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# XTAL


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**LEASIDE — ONTARIO**

**OCTOBER**
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**VOL. VI NO. 3**

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# Filter Facts

By I. H. Nixon, VE3ACL

In the last issue of XTAL it was pointed out how greatly improved filtering and regulation could be obtained from any power supply by means of an electronic regulator. While this device cannot be recommended too highly from the point of view of both performance and economy, nevertheless the old inductance-capacity type of filter will probably continue to find a place in most ham transmitters. Inasmuch as many rigs are still in the design stage, a few facts about this type of filter may be of assistance.

It is an undisputed fact that the average ham before the war looked on his power supply as that heavy thing down at the bottom of the rack that produced pure D.C. (approx.) in limitless quantities merely by connecting a couple of chokes and any condensers that happened to be available to the output of a rectifier whose ratings were unimportant. The writer, on dismantling his pre-war transmitter, discovered to his discomfiture that he had been using a fixed choke in the input and a swinging choke as the second inductance (this simply isn't done in the best circles). To many of these hams, armed with WAC certificates and VK7 QSL's to prove the efficiency of their rigs, it may be difficult to demonstrate the advantages of power supplies that are engineered, not just built; but the task may become easier when it is realized that good regulation in the final amplifier supply will produce cleaner keying, and that improved filtering will make their variable frequency oscillators indistinguishable from a crystal. The argument that rectifiers will last longer is not likely to carry as much weight, for the simple reason that the manufacturers are in the habit of building tubes that will undergo unbelievable punishment and still live; however, all members of the Society for the Prevention of Cruelty to Valves will reap their reward from the knowledge that the blue glow emanating from their 866's is indicative of pleasure and not of pain.

To get down to facts, what is required from any power supply is adequate filtering for the type of service in mind, and good regulation under varying loads. The latter is particularly important in the final amplifier stage of a CW rig (no matter what stage is keyed) and in the Class B modulator where phone is used. For this reason, the following discussion presupposes the use of mercury-vapor rectifiers and choke-input filters, since condenser input is notorious for its poor regulation, and in any case is not recommended for use with mercury-vapor tubes as discussed later.

Filtering or ripple percentage, of course, depends on the supply frequency and the product of the inductance and capacity used. Regulation depends on the IR drop in the transformer and the filter chokes, but to an even greater extent on the inductance of the input choke. While these are the outstanding features of a power supply, another design consideration that should not be overlooked is the peak current rating of the rectifier, if tube life is to be satisfactory. It is because peak current is somewhat difficult to calculate exactly that this particular tube rating is usually ignored by the amateur fraternity, but under certain conditions it can be greatly exceeded without the guilty party being aware of it (condenser input is in the doghouse for this reason). Peak current is also dependent on the inductance of the input choke, the size of the filter condenser following this choke, and on the D.C. load current.

When designing a supply, therefore, the input choke should receive first consideration (assuming, of course, that a rectifier has been chosen which has adequate peak inverse voltage, average load current and A.C. volts per plate ratings). In the majority of supplies which operate under varying loads, poor regulation is due to insufficient input inductance at light loads. Any treatise on the subject will demonstrate how the D.C. output voltage of a choke-input supply (neglecting drops in the rectifier tube and chokes) is .9 of the RMS voltage developed across half the transformer secondary winding, while with condenser input the D.C. voltage at light loads may rise as high as 1.4 times the RMS value. In other words, inserting an inductance between the rectifier and the first filter condenser reduces the D.C. output voltage; it is obvious that by using a very small choke the reduction from the voltage obtained with condenser input will be slight, while with a larger choke it will be greater, until



eventually a value of inductance is reached which brings the D.C. voltage down to .9 of the RMS value. This is known as the **critical inductance**, and using larger values will not cause any further reduction in D.C. output voltage. The catch is that the critical value varies greatly with load current. Under heavy load it is relatively small (as low as 4 or 5 henries) but under light current drain 70 or 80 henries or even higher may be required if the voltage is to be prevented from rising as in a condenser input filter.

Calculation of the critical value of inductance is simplified by using the approximate formula:

$$\text{Lcrit. (60 cycles) Lcrit.} = \frac{\text{D.C. output voltage}}{\text{D.C. output current in ma.}}$$

$$\text{Lcrit. (25 cycles) Lcrit.} = \frac{\text{D.C. output voltage}}{\text{D.C. output current in ma.} \times 2.4}$$

by means of which the values can be determined for both extremes of loading.

Let us suppose that a typical Class B supply requires a critical inductance of 25 and 5 henries at light and heavy loads respectively. An ordinary 10-henry input choke would fill the bill at one extreme but not the other and would give poor regulation, while a 25-henry choke would be satisfactory but would cost more and take up more space. The usual solution is to employ a "swinging" choke, the inductance of which changes with the D.C. current passing through it, being high with small currents and small with high currents. A swinging choke of this nature can easily be made by reducing the air gap in an ordinary choke, which will increase the inductance at light currents but at the same time cause the core to saturate easily (and the inductance to drop) when the current through it is increased. A standard 10-henry choke operated at its rated maximum current with a reduced air gap will have an inductance of only 5 henries (approx.) but at currents around 10 per cent of the rated maximum the inductance will rise to around 25 henries. (Similarly a 30-henry choke can be made to swing from 15 to 60 henries.) In the supply under consideration, then, a 10-henry choke can be used with the air gap reduced; the critical inductance requirements are met, and the D.C. output voltage cannot rise excessively.

Now that the regulation is taken care of, peak current through the rectifier should be investigated. It is necessary to check this only under full load conditions, as peak current is composed of D.C. load current plus the alternating current flowing through the filter and is therefore not likely to be exceeded at light loads.

Now it has been established that there is a definite relationship between D.C. load current, input inductance, and peak current which is sufficiently accurate to obviate the necessity of resorting to mathematics. It works as follows: With critical inductance the peak current through one-half of a full-wave rectifier is double the D.C. current taken from the supply; with the input inductance equal to twice the critical value (known as the "optimum" value) the peak current through one-half the rectifier is only 10 per cent higher than the D.C. current, which is as low as can be achieved with practical components. It is evident then that if we make our input inductance equal to the critical value, the peak current will be within the rating of the tube (for peak current rating is usually at least twice the average or D.C. current rating), but by using the optimum inductance the peak current is substantially below rating. This is desirable, because tubes will last longer; or what is probably of even greater interest to hams, tubes can be operated at around 25 per cent more average current without shortening normal life expectancy, provided the peak current rating is never exceeded. Thus a pair of 866's can be run at 625 ma. or 816's at 325 ma. with no detrimental results. Experience may show that even these figures are conservative for ICAS use.

There is only one qualification to the above, but it is a very important one. If the series resonant circuit formed by the input choke and the first filter condenser resonates at or near the fundamental ripple frequency, the A.C. impedance will drop to approximately the D.C. resistance of the choke and the peak current will rise to very excessive heights. The following table lists values of inductance and capacity which should be avoided for this reason:

| 60 Cycle Supply (120-Cycle Ripple) | | 25 Cycle Supply (50-Cycle Ripple) | |
|---|---|---|---|
| L | C | L | C |
| 5 h. | .35 mfd. | 5 h. | 2 mfd. |
| 10 h. | .175 mfd. | 10 h. | 1 mfd. |
| 15 h. | .12 mfd. | 15 h. | .65 mfd. |
| 20 h. | .09 mfd. | 20 h. | .5 mfd. |
| 30 h. | .06 mfd. | 30 h. | .25 mfd. |

It will be observed that the danger is rather remote with the usual ham combinations, being more apt to occur on 25 cycles than on 60. It is recommended that a minimum of four times the capacity shown above be used with each choke size, which means that on 25 cycles an 8 mfd. (or larger) condenser should be used with a choke which goes as low as 5 henries at any part of its swing.

It was previously shown that our supply under discussion required a choke that would swing from 5 to 25 henries if good regulation was to be achieved. We now see that for reasons of peak current the swing should be from 10 to 25 henries (10 to 30 would be preferable to allow some margin for error at light loads). This no longer can be obtained from a standard 10 henry choke with a reduced air gap. This means we will have to resort to at least 20 henries (nominal value) or, if that size is not available, to 30 henries. This introduces several major disadvantages — much higher cost, increased physical size and weight, and higher D.C. resistance, which in turn means lower D.C. output and to some small extent poorer regulation.

There is, however, a simple circuit which does the job even more effectively and with none of the above disadvantages. It consists of tuning the input choke to form a parallel-resonant, high-impedance filter at the fundamental ripple frequency (Fig. 2).

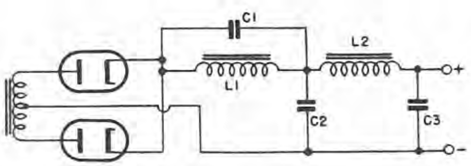


FIG 2

This device brings the cost down to that of a small tubular or oil-filled condenser, greatly increases the effective inductance of the input choke and adds nothing to the D.C. resistance of the filter. In addition, it eliminates the possibility of resonance with the first filter condenser, because the "input choke" (actually L1 and C1 in parallel) no longer contains any reactive component, and this insures the maximum reduction of peak current.

Tuning the input choke in this manner on two samples used in a 25-cycle supply raised the equivalent inductance to five or six times the nominal value at light loads (approx. 15 per cent of the maximum current rating), and to approximately 175 per cent of the nominal value at maximum current. The swing is due to the fact that the tuning was done at minimum load, and both the inductance and the Q are lowered as the current through the choke is increased, which tends to detune the combination from resonance and lower the impedance. (This effect is observed even in smoothing or fixed chokes, the inductance of which changes slightly with D.C. current, although not nearly as much as with a swinging choke.) Thus a 10-henry choke was made to give the same results as a 17.5-60 henry swinging choke with none of the disadvantages of the latter, and while these figures are subject to variation, it is confidently expected that performance of the same order can be expected from chokes of different size and manufacture, and from other ripple frequencies. For best results, however, certain precautions should be observed:

1. The choke used must not be a swinging choke, or the detuning effect as the load changes (mentioned above) will be sufficient to cause poor performance. The slight change in inductance in a smoothing choke with a normal air gap can be allowed for as outlined below.

2. The condenser must be of the paper or oil type and should have a D.C. working voltage rating equal to or higher than the D.C. output voltage of the supply, since it must stand the peak A.C. ripple voltage developed across the choke. Both terminals must be insulated at the same rating from the case or mounting.

3. C1 and L1 in Fig. 2 form the resonant circuit. The size of C1 can be taken from the resonance table given above for the appropriate size of choke, but this should be considered only as a starting point, since the exact inductance of the choke will probably not coincide with the value marked on the nameplate. The capacity should then be varied in 10 per cent increments in both directions until the correct value is found.

4. Tuning can be done at either light or full load, depending on circumstances, with some detuning being inevitable at the opposite extremes. In the supply previously referred to, where a swing of from 10 to 30 henries is required, tuning would probably be most effective at full load, which might produce a swing of the order of 20-45 henries instead of from 17.5-60 as quoted earlier. In this case the choice is dictated by ripple attenuation and peak current, since regulation is amply covered either way. Tuning should therefore be done with maximum load on the supply, noting when the minimum ripple amplitude is atained.

5. In cases where very large inductance is required for regulation, tuning should be done at the lightest load. In this case resonance is indicated when the D.C. output voltage reaches its lowest value. It is probable that this method is the more satisfactory one, since detuning at full load will result in only a slight increase in ripple and peak current compared to the method of paragraph 4.

Ripple can conveniently be measured on an oscilloscope or with a rectifier-type A.C. meter connected to the H.V. through a 4 or 8 mfd. blocking condenser of the required voltage rating. If the latter method is used, care should be taken to switch the meter to its highest range when turning the supply on and off to accommodate the condenser charge.

6. While the attenuation of the fundamental ripple frequency is increased by this circuit, it offers little opposition to ripple harmonics. However, as these are of a lower order of magnitude they are satisfactorily removed by the second section of the filter, which should not be omitted for this reason.

We now have a power supply with the best regulation possible, and in which the peak rectifier current is so low that we can run our tubes considerably over their average current ratings. To date nothing has been said of the amount of ripple present. While most people consider this the prime consideration of any filter, actually it is the least important as far as ease of design is concerned. All that is necessary now is to add a second section which, together with the first which has already been discussed, will reduce the ripple to a satisfactory level. The following formulae can be employed to determine the ripple percentage:

$$\% \text{ ripple} = \frac{650}{L_1 \times L_2 \times (C_1 + C_2)^2} \quad \text{(25-cycle supply)}$$

$$\% \text{ ripple} = \frac{21565}{L_1 \times L_2 \times (C_1 + C_2)^2} \quad \text{(60-cycle supply)}$$

When the input choke is tuned, the value of L1 substituted in the above equations can be from 1.75 to 2 times the nominal value. Note that this method gives approximately four times the filtering which would be obtained from the same choke with a reduced air gap (swinging choke).

When selecting filter components, bear in mind the amount of filtering that is required for the various transmitter circuits as follows:

- .01% ripple for high-gain speech amplifiers.
- .1—.25% for VFO's, low-level speech, RF amplifiers in phone transmitters.
- .5-1% for xtal oscillators, push-pull modulators.
- 5% for RF stages in transmitters used only for CW.



TABLE I

| Supply | Tubes | Chokes | Condensers | Service |
|---|---|---|---|---|
| #1 | 2-816's | 10 h.-10 h. | 10 mfd.-10 mfd. | Class B |
| #2 | 4-816's | 12 h.-12 h. | 16 mfd.-16 mfd. | Class C |

| | | Choke Untuned | | Choke Tuned | | Percentage |
|---|---|---|---|---|---|---|
| Supply | Load | D.C. Volts | Ripple | D.C. Volts | Ripple | Regulation |
| #1 | 65 ma. | 605 | 1.3v. | 588 | .2v. | 11.5% untuned |
| #1 | 150 ma. | 535 | 6.7v. | 536 | 3.7v. | 8.8% tuned |
| #2 | 25 ma. | 1400 | ........ | 1030 | ........ | 28.5% untuned |
| #2 | 150 ma. | 1000 | ........ | 935 | ........ | 9.2% tuned |

**Notes:**—1. Ripple in supply #2 not measured due to lack of equipment.

2. Improvement in regulation greater in supply #2 because load variation greater.
3. Drop in #2 supply full-load voltage (1000 to 935) when choke tuned due to fact that when the choke was untuned, critical inductance was not provided even at 150 ma. load.
4. Further improvements in regulation can be made by using transformers and chokes with very high current ratings in order to lower D.C. resistance. Ten per cent regulation can be considered excellent, five per cent unusual.
5. Maximum voltage across filter condensers reduced almost 400 volts (supply #2) which provides an extra safety factor and longer life.

The ripple percentage will decrease with decreasing load, due to the fact that choke inductance goes up (especially if it is tuned or of the swinging type). It should be noted that tuning the first choke to resonance permits a 25 to 30 per cent reduction in both filter condensers with no accompanying increase in ripple, which means in effect that the use of this circuit should by no means be confined to supplies with varying loads. Another point that should be borne in mind is that if a total of 16 mfds. is to be used, better filtering is obtained when 8mfd. is used in each section than when 4 mfd. is used in one section and 12 mfd. in the other.

The figures given in Table I were obtained from two experimental supplies operating on 25 cycles.

It is hoped that this discussion will clear up certain points which have stood in the way of good power supply design, and which are treated vaguely (even erroneously) in many outstanding texts. It is becoming more and more imperative for the amateur to keep up with progress in the radio art, and there is no better place to start than in the power supply—lowliest chassis of them all. Besides, you will find some effort here will exterminate a lot of bugs just exactly where they should be exterminated — before they hatch!

## THE SHUT-INS

These are the boys who are operating under the most trying conditions. It is the wish of XTAL that they have all the publicity they require. Write in, boys. The hams will see to it that you do not lack assistance.

Clark Pollock, 17 Springhurst Ave., Toronto, is confined to a wheel chair, which still did not prevent him from getting out by taxi to the Radio College of Canada for a six-week's course in radio servicing. He is also a Member of the Wireless Association of Ontario, ARRL and VE Ops. Morely Patterson, 3GQ, has assisted him with his code, etc. Clark would like to have the addresses of any shut-ins who have obtained their licenses.

## CORRECTION

On page 12, column 2, of September XTAL, the equation in the middle of the column should read E over I, instead of as shown.

## The Toronto Hams Present a HAMFEST

Date: Friday, November 16th.
Time: 2 P.M. onwards
Place: Royal York Hotel, Toronto, Ontario
Program: 2 P.M. to 5.30 P.M.—Sessions. 5.30 P.M. to 7.15 P.M.—Rag Chews. 7.15 P.M.—Banquet.

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**The VE Operators Association**
**Leaside, P.O., Ontario**

## ATTENTION ALL VE'S

We have been unable to deliver XTAL to the hams listed below because of incorrect addresses. It is logical to assume that the Department of Transport will have no better luck with official communications.

| | | | |
|---|---|---|---|
| 3AER | 3ANR | 3BT | 3OF |
| 3AFA | 3ATO | 3HT | 3OJ |
| 3AHQ | 3AUZ | 3IQ | 3PO |
| 3AJP | 3BAG | 3JC | 3QR |

If the above hams, or anyone knowing their whereabouts, will send in the correct addresses, we will forward them to the Department of Transport.

## OUR COVERS

As you've guessed, our covers on each issue are done by the camera fiends. Any ideas or photos you may have for future covers would be greatly appreciated.



# Q Meter - - Part II

By G. A. Richards, ex-VE3ALC

Having completed the construction of the instrument described in Part I of this article (see photographs), the next step is to put it into operation and carry out the calibration. It is very important to calibrate the unit with great care if accurate and dependable measurements are expected from it. There is nothing that inspires more confidence in a piece of test equipment than the knowledge that it has been carefully calibrated, preferably by the user. The calibration procedure is not really difficult, though it may be considered a little bit tedious.

The first step in getting the unit into operation is to check that the oscillator is working on all ranges. This may be done by inserting a 10,000-ohm 1-watt resistor in the test terminals, turning the Output control to maximum and the Slideback Voltage control to zero. With the band switch on a low frequency range it should be possible to more than close the eye of the V.T.V.M. with the output at maximum. Check also to see that the V.T.V.M. is functioning properly by observing the eye when the Output control is turned to zero, at which point the eye should open fully. The eye should close at least partially at any dial setting on any range with the output at maximum, and the degree of closing is an indication of the R.F. voltage being developed. On any one band the voltage will tend to be higher at the high-frequency end of the dial; but for any given dial setting, the voltage will be lower on the higher-frequency bands. On the top band the eye may close only about 10 degrees, and still be quite satisfactory.

Front View of Q Meter With Plug-in Standards

**Calibration:**

To describe in detail each minute step in the frequency dial calibration procedure would probably be superfluous, and would promote confusion more than anything else, since no two amateurs are likely to possess exactly identical facilities for the job. However, the following generalized instructions should be of some assistance.

First, all frequency calibration must be performed with the Q-dial trimmer set at mid-capacity. This point may be determined by actual capacity measurements on the trimmer either before or after installation in the circuit; or it may be set closely enough by simply bisecting the angle between the point where the plates are fully meshed and the point where the edges of the rotor plates ar just emerging from the stators. The latter assumes the use of a straight-line-capacity condenser, of course. (Note that it is not correct to assume that the mid-capacity position is half-way between "fully meshed" and "wide open", but is usually about 80° from the fully meshed condition.)

Secondly, it is wise to make rough preliminary checks of the limits of all bands to make certain that there are no gaps between them, and to make any necessary adjustments on the coils, before actually carrying out the calibration procedure. The ranges obtained on the writer's instrument were actually somewhat in excess of the nominal ranges stated, thus providing a comfortable amount of overlap: e.g., Band 2, nominally 150 to 450 kc., tuned actually from 142 to 459 kc.

All frequency checking should be done by heterodyning, in an appropriate receiver, against the best available frequency standards. Band 1 (50-150 kc.) may be checked by beating the harmonics of the Q meter against various broadcast stations. By working out the sub-harmonic frequencies of the 10 or 15 nearby stations it is possible to get several reliable check points across the range. Ten or 12 evenly spaced frequencies should be selected, with perhaps one or two extra ones at the high-frequency end of the band where the curve will probably flatten out. If there is doubt as to which harmonic of the Q meter is being picked up, this may be checked by observing the frequency interval between the several harmonics appearing across the receiver dial. The frequency difference between these harmonics is equal to the fundamental frequency of the Q meter. Bands 2 and 3 may be done similarly to Band 1 except that there will not be as wide a selection of harmonic check points in the broadcast band; and it may be necessary to rely on some more distant stations, and to carry out the procedure at night when their signals are more reliable. Above Range 3 an all-band receiver is almost a necessity. Bands 4, 5 and 6 can be checked by the same general method as bands 1, 2 and 3, except that it will probably be impossible to find enough reliable transmitting stations of known frequencies to provide a sufficient number of check points in these high-frequency bands. It is therefore necessary to provide one's own source of test frequencies.

If a crystal calibrator is available, then there is no problem. If not, it is suggested that a simple oscillator, of almost any description, be thrown together breadboard style (but equipped with a vernier drive on the tuning condenser). This oscillator should tune to 100 or 200 kc. for calibration of Band 4, 200 or 500 kc. for Band 5, and 1 or 2 mc. for Band 6, and should be designed for high harmonic output. The oscillator frequency

can then be set accurately by beating a harmonic against one of the standard frequencies transmitted by station WWV (2.5, 5.0, 10.0, and 15.0 mc.). The oscillator should be given a 30-minute warming period before using, and should be rechecked periodically against the WWV signal. The many harmonics of this oscillator, thus standardized, will provide ample check frequencies to carry out the entire calibration of the three top bands.

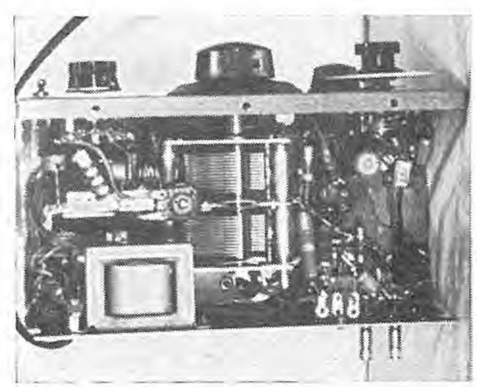
Incidentally, another Q meter of the same description, if available, will fulfil admirably the purpose of the test oscillator.

When the calibration points have been obtained for each band the calibration curve can be plotted. Somewhat greater usable accuracy may be obtained by splitting the curve into two sections as shown in Fig. 4. All bands will have curves of the same general shape (except for compression or expansion in the vertical axis), and if this is not so in any particular case, then the calibration points should be rechecked. Futhermore, it is assumed that the minimum circuit capacity will be very nearly the same on all bands, and that therefore the ratio of maximum to minimum frequency will be the same on all bands; and it is upon this assumption that a single calibration of the Q dial serves for all bands. The assumption is not strictly correct, due to differences in the distributed capacities of the oscillator coils, but for practical purposes these differences may be neglected. (A hair-splitting individual can satisfy himself by shunting each coil with a small fixed capacity until all



bands tune the same proportional amount).

Calibration of the Q dial may now be commenced. With the dial set in the mid-capacity position, as in all of the foregoing procedure, locate the "infinity" mark on the Q dial by marking the dial at the point indicated with the adjustable Q pointer against its stop. The problem now is to locate marks on the Q dial representing frequency changes (above and below that indicated on the Frequency dial) of total amounts reciprocally related to the Q: i.e., for a Q of 100, the Q dial must vary the initial frequency by a total amount of one one-hundredths, one two-hundredths above and one two-hundredths below. Or to choose actual figures, at a Frequency dial setting of 1,000 kc., for a Q of 100, the total frequency variation effected by the Q dial must be 10 kc., 5 above and 5 below 1,000 kc. As stated in Part I of this article, the Q dial is calibrated (arbitrarily) to read directly when the Frequency dial is set at 50, and a "Q multiplier" is applied to the reading for any other dial setting. At 50, the maximum frequency deviation obtainable by moving the Q dial is about one-thirtieth; or, in other words, the lowest Q indicated is 30. However, at the high end of the Frequency dial, the same Q dial capacity variation will naturally cause a much greater frequency variation. In practice, using a mid-line capacity type of main tuning condenser, the proportional frequency variation at the high end will be about three times that at 50, representing a true Q of 10 for a reading of 30. Similarly, at the low end of the frequency range the reading of 30 represents a true Q of about 90.



To proceed with the Q calibration, we shall skip the usual generalized discussion, and describe an example to illustrate the method clearly. The figures to be used apply to the writer's instrument, but it is a simple matter to substitute new figures when calibrating a new instrument.

We shall first set out to find the calibration mark for a Q of 40. To do this we shall choose Band 3, since it is perhaps the one most used. From the frequency calibration chart Fig. 4 we find that at number 50 on the dial the frequency is 708 kc. For a Q of 40 our Q dial must vary the frequency by a total amount of 1/40th of 708 kc. or 17.7 kc.

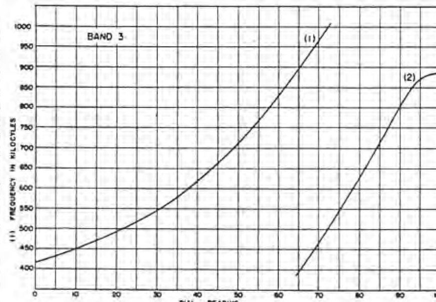



FIG 4 TYPICAL FREQUENCY CALIBRATION CURVE

If we now tune the frequency dial up near to the high end of the same band, to 1300 kc., say, then the same movement of the Q dial as before will cause a change of

$$17.7 \times \left(\frac{1300}{708}\right) 3 = 109.8 \text{ kc.}$$

This greater proportional frequency change is naturally easier to detect and to measure accurately, and so we shall resort to this trick in locating the calibration points.

A total variation of 109.8 kc. means 54.9 kc. above and 54.9 kc. below 1300 kc., and hence the two frequencies of interest are 1300+54.9 and 1300—54.9 or 1354.9 and 1245.1 kc., respectively; or say 1355 and 1245 kc. We use these frequencies as follows: First we tune the main dial to a frequency of 1300 kc. (Q dial at "Infinity" or mid-capacity) and arrange for some form of detector to resonate at this frequency or a harmonic. A beat-note in a receiver may be used, or a simple alternative is to insert a resonant circuit, consisting of a suitable coil and tuning condenser, in the

Q meter test terminals, and tune this circuit for a peak on the V.T.V.M. eye. In either case, the above "detector" is left untouched for the remainder of the process. Then tune to 1355 kc., or 93.5 on the dial (see Fig. 4), as carefully as possible. Turn the Q dial clockwise until resonance is again established. Advance the movable Q pointer up to where the Infinity mark now is. Next tune to 1245 kc. or 86.8 on the dial (see Fig. 4). Without disturbing the position of the Q pointer, turn the Q dial counter-clockwise until resonance is again reached. At this point put a light pencil mark in line with the pointer on the Q dial. The point may be checked by repeating the entire procedure once or twice using different settings on the frequency dial, e.g., 1200 and 1100 kc.

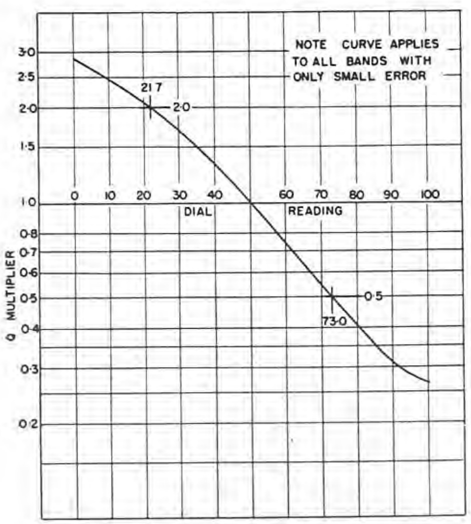



FIG 5 Q MULTIPLIER vs. DIAL READING

When satisfied that the "40" mark has been accurately located, then other points may be found by simply dividing the space between the "Infinity" and "40" marks in the inverse ratio of the Q's, i.e., 80 will be half-way between Infinity and 40, 160 will be one-quarter of the way, 60 will be two-thirds (40/60) of the way, and so on. This method is possible only when a straight-line-capacity trimmer condenser is used in the Q measuring circuit. The same general idea might be used to locate the "30" mark, but since even a straight-line condenser becomees non-linear near the minimum capacity position, it is wise to locate this point using the original procedure described for locating the "40" point.

The above calibration prepares the instrument for reading Q directly, but only when the main tuning dial is set at 50, on any band. One remaining part of the task is the preparation of the "Q-multiplier" curve which permits the Q reading to be corrected for any frequency dial setting, by very simple arithmetic. The Q multiplier is inversely proportional to the square of the frequency, and at 50 on the dial its value is 1.00. It is therefore a simple matter to calculate its value from:

$$\text{Q multiplier} = \left(\frac{f50}{fx}\right)^2$$

Where f50 = frequency when dial set at 50.

Where fx = frequency when dial set at any other point x.

The single curve will apply to all bands with negligible error. Fig. 5 shows the Q multiplier curve for the writer's instrument.

**Preparation of Plug-in Standards:**

For the purpose of using the Q meter to make measurements of condenser capacities, and the inductance and distributed capacity of coils, it is convenient to construct some plug-in coil and condenser assemblies whose properties can be recorded and filed with the various calibration curves. With three such "standards" (one coil and two condensers) it is possible to measure most of the components ever to be encountered. In the writer's instrument the standard coil is a 1.25 mh. pi-wound R.F. choke suitably impregnated and mounted on a short strip of polystyrene, equipped with two banana plugs arranged to plug into the Q meter output terminals and providing an additional pair of binding posts for connection to the unknown capacity. Silver micas are used for the two standard condensers, one of which is approximately 100 mmf. These are mounted in the same manner as the standard coil.

The properties of all of the standards, as well as the output capacity of the Q meter terminals should be checked by

(Cont'd on page 38)



# Rio De Janeiro Conference

There was very little activity at the Conference which affects the amateur fraternity. Contrary to popular opinion, the main purpose of the Conference was not to agree on frequency allocations of bands but rather to consider the renewal and revision of the Santiago Treaty which is mostly concerned with the establishment of an Inter-American Radio Office known as the "O.I.R.," which acts as a registry for all stations licensed by the American countries and also to keep each country fully informed on current radio legislation in other countries. However, it was proposed at the Conference that it might be well for the American countries to discuss informally the question of frequency band allocations so that they could present a comparatively united front at the forthcoming World Conference. The recently announced F.C.C. Allocation Table was presented to the Conference to use as a basis for discussion.

Amateurs who have had an opportunity of studying this Table will remember that the old 160 meter band has been eliminated due to the pressure from other services while the 80, 40, and 20 meter bands remained unchanged. At 10 meters the range is now 28-29.7 mc. instead of the previous 28-30mc. and in addition there is the new band 21-21.5mc., which is intended to compensate to some extent for the loss of the 160 meter band. The 56-60mc. band is moved to 50-54 to make room for television channel No. 2 and instead of 112 to 118 a band 144-148 is allotted. The 224-230 mc. band is now moved to 220-225 and 400-401 is now 420 to 450, but is to be shared with Air Navigation for a time with amateur power limited to 50 watts. When released by Air Navigation the 50 watt limit will be removed. New bands proposed were 1145-1245 mc., 2300-2450, and 5250-5650. While no frequencies were discussed at the meeting higher than 10,000 mcs., the United States Allocation Table assigns 10,000-10,500, 21,000-22,000 as future amateur bands. These were not discussed at the Conference mostly because no information as to their usefulness could be given, and the Conference, therefore, decided that under these circumstances they could not be intelligently considered. Also of considerable interest to most amateurs is the band from 460-470 mc. assigned to citizens radio with the thought that it could be used for walkie-talkie sets, etc.

In general the amateur bands as proposed were agreeable in most cases to the countries represented at the Conference so that it can be expected that when the World Conference convenes that the American countries will support the assignments. One or two objections, however, were filed. Canada objected to the 220-225 mc. and 420-450 mc. bands on the grounds that they were needed permanently in Canada and other countries of the British Commonwealth for air navigational aids. Our government stated that while they were quite willing to change this viewpoint if suitable lighter weight aircraft equipment was developed they did not feel that this was as yet an accomplished fact. It is, therefore, probably likely that amateurs in Canada will not be permitted to use these two bands for some time to come.

Chile said that in their country it was necessary for them to use half the 80 meter band for other services and wanted a note added to the list to this effect, but they were dissuaded from doing this by the other delegates as it was generally felt that the existance of the note might encourage other nations to do the same thing.

Arthur L. Budlong attended the Conference with the U.S. delegation representing the amateur fraternity, and very ably led any discussions which arose on amateur matters. He said that he heard many encouraging comments on the new 21 mc. band, and he feels that most of the other American countries will assign this for use of their amateurs. He felt that due to its good characteristics for north-south transmission that it would prove to be a valuable addition to the "ham" bands.

The only other matter which was discussed at the Conference which concerned amateurs was the resolution at the previous Santiago, Chile, meeting which proposed "that the organizations of amateurs in the American Continent reach agreement among themselves through their representative governments to establish and propose at the next Inter-American Conference a continental plan for the sub-division of the bands among the various types of emission." By agreement at this meeting it was felt that this subject no longer required attention and so it was agreed to delete it from the agreement.

Amateurs connected with broadcasting stations may be interested to know that there has now been some doubt raised regarding the extension of the "Havana Treaty," which determined the manner in which the various standard broadcasting frequencies were to be shared between the countries of North America as well as what countries had dominant station priority of each clear channel. This is because Cuba has indicated that she is dissatisfied with the terms of the Treaty as it applies to her and wishes to have a new Treaty formulated. An attempt is being made to effect a compromise by a meeting being called in January in Washington when either adjustments will be made to permit extension of the present Treaty, or else a new Treaty will be formulated. Canada proposed an extension of two years while the United States suggested one year. It is to be hoped that agreement can be reached to prevent a return to the annoying interference which existed before the present agreement was in force.

## ARE YOU A VE OPERATOR?

### Membership Graph

| | |
|---|---|
| 979 | Nov. 6 |
| 887 | Oct. 11 1945 |
| 719 | Sept. 5 1945 |
| QRX | QRX |
| 485 | Sept. 5 1939 |
| 400 | May 10 1939 |
| 200 | Oct. 6 1938 |
| 100 | June 2 1938 |
| 50 | April 29 1938 |
| 0 | October 1937 |

## MARCONI MAN GIVEN NEW POST

R. R. Desaulniers has been placed in charge of broadcast station equipment sales, with headquarters in Montreal. In 1924 he became a Marconi marine radio officer, and three years later "swallowed the anchor" to take over the post of ship inspector and installation engineer in Montreal. With the erection of their

R. R. Desaulniers

new factory in the town of Mount Royal in 1930, he was transferred there to carry out transmitter development and other experimental work. He later supervised the installation of radio equipment used by the armed forces, police and fire departments, public utilities and other essential civilian communication services. This rich background of experience in the world of radio makes him particularly suited for his new duties.

## W1AW

W1AW, ARRL station, has returned to the air on 3555, 7145 and 14280 kc. One-way transmissions will be made for conveying latest information to U.S. amateurs. Watch for W1AW at 8 p.m., 9 p.m., and 10 p.m. E.S.T.



# Resonant Transmission

By A. P. H. Barclay

### Line Sections (Part I)

**General Discussion:**

Most of us are familiar with transmission lines (open wire or coaxial) as used for transferring radio frequency power from the transmitter to the antenna, but we are probably not so familiar with their uses as resonant sections. Without going too deeply into the mathematics or the theory of these resonant sections, a few facts will be enumerated which, it is hoped, will help us to a better understanding of their characteristics and aid us in thinking up applications which make use of these characteristics.

(1) Since the term "resonant" is used in the description, it at once becomes evident that there must be some analogy to a resonant circuit of inductance and capacity, and hence frequency (wavelength) of operation must be a dependent factor.

(2) To be a resonant section a piece of transmission line must be terminated in an impedance other than its characteristic impedance. For the purpose of this discussion we will be primarily concerned with terminations which are either short circuits, open circuits, or pure resistances.

(3) As a result of paragraphs (1) and (2) above, we have the following conditions in a resonant section:

(a) Power sent down the line is not all absorbed by the load, but some is reflected.

(b) Combination of incident power and reflected power (current and voltage) sets up standing waves of voltage and current on the line. The ratio of maximum to minimum values of the voltage waves (or current waves) produced and the position of these maxima and minima are, of course, dependent upon the type and magnitude of the load mismatch.

(c) For various lengths of line or at various points on a given length of line the magnitude and phase relations of the voltage and current waves are different. They are always 90° out of phase, but may lead or lag one another as the case may be. From our knowledge of the reactance characteristics of a condenser or an inductance, we see that since the current wave is always 90° out of phase with the voltage wave, the line will act like a reactance—capacitive when the current leads the voltage, and inductive when the current lags the voltage. At points where the current wave changes from leading to lagging, we have the conditions for a resonant circuit of inductance and capacity.

(d) The impedance at various points along a given length of line is dependent upon the voltage and current relations at that point.

From the above we can briefly define a resonant transmission line section as "A section of transmission line which possesses standing waves of current and voltage, is of finite length and is not terminated in its characteristic impedance." Further, when a section of line is "resonant at an applied frequency" it is acting in the same manner as a resonant circuit of capacity and inductance.

Let us now investigate the characteristics of a piece of transmission line terminated in a short circuit. In Fig. 1 is shown such a length of transmission line with the voltage and current (standing wave) distribution shown, as well as the general impedance relation. From an examination of the current and voltage relations along the line it is seen how the impedance relations are arrived at. These are as follows: Starting at the shorted end, where the impedance is pure low resistance (equivalent to a series tuned circuit), and moving toward the generator end up to the first quarter-wavelength point, the reactance is increasingly inductive. At the quarter wave point the impedance is pure high resistance (equivalent to a parallel tuned circuit). From the quarter-wave point to the half-wave point the reactance is decreasingly capacitive. At the half-wave point the impedance is pure low resistance again (equivalent to a series tuned circuit). From the half-wave point to the three-quarter-wave point the reactance is increasingly inductive. At the three-quarter-wave point the impedance is pure high resistance (equivalent to a parallel tuned circuit). From the three-quarter-wave point to the full-wave point the reactance is decreasingly capacitive. At

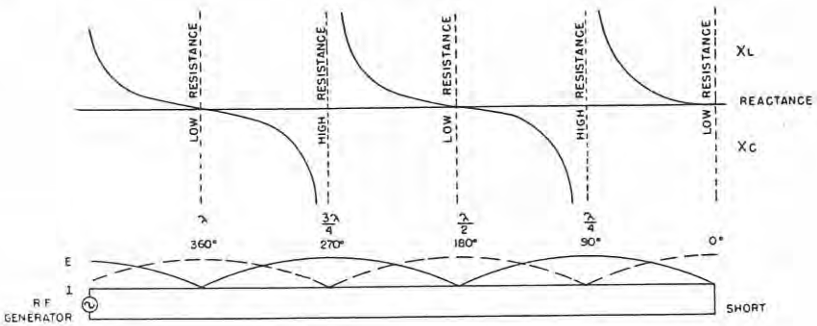


FIG I IMPEDANCE CHARACTERISTIC OF A SHORTED RESONANT LINE

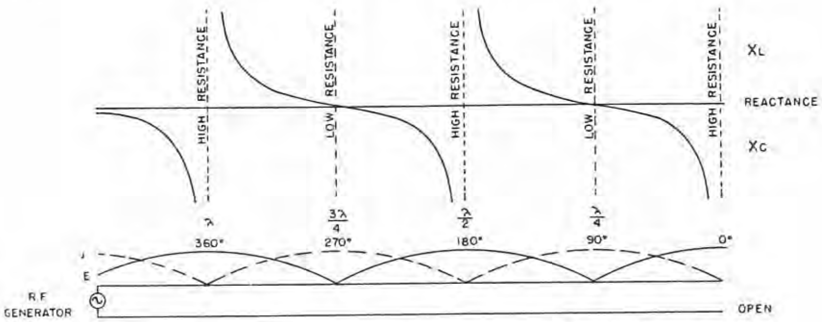


FIG 2 IMPEDANCE CHARACTERISTIC OF AN OPEN CIRCUITED RESONANT LINE

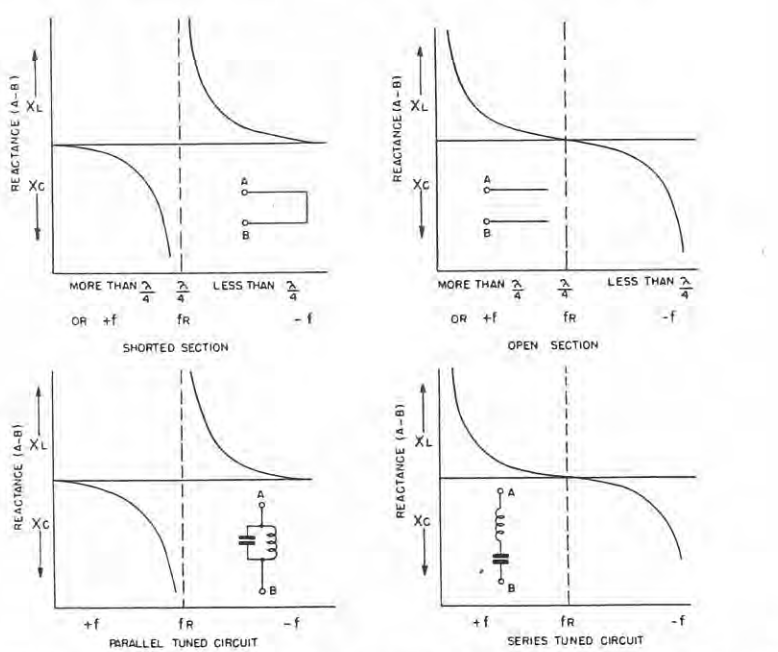


FIG 3 SIMILARITY OF TUNING CHARACTERISTICS OF RESONANT SECTIONS & TUNED CIRCUITS



full-wave point the impedance is again pure low resistance (equivalent to a series tuned circuit).

It is quickly seen that at the half-wave point the reactance phenomenon is repeated. This is true for any length of line, hence adding half-wave sections or multiples thereof to a section of line does not affect the characteristics of the section.

We will now go through the same investigation of a piece of transmission line terminated in an open circuit. Fig. 2 is similar to Fig. 1, but covers the case of the open-circuited line. Examining this in the same manner as Fig. 1, we find that starting at the open-circuited end we have the conditions for a reactance of pure high resistance (equivalent to a parallel tuned circuit). Progressing toward the generator, up to the quarter-wave point the reactance is decreasingly capacitive. At the quarter-wave point the impedance is pure low resistance (equivalent to series tuned circuit). From the quarter-wave point to the half-wave point the reactance is increasingly inductive. At the half-wave point the impedance will be pure high resistance (equivalent to a parallel tuned circuit). From the half-wave point to the three-quarter-wave point the reactance is decreasingly capacitive. At the three-quarter-wave point the impedance is pure low resistance (equivalent to series resonant circuit). From the three-quarter-wave point to the full-wave point the reactance is increasingly inductive. At the full-wave point the impedance is pure high resistance (equivalent to parallel tuned circuit).

Once more it is seen that at the half-wave points the reactance phenomenon is repeated and the same remarks apply as applied to the short circuit termination case.

Summarizing the information we have just gone through, we can say that resonant sections act in the same manner as resonant circuits, with the following deductions:

(1) Quarter-wave shorted circuits, or half-wave open sections are equivalent to parallel resonant circuits of inductance and capacitance.

(2) Quarter-wave open sections, or half-wave shorted sections are equivalent to series resonant circuits of inductance and capacitance.

(3) If the length is not a multiple of a quarter-wave the line acts as a

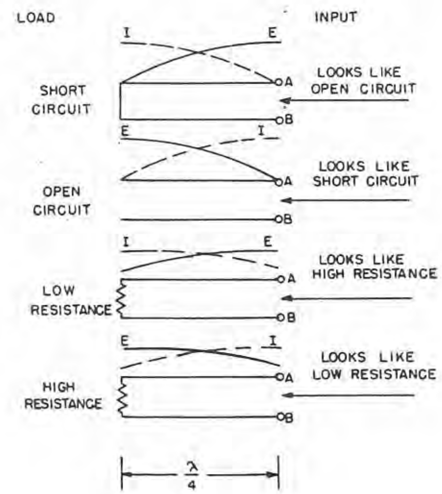


FIG. 4 LOAD INVERSION BY QUARTER WAVE SECTION

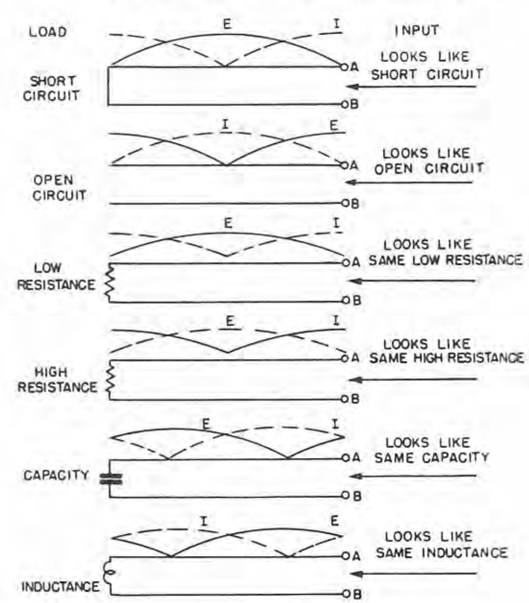


FIG. 5 LOAD REPETITION BY A HALF WAVE SECTION

capacitor on an inductor.

(See Fig. 3 for tuning characteristics of resonant section).

Other information which can be deduced or derived from the foregoing is:

(1) A quarter-wave section inverts a resistive load as seen at the source, and the input impedance can be determined as follows:

$$\text{Input impedance} = \frac{(\text{Line Impedance})^2}{\text{Load Impedance}}$$

(See Fig. 4).

(2) A half-wave section repeats the load. A half-wave section may be looked upon as being made up of two quarter-wave sections, so that the load is inverted by the first quarter-wave section and re-inverted to the original by the second quarter-wave sections. (See Fig. 5).

Other information may be deduced as to what will occur when the loads are reactive and the sections are of lengths other than quarter-wavelength or half-wavelength long; but, as mentioned before, we are not interested in exploring such cases.

**Determination of Characteristics:**

The characteristics of interest are as follows:

(1) Characteristic Impedance.
(2) Length.
(3) Reactance.

(1) **Characteristic Impedance:** The characteristic impedance of a transmission line is approximately

$$Z_0 = \sqrt{\frac{L}{C}}$$

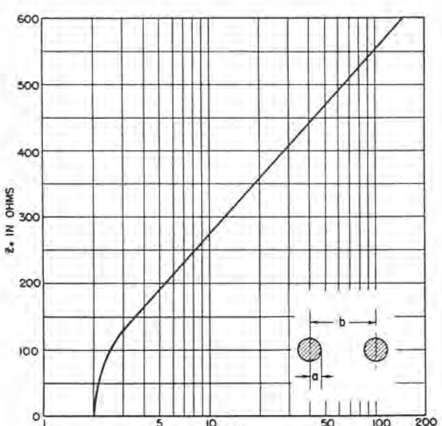



FIG 6 TWO WIRE LINE CHARACTERISTIC IMPEDANCE

hence it is seen that it is mainly dependent upon the values of L and C in the line. Spreading the conductors apart (diameter remaining constant) in a two-wire line, or increasing the diameter of the outer conductor of a coaxial line (effectively increasing the spacing), results in increased inductance and decreased capacity, hence a higher impedance results. Increasing the diameter of the conductors (spacing remaining fixed) in a two-wire line, or decreasing the diameter of the outer conductor, or increasing the diameter of the inner conductor of a coaxial line results in decreased inductance and increased capacity, hence a lower impedance results. A change in the dielectric of the insulating material of the line will change the capacity, hence alos affect the impedance of the line.

A practical formula for determining the characteristic impedance for an open

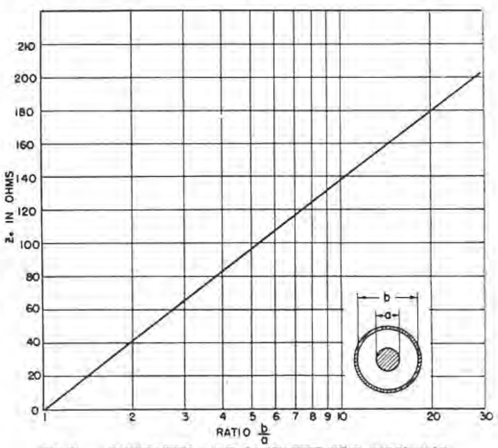



FIG 7 CONCENTRIC LINE CHARACTERISTIC IMPEDANCE

two-wire line with air dielectric is as follows:

$$Z_0 = 276 \log_{10} \frac{b}{a}$$

where a is the radius of the conductor and b is the spacing between centers of the wires.

Note: The conductors may be either tubing or solid.

A similar formula for coaxial lines is

$$Z_0 = 138 \log_{10} \frac{b}{a}$$

where a is the outer diameter of the inner conductor and b is the inner diameter of the outside conductor.

Fig. 6 and Fig. 7 show handy graphs for quickly determining the character-

*(Continued from page 32)*



# News From Members

1AF is with C.B.C. at Dartmouth. He was not shot at during two years at sea during the war, but brags that he was born in 1906 with a 36" inductance, a crystal detector, and had a father who was one of the first British hams, old G2IN, and has been more or less in radio ever since. 1OJ, J. B. Bernard, New London, P.E.I., is building a 6" reflecting telescope, and would like to hear from any others "who are off the A.C. line or who are telescope makers." 1JU checks in from Sackville while on leave from Navy and H.M.C.S. Somers Isles, Bermuda. 1MI has moved up the street to No. 108 in Moncton. 1KS, OPS, OBS, ORS, awaits "go" at Sackville. 1OM is back in Halifax after "R.C.A.F. Europe" and reports "1LZ, 1NV, 1OK, 4MF and himself attending Dalhousie U.; 1NK aiming at an E.E. degree at N.S. Tech.; 1JV, signals officer with R.C.E.M.E. engaged in occupation work in Europe; 1OG back after seeing plenty of action on the continent; 1OB dispensing radio gear at Manning Equipment," and is fighting himself to get the cobwebs out of the old rig. 1CL is glad to see a VE mag. After almost six years, 1EC is out of R.C.A.F. and residing in Halifax, 192 South Street. 1KC is with C.B.C. in Sackville. 1HV has started his own radio business, on release from R.C.A.F. 1CC is still at Dartmouth. 1GJ has been at CFNB during the war and instructing air cadets in spare time, having started the first radio course for air cadets in Canada. 1KQ now on civvy street after three years in R.C.A.F. would like to hear from 3SG. 1MC, 1FS, 1HL, 1AN, 1OA have been heard from.

2BV has been working on inspection and test of high-powered transmitters. 2HI, Ethel Pick, our first YL member, reports from Westmount. We hear also from 2AA and 2BG. The following are dusting up their rigs for an early start; 2GG, 2LW, 2KQ, 2EX, 2QQ, 2DD, 2FK, 2FG and 2GK.

3QL listens to the lads across the river in Detroit on 112 mc. and says "How long?" 3AMN is still in the Navy. 3AHE is back home again after a stretch with R.C.A.F. 3AEO is now fitting shoes again in Owen Sound, instead of radio sets with R.C.A.F. 3AQK is now stationed at St. Thomas, after a Cook's Tour with R.C.A.F., having visited Iceland, Britain, South Africa, India, Ceylon and Egypt. 3FC is looking for 3/16" dural tubing to make arrows for his wartime hobby, archery. 3AZX is still overseas with R.C.A.F. 3ATR is looking forward to handling ham traffic again, although still in the army.

3AHS sent in a Jap acorn type UN954 which he picked up in Kiska in 1943, and although some of the contacts were bent it was found to be quite O.K. and comparable to our 954's if the grid bias was increased. 3JH is with Ontario Dept. of Lands and Forests at the Soo. He misses the great gang of R.C.A.F. fellows he spent five years and eight months with during the war. 3WP, former 3HB, S.C.M., Ontario, is back in London as a fire captain after five years with the R.C.A.F. During that time he advises he was always able to pick out a ham among the men by the way they went to work to overcome any obstacle, and thereby met a lot of dependable chaps. 3OO checks in from Newmarket. 3KP, on the air since '24, is still residing in St. Kitts, but now at 44 Linden St. 3AHB had a field day with the army, where they had five xmtrs and two stand-bys, and overseas with it for five years. 3ADW, a C.N. telegraph operator for 33 years, is about to erect an antenna at Moose Creek. 3QW's XYL holds Prof. Cert. No. 5000, and got her ticket only six weeks after the OM. They've moved to Waterloo. 3ALF, after four and a half years with R.C.A.F., has moved to Toronto and looks after Forest Hill Village police and fire radio. 3ARR is another just out of R.C.A.F. 3AZU is in Parry Sound after five years with R.C.N.V.R., two of it spent as telegraphist in North Atlantic convoy service. Attention, gals!! 3ACM of Kingston is with C.I.L., Nylon Division. 3YA is at N.R.C., Ottawa, after discharge from R.C.A.F. 3ACG has been an operator on Lancasters flying from Montreal to Scotland, and expects to be a VE2 when the green light flashes. Before the flying job he was with T.C.A. 3ACS is back in Orillia at 314 Mary Street after 5.75 years in R.C.A.F. "Flight Looey Dike, 3AFW, A.G. in R.C.A.F., is now plain mister and liking it." His QRA, Mt. Albert. 3PN and 3TV report in. 3TB is with the Pacific Infantry Training Brigade at Vernon, B.C., and looks forward to his return to Toronto soon.

3MB did such a good job of tearing down that he expects it will be some time before he is ready. 3PE, after an absence of five and a half years has returned to his former place of business, a brewer's warehouse, which he suggests might be a good spot for a hamfest later on. 3AZW is planning to incorpoate a lot of navy tricks in his new gear. 3DK and 2AK get together to discuss their ham future. 3HU owns and operates CFPA at Port Arthur, but still anticipates operating for fun.

3IE inquires about bound volumes of XTAL. 3AQB reports in for the Chatham gang—3ANS, 3AGC and Art. Lavery. 3HH is at home after serving in the army since September, 1939. 3ANX is in Ottawa. 3TZ hopes to come from Swastika to Toronto for the November hamfest. 3BD has been at Dartmouth and expects to be back in Toronto shortly. 3NF is back in Weston after serving with a Mosquito Squadron overseas. 3HX writes in to say the Brantford gang is still very much scattered. 3AE is at No. 2 District Depot awaiting discharge and would like to see some U.H.F. articles. The old DX hound 3KE hopes to be after some more soon, after serving with R.C.A.F. 3AIZ is still at Camp Borden with the Army. 3AIU is back in Goderich after six years with R.C.A.F. 3ARB, Aldershot, had a recent visit from 3FW, Fort William. 3LU is engineer with CKPC, Brantford. 3GC, 3QC, 3YJ, 3FD and ADC are all with Sparton at London. 3AJR is with Signals at Edmonton. 3ATM is in Sigs and met 3VY, 4AFA and 3ST on his travels. 3VS is stationed at Yarmouth with R.C.A.F. 3WF has been assembling Diesel power units for radar equipment. 3ATD has been a civilian mechanic with R.A.F. Transport Command. 3APU has finished his hitch as wireless mechanic in R.C.A.F. After testing and installing high-power stuff for the R.C.A.F., 3ANV has many new ideas to try on his new rig.

3AXX has acquired five years' radio experience with the navy, a wife and two junior ops, and may soon be moving from Newmarket to VE1. 3AEM hopes to put a lot of paper planning to the test on two new transmitters. 3ABB is another five-yearer, R.C.A.F. 3AWN would also like to see more on ultra-high and advises 3SF has just received his discharge from R.C.A.F. 3ART has returned from R.C.A.F. to Port Dover, and 3AWQ is still a wireless op in the Merchant Marine. 3AXO and 3AWT have cut new masts from the bush at Dryden. 3AYV has returned home from service as a radar mechanic with R.C.A.F. 3CI is now at Blenheim after serving as an R.C.A.F. padre, and besides that duty, aided the boys greatly with voluntary code instruction. 3TM has returned to Leamington after three years with No. 1 Wireless School at Montreal. 3ANB is now at Strathroy, after his former home at Kerrwood, including all his gear, was destroyed by fire. 3AVM, after R.C.A.F., plans operating on 14 mc. and up.

Nice to hear from 3LW, 3AHP, 3AOQ, 3AIN, 3AVC, 3RW, 3BG, 3AQF, 3DL and 3GY.

4NG claims to be the only ham for miles around Readlyn, Sask. 4YR is C.N. operator at Togo, Sask., which position he acquired when "the old pump handle" could no longer be used for C.W. 4PA is also at Togo after instructing at flying fields throughout Canada. 4AOY is running a service shop at The Pas. 4XT does service work and runs the cinema palace at The Pas. 4GF sent in a list of the gang at Craik, Sask. 4AAW and his brass-pounding XYL are dreaming of ways to string up wires at St. Vital, Man. 4WP now lives at Britannia Bay P.O., Ontario, and will become a VE3. 5DV, engineer at CFAR, Flin Flon, Man., states that there will likely be a club there in the near future. 4EO reports that 4ACS has moved to Princeton, B.C., 4SP to Picture Butte, Alta., and 4VN to Calgary. 4AOZ has moved to Sylan Lake, Alta., and opened Totem Radio. 4AMQ is back in Saskatoon and expecting an early discharge from R.C.A.F. 4ABO is now at Kelowna, B.C.

5TX, Chapman Camp, needs power supply parts. 5RQ is at a convalescent center and expects to become a VE3. 5II is up in the Queen Charlottes. 5AAJ has been at Prince George, where 3ZV and 4LH were stationed with R.C.A.F.

5QB, