, but not in afternoon or night (Gaden).

COBC, 9.37 mc, 32 m: Reasonably good at night (Gaden). (Simpson).

COCX, 9.27 mc, 32.36 m: As good as any Cuban at night, not bad at 3 pm (Gaden).

COCU, Santiago, 7.175 mc, 41.81 m: Is often R4 around 9 pm (Gillett Howe).

COCL, 7.053 mc, 42.54 m: See "New Stations."

COHI, Santa Clara, 6.45 mc, 46.48 m: On some occasions is fair, but is not reliable (Gillett). (Presumably around 10 pm.—L.J.K.). Reasonably good at night (Gaden).

COCU, 6.32 mc, 47.39 m: Opens at 9 pm at good volume (Gaden).

Army Testing

JCJC is call now used and location is said by some reporters to be Jerusalem. The station was heard on 7.84 mc, 38.27 m, from 1 to 3 pm, and 10 pm to M/N, but is now heard announcing at 2 am, "You are listening to British Army Test Transmission, JCJC, on 41.55 metres, a frequency of 7220 kilocycles.—L.J.K.

MISCELLANEOUS

Canada

CKFX, Vancouver, 6.08 mc, 49.34 m: Was put off the air by CBC due to shifting frequency by mistake to 6110 kilocycles (Howe "Universalite").

Madagascar

Radio Tananarive opens at 1 am on 6.16 mc, with fair to good signal (Matthews).

British Mediterranean

A new time for the 25.60 wavelength is from 1.45 to 3.35 pm. Heard in parallel with 31.03 m. (Young, Graham, Gillet, Edel). (Can easily be identified by notes on harp between each different language, of which there are many and at frequent intervals.—L.J.K.)

British Mediterranean is also heard at 2 a.m. on 7.215 mc, 41.58 m . . . do not confuse with Army Testing on 7.22 mc.—L.J.K.

British Mediterranean on 9.67 mc, 31.03 m, heard opening at 1.30 am with notes on a harp. Gives news in English at 2.45 am (Matthews, Edel).

Mexico

XEBR, Hermosillo, 11.82 mc, 25.38 m: Just a fair signal on a couple of afternoons (Graham).

XEQQ, Mexico 30.99 m.: Is R4 at 2.50 pm (Gillett, Simpson, Graham).

XERQ, Mexico City, 9.615 mc, 31.22 m: For the first time this chap reached a strength good enough for me to get out a report to him. Lately has been quite good even up to 11.45 am (Walker).

XETT, 9.558 mc, 31.39 m: Heard shortly after 3 pm with good signal (Gillett).

XEWW, 31.58 m: Terrific signal at 2.45 pm (Graham). Good when closing at 4.15 pm (Gillett) (Simpson).

Switzerland

HER-5, Berne, 11.86 mc, 25.28 m: Heard at 11 pm (Young).

HEI-5, Berne 11.715 mc, 25.61 m: This is the correct call-sign for this frequency (Howe "Universalite").

HEO-4, Berne, 10.345 mc, 28.99 m: Tremendous signal to South America, 9.30—11 am (Howe, "Universalite").

——, Berne, 9.185 mc, 32.66 m: Heard daily from 9.30—11 am in Spanish and later closing in English (Graham).

Berne on 6.34 mc is good from 7—8 am (Graham).

Radio Lausanne on 6.34 mc, 47.28 m, is very good at 4 pm (Young, Graham).

Turkey

TAQ, Ankara, 19.75 m: Fair at 8 pm (Young).

TAP, Ankara, 31.70 m: Excellent with news in English at 3 am. (Matthews).

Vatican City

HVJ, 15.12 mc, 19.84 m: Good at 3.30 pm in Italian (Matthews).

U.S.S.R.

Radio Tashkent, 6.825 mc, 43.96 m: Heard at 11.35 pm (Miss Sanderson).

Radio Petropavlovsk, 6.07 mc, 49.42 m: Heard every evening at 7.30 with an R8 signal (Miss Sanderson).

Mr. Matthews says Moscow on 9.88, 9.86, 7.17, 8.05 and 7.65 all good at night.

Mr. Edel tells me that the station on 25.79 metres is Leningrad till 10.43 pm, but from 10.50 till 2 am announce as Moscow.

NEW STATIONS

(Continued from page 20)

W.G.E.A., who can be faintly heard behind KGEX, does not seriously affect the programme to the Philippines conducted by KGEX from 7 till 11 pm. They continue till 12.45 am being in Dutch from M/N till closing. Excellent signal strength right through. Programme details are given at 7.10 p.m.

n,C6 &&&&|/ ....

WCBN, New York, 9.49 mc, 31.61 m: New call for this part of the dial around 5 pm when it heterodynes KRCA.

JCJC (?), Jerusalem, 7.22 mc, 41.55 m: This This new frequency for Army Testing is reported by Messrs. Edel and Gillett, the former having heard it from 2 a.m., whilst Mr. Gillett was listening at 4.30 am. Both report good signals.

——, 'Frisco, 11.9 mc, 25.21 m: On Monday, 24th July, KWID on 15.29 mc who, by the way, were putting in a particularly good signal, announced at 9.15 am. Programme can also be heard on 11.79 mc and ON A NEW FREQUENCY of 11.9 mc in the 25 metre band. Could not hear a sound on 11.9 mc at that hour, nor do I, yet, no call-sign.—L.J.K.

