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APRIL 15 1945

THE AUSTRALASIAN RADIO WORLD

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and incorporating

ALL-WAVE ALL-WORLD DX NEWS

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EDITORIAL

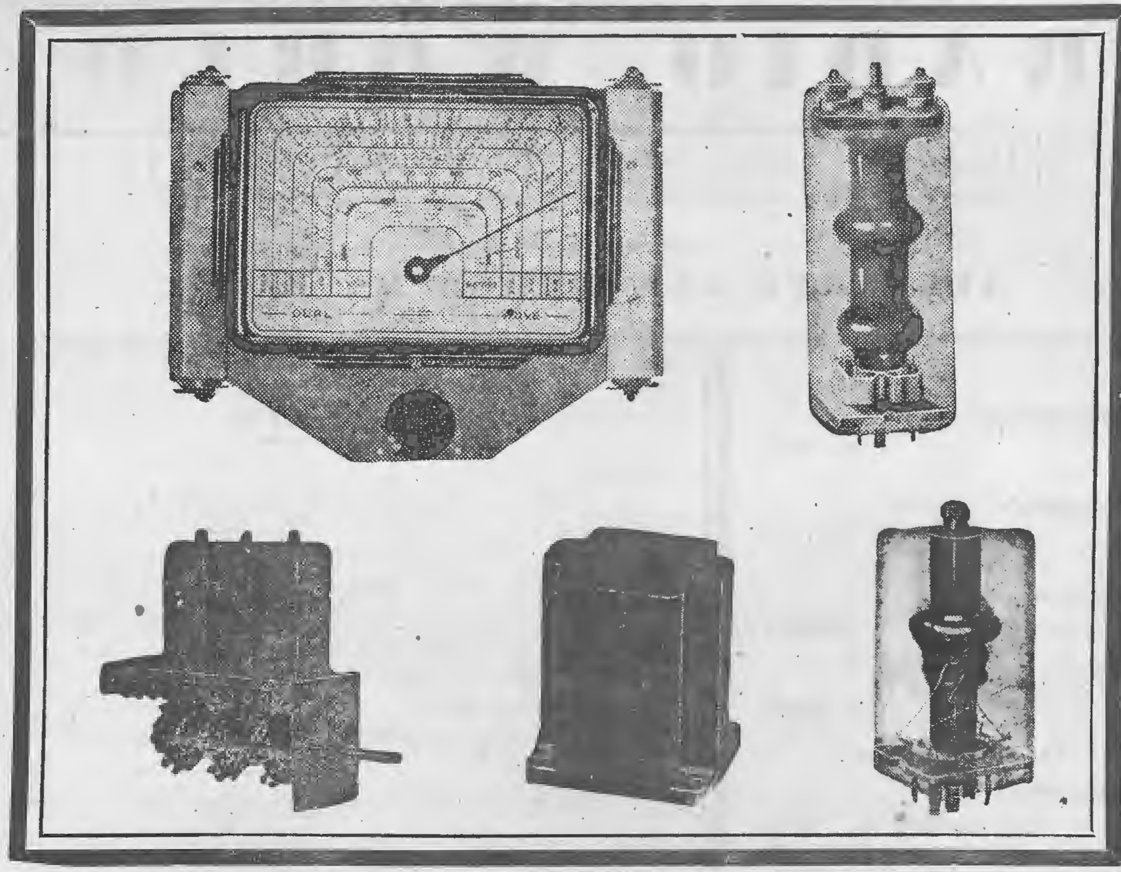
Several readers have written to let me know how much they appreciate the varied style of the articles now being presented in Australasian Radio World. From near and far come contributions, some of them possibly lacking in the niceties of journalism, but all from the hearts of enthusiastic radio men just like you and me.

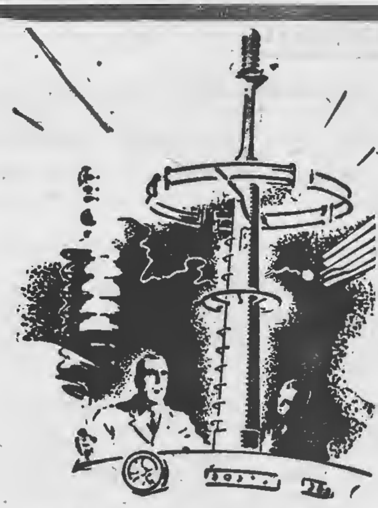
It takes an exception to prove the rule, and so I also find that some people are not in agreement with views expressed by contributors, and so they abuse me for not exercising greater editorial supervision. I can imagine that I am going to get into really hot water for publishing Mr. Stevens' article in this issue. Paul Stevens claims that Australian radio engineers have slavishly followed American design, thereby doing the wrong thing.

Personally I do not think that Mr. Stevens has presented both sides of the case, nor do I think that his arguments are all entirely sound, yet I feel that the article is well worth publishing exactly as submitted. Some of my thin-skinned friends are going to be hurt by the inferences; others may be shocked by the audacity of anyone daring to suggest that our set designers are not infallible.

My courage comes from the thought that in these days of so much talk about freedoms, that my readers should have the right to freely criticise, so long as their criticism is within the bounds of reason. Those who do not agree with views expressed will be gladly afforded space to state their claims and present their cases.

LOOKING BACK . . .





. . . Yet Planning Ahead

In less than twenty years radio has grown from a schoolboy's hobby to a giant, world-wide industry . . . with ramifications thot extend into every branch of radio-physics ond every phose of our daily lives. And nowhere has this development been more marked than in the newly-discovered field of electronics . . . the door that opened the way to the miracle of rador . . . the endless possibilities of FM . . . and made radiovision an accomplished fact.

Throughout this entire period R.C.S. Radio Pty. Ltd. has kept pace with world progress, so that, although the entire resources of the Company are today devoted to the output of urgently-needed defence equipment, the coming peace will find them ready to supply both the amateur set constructor and the trade monufacturer with the exoct type of precision-built components required to build the circuits of the future. And, thanks to experience goined during the war yeors . . . improved manufacturing processes and facilities . . . and new type of plastic insuloting materials . . . the quality of R.C.S. products will be higher than ever.

R.C.S.

R.C.S. RADIO PTY. LTD., SYDNEY, N.S.W.

A BALANCED LINEAR V.T.V.M.

One of the handiest pieces of equipment for the enthusiast or the professional radio man is the vacuum tube voltmeter.

By
S/Ldr. H. W. Holdaway
RAAF Group 469
East Sale
Victoria

THIS article describes a vacuum tube voltmeter with an extremely linear calibration. A big weakness with most vacuum tube voltmeters is that special calibration is needed, and requires fairly regular checking to allow for changes due to the ageing of valves. In this instrument, precautions have been taken to make the calibration linear and as nearly as possible independent of normal variations in valves and mains voltages. To provide still greater certainty, this instrument features a built-in calibration check. Changes in calibration are minimised by operation of the valves under reduced voltage and current conditions.

Range

Ranges covered are: 1-10-100 volts at 2 megohms input resistance; 5-50-500 voltages at 10 megohms input resistance; and 10-100-1,000 volts at 20 megohms input resistance, both on D.C. and A.C.

Linear Calibration

In a recent (June) issue of "Wireless World," there appeared an article describing a pentode-diode valve voltmeter, the principal feature of which was its linear calibration on D.C., and linearity down to about 1/15th full scale on A.C. Two similar valves were used in a balanced Wheatstone-bridge circuit similar to that of Figure (1). The bridge arrangement ensures balance even when fluctuations occur in H.T. and heater voltages, and linearity is achieved by operation under Class A conditions, together with the use of a limited amount of negative feedback. The sensitivity of the original circuit was quite good, the lowest range giving 1 volt full scale at 1 megohm input resistance, i.e., 1 million ohms per volt.

Valve Types

Altogether, this appeared to be a pretty useful sort of instrument, but on checking up it was found that there is no valve readily available in Australia to do the same job as the Pen 4 D.D. valves used in the original circuit. The Pen 4 D.D. is a doubel-diode power output pentode, the latter being required for satisfactory operation of the equipment with an 0-1 m.a. To build a similar circuit it would thus be necessary to use two power valves and a diode, such as 6X5GT, the addition of one more valve, which is undesirable.

Meters Available

Fortunately, the control on meters was relaxed recently, and the writer was able to obtain an 0-100 micro-ammeter, and this appeared to solve the problem. The circuit of Figure (1) was made up, following on similar lines to the original pentode-diode valve voltmeter. Two 6B6G double-diode high-mu triodes were used instead of the original Pen 4 D.D.'s, and an 0 to 0.1 micro-ammeter instead of the original 0-1 micro-ammeter. The 6B6G's form two arms of a balanced Wheatstone bridge, the other two arms being formed by the resistances R7 and

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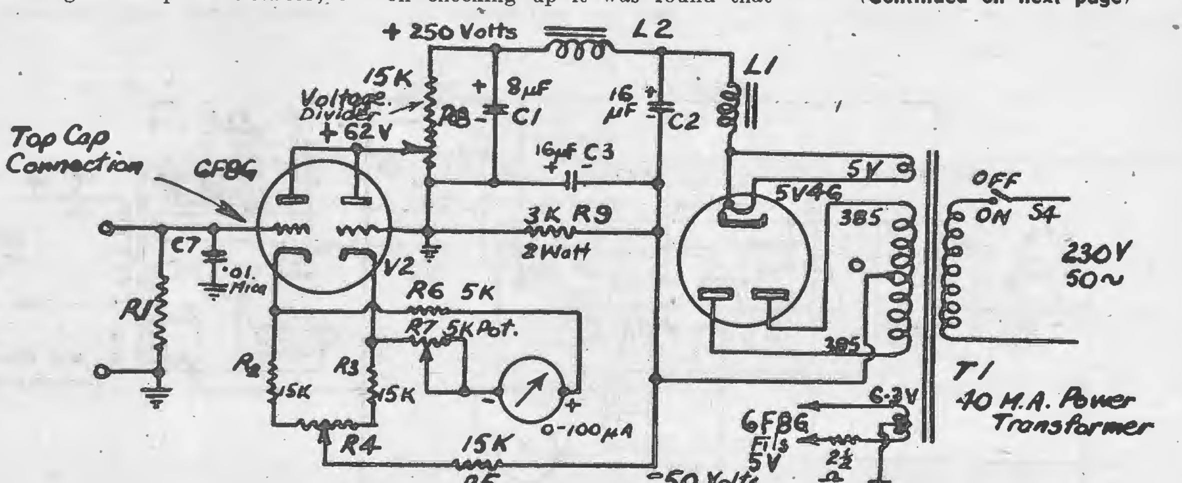

FIGURE (2) Basic D.C. Voltmeter Circuit

VACUUM TUBE VOLTMETER
(Continued)

R9 and the two portions of the tapped resistance R8. The latter is adjusted until the bridge is balanced and no current flows through the meter. The application of a positive D.C. voltage to V1 grid unbalances the bridge and causes a proportional deflection of the meter. On A.C. the diode section of V2 is placed in series with the meter, which thus can respond only to the positive half cycles of the A.C. voltage applied to V1 grid, so recording an average reading.

Supply Fluctuations

This circuit is very linear, and to all intents and purposes is independent of supply voltage fluctuations both as regards the balance or zero setting, and as regards calibration.

Grid Leaks

However, there is a drawback: the input resistance is limited by contact potential effects in V1 grid circuit. This possibility had not been entirely overlooked, as it is a recognised feature with high-mu valves, but the decision to try 6B6G's was based on the manufacturer's commendation that up to 10 megohms may be used in 6B6G grid circuits, where the plate current is less than 1 milliamp. While this is strictly applicable only to audio emplifier circuits, it was hoped that negligible trouble would be experienced with a grid resistor of 2 megohms in the

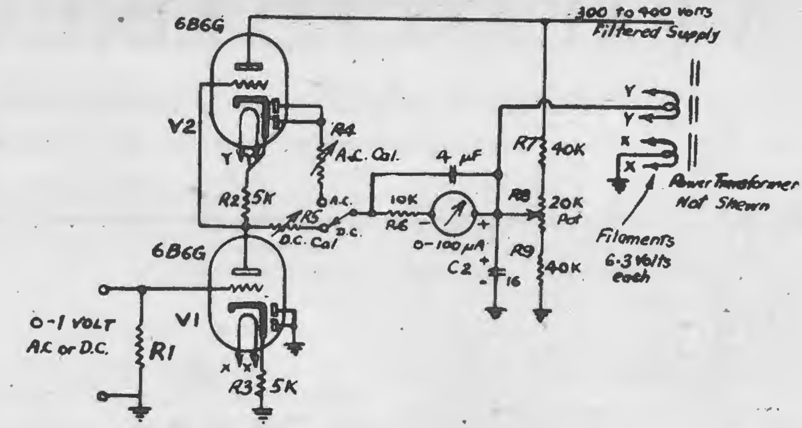

FIGURE (1) Original A.C./D.C. voltmeter Circuit (Simplified)

V.T. voltmeter circuit.

Low Grid Current Desirable in a D.C. V.T. Voltmeter

Low grid current is essential, if the input resistance of a valve voltmeter is to be kept as high as possible (especially so if the voltmeter is to be used for a megohmmeter circuit). Grid current can be minimised in a normally-operated triode by observing certain precautions, as follows:—

(1) By using self bias (or cathode bias).

(2) By operating the tube at subnormal cathode current.

(3) By using subnormal heater voltage.

(4) By selecting valves which have low grid current.

The use of cathode bias ensures that adequate bias is always available to prevent collection of space charge electrons by the grid. In certain instances, the grid itself may emit electrons, and the chief factor bringing this about is heating of the grid by radiation from the nearby cathode. By using a low value of cathode current, it is possible to obtain satisfactory operation with filament voltages of 5 volts instead of 6.3 volts, the corresponding reduction in heating being accompanied by reduced grid emission. Operation at reduced plate voltage is of further assistance in this regard, since for grid emission the plate and grid may be considered as the elements of a diode.

With these principles in mind, several circuits were tried out, and

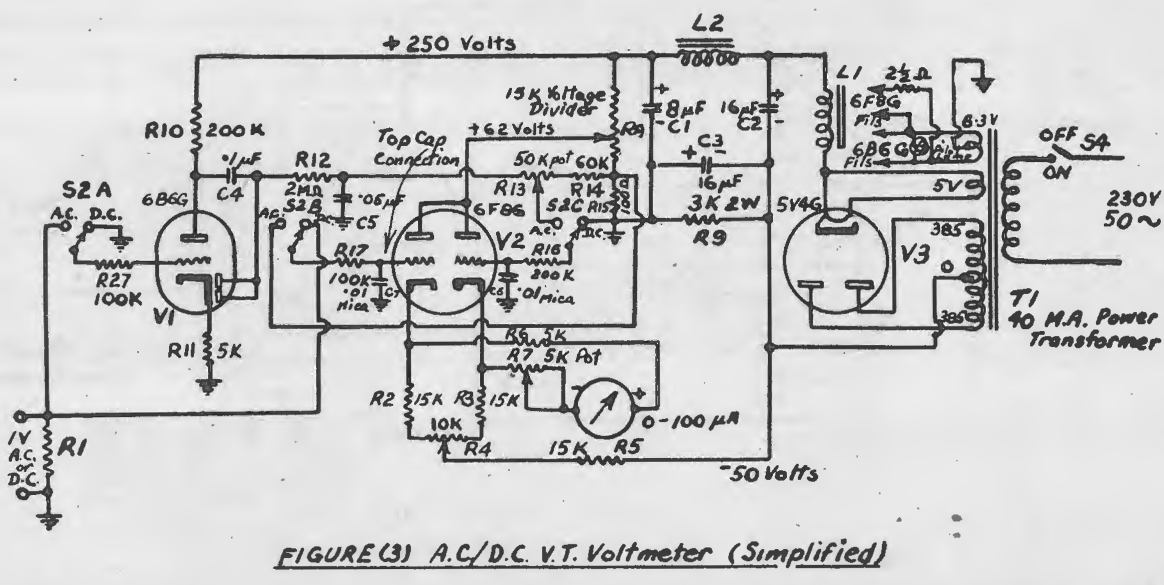

FIGURE (3) A.C/D.C. V.T. Voltmeter (Simplified) the circuit of Figure (2) was finally decided upon as giving adequate linearity with negligible grid current effect. It will be noted that the 6F8G is operated with 5 volts on the filament and the better insulated top cap grid connection is used as the input signal grid in preference to the base pin grid connection.

Bridge Circuit

This circuit, Figure (2), is another form of balanced Wheatstone bridge. Linearity has been achieved by employing a relatively large degree of negative feedback and by using partial push-pull action to reduce even order harmonics. The push-pull action is achieved by cathode circuit coupling through the common resistor R5, the action being similar to that of the original "Barnes Mystery Circuit." The bias arrangement of both triode sections is such that these are operating under Class A conditions. Negative feedback is provided by the cathode resistors R2 and R3, which also, incidentally, with R4 form two arms of the Wheatstone bridge. The bridge may be balanced by means of the potentiometer R4.

Select Valves

All valves are not suitable for vacuum tube voltmeter operation. Some tubes may be slightly gassy, and in some cases a portion of the sensitive emitting material may become deposited on the grid during the manufacturing process. Tubes in either of these classes, though perfectly satisfactory for normal receiver operations, would be unsuitable for V.T. voltmeter operation, due to excessive grid current. In selecting a 6F8G for use in such a circuit as that of Figure (2), a tube should first be selected which shows balanced emission on both triode sections using a normal tube checker. The circuit may be roughly wired up on an old chassis, as in Figure (2), using for R1 a 10 megohm or 5 megohm resistor. After the circuit has warmed up and R4 has been balanced for zero meter deflection, the change in meter reading on shorting out R1 should be only a fraction of a meter division. On using a 2 megohm resistor for R1, the change on shorting out R1 should be impossible to detect. If this is not the case, the valve is unsuitable for V.T. voltmeter operation. Luckily, most tubes are satisfactory, and it will probably be only a case of first selecting a valve that gives balanced triode emission on your dealer's tube checker. In any case, don't break the carton seal

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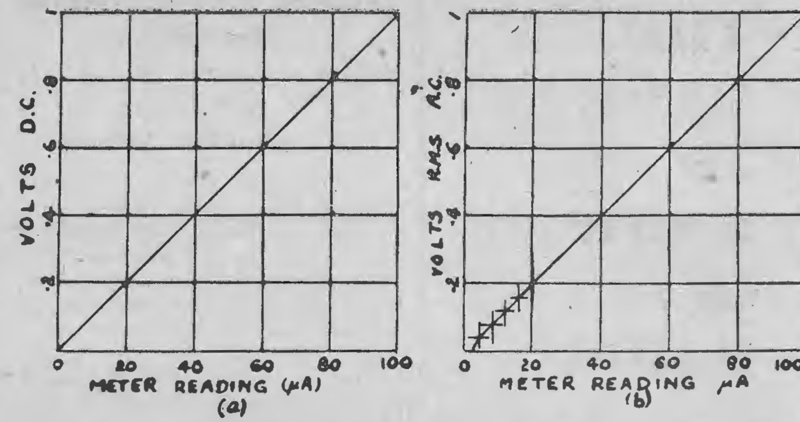

FIGURE (5) Calibration Curves (a) D.C., (b) A.C.

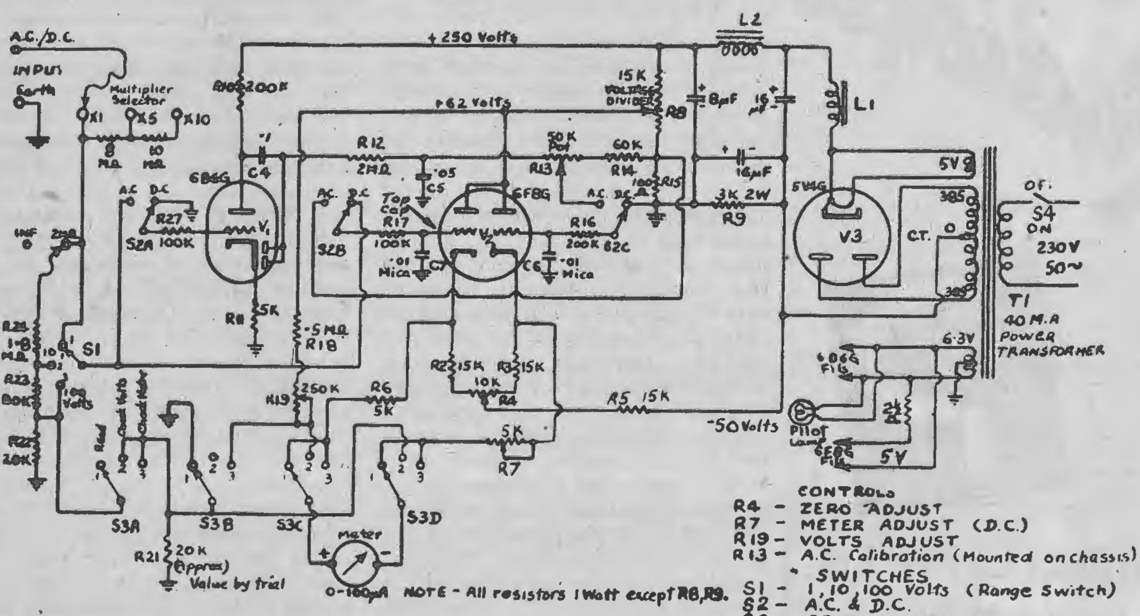

FIGURE (4) Circuit Diagram of Linear A.C./D.C. V.T. Voltmeter.

VACUUM TUBE VOLTMETER

(Continued)

until you are satisfied that the valve is suitable.

A.C. Vacuum Tube Voltmeter

For the A.C. section, it was decided to use a diode rectifier preceded by a stabilised audio amplifier, and to use the D.C. voltmeter to measure rectified output from the diode. There were several reasons for the choice of this rather novel circuit arrangement. The prime reason was the linearity of a diode at relatively large applied A.V. voltages. Large voltages are made possible by using a preceding amplifier, and the latter also acts as a buffer and ensures a high input impedance. A 6B6G using negative current feedback is capable of reasonably constant amplification for normal supply voltage variations, and is sufficiently linear, when used under suitable operating conditions. The only result from grid contact potential effects is to slightly shift the operating grid bias, which would produce a negligible change in the amplification. The complete circuit arrangement is given in Figure (3). It will be noticed that the **negative** voltage output from the diode rectifier is measured by applying a fraction of it to the second grid of the 6F8G.

Built-in Calibration Check

The principal objection (and a fairly sound one) to the use of a vacuum tube voltmeter is that there is always a certain measure of uncertainty as to the reliability of calibration. This is often overcome by frequent checking of the meter calibration, in cases where accurate calibration is desirable. If a voltmeter is inherently linear, calibration can only change in terms of overall sensitivity, and this may be checked sufficiently at full-scale deflection. Accordingly, it was decided to take advantage of the linearity inherent in this meter to provide a built-in calibration check for quick and simple checking of calibration. This is admittedly a refinement, but it was considered worthwhile by the writer on the grounds of the added certainty provided. However, if desired, this section of the circuit could be omitted, and a reasonable degree of constancy may be expected, due to the negative feedback used in the circuit of both A.C. and D.C. voltmeters.

Figure (4) shows the complete circuit, also including the range selector switch and multiplier selector. It will be readily seen that the high voltage ranges are provided by tapping down on a high resistance potentiometer network placed across the voltage under test. A wide range of voltages is covered by using a range switch and an additional multiplier selector, multiplying factors being selected by a plug-in selector. Of course, if preferred, these factors could be selected by a Yaxley type three-position switch. An additional plug-in selector makes it possible on the 1-volt range to connect the voltmeter input grid direct to any circuit being measured without any shunting by the voltmeter grid resistors. Where it is desirable to have the highest possible input resistance and the least possible disturbance of the tested circuit (such as, perhaps, a test on an A.V.C. or similar circuit), this provides the means for doing so.

Range Selector

Referring to Figure (4), it will be seen that when the ganged switch S3 is in position (1), the circuit is identical with that of Figure (3), apart from the range selector switch and associated circuit. This is the "READ" position of S2. In position (2), 62 volts is applied through resistors R18 and R19, the microammeter and the parallel resistors R21 and R22. After R19 has been adjusted for full-scale reading, 1/10th m.a. should flow through the 10K combination of R21 and R22, thus producing 1 volt drop. This is the "CHECK VOLTS" position of Switch S2. In position (3), the microammeter is returned to the cathode circuits of V2, and the 62 volts is applied through R18, R19 to R21 and R22. Thus, if R19 has been previously adjusted in position, "CHECK VOLTS," there should now be very nearly 1 volt applied to the grid of V2. If the V.T. voltmeter is in correct calibration, it should now give full-scale deflection. This is the "CHECK METER" position of switch S2. If the V.T. voltmeter has been already calibrated against a standard D.C. voltmeter, it will probably be found that full-scale deflection is not exactly the same in both these cases. The cause

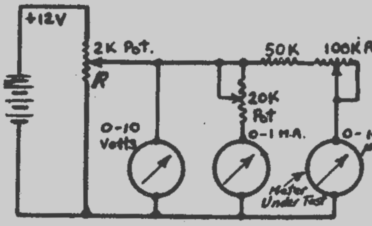

FIGURE (6) Linearity Check

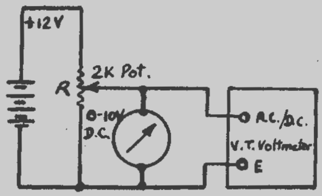

FIGURE (7) D.C. Calibration

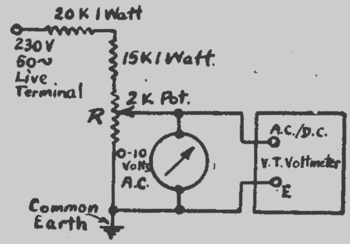

FIGURE (8) A.C. Calibration.

of this is that very few commercial microammeters read exactly 100 microamps full scale when purchased. Similarly, if R21 and R22 differ from their marked values, the same result would be obtained. The method of cure is the same in either case. Temporarily hook-up a 50K potentiometer in place of R21, and this may be adjusted until full-scale deflections are obtained in both positions (2) and (3) or S2 (the V.T. voltmeter having been previously calibrated against a reliable voltmeter and a suitable voltage source). The 50K potentiometer can now be replaced by a set of fixed resistors having the same **measured** value. An alternative, though less refined, method would be to place a check mark on the meter dial for either "CHECK VOLTS" or "CHECK METER," whichever gives the smaller reading, the other being set to full scale reading.

Meter Safeguarded Against Excessive Overload

Adequate filtering has been provided in the grid circuits of V2 to prevent disturbance by unwanted A.C. components, and the effect on the meter in operation is that it appears just nicely damped. The grid stoppers R16, R17, R27, prevent damage to the valves V1 and V2, due to accidental application of a higher voltage than the selected range. The maximum unintentional overload that can be applied to the meter itself is limited to about 10 times full scale indication, i.e., about 1 milliamp. This is insufficient to damage a normal meter when applied for a short period.

Power Supply

A normal 40 m.a. power transformer is used in conjunction with a 5V4G rectifier and a two-section choke input filter. The current drain should not exceed 20 milliamps, so that almost any small chokes or old audio or speaker transformers could be used for filtering. If the latter were used, the type intended for single-ended operation with a pentode would be the most suitable. One is almost certain to find something suitable in the junk box. It will be noticed that the 5 volts for the 6F8G filaments is obtained by inserting a 2½-ohm resistor in series with one of the filament leads to the 6F8G. In the writer's case, this resistor was made up of the required amount of 24 S.W.G. nichrome wire (20 S.W.G. Eureka wire will do), wound around an old IRC resistor, the end connections being made by fitting small brass clamps over each end. Pigtails were wrapped around and soldered to each clamp. A lighter gauge of resistance wire to that quoted should not be used as it will overheat, and much heavier will result in too great a length of wire being needed. An alternative would be to use a second 50-volt or 4½-volt winding (if available on the transformer) to supply the 6F8G, or if a second 6.3-volt winding is available, a few turns could be removed from this winding to bring the voltage down to 4½ to 5 volts.

Layout

A fair degree of latitude is permissible in the layout. Figure (9)

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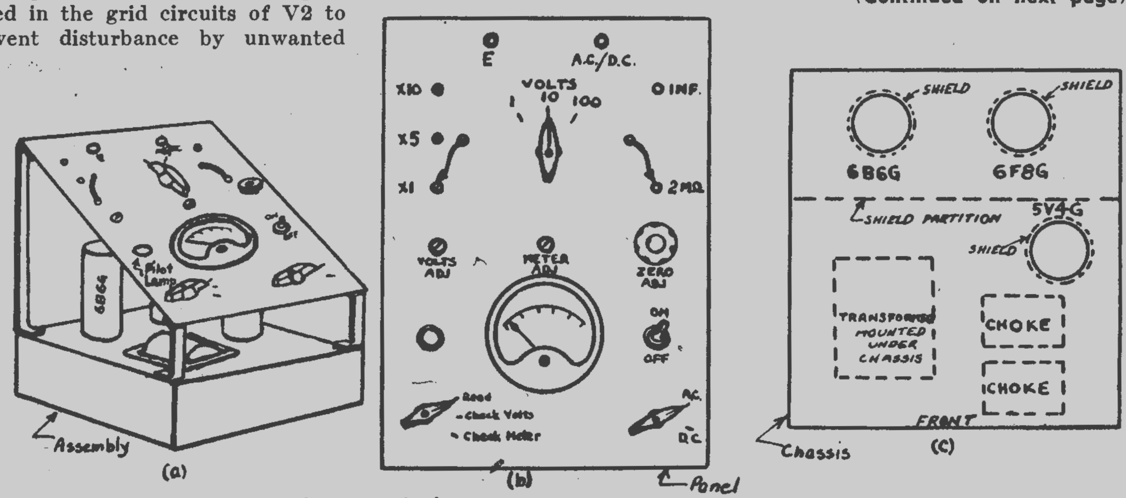
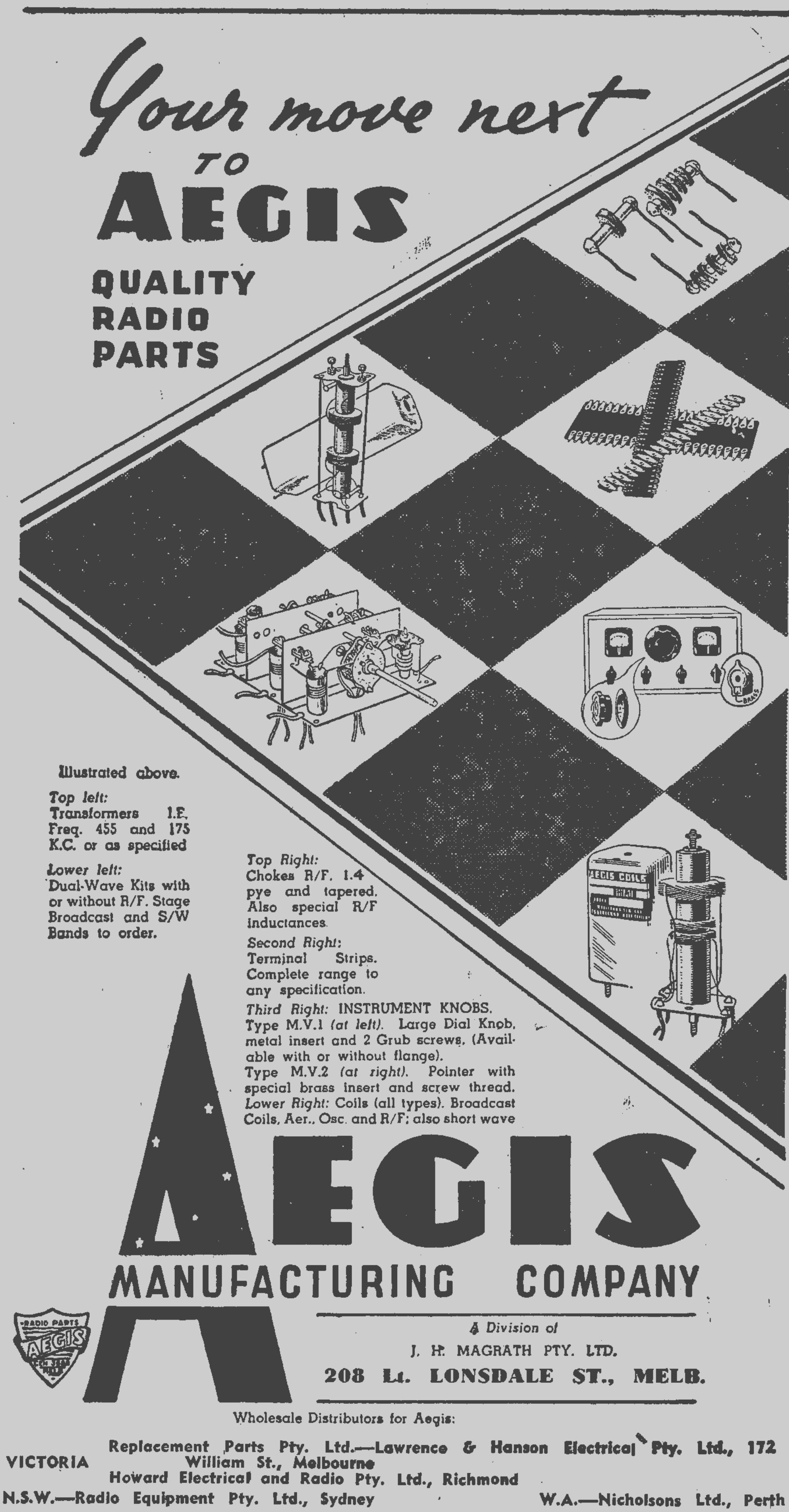


FIGURE (9) LAYOUT



VACUUM TUBE VOLTMETER

(Continued)

shows the type of layout used with satisfactory results by the writer. Shielding of the power supply section and the unit as a whole, and the use, if possible, of a non-magnetic material for the chassis are desirable, to prevent unwanted effects from stray A.C. pick-up. It will add little to the cost to place cans around all three valves (home-made cans will do quite well), and greater freedom from pick-up and greater guarantee of satisfactory operation will be the result.

If the base chassis is made deep enough to mount the transformer underneath, this will provide more room for the meter and switches above the chassis. The filter chokes and condensers should also be mounted below the chassis and kept reasonably clear of the valves V1 and V2. It is a good plan to put a metal partition across the underside of the chassis to still further screen the voltmeter section from the power supply section. The whole unit should be placed in a metal-lined box to prevent stray A.C. pick-up. It is necessary to cover in the underside of the chassis, and the panel itself should be made of metal or should, at least, be metal-backed. Pick-up of R.F. from the mains is minimised by connecting two .01 mica condensers between each side of the 240 volts mains input and chassis.

The 50K A.C. calibration potentiometer R13 may be mounted on the base chassis, since it should not require regular adjustment.

Calibration

A.C. and D.C. calibration curves of the instrument are shown in Figures 5 (a) and 5 (b). It will be seen that calibration is completely linear on D.C. and linear over the useful range on A.C. The calibration should follow that of the two curves, provided the zero adjustment is made on the D.C. position and not altered on switching to A.C. The meter should give a small reading of about 2.6 microamps. for zero A.C. input. The 100-ohm resistor R15, by applying a small positive bias to the diodes of V1, is of assistance in reducing the errors at low-scale readings, as this compensates

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CONTINENTAL DESIGN

A Provocative Criticism of Australian Trends

LOOKING through one of our trade periodicals, my interest was aroused by an advertisement for I.F. transformers using for the first time in Australia the "pot core," which, according to the quite believable claims of the advertisers, give about double the efficiency (Q-factor) compared with coils of similar inductance using the standard cylindrical cores. This advertisement is certainly symptomatic; simply, because it appeared in Australia in 1944, while on the Continent the pot core was generally used by progressive radio designers as far back as 1937 or even 1936!

On Wrong Track?

This is not so much a symptom of backwardness as it indicates the fact that most of Australia's radio manufacturers have up to now been backing the wrong horse, called U.S.A.; for there are two distinctive schools of radio designing: the American and the European. Everybody knows how cheap receivers are in U.S.A. A set worth £25 in Australia could be obtained for about 10 dollars in America, the price including a complete set of spare valves! It is therefore only natural

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Bondi, N.S.W.

that any desired improvement of a set's performance is simply achieved by adding another valve and I.F. transformer for the cost of an extra dollar or two. This is also most likely the reason for the little attention the pot core has been receiving in "the States" up to now, although much work has been done by American scientists in that direction.

Valve Costs

The position on the Continent is entirely different. There, valves and other components cost about as much as in Australia and selectivity and sensitivity have to be gained by increasing the efficiency of valves and coils to keep the price of the receiver down. The performance of a good continental 4-valver is therefore almost equal to the average American 5-"toob" set.

And now let us have a look at the conditions in this country. Prices of radio sets are equal to those in Europe, yet, as mentioned before, they are entirely built the American way. Here, the American valve is the accepted standard in spite of their inferiority to the continental types (see valve charts).

Loss of Selectivity

The low-plate resistance of the R.F. types, especially of the pentagrid converters, have a considerable damping effect on the following tuned circuits, thus decreasing selectivity and gain. Certain continental types like the EK2, EBF2, EL3 are being used by some manufacturers, and they are about the only indica-

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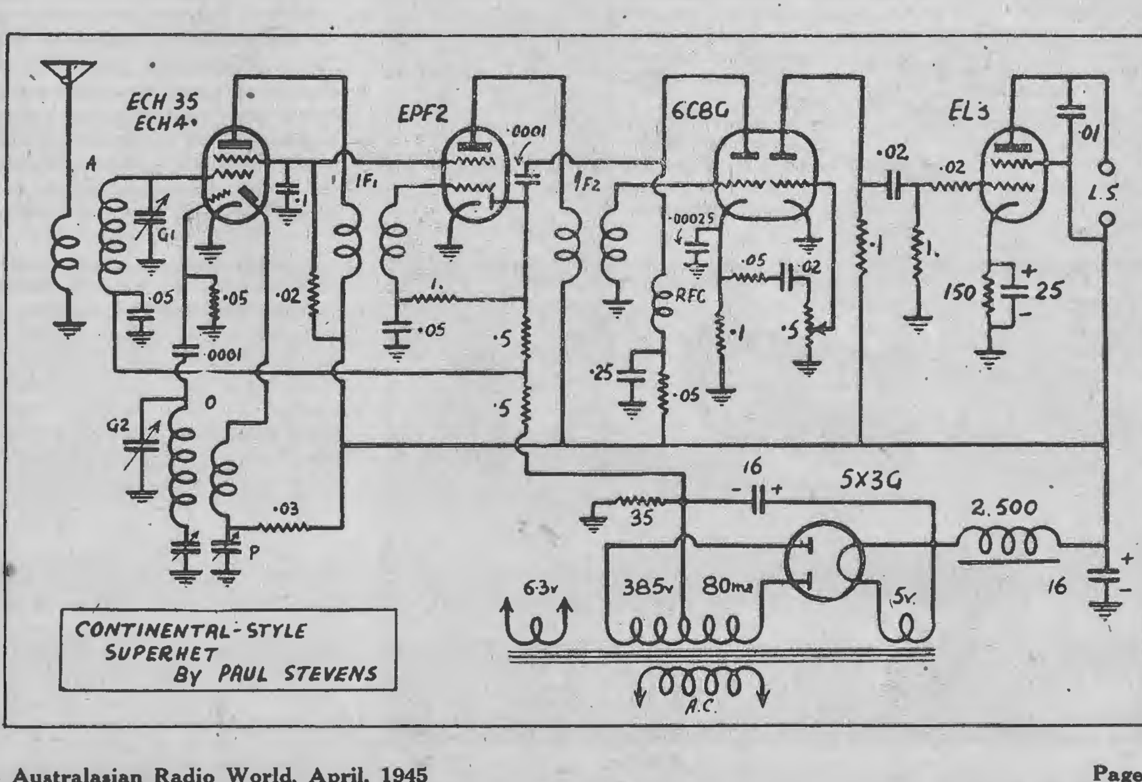

CONTINENTAL DESIGN

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tion of European influence on Australian radio designing.

Coils and I.F. transformers are strictly American. No real attempt seems to have been made to increase their efficiency, and the adjustable iron core of the conventional types is more intended as a means of tuning than to increase the Q factor; for there is hardly any difference between the ohm's resistance of these coils and the old trimmer tuned air-cored types, and therefore the Q-factor, a direct function of the loss resistance, could not be much different either.

To sum up, we find that the average Australian receiver built to American principles is comparatively highly priced, its efficiency impaired by medium gain valves and by the use of indifferent coils and I.F. transformers.

Continental valves are being manufactured in Australia and are available at the same price as American types, and the manufacturing costs of pot cored coils and I.F. transformers should not be much higher than the costs of our present ones. I cannot, therefore, see any technical reasons why they should not be introduced in this country and accepted as a new high standard by Australia's radio industry.

The real reasons why this has not been done are probably certain big business and trade interests, which, as so often before, stood in the way of development and progress, but, as I intend to keep this article strictly technical, I do not want to discuss this matter any further. (To the Editor: Please leave this part out, if you do not think it suitable for publication.)

A Suggestion

Let us now design a receiver according to this proposed New Order of efficiency, in other words, we will try to get maximum gain and selectivity with a minimum number of valves. Fig. 1 shows the circuit diagram.

The aerial coil is pot cored to get the highest possible gain before the converter valve and so decrease the noise level of the receiver on weak stations much more efficiently than the conventional types. For broadcast alone, the new iron-cored loop aerial might be very commendable.

The Converter

Now to the converter stage. Here we have several valves to choose from: Pentagrid converters have high conv. conduction, but low plate resistance and high noise level; the triode heptode 6Y8G is excellent for plate resistance and noise level, but the conversion conductance is very small. 6K8 and 6SA7 are both just converters with medium conductance and plate resistance. So we do not seem to get very far with American valves. Now for the available continental types: There is the well-known EK2 octode. Its conv. conductivity is as high as the pentagrid converter's (550 mmhrs) but the plate resistance is nearly 6 times as high (2 megohms) and the noise level very low. Its disadvantage: frequency shift on short waves when A.V.C. is applied. Then we have the ECH35 and ECH4. They are triode hexode, respectively, triode-heptode types, very stable on short waves, and their conversion conductance is still higher than the EK2's (650, resp. 750 mmhrs.). Figures for the plate resistances are: 1.3, resp. 1.4 megohms, still about 4 times as much as the 6A8G. Their noise level, according to information from the manufacturers, is low in spite of the comparatively high plate and screen current, due to special design of the grids (?). So the issue is pretty simple: for the broadcast it is just a toss-up between EK2, ECH35 and ECH4, while on short waves only the latter two should be used. Well, working A.V.C. is absolutely necessary on short waves. The EK2 is therefore out of the question. Even to ECH35 or ECH4 only half the available A.V.C. voltage should be applied (see Fig. 1) as these valves, too, show a certain amount of frequency shift.

The oscillator coil can be of conventional type, but a pot core would decrease its size quite considerably.

High-gain I.F.

The converter stage is followed by a pot core high gain I.F. transformer. This sort of iron dust core (Fig. 2), which completely encloses the coil, forms an easy path for the magnetic lines of force, thus reducing the number of turns required for a certain inductance; but less turns mean less ohmsic resistance and therefore higher Q-factor. The two pots of the primary and secondary have to be brought rather close together to get the necessary coupling between them.

The I.F. valve is chosen according to the same principles as the converter: transconductance and plate resistance. We again find in both respects all available American valves inferior to their continental equivalents, and so we choose the EBF2 a diode super control pentode, which suits our purposes to perfection.

Detector Damping

We are coming now to the problem child of the radio designer, the second I.F. transformer. The diode detector, which usually follows it, is a rather big load for it, and the resulting damping effect makes the secondary almost useless as far as its contribution to the selectivity of the set is concerned. By tapping it or giving it less turns than the primary, matters can be considerably improved in that respect, but these methods bring about a loss of gain instead. The common practice of feeding the A.V.C. diode from the primary to get higher regulating voltage makes it still worse. It is, therefore, usually the first I.F. transformer which bears the brunt of the task of making the receiver selective. Here in Australia we have up to now been satisfied if we were able to listen to our metropolitan stations and nobody seemed to have worried when each one of these blotted out at least two other stations (one on each side) through lack of selectivity of our average sets. On the Continent, however, a good radio set is expected to give a clear background-free reception, even with a strong station only 10KC "away." Before the development of the iron core, those receivers depended on low I.F. frequency (110-150KC) to get the required selectivity, together with the "flat top" characteristic which reduces the otherwise bad side-band cutting (attenuation of high audio frequencies).

Infinite Impedance

To get high selectivity without sacrificing gain in the second I.F. transformer, I used a different sort of detection, the "infinite impedance" detector. It consists of the one section of the 6C8G, which has its grid connection on top of the valve, while the other one serves as audio amplifier. The I.F. choke in the plate circuit of the detector valve (see Fig. 1) gives a certain amount of amplification of the I.F. voltage, which is fed to one diode of the EBF2 for amplified A.V.C. The amplification here depends entirely on the cut-off characteristic of the detector valve. A 6J7G or 6C6 valve, for instance, if used in the same way, works all right as demodulator, but there is no I.F. amplification; the signal in the plate circuit being actually weaker than in the grid. (I have incorporated this detector circuit using a 6C8G in the sanatorium receivers of the Queen Victoria Homes, Wentworth Falls. Station 2KA, which is less than 3 miles away, and 2BL, Sydney, adjacent to it on the dial, came in with exactly the same volume at daytime! This is to show how well the amplified A.V.C. works!).

By this method we have made the 2nd I.F. transformer as effective as the first, and it is now easy for the designer to juggle coupling and inductance of the coils till he gets the best possible flat-top selectivity and amplification.

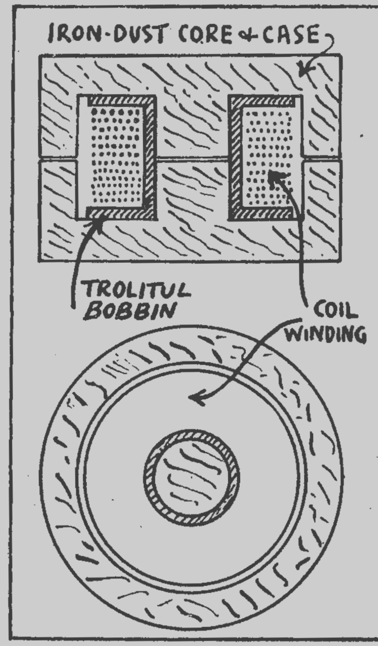

Fig. 2

The infinite impedance detector is nothing but an anode bend detector with 100 per cent inverse feedback applied by taking the audio signal off the cathode, the plate being directly connected to a high "B" voltage. It does not place any load on the preceding tuned circuit and is the best detector known to date, being even superior to the diode for its freedom of distortion.

The high transconductance of the EL3 output valve compensates for the lower gain of the 6C8G, which, however, is the best available valve of its kind.

Tone Control

No tone control is shown in our diagram, and its incorporation and design could be left to the discretion of the individual designer.

The rather square selectivity curve of our set will, of course, attenuate the high audio frequencies very badly, but as at least 9 out of 10 listeners manifest their dislike for them by turning the tone control to the "mellow" position to cut them off, this could hardly be called a disadvantage. The higher selectivity also causes a marked decrease in static interference, and people will start to listen to country and interstate

(Concluded on page 34)

CONTRAST WITHOUT DISTORTION

THE average radio man, when checking a piece of audio equipment he has constructed, is content to make a frequency run with an audio oscillator and output meter (or scope), and then to make a distortion check at one or two fired frequencies. After completing the necessary calculations to a couple of decimal places, he is then inclined to state, categorically, the frequency range and distortion for his equipment, in black and white.

By
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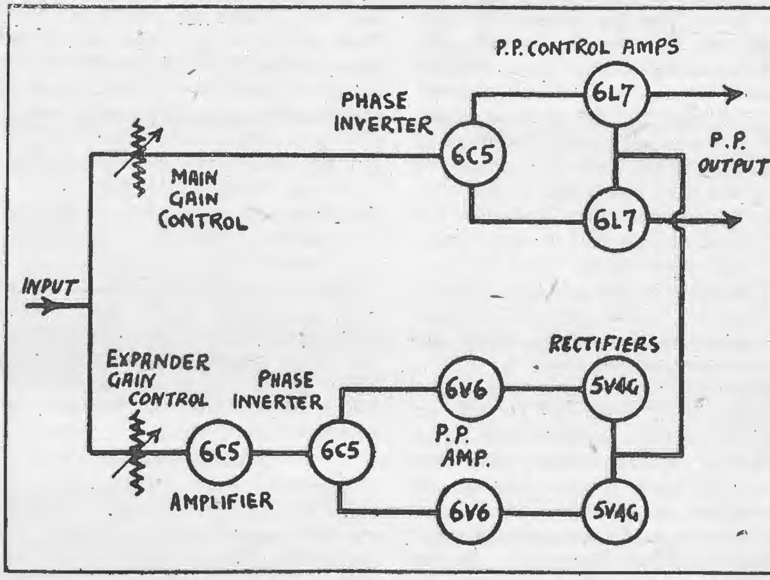
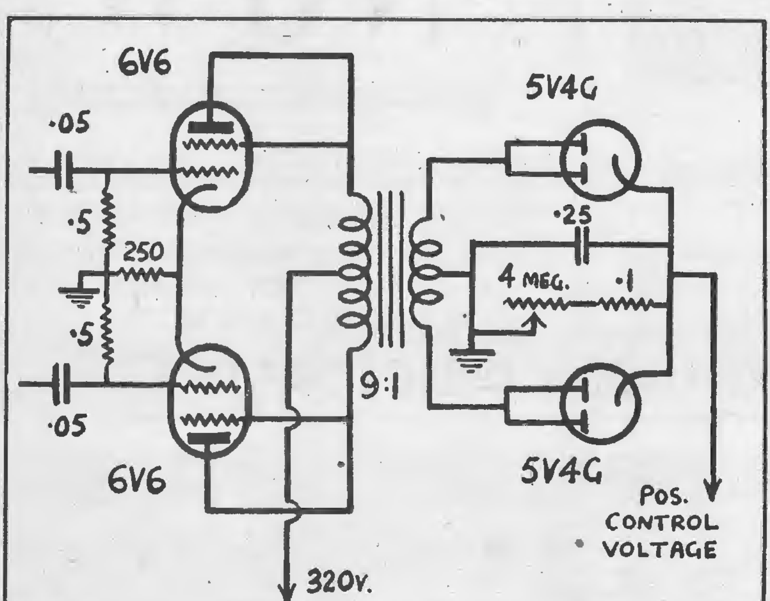


A fellow enthusiast, reading a description of a so-called "wide-range, low-distortion" amplifier, is tempted to build one. The decimal points seem to assure the would-be constructor of the validity of the performance claims. Unfortunately for his efforts, however, in many instances the audible results are not what he was led to expect from the figures quoted; although, if the original measurements were repeated on his home-constructed amplifier, the designer's results would almost certainly be duplicated.

The fault, strangely enough, lies in the method of measurement employed by the original constructor of the equipment.

Until a few years ago, it was customary to use a sine wave audio signal generator source to check frequency response and distortion. The modern trend is quick and accurate, and employs either a saw tooth or square wave of variable frequency, as a signal source, instead of a sine wave. The equipment has then to handle a number of frequencies simultaneously (as in actual use), rather than a single frequency. Intermodulation distortion and spurious oscillations which are not revealed by the older method of testing, and which are so objectionable to the ear (and difficult to track down) can then readily be detected. Thus audio systems which apparently test satisfactorily, may have objectionable features which cause the home constructor to lose faith in the amateur designer.



Contrast Expander

An example of this is the contrast expander, also referred to as a volume expander. Unless proper dynamic tests are made on an expander amplifier stage, any measurements of distortion level should be viewed with suspicion.

Two fruitful sources of distortion which are overlooked by experimenters are mentioned hereafter. It is felt that many of the objections raised by those who have listened to early models of expander amplifiers would be quickly dropped, if the distortion introduced by the expander action was reduced. It is therefore recommended that those who have felt dubious of the merits

(Continued on next page)

CONTRAST

(Continued)

of the contrast expander, construct one embodying the suggestions outlined, and note the results obtained.

It is necessary that push-pull expander tubes (with the signal fed in push-pull to the control grids, and the expander control voltage in parallel to the injector grids) be used for the following reasons:

(a) Even harmonic distortion is cancelled by virtue of the push-pull connection.

(b) Unwanted signals from the expander rectifier circuit are cancelled in the output circuit due to the parallel feed.

Further, to avoid another source of distortion common to all expanders with a symmetrical "rise-and-fall" characteristic, the rise should be made fixed, while the fall should be made adjustable to suit the character of the speech or music being amplified. Preferably the rise should occur instantaneously and the fall should be variable from 25 milli-seconds to 1 second.

In the circuit shown, the delay in the rise is approximately 200 micro-seconds, according to calculations, and the fall is as mentioned above, as being satisfactory.

The rapid rise in expander control voltage is achieved by reducing the resistance in series with the reservoir condenser, thereby reducing the condenser charging time. This resistance is made up of the internal resistance of the diode plus the plate resistance of the amplifier tube feeding the diode. This reduction is made in two ways:

(a) By using a low impedance diode (e.g., a power rectifier).

(b) By using a low plate impedance triode amplifier, transformer coupled to the diode.

Suitable diodes in the order of preference would be the 5V4G, 25Z5 and 6X5 (or their equivalents). To bring the diode internal resistance down to a sufficiently low value, it is desirable to use two rectifiers in parallel.

Suitable Valves

Suitable amplifier tubes would be the 6V6 and 6F6 (triode connected) or their equivalents. To reduce core saturation, the use of push-pull amplifier tubes is recommended. Little further advantage would accrue if the triode amplifier stage were connected as a cathode follower to reduce the reflected resistance to a still lower value, as the diode internal resistance is the governing factor, it being several times larger than the resistance of the amplifier stage, viewed from the secondary side of the coupling transformer.

A block diagram, showing one way of employing this amplifier-rectifier combination in conjunction with a typical audio amplifier, is also presented. No values of components are shown, as the individual will probably wish to incorporate these suggestions into an existing amplifier, rather than build one specially for the purpose.

For Radio Use

Should this expander amplifier, shown in block form, be used with a radio tuner, it will be desirable to use a cathode follower stage between the diode detector load and the audio amplifier input, thus improving the AC/DC ratio of the diode load, and thereby removing a source of modulation distortion.

For guidance, details of the construction of the coupling transformer are appended. The turns ratio is based on the assumption that a maximum voltage of approximately 14 is required to obtain full expansion from the controlled tubes. In any particular instance, the turns ratio can be varied to suit the tubes employed as expander amplifiers (6L7 or 6K7, etc.), as well as their

(Concluded on page 29)

ÆGIS COMPONENTS DO WAR JOB

FACTORY EXTENSIONS AT MAGRATH PTY. LTD.

The steady upward curve denoting the progress of J. H. Magrath Pty. Ltd., the well-known wholesale house, of 208 Little Lonsdale Street, Melbourne, is a tribute to the vigorous and capable direction of Managing Director James ("Jim") H. Magrath, who has consistently followed a policy of keen service and courteous assistance to his wide clientele.

Recently more floor space was acquired to accommodate additional plant in the manufacturing section where Aegis products are made, and today we find this company, which commenced business not so very many years ago, occupying a prominent place in the trade in the Southern State.

Aegis components are very well known for their quality, being of robust construction and built of high-grade materials. The range includes Dual-Wave Kits, I.F. Transformers, Broadcast and Short-wave Coils, Permeability Iron Core Coils (incorporating all the latest developments) and all types of special R.F. equipment.

As may be expected, much of the output of this company is taken up in supplying the requirements of Defence Departments, which have placed extensive orders for products which cannot, for obvious reasons, be described here, but, despite the understandable difficulty in supplying fully the requirements of customers, Magrath and Co., to use the words of the managing director: "We do our very best to meet the demands and very often go to no end of trouble to help out our clients, and what's more we are glad to do so; our efforts never go unappreciated."

Technical schools also are numbered among the clients who are extensively using Aegis products.

Valuable Agencies

Magrath and Co. are sole Victorian Factory Representatives for Radio Equipment Pty. Ltd., Sydney, manufacturers of many types of testing equipment, meters and other lines; Commonwealth Moulding Co. Pty. Ltd. (Marquis Mouldings), Britannic Resistors and Ultimate lines.

They are also distributors for Rola loudspeakers.

At left: Portion of one of the assembly lines at the Magrath factory. Aegis coils and I.F.'s being made.

At right: Drilling in the machine shop; beyond is one of the test rooms.

Below left: Aegis coils and I.F.'s are wound on machines like the one being used here. Right: The despatch room always presents a busy scene like that pictured below.

A SHORT COURSE IN RADIO

Inductance and Capacity

FARADAY discovered and proved experimentally that a varying magnetic flux would induce an EMF in a conductor under its influence.

Figure 21 shows the circuit of Faraday's experiment and can be seen to consist of an iron ring around which two coils of insulated wire are wound, one of these coils is connected, through a switch to a battery, while the other is connected to a sensative galvanometer.

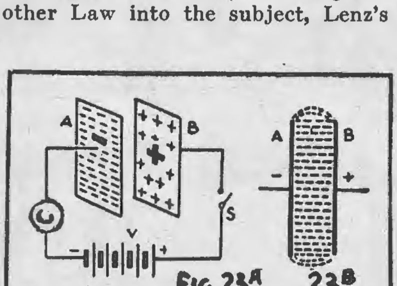
When the switch, in the primary circuit, is switched on a momentary flow of current is indicated in the galvanometer connected in the secondary circuit; when the switch is opened a momentary flow will again be indicated by the galvanometer but in a direction opposite to that previously.

Induction

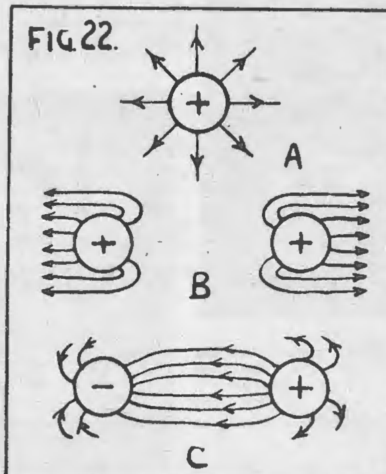
The results of this experiment are important and are that, while the primary current is growing, an EMF is induced in the secondary, and while the primary current is decaying EMF is again induced in the secondary but in the opposite direction. Other experiments have also confirmed this result from which we are able to deduce that whenever the magnetic lines of force threading a circuit changes, an EMF is induced in the circuit.

We have already learnt that if a current is passed through a straight wire, a magnetic field is set up surrounding it; this field may be greatly strengthened by winding the wire in the form of a coil or solenoid as seen in Figure 15 (b).

It is now necessary to bring another Law into the subject, Lenz's Law, which, stated simply, says: "Induced EMF's act in such a direction as to oppose the force to which they are due."



We will now return to our coil, which is now fitted with an iron core and connected in series with a battery and switch: when the current is switched on, magnetic lines of force will build up quickly in the core; according to Faraday's experiment the varying magnetic field will induce an EMF in the coil and by Lenz's Law this EMF will be in an opposite direction to that applied by the battery. This type of induction

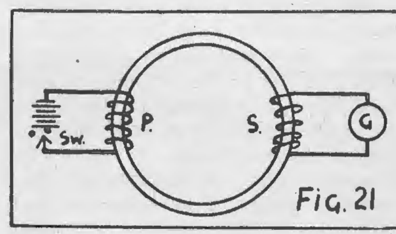


which is caused by the change of current in the circuit itself is known as "Self induction."

This self-induced EMF will act in a direction that will oppose the force to which it is due, a decreasing current will give rise to an EMF acting in the direction of the applied current, which will tend to prevent the decrease.

The duration of these inductive effects occupies only a very short time, and may only be in the order of thousandths of a second.

A useful analogy which will help beginners to understand the meaning of inductance is the flywheel. Just as inductance resists the action of an applied EMF in setting up a



magnetic field, so the inertia of a flywheel hinders the force that is applied to set it in motion.

Also, just as the effect of inductance is to delay the decay of an EMF after the circuit has been broken, so the energy stored up in a flywheel in motion tends to keep it going when an effort is made to stop it.

Self inductance or, as it is more commonly referred, "inductance" is the ability of a circuit to oppose changes in the value of the current passing through it.

The voltage induced by the self-inductance is commonly referred to as the "back EMF."

Iron, and certain other alloys, have a high value of permeability, so an iron core within a coil will greatly increase the intensity of the magnetic field, thereby increasing the inductance of the circuit.

Unit of Inductance

The unit of inductance, which is usually designated by the letter "L," is the henry. It can be defined as the inductance present if the current changing at the rate of one amp per second, in a circuit, induces an EMF of one volt in it.

In radio work the henry is a suitable unit to use for specifying the inductance of iron-cored components such as smoothing chokes and audio chokes. It is, however, far too large for other purposes, such as giving the inductance of radio frequency coils or chokes, and so the millihenry (one thousandth of a henry) or micro henry (one millionth of a henry) are used.

As typical examples, an ordinary filter choke for H.T. smoothing purposes has an inductance in the neighbourhood of 30 henries, while

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the secondary winding of a tuning coil to cover the broadcast band may have an inductance of about 300 microhenries.

Mutual Inductance

If the current flowing through a coil is such that it produces a varying magnetic flux in such a direction it will cut the turns of another coil, a current will be induced in this second coil; this induced current will be varying, so will therefore induce another current back in the first coil. This process is called "mutual induction" and the two coils are said to possess "mutual inductance."

Mutual inductance between two circuits can be easily altered by varying their relative positions.

The formula for calculating mutual inductance, when the magnetic fluxes of the two coils are assisting one another, is $L = L_1 + L_2 + 2M$, where M is the mutual inductance; if they are placed so that their poles oppose each other the formula then becomes $L = L_1 + L_2 - 2M$.

As with self inductance, the unit of mutual inductance is the henry; two circuits have a mutual inductance of one henry if the EMF in one circuit is one volt when the current is changing in the other at the rate of one amp per second.

Inductances in Series and Parallel

Inductance coils can be connected in series, parallel or series-parallel, and providing there is no mutual coupling the resultant inductance is calculated exactly as it would be for resistances similarly connected, with, of course, the proper inductance values substituted for resistance values.

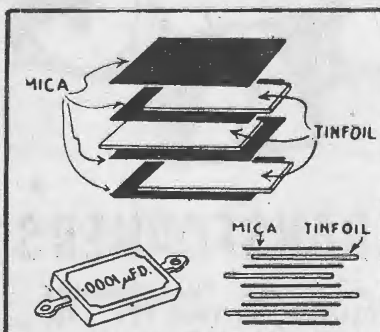

FIG. 26A.

Thus, the total inductance "L" of two coils connected in series, having inductance values of "L_1" and "L_2," is given by the formula:

$$L = L_1 + L_2$$

If the coils were connected in parallel, the value of "L" would be given by the formula:

$$\frac{1}{L} = \frac{1}{L_1} + \frac{1}{L_2}$$

Inductive Reactance

We have seen how a coil offers an opposition to an alternating current by developing a back EMF. This opposition or "impedance" offered to an alternating current of given frequency by an inductance is called its "inductive reactance" which is represented by the symbol "XL."

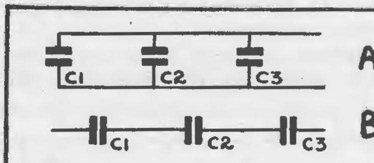

FIG. 24

$$XL = 2\pi fL$$

where XL is the inductive reactance in ohms; π is 3.14; f is the frequency in cycles; L is the inductance in henries.

It will be noticed that the inductive reactance is expressed in ohms; this is due to its effect being similar to a resistance, but it should be noted that reactance reduces the current by producing an opposing EMF, so therefore controls alternating EMF without waste. Resistance dissipates energy in the form of heat.

Some Practical Examples

As an example, take a smoothing choke rated at 20 henries. It might have a D.C. resistance of 250 ohms, but this is negligible compared with its impedance to a 50-cycle alternating current, which we will presume is the frequency applied;

$$XL = 2\pi fL$$
$$= 2 \times 3.14 \times 50 \times 20 \text{ ohms}$$
$$= 6{,}280 \text{ ohms.}$$

We can see that, if the frequency is doubled, the impedance is doubled too.

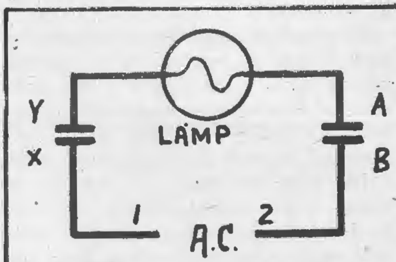

FIG. 25.

Again, an RF choke with an inductance of 250 milli-henries might have a D.C. resistance of 300 ohms. Its impedance to an alternating current of 1,000,000 cycles per second (1 megacycle) will be calculated:

$$XL = 2\pi fL$$
$$= \frac{2 \times 3.14 \times 1{,}000{,}000 \times 250}{1{,}000}$$
$$= 1{,}570{,}000 \text{ ohms.}$$

It will be noticed that we divided the formula by 1,000; the reason is that the inductance must be converted from milli-henries to henries.

If an audio frequency of 1,000 cycles were applied to the same choke the impedance would be only 1,570 ohms.

These examples show one important use of inductances in radio, in that an inductance coil or choke can be designed to provide an easy path for direct current, while offering considerable resistance to alternating currents. Again, by using a smaller inductance value, a negligible impedance will be offered to low frequency alternating currents, but a high impedance to currents of high, or radio, frequencies.

Practical Inductances in Radio

In receiving circuits, disregarding the power supply, the voltages and currents are small, so that the insulation need not be very great, so the inductances can be made very compact.

In the low power stages of a transmitter, inductances may be of similar construction to the receiving type. As soon as the power is increased it will have large currents flowing and large voltages induced across them. Sometimes these coils

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are of copper tubing with well-spaced turns and with a high order of insulation.

The inductance of a coil may be varied over a range with a device known as a "variometer"; this consists of two coils connected in series and mutually coupled, and constructed in such a manner that their fields may be made to oppose or assist each other. When in one position the windings of the coils will be in such a direction that the field produced by one may nearly cancel all the field caused by the other, and in this position the effective inductance of the two coils is minimum. If one coil is rotated 180° the two fields will assist each other so the inductance will be maximum. The inductance is continuously variable between these two points and will depend on the position of the axis of one coil to the other.

Until about 1933 all tuned receiving inductances were made with air cores, as the losses due to eddy currents and hysteresis, at radio frequencies, in iron cores is very great.

A special type of iron core is now utilised in some types of R.F. coils; this core is made up of powered iron; each particle of iron is first treated with an insulator, so that when made up into a core they will be insulated from each other, which makes it practicable to use these cores at radio frequencies.

Skin Resistance

When D.C. flows through a conductor, all of the cross-section provided is used; alternating currents tend to flow on the surface of the conductor and the higher the frequency the more marked is this tendency. A circuit with a D.C. resistance of 5 ohms may offer a resistance of up to 50 ohms for high-frequency currents because it is forcing itself to the surface, thus making use of only a very small section of the conductor, which is in effect, reducing the cross-section available for the current to flow through. This resistance is known as "skin resistance."

Efforts are made to overcome the skin resistance by increasing the available surface area; if tubing is used, both the inside and outside surfaces are used by the high-frequency A.C. to flow through.

"Litz" wire is also another method that assists in increasing the surface area of a conductor which consists of a number of thin insulated wires braided together.

Electrostatics

A "charge" of positive or negative electricity may be isolated by friction and experiments to prove this are simply carried out.

If a piece of amber is rubbed on silk it will lose some of its electrons to the silk and so in this state will possess a positive charge. If a piece of sealing wax is rubbed briskly on a piece of flannel it will acquire electrons from the flannel; if the sealing wax is brought in the vicinity of the amber they will attract each other and, generally, follow the same laws of attraction and repulsion as magnetism.

The electric field around an isolated electric charge is shown in Fig. 22 (a) and can be seen to be radial. Figs. 22 (b) and (c) illustrate the resulting electric field when two like charges and two unlike charges act on each other respectively. The space separating the two charges is called the "dielectric."

When dealing with the quantitive side of electrostatics the electric field is regarded as consisting of lines of electric flux, so the greater the electric field the larger will be the number of electric lines of flux. One line of electric flux is regarded as being the total flux which starts from a unit positive charge, which, as stated before, is convenient for calculations.

The Condenser

If two separated metal plates are

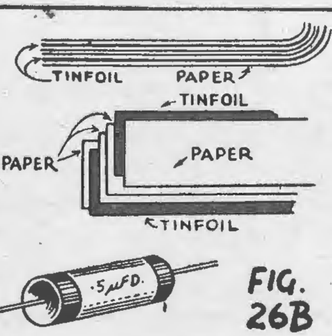

FIG. 26B

connected in series with a switch, battery and current indicating galvanometer, illustrated in Fig. 23 (a) and the switch is closed, a momentary flow of current will be indicated by the galvanometer. As we know, an electric current is no more than a stream of electrons; so the tendency is for the battery to drive electrons round the circuit in a clockwise direction. The result is that electrons are drawn off from plate B by the battery and passed on the plate A, where they accumulate. Thus the plate A will be negative and the plate B positive.

The stream of electrons passing from A to B constitute the charging current for the cendenser. While it is flowing, the potential difference between the two plates is building up, and it is in such a direction as to oppose the action of the battery. Consequently, the charging current, which is high at first, diminishes until the potential difference between the plates becomes equal to the EMF of the battery. The current then ceases to flow, and the condenser is fully charged. Thus a condenser acts as a kind of reservoir for electricity.

If the plates are taken out of the circuit and short circuited, a spark will jump between the plates, showing that a certain amount of electricity has been stored in the plates.

The two plates that have been described are known as a condenser and essentially consist of two conductors separated by a "dielectric."

The Unit of Capacity

The quantity of electricity that can be stored in a condenser is stated in coulombs and it can be expressed as the capacity multiplied by the voltage.

$$Q \text{ (coulombs)} = C \text{ (capacity)} \times E \text{ (voltage)}$$

The unit of capacity is the farad, and a condenser has a capacity of one farad when the application of a potential difference of one volt between its terminals drives one coulomb of electricity into it.

Since a condenser of one farad capacity would be very large indeed, it is usual to work with microfarads and micromicrofarads (abbreviated mfd. and mmfd.).

$$1 \text{ microfarad} = \frac{1}{1{,}000{,}000} \text{ farads}$$

$$1 \text{ micromicrofarad} = \frac{1}{1{,}000{,}000{,}000{,}000} \text{ farads}$$

$$\text{or} = \frac{1}{1{,}000{,}000} \text{ microfarads}$$

Thus a 1 mfd. condenser has a capacity of one-millionth of a

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FUNDAMENTALS
(Continued)

farad, and one of 1 mmfd a capacity of one million-millionth of a farad.

The capacity of a condenser depends on three things: the size of the plates, the distance they are apart, and the nature of the material separating them, known as the dielectric. If the effective area of the plates is halved, or the distance between them is doubled, then the capacity is halved.

Dielectric

With regard to the dielectric, this can be anything that is an insulator —a gas, like air, a liquid, such as certain kinds of oil, or a solid like mica or ebonite. Every insulating substance has its own dielectric constant (alternatively called "specific inductive capacity"). This is a figure that is based on air as unity, and it indicates the effect that that particular substance has on the capacity of a condenser when it is used as the dielectric.

For example, the dielectric constant of a certain grade of mica might be 6 (as stated above, that of air is 1). Therefore, given the same area of plates and distance of separation, a mica dielectric condenser will have a capacity six times that of an air dielectric condenser.

It will be noticed that condensers have a rated D.C. working voltage, which means that the insulation of the dielectric is sufficient to safely withstand this voltage. If the voltage were increased above this, the dielectric would probably puncture and the plates short circuit.

The capacity of a condenser may be calculated from the following formula:

$$C = .0885 \times \frac{KA}{d}$$

where C is the capacity in micro-microfarads; K is the dielectric constant; A is the effective area of one side of one plate in square centimetres; and d the dielectric thickness in centimetres.

Condensers in Parallel

Just as resistors are connected in series and parallel to obtain required values, capacities are connected in a similar manner, but with contrary results.

When capacities are connected in parallel, Fig. 24 (a), the rsultant capacity is equal to the sum of the separate capacities, no matter how many are so joined. Thus, the resultant capacity C of the condensers shown in Fig. 24 (a) is equal to $C_1 + C_2 + C_3$. If $C_1 = .0005$ mfd.; $C_2 = .01$ mfd. and $C_3 = .006$ mfd., then—

$$\begin{aligned} C &= C_1 + C_2 + C_3 \\ &= .0005 + .01 + .006 \\ &= .0165 \text{ mfd.} \end{aligned}$$

Condensers in Series

When condensers are connected in series, as shown in Fig. 24 (b), the resultant capacity is always less than that of the smallest condenser used and may be obtained from this formula:

$$\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$$

For a simple example, if C_1 is .5 mfd.; C_2 is 2 mfd.; and C_3 is 4 mfd., then—

$$\begin{aligned} \frac{1}{C} &= \frac{1}{.5} + \frac{1}{2} + \frac{1}{4} \\ &= \frac{8 + 2 + 1}{4} \\ &= \frac{11}{4} \\ C &= \frac{4}{11} \\ C &= .3636 \text{ mfd.} \end{aligned}$$

An easy formula to use when only two condensers are involved is the following—

$$C = \frac{C_1 \times C_2}{C_1 + C_2}$$

If C_1 is .004 mfd.; and C_2 .006 mfd., then—

$$C = \frac{.004 \times .006}{.004 + .006}$$

$$= \frac{.000024}{.01}$$

$$= .0024 \text{ mfd.}$$

A.C. Flow Through a Condenser

A simple experiment can be carried out to show how a conduction A.C. will flow through a condenser. Fig. 25 shows a lamp connected in

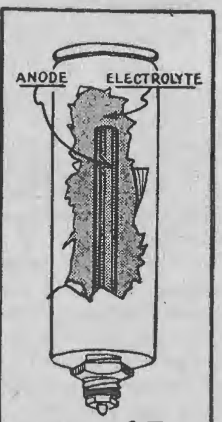


FIG. 27

series with two condensers, AB and XY, and a source of A.C., 1, 2. When 2 is on the positive half cycle electrons flow from 1 towards X and from B towards 2, making X negative and B positive, by electric induction through the dielectric the negative charge on X will cause a similar displacement of electrons away from Y flowing through the lamp towards A. When 2 is on the negative half cycle, a reverse process will take place and electrons will "flow" from A to Y through the lamp which shows that alternating conduction currents will "flow" through a condenser which are to direct currents open circuits, so a condenser will pass an alternating current, yet offer practically infinite opposition to a direct current; this property is repeatedly utilised in a radio circuit.

Capacity Reactance

Condensers have a similar property to the inductance to offer an impedance to the flow of alternating current, but in the case of the condenser it is opposition to the voltage which acts to charge the condenser. In the case of condensers, the term capacitive reactance is used to describe this effect, the formula for capacitive reactance being:

$$X_c = \frac{1}{2\pi fC}$$

where Xc is the capacity reactance in ohms; π is 3.14; f is the frequency in cycles per second; and C is the condenser capacity in farads.

Where the capacity is given in microfarads, the formula becomes:

$$X_c = \frac{1,000,000}{2\pi fC}$$

Types of Condensers

Fixed condensers of capacities from 1 mfd. or so downwards are generally either mica or paper types—mica up to about .01 mfd., and paper from .005 mfd. upwards.

Mica condensers are flat in shape, and, to keep them compact, a large number of small tinfoil plates, interleaved with thin strips of mica, are used in their construction. This

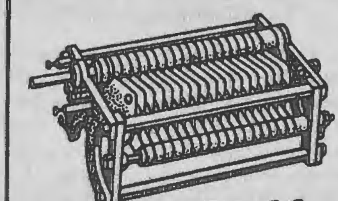


FIG. 28

is illustrated in Fig. 26 (a). After assembly, the leaves comprising each set of tinfoil plates are joined together and taken to a solder tag, the finished condenser being housed in a flat bakelite case, with the capacity stamped on it.

With paper dielectric condensers, a different type of assembly is adopted. Instead of two sets of many small plates of tinfoil, there are two long strips and a special waxed paper dielectric. Fig. 26 (b) shows the arrangement of paper and tinfoil.

The two strips of foil are not entirely covered by the paper. The

(Continued on next page)

FUNDAMENTALS

(Continued)

edge of one strip projects slightly beyond the paper on one side, and the edge of the other emerges similarly on the other. It is to these exposed edgings of foil that the connecting wires, or pigtails are soldered, after the whole has been tightly rolled into a cylinder and before it is housed in the familiar tubular case.

Electrolytic Condensers

For capacities greater than 2 mfd. or so, paper type condensers are rather bulky and expensive, and so electrolytic condensers are generally employed where large capacities are required, as in power supply filter circuits and across resistors used for providing bias for single output valves.

In appearance, a wet electrolytic is cylindrical, and somewhat resembles a single cell from a dry battery. In construction also it is not unlike a dry cell. In the centre is an aluminium rod, carefully insulated from the outer round aluminium case. Between the two is a special liquid which is the electrolyte, or conductor of electricity, and which actually forms one plate of the condenser. The electrolyte may consist of a chemical solution of ammonium borate or sodium phosphate.

In order to convert the arrangement into a condenser, however, current has to be passed through it, this process being termed "forming the condenser." Its effect is to cause a very thin, non-conducting film to form on the inner metal rod, and it is this film that constitutes the dielectric between the inner positive electrode, and the liquid. The latter is in direct contact with the outer metal case, termed the negative electrode. An electrolytic condenser of this type is illustrated in Fig. 27.

The area of the aluminium anode can be increased in several ways, one method being to provide it with a corrugated surface.

As the dielectric formed is very thin, the capacity of an electrolytic condenser is high in a compact form.

There is also a "dry" type of electrolytic condenser, but, like "dry" batteries, they are not really dry. Either a paste or some absorbent material soaked in a liquid constitutes the electrolyte.

With the "wet" type a vent is provided in the form of a rubber nipple, which permits any surplus gas to escape.

When connecting up an electrolytic it should always be remembered that it is polarised; with the wet type the aluminium rod in the centre is positive, and is connected to the positive side of the supply; the outer can is negative, and should be connected to the negative side of the supply. With the dry type the positive and negative are indicated somewhere on the container, and should be connected in a likewise manner.

Variable Condensers

A variable condenser is one whose capacity is continuously variable between its designed minimum and maximum capacity.

The tuning type of variable condenser is illustrated in Fig. 28 and can be seen to consist of a set of fixed plates (stator plates) with which is interleaved a set of movable plates (rotor plates) when at its maximum capacity position; air is the dielectric. As the rotor plates are moved out of mesh so the capacity of the condenser is reduced, until the plates have been rotated about 180° when the condenser will be at its minium capacity setting.

These days the maximum capacity of the condenser that is used in a broadcast or dual-wave receiver is usually about .000385 or .00043 mfd., which is sufficient to cover the broadcast band with one set of coils.

When it is desired to tune more than one circuit, two or more condensers may be "ganged" together so that one spindle will revolve them all simultaneously, thus obviating the necessity for tuning two or three dials. It appears to be economically unsound to gang more than three condensers, which, however, is sufficient for most purposes.

If a variable condenser is examined it will be noticed that the number of rotor plates exceeds the stator plates by one.

The Trimming Condenser

It is practically impossible to construct gang condensers so that each section will have exactly the same capacity, so a condenser of very small capacity is connected in parallel with each section to compensate for these variations. The capacity of the trimmers may be varied over fine limits. It usually consists of two metal plates with mica dielectric; one of the plates is made of spring brass and the space between the two plates may be varied by an adjusting screw that alters the tension on the spring brass plate, thus varying the capacity.

WHAT IS A DECIBEL?

The importance of a variation in a physical quantity is sometimes dependent only upon the amount of variation, but more often it is also dependent upon the size of the quantity in question. The decibel is particularly suited to the measurement of the change in a physical quantity when the portion of the quantity represented by the change is of primary interest. It gives a linear measure of the effect of such a variation.

In communication work the decibel is most commonly used to measure power ratios.

If a certain radio signal is said to be raised in level by 3 db, its power has been doubled. 10 db corresponds to a power ratio of 10, 20 db to 100, 60 db to 1,000,000.

The practical value of the unit arises from the fact that these ratios of power gain or loss as expressed in db come nearer to counter it than do direct power ratios. A loss of 60 db in signal comes nearer to reducing the usefulness of the signal by a factor of 60 than it does by a factor of 1,000,000. The very large range of power used in communication work can be expressed in terms of decibels without using inconveniently large numbers.

When decibels are used to express the voltage or current gain of an amplifier, care must be taken in the interpretation. If the two voltages are to be compared are measured across equal resistors, the voltage and current gains or losses in db will be just twice the power gain or loss. If the loads are not equal resistors, the relation is more complicated.

TECHNICAL REVIEW FROM U.S.A.

Latest News direct by Cable

NEW YORK.—Development of a system of pulse time modulation applicable to wire and radio, including broadcasting and television sound channels, was disclosed at a meeting of the Institute of Radio Engineers by E. Labin and E. M. Deloraine, of Federal Telephone and Radio Laboratories, associate of the International Telephone and Telegraph Corporation. It consists essentially in transmitting intelligence by pulses of constant amplitude and duration. Instantaneous amplitude of voice is translated into a variation of time intervals of successive pulses, the rate of variation corresponding to instantaneous frequency of signal. Its main advantages include simplification derived from the use of more rugged repeaters, capable of operating on trigger action and thereby reducing the usual requirements for stability of distortion and noise.

Distortions introduced in different repeaters are not cumulative. Development work started in 1937 on the basis that, with modern transmission technique, a much wider band-width per channel is available than is strictly required by the elements of most signals transmitted. Compared with amplitude and frequency modulations, pulse-time modulation appears promising for multi-channel, coaxial cable, telephone, telegraph and facsimile transmission systems, also point-to-point radio. and ultra-high frequency broadcasting and television sound channels.

★

Disk Seal Tubes Important

Development of the new General Electric "Disk Seal Tubes" for generating high frequency radio waves of considerable power, may speed the conquest of a new part of the radio spectrum. Disk tubes, one of which is called "Lighthouse" because of its shape, provide a novel means of producing very short waves.

They have played an important war role and should play a vital part in the post-war creation and expansion of micro-wave industries, such as television, navigation, etc. A disk seal tube is similar to tubes used in radio sets; it has heated cathode for emitting electrons; a grid controlling their passage, and anode for receiving them. However, they are built differently from simple disks and cylinders. With high frequencies for which the tubes are used, the shape has an importance lacking in tubes for lower frequencies such as those of ordinary broadcast stations formerly the evacuated part of the system was called the tube, and the wires and other parts were called the circuit, even though there is no line of electrical demarcation. The disk tube is the embodiment of the principle that in the micro-wave field there is no sense in speaking of tubes and circuits as distinct entities. Preferably, we think of a micro-wave oscillator not as an electron tube with an attached circuit but as a single electrical system having one section walled off and evacuated to house electronic activity.

★

Crystal Production

A new production technique for quartz crystals uses X-rays to adjust delicate plates to their final frequency at the rate of thirty to fifty cycles a minute. Plates for the six to eight megacycle range can be lowered up to three kilocycles by X-ray exposure. Since the frequency can be checked continually during the treatment, the crystal can be removed from exposure the instant it reaches the correct frequency. The equipment developed by the North American Philips Company employs a new high-intensity water-cooled X-ray tube. Experiments made by the Reeves Sound Laboratories show that frequency change is permanent beyond any temperature range crystal is likely to experience. Applications of the technique include: recovery of overhot crystals having been carried too far in finishing and hence being too high in frequency; precise adjustment of standard crystals for calibration and testing; manufacture of precision crystals for frequency and time standards; precise adjustment to final frequency without the possibility of future ageing.

★

Locating Breaks

Guesswork usually involved in locating broken wires under the insulation of electrical extension cords and wires is eliminated when the electronic tester developed by the Consolidated Vultee Aircraft Corporation is used. In the unit, one electronic tube is connected as a self-excited oscillator operating on about 400 cycles frequency. The oscollator output is applied to the cord. A small amount of signal energy is picked off the cord by the metal ring through which the cord is passed. Fed to a high-gain amplifier, signal amplitude is sufficiently increased to operate the output meter. When the break in the conductor passes through the ring the sudden change in meter deflection instantanoeusly indicates the broken spot, eliminating the necessity of cutting the cord in several places to locate the break.

★

U.S. at International Conferences

Francis Colt De Wolf, chief of the Telecommunications Division of the State Department, principal speaker at the annual banquet of the Institute of Radio Engineers in New York on January 25, said that the State Department invited other Federal agencies and private industry to join in studying what should be the position of the United States at the forthcoming International Telecommunications Conferences, the first of which—the third Inter-American Radio Conference—will be held at Rio de Janeiro in June this year. Thereafter, the world conference is anticipated to continue the work of the Berlin, London, Washington, Madrid and Cairo Conferences. De Wolf viewed the main purpose of international conferences as being to make the best use of available radio frequen-

(Continued on next page)

U.S. REVIEW

(Continued)

cies. The Federal Communications Commission recommendations for post-war frequency allocation for radio services between twenty-five and thirty thousand megacycles opened new vistas for radio, frequency modulation, television, facsimile, "walkie-talkie," etc. The next international conference will thus be confronted with the tremendous problem of adequate control of radio to the maximum benefit to all users.

Control in radio is essential to prevent chaos, said Mr. De Wolf. If the splendid co-operation of the 1938 Cairo Conference between industry and Government continues, he is confident that solutions will be reached proving acceptable to all radio spectrum users. For two years the Telecommunications Division of the State Department has worked on post-war telecommunication plans, many still in the blueprint stage.

The Division has in mind a plan for the modernisation of existing international telecommunication bodies, particularly in the field of radio interference and radio regulation. In this and other fields, probably, a small amount of sovereignty is to be surrendered to insure more efficient control of radio, which knows no national boundaries. The Division envisages the possibility of the formation of an Inter-American Telecommunication Union to accomplish for the western hemisphere what the International Telecommunication Union at Berne did on a world basis. It is considering also means to assure radio services to certain points for twenty-four hours a day without interference from the magnetic pole. Such service is now assured between New York and Moscow through relay American stations. Government engineers are now studying the possibility of a so-called equatorial belt system and another plan even better than routing radio waves along the equator.

HIGH FIDELITY

Major Edwin H. Armstrong, exponent of frequency modulation, recnetly gave his views on high fidelity as follows:—

"Ther ehas been some discussion as to how many cycles are good enough for the ordinary listener. I think the best way to state the difference between 10,000 and 15,000 cycles per second is the difference between something which is good and something which is real."

Several Government radio agencies and post-war committees will consider new allocation plans to be submitted to the next International Conference on behalf of the United States.

De Wolf said he anticipates holding a conference soon with representatives of the British Commonwealth on more efficient and economical means of communications between English-speaking peoples.

(By courtesy of the U.S. Office of War Information.)

Production of Audio Frequencies

An interesting account of some experiments

By
V73098
Sgt. G. L. F. Smith
2 Coy., 1 A.S.T.B.
Bonegilla

THIS article is not intended to be either a theoretical discussion or a description of a particular instrument. Instead, it is the intention to discuss various means of obtaining audio frequency signals, and also to give the results of some tests which have been carried out on one or two different circuits. From the information so given, it is hoped the reader may glean enough data to enable him to build an audio-frequency oscillator to suit his particular needs.

Requirements of an A.F. Source

There is little doubt that any one handling receivers or amplifiers in any way is continually finding a need for a source of A.F. Firstly, such a piece of equipment should be either continuously variable over the entire audio spectrum or else have provision for the supply of a number of frequencies to be made available as required. Secondly, to prevent inaccuracies in any tests which may be carried out using the equipment, its output should be as free from distortion as possible. Furthermore, its output should be calibrated as regards voltage or else a means of measuring the output should be utilised.

Means of Obtaining A.F. Signals

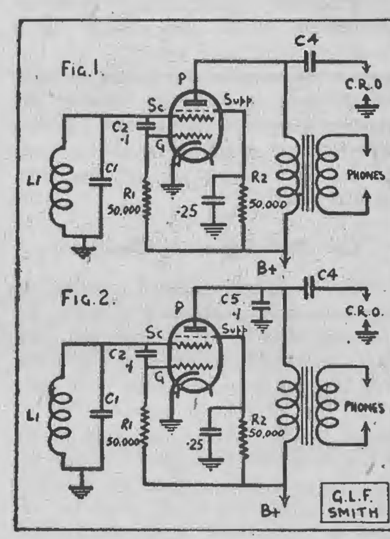
The Gramaphone Record. Possibly the easiest method by which A.F. can be obtained is by using a microphone and feeding its output to the equipment under test. The faults in this system are fairly obvious and really require little further mention. There is little doubt that the gramophone record is very popular as a means of providing audio signals for test purposes. Most experimenters possess the necessary pickup and motor, and use it in conjunction with normal recordings.

Besides the usual type of recording, the disc manufacturers normally market a very comprehensive range of recordings covering all types of audio signals from 50-cycle upwards, in pure tones and also complicated forms of audio. The catalogues of the firms concerned give a complete list of these recordings and their characteristics, although at the present they may be off the market. In order to obtain the output true to label, these discs must be run at correct speed and to facilitate this they are usually fitted with a stroboscope label. A point regarding the use of stroboscope indicators is that by using a neon lamp as the means of illumination, much more ease will be noticed in maintaining the motor speed. As a normal lamp is never completely out between alternations in the line voltage, a blurred image will be the result on the stroboscope, whereas with neon lamps they are extinguished completely and the stroboscope label stands out clear and sharp.

The disadvantages with this system are that pickup response characteristics vary, distortion is likely to be introduced by the pickup, and noise level becomes progressively higher as the record wears, resulting in spurious readings. Short running time is a factor also, particularly where prolonged tests are being carried out.

Apart from these disadvantages, these recorded tones supply a very easy-to-obtain source of audio frequency, both of good wave form and small cost. Present shortages will most likely prevent the purchase of these discs, but in any case they will again be available when conditions return to normal.

The Tone Wheel. This method of producing audio signals is one of the means by which electric organs produce the original fundamental tones. A tone wheel is a shaped wheel which rotates so that the projections on the wheel pass the tip of a permanent magnet. On this magnet is wound a pickup coil. The frequency of the voltage induced is governed by the number of projections on the wheel passing the mag-



net per second. Naturally the frequency can be varied by changing either the motor speed or the wheel in use. A number of these wheels on the one shaft would give a range of different frequencies. This system is quite simple to get going and would provide an experimenter with plenty of scope for his own skill in building one up.

Valve Oscillators. Obviously the most logical choice as audio generators, the valve oscillators can be the source of so much distortion that they are more or less useless, unless precautions are taken to ensure that the circuit is operating so that its output is as pure as possible.

There are several standard circuits such as **Hartley, Colpitt's,** etc., which have been well tried by most people, but the one that has been found to be very easy to get going is the **negative resistance** circuit using a pentagrid valve. In its simpler form, using a tetrode valve, it is more usually known as a **"dynatron"** oscillator.

As there have been descriptions as to how this circuit operates in various publications, it is not the intention here to give any theoreti-

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cal discussion, other than what may be necessary in the course of explaining the tests. This is not intended to be a description of a complete oscillator ready to go, but rather the results of a series of tests which were carried out, so that the prospective constructor can use the information so given to go to work on an instrument to suit his own requirements.

The Two-Terminal Oscillator

This name has been coined to describe this particular circuit, as, looking at Fig. 1, it will be seen that the tuned circuit which governs the frequency is a single coil only with no feed-back system which would require adjusting. This really is the main advantage of this circuit as any coil can be connected between control grid and earth, and be expected to produce oscillations.

Briefly, the circuit uses a 1C7 pentagrid valve with a total H.T. supply of 60 volts in the original tryout. The voltage to the oscillator plate measured with a 20,000 ohms per volt meter was around 25 volts and the screen grid read 20 volts, while the plate had the full "B" supply applied to it.

R and C values are shown except for C1, which is governed by the frequency required, and in fact was entirely omitted at the first trial. L1 was an air-cored coil of several hundred turns and its inductance was unknown. Headphone output for monitoring was from the secondary of the output transformer.

A cathode ray oscilloscope was used in the tests to check the wave form and was connected through a .25 mfd. condenser to the plate and the other side to earth.

Immediately the circuit was put into operation, results were obtained.

Output was very high, although no attempt was made to measure it at this stage owing to lack of an instrument. The frequency was high, somewhere in the vicinity of 10 kc's, while the wave form was almost completely flat-topped, indicating an extremely high harmonic content.

The first series of tests to be carried out was to insert C1 in the circuit in increasing quantities. As an addition of capacity to a resonant circuit lowers its resonant frequency, the frequency of the signal was progressively reduced with each addition and another point noted was that, as the frequency was decreased in this way, the output of the circuit became purer in form and also the signal was reduced. Eventually a point was reached where it was extremely difficult to maintain the circuit in oscillation. This was a point of very pure output, although there were still slight evidences of distortion.

Filament Polarity. Being a battery tube the 1C7G is critical as regards the filament supply polarity. Pin 2 is the positive terminal and Pin 7 the negative and it was found that if connected in the reverse direction, distortion was very bad. The use of A.C. heater tubes would remove this source of trouble of course, but, if using battery types, adhere to maker's recommendations unless a C.R.O. is available to check results.

Component Values

Varying the value of the resistances and condenser had very little effect on the quality of the signal. It was found, though, that decreasing R1 and R2 to about 10,000 ohms had a slight increasing effect on output. Decreasing the "B" supply produced little difference until the point was reached where oscillations ceased. An increase in output and a corresponding increase in distortion was caused by increasing the H.T. supply voltage.

Output Connection

As mentioned earlier, the C.R.O. was connected between plate and earth. It was decided to connect it right across the tuned circuit and, as would be expected, across an oscillatory circuit the output was a pure sine wave. At this point in the proceedings an output meter was obtained to check the output volts, but unfortunately proved faulty. While it was connected across plate and earth a very marked improvement was noticed in the wave form, which became almost pure.

A resistor of equivalent value to the meter was tried across these points with no effect. It was then realised that the condenser in series with the meter may have been the cause of the improvement, so a .1 mfd. condenser was tried, with the results that we again had excellent output. Fig. 2 shows the final circuit including this condenser.

A very important result of this alteration was that the value of C1 could be reduced naturally with an increase in frequency, without any apparent decrease in quality.

During all these tests, L1 had not been changed at any time. It was then replaced by the secondary of an iron-cored microphone transformer, and, knowing the pitfalls that crop up with iron-core inductances, it was expected that the quality would suffer. Surprisingly, the quality remained as before, but most amazingly, the frequency was out of the audio range. Adding C1 to the circuit in varying values soon altered this condition without otherwise causing trouble.

Type of Tuned Circuit

From the above results it can reasonably be assumed that the type of inductance is not very important, but must be of the correct value. Choose one whose value will produce oscillations at the highest frequency required, so that a barest minimum of capacity is used to produce any other frequencies. Unless this is done, the circuit will not oscillate at the lower frequencies.

Frequency Stability

The tests were all carried out on a sheet of three-ply for a base and, naturally, the components were far from being rigid. Taking these facts into consideration, the frequency stability of the oscillator was of a very high order.

Use of A.C. Valves

The original circuit was primarily designed to operate using A.C. pentagrids and with 250 volts. No doubt very similar results would be obtained under these circumstances and provided the H.T. is reduced to the barest minimum for satisfactory operation, little trouble should be experienced in getting good results. Here again the use of a C.R.O. would be a great advantage.

Conclusion

Summing up this type of oscillator, the following points are noticeable:

1. Reaction or feed-back circuits are dispensed with, eliminating the

(Continued on page 34)

VACUUM TUBE VOLTMETER

(Continued from page 10)

for the standing bias on V1 due to the action of the resistor R11.

Calibrating the Voltmeter

While the full-scale sensitivity of the meter is taken care of by the series adjustment R7, it is impossible to allow for non-linearity in the original marking of the microammeter. The meter used by the writer, a Palec meter, was linear up to 80 microamps, but the deflections were a couple of divisions short of 100 microamps at full scale with a gradual falling away between 80 and 100 microamps. When the voltmeter was adjusted on full scale, it was thus found to be in error at all other points.

The procedure adopted was to check the meter against several meters of about 1,000 ohms per volt sensitivity. The circuit of Figure (6) was used. In the author's case, two 0-10 voltmeters AB were available, and one 0-1 milliameter CD, all of different manufacture. The meters AB and CD were set to correspond at full scale by adjusting the variable potentiometer at C, and, on varying the potentiometer R, all were found to agree at every point of the respective scales. Thus, there was reasonable certainty that all these meters were linear over the whole range. In the case of the microammeter EF, however, it was found possible to obtain point by point agreement only up to 80 microamps., and from there the meters diverged. The potentiometer R was adjusted to bring AB and CD to successive scale divisions within this range and corresponding readings taken on EF and noted. The microammeter was then carefully removed from its case and the scale divisions between 80 and 100 erased with a Gem razor, just leaving a tiny spot at the base of each division mark to locate where it had been. Using these spots, new division marks were ruled on to the face with a fine pen and Indian ink at the readings corresponding to each of the calibration readings previously taken. When applying the ink, it was found helpful to build a stack of books up to the height of the meter face and to place these near the meter to provide a hand rest.

After this, the meter should be restored to its case and a linearity check repeated. If everything has been done properly, agreement should be obtained at all scale divisions.

D.C. Calibration

The next step is to correctly calibrate the D.C. section of the meter. A word of warning at this stage—be certain that the range resistors R22, R23, R24, R25 and R26 are all accurate, or at least that their ratios are accurate. A check on the correspondence of readings on rotating the range switch and altering the multiplier selector will give some indication as to whether this condition is fulfilled. The circuit of Figure (7) was used by the writer for checking D.C. calibration. The balance or zero adjustment should be first set with the input voltage removed. Using the 10-volt range for calibration, the battery should be switched into circuit and the potentiometer R adjusted to give full-scale reading on the 0-10 voltmeter V. Adjustment of the V.T. voltmeter sensitivity is obtained by varying R7 until the V.T. V.M. gives full-scale reading. It should be found on varying R that agreement is obtained over the whole scale on both the voltmeter and the meter V. At this stage, the built-in calibration check should be adjusted as described earlier in the article.

A.C. Calibration

As the A.C. and D.C. calibrations are interdependent, the A.C. calibration should be made soon after finally checking the D.C. calibration, and in particular, the setting of R7 should not be altered. The circuit arrangement is given in Figure (8), and follows the same lines as that of Figure (7). The voltmeter V should be reliably calibrated over the range 0-10 volts. Calibration is secured by adjusting the zero balance R4 to give correspondence at 1-volt (1/10th full scale), and the A.C. calibration potentiometer R13, to give correspondence at 10 volts or full scale. As the two controls R4 and R13 are not completely independent, two or three adjustments will be necessary. It should then be found that agreement occurs at all voltages in the range 0-10 volts. In the writer's case, it was found that agreement was obtained with the zero balance potentiometer exactly in the same position as required for the D.C. zero balance. In any case, the A.C. input should be removed, the terminals shorted out, and the true A.C. electrical zero obtained. This position may be marked on the meter face if desired. This zero should always be used in setting up prior to taking A.C. measurements. A reading of 2.6 microamps corresponded to zero in the writer's case. The 50-cycle calibration will be found to hold over the normal audio frequency range without error.

Conclusion

The voltmeter described in the article has been developed after a good deal of theoretical and experimental work, and it is believed it will fill a valuable place on the test bench for the amateur who wants a really reliable vacuum tube voltmeter that can be used with very nearly the same degree of confidence as any normal meter.

A subsequent article will describe additions which may be made to this instrument to enable a very wide range of resistance and capacity measurements to be made. Resistance measurements from zero to 1,000 megohms, and capacities from 50 picofarads to 50 microfarads may be readily accommodated.

CONTRAST

(Continued from page 16)

operating conditions.

If a 4 megohm potentiometer is not available for the time delay control, a dual 2 megohm unit, with the sections wired in series, will serve.

Coupling Transformer Details

P.P. 6V6 triodes feeding Par. 5V4G full wave.

Core material: A high-grade audio steel, preferably Permalloy.

Power input: 4 watts approx.

Primary inductance (minimum): 20 henries.

Leakage inductance (total ref. to prim.—maximum): .1 henry.

Primary wire gauge (minimum size): 38 SWG enam.

Secondary wire gauge (minimum size): 26 SWG enam.

Primary DC resistance (maximum): 500 ohms.

Secondary D.C. Resistance (maximum): 60 ohms.

Note.—Both primary and secondary windings are centre-tapped.

Turns ratio (whole prim. to whole sec.): 9 : :1.

Shortwave Review

CONDUCTED BY L. J. KEAST

NOTES FROM MY DIARY

This is the time of the year when loggings are shown with a certain amount of trepidation. As is customary, I have checked most of the loggings shown and am hoping the signals will remain strong enough for our readers to hear. But, with the autumnal equinox, and now the moon on the wane, what was good last night may be very naughty this evening and the same thing goes for the lads before breakfast. Take the 19-metre band; in the early evening there is very little about and it is often 9 o'clock before signals are good. Even then, reception is sometimes only good enough for an ardent dx-er and would certainly not be a good time for an initiate.

But there are still some very fine signals to be heard and one would be wise to watch the 25-metre band, some early evening East-Coast Yanks must show up soon. For those of us who can listen-in during the daytime there is a good time in store as already there are indications of the winter timetable coming into effect. I'll bet Wally Young is already well set with a rug and radiator waiting for the Europeans to "come good" and the news nowadays suggests that a large number of "silent transmitters" will be throwing in the big switch pretty soon.

THE VOICE OF AMERICA

"The Voice of America" is on the air 24 hours a day, speaking in 41 languages and dialects. The weekly output in terms of 15-minute broadcasts exceeds 3,500 programmes, nearly 5,250,000 words—about five times as many words as there are in all the works of Shakespeare.

In 1941 when the United States was attacked, the U.S. Radio went to war. The 11 U.S. short-wave stations, owned by private companies, swung into action. Then the Government leased these stations and began acquiring its own transmitters. The power of many stations was increased, and efficiency was enhanced by the union of the transmitters into a single network.

The country also drew upon the facilities of 56,000 American amateur radio operators who for many years had been using short-wave to talk to other amateurs all over the world. These men now furnished a priceless reservoir of trained personnel for the American barrage of news. Radio became another weapon in the arsenal of democracy. By the end of 1942 there were 14 major U.S. stations in the foreign broadcast service and 22 more were under construction.

Today the U.S. Office of War Information in New York City and San Francisco is supervising U.S. broadcasting to most countries of the world. Short-wave to the 20 South and Central American republics is regulatd by the Office of the Co-ordinator of Inter-American Affairs.

The two biggest U.S. radio networks are co-operating with the Government in the short-wave programme. The National Broadcasting Company and the Columbia Broadcasting System have many hours of short-wave broadcasts daily. From all U.S. short-wave stations special programmes with news and entertainment are broadcast to U.S. troops overseas.

The programmes to Europe are frequently relayed by British stations and United Nations transmitters in Africa and Italy. Many of the Chinese programmes are rebroadcast by China's powerful transmitter in Chungking.

—Extracts from article by Henry B. Krantz.

THE VOICE OF THE ANDES

Read somewhere that HCJB, Quito, Ecuador, had closed by orders from the Ecuadorian Government, due to a decree that "foreigners" were not permitted to conduct radio stations.

Well, there is something wrong somewhere, as, instead of leaving the air, they are more active than ever, having introduced a new frequency, 15.115 m.c., which is heard nightly in New South Wales and still another, reported by our old friend, Arthur Cushen, 4,105 m.c. So, instead of going to the pack, they have remained in it, and well-shuffled at that.

SPECIAL NOTICE

Change in schedule for BBC Pacific Service, as from 8th April, 3-7 p.m.:

3-4.30 p.m.: GRM, 7.12 m.c., 42.3 metres, for Australia and New Zealand. GRV, 12.04 m.c., 24.92 metres; GRX, 9.69m.c., 30.96 metres; GVZ, 9.64 m.c., 31.12 metres, for Australia. GSN, 11.82 m.c., 25.38 metres, for New Zealand.

4.30-5.45 p.m.: GRM, for Australia and New Zealand. GRV, GRX, GWD, 15.42 m.c., 19.46 metres, for Australia. GVZ, GSN, GWD, for New Zealand.

5.45-7 p.m.: GRV, GRX, GWD, for Australia. GVZ, GSN, GWD, for New Zealand.

Since March 11th, the BBC have been putting over special programmes for the British Fleet in South-eastern Australian waters:

2-6 p.m.: GSW, 7.23 m.c., 41.49 metres; GRY, 9.60 m.c., 31.25 metres; GVX, 11.93 m.c., 25.15 metres.

6-6.30 p.m.: GSW, 7.23 m.c., 41.49 metres; GVX, 11.93 m.c., 25.15 metres; GSF, 15.14 m.c., 19.82 metres.

6.30-7 p.m.: GVX, 11.93 m.c., 25.15 metres; GSF, 15.14 m.c., 19.82 metres.

SAYS WHO?

"The Voice of Britain" is heard over KCBF, 9.75 m.c., from 12.15 till 12.30 a.m. (An earlier edition but of five minutes' duration only, is heard over KNBI, 49.83 metres, and KNBX, 39.66 metres, at 7.05 p.m. At conclusion of news you are recommended to hear a fuller news bulletin at 2.15 p.m. G.M.T. (12.15 a.m. Sydney) on 6179 and 9750 k.c. —L.J.K.)

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Have rceived veries from WCBN, 11.145, 9.49 and 6.17 m.c.; KGEI, 15.13 m.c.; KGEX, 15.33 and 9.53 m.c.; SUX and WVLC.—Cushen.

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Many of our dx-ers will remember Norman Paige at the KGEI mike 'way back in 1941. I heard a Norman Paige the other day speaking as a Blue Network correspondent at Guam, and think it is the same person. Station was KRHO, 16.85 metres; time, 10.15 a.m.; session, American Correspondents' Report.—L.J.K.

Mr. L. S. Harrison (AW785DX), of Yengarie, Maryborough, advises receiving verifications from All India Radio; FK8AA, Noumea; VPD-2, Suva, and KGEI. I have to thank Mr. Harrison for sending a copy of information supplied by A.I.R.

Have not heard Paris lately on 19.68 metres — last occasion was 13th March, but think heard them on 31.61 metres, badly interfered with by GWF.—Edel. (Yes, I have heard the call "Ici Paris" on 31.61 metres several afternoons and I prefer to put it that they, Paris, interfere with poor old KNBA, who is there from 1.30 till 6.45 p.m. Paris also interferes with GWF, who while on intermittently from around 4 p.m. also upsets KNBA. Sometimes just to make it still further difficult, Morse hops in. But I think Paris may be back again on 19.68 metres, as I certainly heard them call on Saturday, 31st March, at about 10.10 p.m.—had it been the next night I may have thought someone was pulling my leg.—L.J.K.)

Who is the stranger on 11.71 m.c. at 2 p.m.?—Cushen.

Rex Gillett has put it over the Adelaide boys beautifully. He has logged an exclusive station, Radio BAWL. He listens for anything from 2½-3 hours nightly. Frequency and location is not given, but the chief operator of the station is his new 8lb 14oz baby girl. Congrats, Rex.—L.J.K.

English session from 9.40 till 10.20 p.m. is heard from Moscow on 25.36, 25.79 and 49.42 metres.—Good signal except for 25.36, which is very weak.—Edel.

Rome on 6.04 m.c., 49.66 metres, is heard from 7-9 a.m.—Howe "Universalite."

KU5Q, Guam, 9.32 m.c., 32.25 metres, heard calling NPG-5 at 6.30 p.m.—Gillett.

Here is another selectivity test: KWY, 7.56 m.c., and KNBX, 7.565 m.c. A good time to make it is from 9.30-10 p.m. when Carmen Ligaya is putting over her programme, "Music America Loves Best," through KWY. If you get out of step you will find KWY is in parallel with KGEX, 7.25 m.c., 41.38 metres, whilst KNBX runs with KNBI on 6.02 m.c., 49.83 metres. Morse is often bad on the 39-metre band at night, particularly on KWY, but KNBX is good in afternoon in Latin-American programme through United Network, signing at 3.05 p.m., when they remind you "next transmission to Latin-America through KNBX will be on 21.61 m.c. at 1 a.m.—L.J.K.

FZI, Brazzaville, who has not been heard for some time on 11.687 m.c., is back again in relay with 11.970 m.c., at 7 a.m., signal fair.—Gillett.

NEW STATIONS

PY, Manila, 9.305 mc, 32.24 m: This transmitter, which is owned and operated by Press Wireless Inc., is new to this country, I think. Mr. Edel heard them calling KCT-3, Los Angeles, at 11.45 p.m. on 11th March, when they were conducting a test.

KGOY, Chungking, 15.22 mc, 19.71 m: Here is a new spot for the Chinese International Station XGOY, Chungking. Heard conducting a test from 23rd to 26th March from 7-7.50 p.m. They asked the BBC Monitoring Service to let them have a comprehensive report on reception. To where they were directed I do not know, but round about this time of the year they move to 15.205 mc and beam to us. I am hoping they will make it 15.22 mc, as the signal is quite good, maintaining R7 Q4 right through.—L.J.K.

RADIO SOMALI, ? Berbera, 7.125 mc, 42.10 m: This is a nice catch reported by Rex Gillett. It appears the first to hear it was Ern Suffolk, of Lobethal, South Australia. They were then closing at 12.30 a.m. Rex followed them up and has now heard them at 2.30 a.m. presenting a BBC musical programme. At 3 a.m. identification was given in English and a native-type programme followed. It was still audible at 4 a.m. Mr. Gillett does not mention location, but presumably it is Berbera, the capital.

RADIO BELGRADO, Belgrade, 9.42 mc, 31.85 m: Here is another of the Europeans to show up, although it appears to be a new frequency for Yugoslavia. Mr. Edel reports hearing the call at 1.45 a.m. when signal was R7. Languages used were Slovakian and Italian. Nice catch, Leo.

CHTA, Sackville, 15.22 mc, 19.71 m: In March issue I referred to this station as operating but doubted whether we would hear it at the time it was said to be on the air, viz., 8.45-11.15 p.m. Well, a look at "The Month's Loggings" will show that it IS being heard, and how?

KNBX, San Francisco, 21.61 mc, 13.88 m: In March issue I doubted if we would hear this outlet of the National Broadcasting Company between 1 and 8.30 a.m., and to my great surprise I logged it on March 7th at 7.30 a.m. and held them till they closed at 8.30. Signal was only fair but could be copied. Background was high. From 1-8.30 a.m. KNBX carries United Network programme.—L.J.K.

CHANGE OF SCHEDULE

KGEX, 'Frisco, 15.21 mc, 19.72 m: Now opens at 7.15 a.m. and picks up KROJ (19.75 m) programme. When KROJ closes at 7.45, KGEX gives news at slow speed for an hour with the exception of five minutes normal speed at 8 a.m. At 8.45 musical programme and from 9 a.m. continues with similar programme to the East as formerly, picking up KROJ (16.89 m) at noon and remaining with them till closing at 1.15 p.m. KROJ, as usual, closes at 1.45 p.m.

The MONTH'S LOGGINGS

ALL TIMES ARE EASTERN AUSTRALIAN STANDARD TIME

Pressure on space only permits of unusual Loggings or alterations in schedules or frequencies.

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 Avenue W., Carlingford. Urgent reports, 'phone Epping 2511.

OCEANIA

VIG, Port Moresby 15.08mc, 19.89m
Heard at 10.15 a.m. (Young).

XBC, Dutch New Guinea, 12.65mc, 23.72m
Heard at 8 p.m. (Young).

FK8AA, Noumea 6.208mc, 48.39m
Closes at 8 p.m. with strong signal but modulation bad—very zizzy (Edel).

AFRICA

Algeria

AFHQ, Algiers 11.765mc, 25.50m
"V. of A." in Basic English at 1 a.m. (Edel).

Belgian Congo

RNB, Leopoldville 9.78mc, 30.66m
Good signal in afternoon (Miss Sanderson). Relays BBC till 2.45 p.m. at good strength (Cushen).

British Somaliland

Radio Somali, ? Berbera, 7.125mc, 42.10m
See "New Stations."

French Equatorial Africa

FZI, Brazzaville 11.97mc, 25.06m
Much improved signal (Gaden).

Egypt

JCTA, Cairo 7.195mc, 41.69m
Heard in relay with the "Forces Programme" from Cairo on 7.22 mc until closing at 7 a.m. with good signal (Gillett).

Madagascar

Radio Tananarive, Tananarive
12.135mc, 24.72m
Heard from 10 p.m. (Edel). Closes with "Marseillaise" at 11.30 p.m.; morse is troublesome on this spot (Gillett). (Note slightly higher frequency.—L.J.K.)

GREAT BRITAIN

B.B.C., London

GWD 15.42mc, 19.46m
R8 at 10.45 p.m. (Edel).

GSO 15.18mc, 19.76m
R8 at 10.45 p.m. (Edel).

GSF 15.14mc, 19.82m
Very fine signal at 10.50 p.m. (Edel).

GWC 15.07mc, 19.91m
In Spanish at 10.45 p.m. R7 (Edel).

GVY .... 11.955 mc, 25.09m
French to Europe at 10 p.m. Signal weak (Edel).

GWQ 11.84mc, 25.34m
Heard in German at 11.45 p.m. with R7 signal (Edel).

GRU 9.915mc, 30.26m
Dance music with R8 signal at 12.45 a.m. —L.J.K.

GRX 9.69mc, 30.96m
AFRS programme from 11.45 a.m.-12.45 p.m. (Cushen).

GRY 9.60mc, 31.25m
Terrific to British Fleet at 5 p.m. (Cushen).

GWS 6.035mc, 49.71m
Heard over here from 7.15-11.45 a.m. (Howe "Universalite"). Good level at 4 a.m. in French and still good at 7.30 a.m. (Gillett).

THE EAST

China

XGOY, Chungking 11.909mc, 25.17m
News in English at 8 p.m. followed by music (Miss Sanderson, Young).

XGOA, Chungking 9.72mc, 30.86m
Heard in news and music at night (Miss Sanderson).

XGOY, Chungking 9.645mc, 31.10m
Calls U.S. networks at 1.15 a.m. (Cushen).

XGOY, Chungking 7.15mc, 41.96m
Calls U.S. networks at 1.15 a.m. (Cushen).

India

VUD-5, Delhi 17.83mc, 16.83m
Being heard again, but this time at night from 7-9 p.m. Signal good, R8 Q4 when closing.—L.J.K.

VUD-8, Delhi 15.35mc, 19.54m
News in French—good (Miss Sanderson, Young).

S.E.A.C., Colombo 15.27mc, 19.64m
Heard in news, English, and in Japanese, also recorded music (Miss Sanderson).

VUD-, Delhi 15.16mc, 19.79m
Heard at 12.45 p.m. (Young, Miss Sanderson).

S.E.A.C., Colombo 11.81mc, 25.40m
News-cast and music heard at night (Young).

VUD-5, Delhi 7.275mc, 41.24m
Heard at 12.45 a.m. (Young).

Delhi 3.49mc, 85.96m
When signing at 2.30 a.m. announces "Forces Broadcasting System"—has BBC news at 1 a.m. (Cushen).

AMERICA

Central

Costa Rica

TIPG, San Jose 9.62mc, 31.20m
Very weak at lunch-time. Some nights is really good after 10 p.m. (Gaden).

Dominican Republic

HI3X, Ciudad Trujillo 11.855mc, 25.25m
Heard till 12.30 p.m. but poor signal (Cushen).

Panama

HP5G, Panama City 11.78mc, 25.47m
Nice about 8 a.m. Heard weakly at noon (Gaden). Very good in afternoon. Heard at noon and better after KCBF signs. HP5G closes 2 p.m. (Cushen). Mr. Cushen refers to KCBF on 11.77mc, who close at 1.45 p.m.—L.J.K. Fair at 7.15 a.m. (Gillett).

HP5A, Panama City 11.695mc, 25.64m
Fair at 7.15 a.m. in Spanish language and musical programme (Gillett, Gaden).

South

Argentine

LRS, Buenos Aires 9.32mc, 32.19m

LRY-1, Beunos Aires 6.085mc, 49.30m
Heard till 4 p.m. Sundays. Often announces LRS and LR4 (Cushen).
This is reported to be the call for this frequency (Howe "Universalite"). (This was previously known as LRE—L.J.K.).

LRS-1, Buenos Aires 6.065mc, 49.44m
Has moved to here from 5.90mc. Heard 7 a.m.-2 p.m. (Howe "Universalite").

Brazil

PRL-8, Rio de Janiero 11.715mc, 25.60m
Heard at 6 a.m. in English and now improving from noon to 1 p.m. in English for U.S.A. (Cushen).

Colombia

HJAP, Cartagena 4.93mc, 60.92m
Opens at 9 p.m. with news (Cushen).

Chile

CE-1180, Santiago 11.995mc, 25.01m
Heard right through the midday at very fair strength, uses chimes—signs 2 p.m. (Cushen).

CE-1185, Santiago 11.85mc, 25.32m
Heard at 12.30 p.m. at good strength, suffers interference. Musical programme closes at 1 p.m. (Cushen).

CE-970, Valparaiso 9.728mc, 30.82m
When closing at 2 p.m. announces in English (Cushen).

Dutch Guiana (Surinam)

PZX-5, Paramaribo 15.405mc, 19.48m
Still quite a nice signal each night. Their chimes and the very mechanical calls intrigue me. There is also the uncertainty as to how much slow their clock is, too (Gaden). (Note: I have shown frequency announced by station. —L.J.K.)

Ecuador

HCJB, Quito 15.115mc, 19.85m
Is operating on this new frequency from 8-11 p.m. and 4.30-9 a.m. (Howe "Universalite"). Often heard with other frequencies at 7.30 a.m. at good volume. Also heard at 10.30 p.m. (Gillett). Best at 6.30 a.m. when it is better than the Yanks. Weak at 12.15 p.m. Heard weakly at night (Gaden).

Paraguay

ZPA5, Encarnacion 11.955mc, 25.10m
Loggable at 10 a.m., but suffers from morse (Cushen).

Peru

OAX5C, Lima 9.80mc, 30.61m
Heard at 11.15 a.m. (Young).

OAX4Z, Lima 5.895mc, 50.90m
"Radio Nacional de Peru" has moved to this frequency from 6.082mc (Howe "Universalite"). Heard them on this new frequency till after 2 p.m. (Cushen).

U.S.A.

San Francisco unless otherwise mentioned

KNBI 15.34mc, 19.56m
Poor on opening at 9 a.m.—improves (Gaden).

KWIX 15.29mc, 19.62m
Now and then is quite good; usually poor (Gaden).......

KCBA 15.27mc, 19.64m
Never a very good station—best near 10.30 a.m. (Gaden).

KGEX 15.21mc, 19.72m
News at dictation speed 12.05 p.m. (Miss Sanderson). Good till closing at 1.15 p.m. (Cushen, Gaden).

KROJ 15.19mc, 19.75m
Opens at 6 a.m. at fair strength, but from 6.45 till 7.15 is often upset by WOOC.—L.J.K.

KNBC 15.15mc, 19.81m
This is the one from 11.20 a.m. (Gaden).

KRCA 15.12mc, 19.84m
Very good forenoon station till closing at 1 p.m. (Gaden).

KNBA 13.05mc, 22.98m
Not as good as KNBC in 11.20 a.m. session (Gaden).

KNBX 11.89mc, 25.23m
News at 11 a.m., etc.; signs at 1 (Cushen).

KNBC 11.89mc, 25.23m
Good in late afternoon (Gaden).

KCBF 11.77mc, 25.49m
Signs at 1.45 p.m. with United Network. Fair signal.—J.L.K.

KWIX 9.855mc, 30.44m
Very good at 8.30 p.m. (Miss Sanderson).

KCBF 9.75mc, 30.77m
At 10 p.m. in English is about 50-50 with WLWR in French (Edel).

KNBC 9.70mc, 30.93m
News in Japanese at 7.45 p.m. (Miss Sanderson).

KWID 9.57mc, 31.35m
Heard in mid-afternoon at good strength (Cushen).

KGEI 9.55mc, 31.41m
Good signal at 4 p.m. (Cushen). Can be followed at good strength from opening at 3.20 p.m. till closing at 6.45 p.m.—L.J.K.

KNBA 9.49mc, 31.61m
Home-town news at 4.05 p.m. (Miss Sanderson).

KES-2 .... 8.93mc, 33.58m
English Weekly Review at 12.45 a.m. (Edel).

KNBA 7.805mc, 38.43m
Good signal in Japanese at 10.15 p.m. (Edel, Gaden).

KCBF 7.57mc, 39.6m
Good especially near closing at 6.15 p.m. (Gaden).

KNBX 7.565mc, 39.66m
Signs at 3.05 p.m. with United Network (Cushen). Opens again in AFRS at 7 p.m. in parallel with KNBI, 6.02 m.c.—L.J.K.)

KGEX 7.25mc, 41.38m
Good after 5 p.m. (Cushen). News at 9 p.m. (Miss Sanderson).

KWIX 7.23mc, 41.49m
No good now with GSW on top (Cushen). Same here.L.J.K.

KCBA 6.17mc, 48.62m
Trans. in Dutch at 12.30 a.m.—good signal (Edel).

KRHO, Honolulu 6.12mc, 49.02m
News in Japanese 8.15 p.m. (Miss Sanderson). On March 20th did **not** re-open at 1.30 a.m. (Edel).

'Frisco

KROJ 6.105mc, 49.15m
Good at night (Miss Sanderson).

KGEI 6.09mc, 49.25m
Morse has found this one, too, but the General Electric laddie gets through.—L.J.K.

KNBI 6.02mc, 49.83m
Heard from 7 p.m. (Cushen).

U.S.A. other than 'Frisco

WLWL-2, Cincinnati 15.23m, 19.69m
"Stories Behind the News" at 9.30 p.m. (Miss Sanderson).

WRCA, New York 15.15mc, 19.81m
Heard nicely around 8 a.m. (Gaden).

WRUA, Boston 15.35mc, 19.54m
Very weak in a.m. (Gaden).

WLWL-1, Cincinnati 13.02mc, 23.03m
News in Italian followed by music at 7.15 a.m. (Miss Sanderson).

WNBI, New York 11.87mc, 25.27m
Signs at 2 p.m. in English (Cushen).

WCRC, New York 11.83mc, 25.36m
Signs at 2 p.m. with great signal (Cushen).

WRUL, Boston 11.73mc, 25.58m
Heard at 10.30 p.m. (Cushen, Miss Sanderson).

WBOS, Boston 9.897mc, 30.31m
Heard till 7.45 a.m. at good strength (Gaden, Cushen).

WNRA, New York 9.85mc, 30.44m
"Songs for Listening Session" 10.30 p.m. (Miss Sanderson). Very good from before 8-10 a.m. (Gaden).

WLWR, Cincinatti 9.897.5mc, 30.44m
Heard well at 10 a.m. (Gaden).

WLWR, Cincinnati 9.75mc, 30.77m
News in French at 7.50 a.m. (Miss Sanderson, Gaden).

WLWL, Cincinnati 9.70mc, 30.93m
Broadcasts to Europe till 6.45 a.m. (Cushen).

WRUS, Boston .... 9.70 m.c., 30.93m
Much improved at 9 a.m. (Gaden).

WLWO, Cincinnati 9.59mc, 31.30m
News in Flemish at 7.40 a.m. (Miss Sanderson).

WGEO, New York 9.53mc, 31.48m
Nice signal at 7.30 a.m. (Gaden).

WNBI, New York 9.67mc, 31.02m
Good at 7 a.m. (Gaden). (Closes at 7.30 a.m.—L.J.K.

WLWS, Cincinnati 7.832.5mc, 38.34m
Musical programme to Latin America 9 p.m. (Miss Sanderson). Heard closing at 10.30 p.m. after Spanish programme; signal R7-8 but spoilt by morse (Edel, Gaden).

WOOC, New York 7.820mc, 38.36m
AFRS programme 3-4.30 p.m. (Cushen).

WNRX, New York 6.10mc, 49.18m
Can be followed till about 9 a.m. (Gaden).

WRUA, Boston 6.06mc, 49.50m
Quite good at 7 a.m. (Gaden).

U.S.S.R.

Moscow unless otherwise mentioned.

—— 11.83mc, 25.36m
Very good in Spanish at 2.50 p.m. French is eard from 3 p.m. Is in parallel with 31.65m.—L.J.K.

—— 11.63mc, 25.79m
Paul Winterton calls BBC at 9.45 p.m. (Edel).

—— 9.545mc, 31.43m
Heard most nights at fair strength (Miss Sanderson).

—— 9.48mc, 31.65m
Very good in parallel with 25.36m in early afternoon.—L.J.K.

Radio Tashkent 6.825mc, 43.96m
Heard in Russian at 12.30 a.m. (Edel).

—— 6.77mc, 44.32m
Has an R9 plus signal at 12.30 a.m. (Edel).

—— 6.07mc, 49.42m
Closed at 10.20 p.m. (Edel).

—— 5.951mc, 50.40m
Home programme at 11.30 p.m. (Edel).

WEST INDIES

Haiti

HH3W, Port-au-Prince 10.13mc, 29.62m
Musical programme and talk in Spanish at night (Miss Sanderson). Signal now only R4 (Edel).

MISCELLANEOUS

Azores

Radio Ponta Delgada 7.02mc, 42.74m
At 5.15 a.m. is usually fairly easily logged with popular musical programme (Gillett).

Canada

CHTA, Sackville 15.22mc, 19.71m
Not such a good signal now, but heard best after 10 p.m. but signs at 11 p.m. (Cushen). It is 10.45 before I can hear CHTA and it is then very weak (Edel). Fairly good on odd occasions from about 10 p.m. (When in the clear earlier is badly heterodyned.) Sometimes heard with an all-English programme; other times French is used in addition to English (Gillett). At 10 p.m.on 23rd March, heard a lady announcer, "This is Canada calling. CHTA on 19.71 metres." News was then read with local news and sporting items. Fifteen minutes of music for Latin-America and then news for French listeners (Miss Sanderson). Have heard him well at times, badly at others. When he is good he beats all the Yonks on the 19-metre band except WLWS, but as WLWS is a Crosley, that is no disgrace (Gaden).

CBFX, Montreal 9.63mc, 31.15m
Good at 10.30 p.m. (Young).

CFRX, Toronto 6.07mc, 49.42m
Heard call-sign and frequency at 10 p.m. Morse bad; signal R4-5 (Edel).

France

Paris 15.24mc, 19.69m
Heard from 10-11.30 p.m. (Gillett).

Paris 11.845mc, 25.33m
Opens between 6 and 6.45 p.m. (Gillett).

Paris 9.52mc, 31.51m
Heard opening at 6 a.m. but is hard to follow because of interference from GWJ and GSB (Gillett).

Paris 9.49mc, 31.61m
From around 5 p.m., spoils good signal from KNBA.—L.J.K.

Italy

HVJ, Vatican City 17.445mc, 17.20m
Heard at midnight (Young).

"The Voice of Italy" 6.02mc, 49.80m
Heord well at 6.50 a.m. with musical programme (Gillett).

Luxembourg

Radio Luxembourg 15.105mc, 19.86m
Quite good about 10.45 p.m. when in contact with WQV, New York (Gillett).

Mexico

XEQQ, Mexico City 9.68mc, 30.99m
On Sundays broadcasts till 4.15 p.m.—signs with "Bolero"; other days signs at 3.45 (Cushen).

XEWW, Mexico City 9.50mc, 31.58m
Has been wonderful strength several nights about 11 o'clock (Gillett).

Poland

Polske Radio, Lublin 6.115mc, 49.05m
Very good signal after KRHO signed off at 1.15 a.m. News in Polish—male and female announcers (Edel).

Switzerland

HEI-5, Berne 11.715mc, 25.61m
Very fine 6-7.30 p.m. Tuesdays and Saturdays (Cushen). Signal fades a little after 6.45—have recommended opening earlier.—L.J.K. Heard opening at 1 a.m. with musical programme. Talk at 1.30 in English. Delightful signal (Edel).

HEI-2, Berne 6.345mc, 47.28m

Syria

FXE, Beirut 8.025mc, 37.41m
"Radio Levant" in Arabic with R6 signal at 12.45 a.m. (Edel). (Note: Back on old frequency.—L.J.K.)

Speedy Query Service

Conducted under the personal supervision of A. G. Hull

J.C. (Caboolture, Q.) writes: "From a study of radio—or rather on interest in radio over several years, together with some practical experience—I have concluded, along with many others, that for a two-stage audio circuit, single-ended, and of reasonable power for home use, it is very difficult to surpass the combination of a petode driver—6C6, 6J6, 6B7, 6G8, etc.—followed by a triode of which the A3 is the only type commonly used. Theoretically, the arrangement is hard to fault. Its fidelity is only matched by the pentode output valves with inverse feedback, and in my opinion the "listening test" inevitably favours the triode.

This opinion is not mine alone by any means. Recall your own publications of about 1937 when your good single-ended amplifiers were the good old 6C6—6A3 or 2A3 combination.

With this in mind, I have for a long time wondered why commercial radio designers appear studiously to avoid this combination of valves. They are quite fond of a triode driving a pentode, which seems to me to use each valve in the less favourable application. They also use pentode-pentode, with and without inverse feedback—BUT NARY A TRIODE.

Now, these commercial radio designers are no fools, and so I conclude that I must be seeing on'y one side of this argument. I should like your opinion on this question: "Why is it that the output valve combination, pentode driver—triode output, so good in theory, and so popular with amateurs, has never to my knowledge been used in the popular commercial receivers?"

A.—We can offer no explanation of this peculiar state of affairs. Possibly some of our factory technicians will assist with a reply.

* * *

T.McK. (Howard, Q.) is a schoolboy with limited means. He wants to know if a top of a kerosene tin can be used as a chassis.

A.—Yes, there is no fundamental reason why a kero tin should not be used; in fact, it is quite good to solder to. In fact, we published a photograph of an amplifier built in a kerosene tin in an issue about April, 1940, if memory serves aright.

* * *

W.W. (Narromine) enquires about our reply-by-mail service.

A.—Frankly, we do not like to say too much about this service these days, as manpower problems are insuperable. The service is still in operation, theoretically, but, in fact, you have to be exceedingly lucky to get a reply within a month, a lot depending on how simple the question is. Some people can ask awkward sort of questions which take hours of time to cover fully. We are not afraid to make this confession, because we know that most technical journals, both here and abroad, have been compelled by circumstances to discontinue their query services entirely.

* * *

R.A.C. (Black Forest, S.A.) has built a set from a circuit in the March, 1944, issue, but it does not operate and the bias resistor overheats.

A.—This is a certain indication of excessive current being drawn from the high tension, or even of a short circuit from high tension to earth. If the output valve appears to overheat, then we would suspect a broken-down coupling condenser in its grid circuit. But if the output valve is cool, then we suspect that an electrolytic condenser or the .1 mfd. across the high tension has broken down. Take out the .1 mfd. condenser for a start and see if this stops the overheating. Look carefully for mistakes in wiring and for lumps of solder short-circuiting valve socket terminals. The circuit was O.K., so you need not worry about getting another circuit, but concentrate on finding the fault in the set.

* * *

J.A.J. (Whitebridge) enquires about a part-time radio servicing licence.

A. — Application for a licence should be made to the Directorate of War Organisation of Industry, Ministry of Post-war Reconstruction, Sydney. Drop them a line with details and they will send you back the forms to fill in. There is no charge for the licence fee. Your subscription expires with the issue of September, 1945.

* * *

S.G. (East Coburg, Vic.) has a set which runs well for an hour and then fades, but may give a click and return to normal.

A.—This sort of trouble drives servicemen nearly crazy, even when they have the set in front of them on the bench with meters in circuit. You can imagine how helpless we feel at this distance, and with so little to go on. If you can be sure that all voltages remain normal during the fade, it would appear almost certain that the trouble is due to a screen by-pass condenser going open circuited, due to faulty internal connection. Try replacement of this by-pass condenser. Make quite sure about the insulation of the aerial terminal.

* * *

E.H.W. (Subiaco, W.A.) writes at some length.

A.—Your letter greatly appreciated and would like to answer in full when time permits, but especially busy at the moment. Hope to get a November issue for you, but they are very scarce. Not much hope for a good audio trannie until things get back to normal.

AUDIO FREQUENCIES

(Continued from page 28)

need for adjustments.

2. Any coil can be made to operate in the oscillatory circuit.

3. Reasonable variations in supply voltage have very little effect on the oscillator's output.

4. A simple tapping switch to progressively increase the value of C1 provides an excellent means of obtaining a series of fixed frequencies.

5. The entire unit can be built up very small and inexpensively, and also the parts are readily obtainable.

CONTINENTAL DESIGN

Continued from page 13)

stations, which, on our present-day sets, are usually marred by static, "monkey chatter" from adjacent strong stations and fading.

For the builder, this new high-gain set will, of course, have a few stability problems. It will have to be designed, not just stuck together. It will be a job to be tackled by radio engineers or experienced amateurs. The beginner will probably only get a concerto in screech sharp major out of it.

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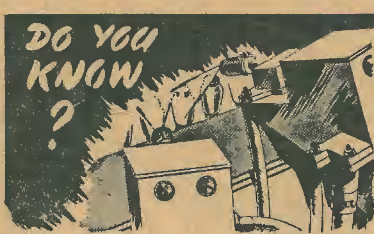

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—H.B., Western Australia.

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—D.H., Home Hill, Q'ld.

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