Allied and Neutral Countries Short-Wave Schedules

These schedules which have ben compiled from listeners' reports, my own observations, and the acknowledged help of "Universalite" and "Victory News", are believed to be correct at time of going to press, but are subject to change without notice. Readers will show a grateful consideration for others if they will notify me of any alterations. Please send reports to: L. J. Keast, 23 Honiton Ave., W. Carlingford. Urgent reports, 'phone Epping 2511.

Loggings are shown under "Short Wave Notes and Observations." Symbols: N—New stations; S—Change of Schedule; F—Change of frequency; X—See Short-wave Notes.

Call Sign	Location	Mc.		M.	Time: East. Australian Stand'd
GSH	London	21.47	N	13.97	8 pm—1.15 am.
GVO	London	18.08		16.59	1—2.15 am.
AFHQ	Algiers	18.02		16.64	9.20 pm
GRQ	London	18.02		16.64	11—1.15 pm
VWY	Kirkee	17.94		16.72	Around 9.30 pm
GRP	London	17.87	S	16.79	1.30—3 am.
EIRE	Athlone	17.84		16.82	10—11.20 am; 3.30—4 am; News 2.45 am
WCDA	New York	17.83		16.83	11 am—4.30 am
WCRC	New York	17.83		16.83	7.15—9.15 am
GSV	London	17.81	S	16.84	5.30 pm—1.15 am
VLI-8	Sydney	17.80		16.85	Idle.
WLWO	Cincinnati	17.80	S	16.85	7.30—8.45 am; 10 pm—4.30 am
GSG	London	17.79		16.86	8—8.30 pm; 1.15—2.45 am
WRCA	New York	17.78		16.87	11—2.45 am
WNBI	New York	17.78	N	16.87	Heard at 8 am
OPL	L'poldville	17.79		16.88	4.55—6.15 am
KROJ	'Frisco	17.76	S	16.89	11 am—1.45 pm
WRUW	Boston	17.75		16.90	1—3.15 am. heard around 10 am
GVQ	London	17.73	S	16.92	2—2.15 am
LRA-5	B'nos Aires	17.72		16.93	Sats 6.45—6.30 am
—,	Brazzaville	17.71		16.94	6.30—7 am
GRA,	London	17.71		16.94	6 pm—2.45 am; News 6 pm
HVJ	Vatican City	17.44	N	17.20	11 pm—1 am
GVP	London	17.70		16.95	7 pm—12
KMI	'Frisco	17.09		17.5	1—4 am
WCW	New York	15.85		18.93	3 am—7 am
LSL-3	Beunos Aires	15.81		18.97	
—	Moscow	15.75		19.05	9.40 pm—11.30 pm
FZI	Brazzaville	15.59		19.25	9.15—10.15 pm
RNB	L'poldville	15.53		19.33	9 pm—11 pm
KKR	Bolinas	15.46		19.4	Irreg. noon
GRD	London	15.45	S	19.43	3.45—5.15 pm; 1.15—3.45 am
GWE,	London	15.43	S	19.44	8 pm—1 om
GWD	London	15.42	S	19.46	3—7 pm; 9.15—10 pm
—	Moscow	15.40	N	19.47	11 pm—2 am
GRE	London	15.37		19.51	5.45—7 pm; 10.15—1 am; 1.30—4 am
ZYC-9	Rio deJ'niero	15.37		19.51	Schedule unknown.
KWU	'Frisco	15.35	S	19.53	1—4 am; 6.30—8.15 am; 9.45—11.30 am
—	Moscow	15.35		19.54	8.15—10.20 pm. (English from 9.40)
VUD	Delhi	15.35	N	19.54	1.30—5 pm
WRUW/L	Boston	15.35	S	19.54	8.15—9.15 am; 8 p.m.—
WGEA	Schenectady	15,33		19.57	7.30—8.45 am
KGEX	'Frisco	15.33	N	19.57	8.15 am—3 pm
KGEI	'Frisco	15.53		19.57	Closes at 11 am
WGEO	Schenectady	15.33		19.57	9.15 pm—5.30 am
VLI-3	Sydney	15.32	S	19.58	7.30—8; 8.15—11 pm
VLC-4	Australia	15.31	N	19.57	3.10—3.40 pm
GSP	London	15.31	S	19.60	5.7 am; 3.45—6 pm; 9.15—10 pm; 1—2.15 am
GWR	London	15.30	N	19.61	9—9.30 pm; 2—8 am
KWID	'Frisco	15.29		19.62	3.30—11 am;
VUD-3	Delhi	15.29		19.62	1—7.30 pm; 9.30—11 pm
WCBX	New York	15.27		19.64	9 pm—6.45 am; 7—9.45 am
GSI	London	15.26	S	19.66	1.30—7 am
WLWK	Cincinnati	15.25		19.67	7.30—10.15 am; 10.15 pm—7.15 am.
VLG-6	Melbourne	15.23	S	19.69	Noon—12.30
—	Moscow	15.22		19.70	7.15—7.40 am; 8.47—9.30 am; 11.15—11.40 am; 9.40—10.20 pm
WBOS	Boston	15.21		19.72	10.15 pm—1 am; 1.15 am—2.45 pm
XGOY	Chungking	15.20		19.73	Heard testing with U.S.A. 5—7 pm
TAQ	Ankara	15.19		19.75	7.30—10.15 pm; 11.30 pm — 12.45 am.
KROJ,	'Frisco	15.19	S	19.75	5—10.45 am

Call Sign	Location	Mc.		M.	Time: East. Australian Stand'd
WOOC	New York	15.19	S	19.75	9.45 pm—4.45 am
WKRX	New York	15.19		19.75	5.30—7 am
XGOX	Chungking	15.18		19.76	Wed. only, 10—10.45 am
GSO	London	15.18	S	19.76	3—6 pm; 8.30 pm—1.45 am; 2—2.15 am
TGWA	Guatemala	15.17		19.78	3.45—4.55 am (Mon. till 8.15 am)
VLG-7	Melbourne	15.6	S	19.79	6—8.10 am (Sun. from 6.45)
SBT	Stockholm	15.15		19.80	1—4.15 am. News 1.01 am
WNBI	New York	15.15		19.81	10 pm—7 am
WRCA	New York	15.15	N	19.81	7.15—9.45 am
GSF	London	15.14	S	19.82	3.5 pm; 2.15—6 am
KGEI	'Frisco	15.13		19.83	3—8.30 pm
WRUS	Boston	15.13	S	19.83	5—6.30 am;
HVJ	Vatican City	15.12		19.84	Irregular in afternoons
—	Moscow	15.11	S	19.85	7.15—7.40 am; 8.48—9.30 am; 11.15—11.40 am
HVJ	Vatican City	15.09		19.87	See 19.84 m.
GWC,	London	15.07	S	19.91	3—5.15 pm; 8 pm—2 am; 4—6 am
GWG	London	15.06		19.92	No schedule.
WWV	Washington	15.00		20.00	See 10 m.c.
—	Moscow	13.42		22.35	Around 10.45 pm
WKRD	New York	12.96		23.13	10 pm—9.15 am
HER-	Berne	12.96	N	23.14	Tues and Sats 6—7.30 pm
CNR	Rabat	12.83		23.38	9.30—10 pm
HCJB	Quito	12.44	S	24.11	6—1.15 pm; 9.55 pm—11 pm
—	Moscow	12.26	S	24.47	Home prog. 3—9 pm; News 9.20, calls BBC 10.30 pm
TFJ	Reykjavik	12.23		24.54	3.15—3.30 pm
—	Moscow	12.19		24.61	7.45—9.23 am; 10—10.50 am
—	Moscow	12.17	S	24.65	4.45—5 pm; 7.30—8.50 pm
R. France	Algiers	12.12		24.75	2.30—4.30 pm; 5—7.30 am;
ZNR	Aden	12.11		24.77	7.45—8.15 am
GRF	London	12.09	S	24.80	8 pm—3.45 am
GRV	London	12.04	S	24.92	3—7 pm
CE-1180	Santiago	11.99	N	25.01	8 am—2 pm
FZI	Brazzaville	11.97	S	25.06	4.45—8 am; 3—4.15 pm
Radio TBILISI	Tiflis	11.96	S	25.08	8.45—11.45 pm
GVY	London	11.95		25.09	8 pm—1.45 am; New 9 pm, 11 pm and 1 am.
—	Moscow	11.94	N	25.10	9.40—10.54 pm in English
ZPA-5	.. Enc'nac'n	11.95	N	25.10	Heard around 10.30 am
GVX	London	11.93	S	25.15	7.15—10 am
XGOY	Chungking	11.90	X	25.19	8—9.35 pm; 10.30 am
KWIX	'Frisco	11.9	N	25.21	3—9.58 pm
CXAIO	Montevideo	11.90		25.21	9.5 am—12.10 pm
WRCA	N.Y.	11.89	S	25.22	6—10 pm
VPD-2	Suva	11.90		25.22	8.30—10 am
WKTM	New York	11.89		25.23	8—10 am
AFHQ	Algiers	11.88		25.24	6.57 pm
VLR-3	Melbourne	11.88	S	25.25	Daily 11.45 am—5.45 pm (Sun from 12.30
WOOW	New York	11.87	N	25.27	9.45 pm—4.45 am
VLI-2	Sydney	11.87	S	25.27	Idle
VLC-3	Australia	11.78	N	25.47	Not yet in service
WBOS	Boston	11.87	S	25.27	5—7.15; 7.30 am—2 pm; 7.45—9.30 pm
VUD-,	Delhi	11.87		25.27	7.30—10.30 pm; News 7.30
KWIX	'Frisco	11.87	S	25.27	6—9.30 am
XGOY	Chungking	11.87	X	25.27	See 25.19
HER-5	Berne	11.86		25.28	10.55—12.30 am
GSE	London	11.86	S	25.2[illegible]	8 pm—4.45 am; 5.15—7 am
WGEX	Schenectady	11.84	S	25.33	10 pm—10.15 am
VLG-4	Melbourne	11.84	S	25.34	6.10—7 pm; 7.30—9.45 pm
GWQ	London	11.84		25.34	7 pm—12.30 am 1.30—4.45 am
VLW-3	Perth	11.83	S	25.36	8.45—11.45 am; 1.30—8.15 pm (Sun. 8.45 am—8.15 pm)
—	Moscow	11.83		25.36	Opens at 11 pm in Hindustani
WCRC	N.Y.	11.83	S	25.36	5.15—8.45 am; 9 pm—
WCDA	N.Y.	11.83	S	25.36	5.15—8.45 am; 9 pm—m/n
GSN	London	11.82	S	25.38	5.45—7 pm; 4—5.15 am
XEBR	Hermosillo	11.82		25.38	11—3 pm
COBH	Havana	11.80		25.41	Heard at 8 am and 9.30 pm
GWH	London	11.80		25.42	7 pm—12.30 am; 1.30—4.45am
WRUA	Boston	11.79		25.45	8—9.30 pm
VUD-6	Delhi	11.79		25.45	7.45 pm—12; News 7.45

Call Sign	Location	Mc.	M.	Time: East. Australian Stand'd
KGEI	'Frisco	11.79	25.43	7 am2.45 pm
GVU	London	11.78	S 25.47	2—6 pm; 9—10 pm; 12.45—3.30 am
HP5G	Panama	11.78	25.47	11.15 pm—12.30 am; 2.45—6 am
HER-	Berne	11.78	25.47	4—7.45 am
VLR-8	Melbourne	11.76	S 25.51	6.10 am—10.03 am (Sun. 6.45 am—12.45 pm)
VUD-	Delhi	11.76	N 25.51	1.18—5.15 pm
GSD	London	11.75	25.53	7 am—12.15 pm; 3—5.15 pm; 1.15—6.30 am
—,	Moscow	11.75	25.53	9.30—9.55 am
GSB	London	11.75	25.53	2—2.45 pm
HVJ	Vatican City	11.74	25.55	Calls Aus. Tues. and Sat 4 pm
COCY	Havana	11.73	25.56	11 am—4.15 pm
GVV,	London	11.73	25.58	8.45 pm—1.15 am; 1.30—6.30 am
WRUL,	Boston	11.73	S 25.58	6—8 am; 8.15—9.15 am; 1.30—4 pm
CKRX	Winnipeg	11.72	25.60	3—7.45 am
OPL	L'poldville	11.72	25.60	9.55—11 pm; 4.55—6.15 am.
Brit. Medit. Stn		11.72	S 25.60	10.45 pm—m/n; 3—5 am; 6—6.30 am; 1.45—3.35 pm
HEI-5	Berne	11.71	25.61	Daily: 4—7.45 am; Tues & Sat 6—7.30 pm
PRL-8	R. de J'niero	11.72	N 25.61	English announcements at 6 am
YSM,	San Salvador	11.71	25.62	4—5 am
VLG-3	Melbourne	11.71	S 25.62	3.10—3.45 pm 3.55—4.40 pm; 4.55—5.25 pm; 5.30—5.50 pm; 10—10.45 pm
WLWO	Cincinnati	11.71	S 25.62	4.45—7.15 am;
WLWK	Cincinnati	11.71	S 25.62	8.30—10 pm
CXA-19	M'tevideo	11.70	25.63	9—10 pm; 7 am—1 pm
SBP	Motala	11.70	25.63	1—4.15 am; 7.20—8.40 am; 11 am—12, opens again at 9.05 pm
CBFY	Montreal	11.70	25.63	9.30 pm—1.30 pm
GVW	London	11.70	S 25.64	4—7 am
HP5A	Panama City	11.70	25.64	11 pm—3 am; 11.10 am—3 pm
CE1170	Santiago	11.70	25.64	10 pm—12
GRG	London	11.68	S 25.68	7—10 am; 3.30—6 pm; 8.15—9.15 pm; m/n—3.45 am
—,	L'poldville	11.67	25.71	Now on 11.64 mc.
WKRX	New York	11.67	N 25.71	Heard testing at night
RNB	L'poldville	11.64	N 25.76	3—3.45 pm
Leningrad		11.63	N 25.79	9.30—9.43 pm; 9.50—10.17 pm; 11.30—11.43 pm; 11.50 12.18 am
COK	Havana	11.62	25.83	2 am—1 pm (Mon. 3—9 am)
Dadio Dakar		11.41	N 26.29	Closes 7 am
WRUA	Boston	11.14	S 26.92	10 pm
WCDA	New York	11.14	26.92	4—6 am
WCBN	New York	11.14	N 26.92	6—9 am
CSW6	Lisbon	11.04	27.17	5—8.30 am
KWV	San F'cisco	10.84	S 27.68	4—7.15 pm; 7.30—9 pm
—	Stockholm	10.77	N 27.83	Around 3.45 am
VQ7LO	Nairobi	10.73	27.96	12.45—5 am
KES-3	'Frisco	10.62	S 28.25	3—8.15 pm
VLN-8	Sydney	10.52	28.51	Idle at present
—	Moscow	10.44	S 28.72	3—6 pm and again at 9.15 pm
ZFD	Bermuda	10.33	N 29.03	Heard around 6 am
—	Moscow	10.23	29.33	4.15—5.50 pm; 9 pm—11 pm
—	Moscow	10.10	29.68	4.45—5.45 pm
HEO-4	Berne	10.34	N 28.99	9.30—11 am
Moscow		10.08	29.75	Heard at 3.50 pm
SUV	Cairo	10.05	S 29.84	4.30—5.30 am; 5.30 am
WWV	Washington	10.00	30.00	Freq. check ¼ hour
—	Brazzaville	9.98	30.06	4—5.20 am; 7—7.30 am 7.30—8.30 pm; 11.45—12.15 am
HCJB	Quito	9958	S 30.12	6—7 am; 9.55—11.30 am
WRX	New York	9905	30.29	8 am—2 pm; 2.15—7 pm
WKRD	New York	9897	30.31	6.45—8.30 pm; 5—7 am.
WKRX	New York	9897	30.31	8—10.45 am
KROJ,	'Frsco	9.89	S 30.31	6 pm—11 pm
—	Moscow	9.88	S 30.34	11 pm—1 am Home prog.
CR7BE	L. Marques	9.86	X 30.42	4.30—6.30 am; News 5.50 4.25—6.30 am; 3—4 pm; 7.30—10 pm
EAQ	Madrid	9860	30.43	4—6 am; News 4.15
—	Moscow	9860	S 30.43	8—10.15 pm
KWIX	'Frisco	9.85	F 30.44	6—8.30 pm
COCM	Havana	9833	30.51	9.45 pm—3 pm
GRH	London	9825	S 30.53	5—7 am; 7.15 am—2.45 pm; 3—7 pm
LSE	Monte Grande	9.80	N 30.61	Heard around 1.30 pm
RNB	L'poldville	9.78	S 30.66	3—4.45 pm; 1.55—2.30 am 3.15—8.30 am
—	Moscow	9770	30.71	10—10.30 am.
WKLJ	New York	9750	S 30.77	Heard at 8.30 pm
T14NRH	Heredia	9740	30.80	10—11 pm (Wed. Fri. & Sun. 1.30—3.30 pm)
CSW-7	Lisbon	9735	30.82	See 27.17 metres.

Call Sign	Location	Mc.	M.	Time: East. Australian Stand'd
Leningrad		9.72	N 30.85	Heard around 5.15 pm; 9—10 pm and 11 pm
CE-970	V'paraiso	9.73	30.82	Heard around 8.45 am
XGOA	Chungking	9720	30.86	5—6 am; 9 pm—1 am; News 12 am
PRL-7	R. de J'niero	9.72	S 30.86	6 am—1 pm; 11.15 pm—5.55 am
OAX4K	Lima	9715	30.88	8.30 am—2.20 pm
—	Brazzaville	9.70	N 30.92	Heard at 7.30 pm
WRUW	Boston	9.70	S 30.93	4.45
WRUS	Boston	9.70	S 30.93	1.30—4 pm; 8—9.30 pm
FIQA	Tananarive	9700	30.93	12.30—1 am
GRX	London	9690	S 30.96	7.15 am—12.15 pm
TGWA	Guatemala	9685	30.96	11.50 am—3 pm (Mon. 10 am—2.45 pm)
LRA-1	B'nos Aires	9688	30.96	1.30—4 am; 5.30—6.30 am—
VLC-2	Australia	9.68	N 30.99	5.30—6.30 pm; 7—8 pm
XEQQ	Mexico City	9.68	30.99	Midnight—4.45 pm
VLW-6	Perth	9.68	30.99	8.30 pm—1.30 am
WRCA	New York	9.67	N 31.02	10 am—4 pm
WNBI	New York	0.67	31.02	6 pm—9.30 pm
Brit. Medit Stn.		9.67	31.03	6—8 am; 1.45—3.35 pm; 10.45 pm—m/n; 3—5 am
VLQ-3	Brisbane	9.66	S 31.05	11.45 am—5.15 pm (Sun from 11 am)
GWP	London	9.66	31.06	Heard at 10.30 pm
LRX	B'nos Aires	9.66	S 31.06	1.30—7 am
WGEO	Schenectady	9.65	31.08	Not in use at present
WOOC	New York	9.65	S 31.08	6—9 am
WCBX	New York	9.65	31.09	1.45—4 pm
XGOY	Chungking	9.64	31.10	9.35 pm—1.40 am; News 12 and 1 am
COX	Havana	9.64	31.12	2.50—2 pm
LRI	B'nos Aires	9.64	31.12	7.57—10 pm! 3.30—4.30 am; 5 am—1 pm
GVZ	London	9.64	S 31.12	3—7 pm
CBFX	Montreal	9.63	N 31.15	Heard around 9.30 p.m.
VUD	Delhi	9.63	N 31.15	Heard around 9.30 p.m.
GWO	London	9.62	S 31.17	3.45—5.15 pm 8 pm—2 am
—	Addis Ababa	9.62	31.17	1.40—2.30 am
TIPG	San Jose	9.62	N 31.20	Heard around 10 pm
VLC-6	Shepparton	9.61	N 31.21	1—1.45 am
XERQ	Mexico	9.61	31.21	Heard at 2 pm
ZYC-8	Rio de J'n'ro	9.61	31.21	9 am—12
AFHQ	Algiers	9.61	N 31.22	Around midnight
ZRL	Capetown	9.60	31.22	5.15 pm—12.30 am.
HP5J	Panama City	9.60	31.23	10 pm—4.30 am; 11.30 pm—1.30 pm; Sun. 11 am—1 pm Mon.
CE960	Santiago	9.60	31.24	9 am—2 pm
GRY	London	9.60	S 31.25	3.25—7 am; 3.15
—	Athlone	9.59	31.27	7.05—7.25 am; News 7.10 am 8.30—11.35 pm; 12.15—1 am; 2.30—4.30 am; News 10 pm; 12.50 am and 4 am
VUD-4	Delhi	9.59	31.28	
VLI-6	Sydney	9.59	N 31.28	4.55—5.25 pm; 7.30—8 pm
WCRC	New York	9.59	31.30	5—8.45 pm
WLWO	Cincinnati	9.59	31.30	9 am—2 pm
VLR	Melbourne	9.58	31.32	6—11.30 pm
VLI-10	Sydney	9.58	X 31.32	Idle at present
VLG	Melbourne	9.58	31.32	12.15—12.45 am—1—1.45 am
GSC	London	9.58	S 31.32	7.15 am—Noon
WRUS	Boston	9.57	S 31.35	6.45—8 am; 8.15 am
KWIX	'Frisco	9.57	S 31.35	10 am—2.45 pm; 8.45 pm
KWID	'Frisco	9.57	S 31.35	Not in use at present
—	Khabarovsk	9.56	S 31.37	7.40—8.45 pm; 6 pm—12
OAX4T	Lima	9.56	31.37	11 pm—Midnight
XETT	Mexico	9.55	31.39	Continuous
GWB	London	9.55	31.41	6.15—7.45 am; 4.10—4.30 pm 5.10—6 pm; 6.30—7.30 pm; 8.45—10 pm; 10.45 pm—11.15 am; 1.30—5.45 am.
XEFT	Vera Cruz	9.54	X 31.42	Midnight—4.15 pm
—	Moscow	9.54	31.43	1.15—1.40; 9.30—10.20 pm
VLG-2	Melbourne	9.54	S 31.45	10 pm—Midnight
VLC-5	Shepparton	9.54	N 31.45	1—1.45 am
AFHQ	Algiers	9.53	31.46	12.45—1 am; 2—8.30 am; News 5 am
SBU	Stockholm	9.53	31.47	7.20—7.35 am; 11 pm—12. News 7.20 and 11 am
HER-4	Berne	9.53	31.47	See 25.61 metres
WGEO	Schenectady	9.53	31.48	5.15—7.15 am; 7.30 am—9.30
WGEA	Schenectady	9.53	N 31.48	5.30—10 pm
KGEX	Frisco	9.53	N 31.48	7 pm—12.45 pm
GWJ	London	9.53	31.48	7—10.45 pm; 11 pm—12.30 am
ZRG	Joh'burg	9.52	X 31.50	11 pm—12.45 am
—	London	9.52	N 31.51	Absie heard at 8 am
COCQ	Havana	9.51	31.53	10 am—1 pm; 8.20—11 am
GSB	London	9.51	S 31.55	7.15 am—1.30 pm; 2 pm—1 am; 3.45—7 am
PRL-7	R de Janeiro	9.50	F 31.57	Moved to 30.86 metres
XEWW	Mexico City	9.50	S 31.58	11.58—4.15 pm
GWF	London	9.49	31.61	6—7.45 pm; heard around 1.50 pm
KRCA	'Frisco	9.49	S 31.61	4 pm—2 am

SPEEDY QUERY SERVICE

Conducted under the personal supervision of A. G. HULL

G.H. (Paddington) cannot get a satisfactory repair job done.

A.—No, we are sorry, but it is quite impossible for us to handle any laboratory service or repair work at present. We are not surprised to hear of your difficulties, as the set is something rather out of the ordinary and you could not expect any ordinary repairman to handle it effectively.

B.A.C. (Allentown) is interested in photo cell theory.

A.—Perhaps the simplest way would be to say that the photo cell will pass a current which is regulated by the amount of light thrown into it, whereas a radio valve will pass current according to the voltage on the grid. The more light put into the cell the greater will be the current flow and it is then only a matter of putting an external resistor in the current circuit and there will be a voltage drop across the resistor which will vary according to the light impulses. This varying voltage can then be impressed on the grid of an amplifier in similar manner to audio or radio signals.

"Junior" (Artarmon) is interested in using a radio transformer to operate a set of miniature lights.

A.—Yes, you can use the radio transformer in the way you suggest. The main point will be to take the greatest care to avoid shock by getting into contact with the power mains input, but if you have the input leads thoroughly insulated you should be safe enough. Leave the high tension terminals bare; do not on any account connect them together as this would mean a short circuit and cause the transformer to overheat. Take fairly heavy leads away from the six volt terminals and use motor car lamps if you like. Unless something out of the ordinary, you will find that the maximum current drain will be about six amps at six volts, which is only 36 watts in all, enough for lamps requiring a total of this wattage. Motor cycle headlamps are about 24 watt, so you couldn't expect to run more than one or two of them. It would be a fairly simple matter to rewind the transformer with the same number of turns as on the present six-volt winding, but with very heavy gauge wire. Then you could draw up to about a hundred watts quite easily.

W.L.J. (Queensland) wants to use the "Vibra" amplifier (June, 1940) from d.c. power mains.

A.—To use the amplifier on 240 volt d.c. mains it would be easy enough to get the h.t. from the mains, through chokes as suggested, but you will need to pay attention to the matter of polarity and also as to the potential between the negative main and "earth", as this is a danger point unless the whole output is shielded and protection from contact with the metal is assured. This is not so easy when a microphone is employed as it may be found essential to earth the case of the microphone and the shielding of the mike cable. To run the heaters from the mains, too, it would be necessary to wire then in series, with a compensating resistor of 42 ohms across the 6J7 heater in order to bring its current consumption equal to that taken by the 6V6. Then a 100 watt lamp would be needed in the circuit to limit the amount of current.

Whether the gain would be sufficient for microphone work of the type you mention would depend largely on how close you are to the mike when you sing and whether you just want to reinforce the singing a bit or whether you want to rattle the windows. The actual voltage output of crystal mikes also varies considerably, even amongst mikes of the same type and brand. A few tests would soon show whether the gain is sufficient.

D.M.B. (Mt. Eden, N.Z.) wants to know why American power transformers have the secondary and primary windings wound in opposite directions.

A.—Sorry, but we haven't had much experience with American power transformers and haven't noticed this peculiarity before. Offhand we cannot imagine any particular reason why it should be done or what the aim would be. Perhaps some of our readers can oblige with an explanation?

B.S. (Brisbane) has made the three-way tone control from the May issue but finds that the operation of the controls cuts down the gain.

A.—Yes, this is normal and we thought we pointed out clearly enough that the control is always on the "loss" side. cutting down the amplification at the unwanted frequencies. This makes it essential to have ample gain in reserve.

H.A. (Robertson) asks for the "Radio Step by Step" series of back numbers.

A.—Sorry, but stocks of these have been exhausted again. We doubt if there is any chance of reprinting the series in our issues but there is a possibility that we will produce a revised and improved version as a booklet. At the moment we are going into the possibility of getting the necessary paper, etc., and if anything comes of it we will let you know.

A.N.P. (Kyogle) wants details for building a small receiver for use in a bush hut with cement-bag walls, located on a cleared ridge.

A.—With regard to your enquiry about a book on the subject of building a set suitable for use in a bush hut, almost any type of battery set could be used, and we have described the construction of these in a number of past issues, but the big trouble is in regard to the parts.

We don't think that there would be the remotest chance for you to obtain a full set of parts for the construction of a set, tuning condensers, batteries, valves and other parts being most difficult to obtain and many other components being subject to controls of all sorts under National Security Regulations, etc.

The construction of receivers has been prohibited for some time, and although this is mainly considered in regard to factories, it also holds good for amateur set building.

Under the circumstances we can only suggest that you wait until the war has been cleaned up. It won't be long now!

G.J.B. (Ballarat, Vic.), and about fifty others, want to know when the direct-coupled amplifier will be described by Charlie Mutton.

A.—Already an amazing amount of interest has been expressed in this article and we expect that it will cause a mild sensation when released. The article is in course of preparation and, if all goes well, should appear in the September issue.

W.H. (Burwood, Vic.) asks whether it is reasonably possible to pick up American broadcasting stations on the broadcast band.

A.—There is no doubt that many of the powerful American broadcast stations can be picked up in Australia under ideal circumstances. Normally the local stations will blanket over these Yanks, but after midnight they can be heard, once in a while, with a really good set, efficient aerial and good location. It would be unreasonable to expect to get the signals at good programme strength.

S.L.B. (Crows Nest) wants articles on the construction of test equipment from "junk" parts.

A.—Afraid we don't like the idea very much. A lot depends on what you call junk. Looking them over we gain the impression that many of the instruments recently detailed could be built up with odds and ends from around the worshop, although hardly junk. Thanks for the other kind remarks.

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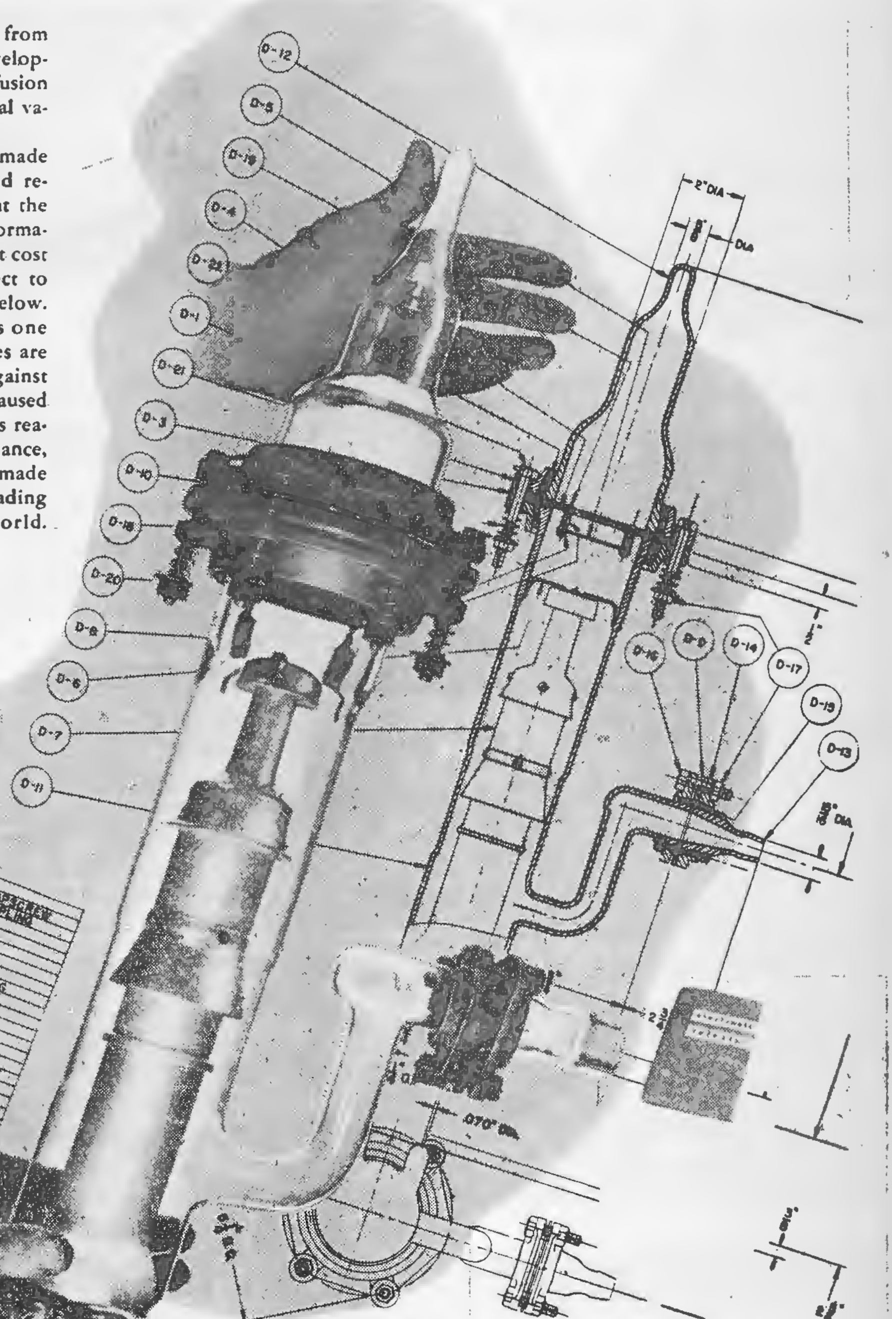

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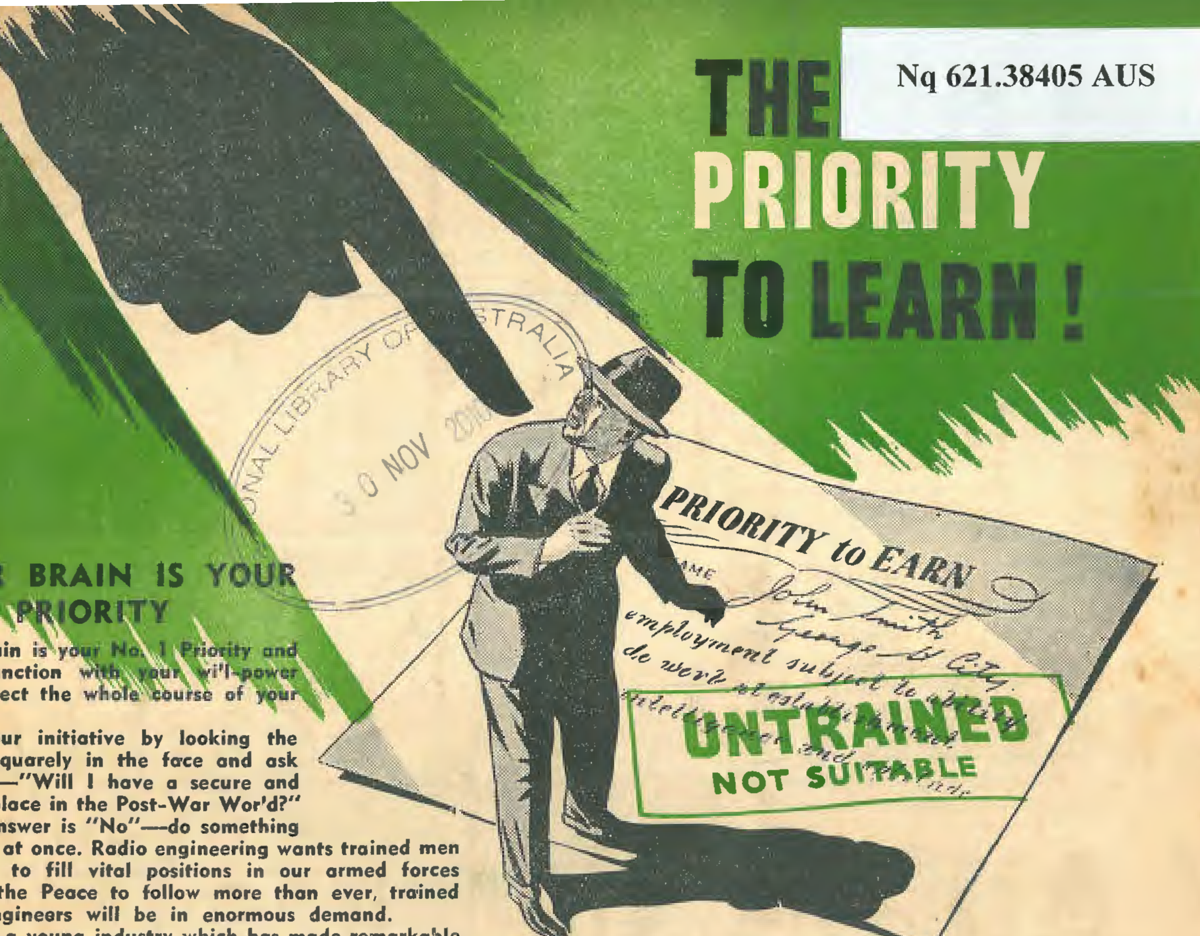

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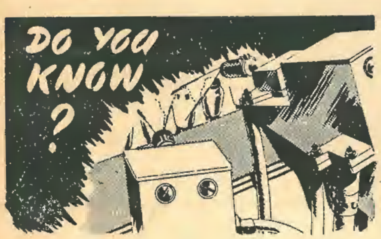

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—D.H., Home Hill, Q'ld.

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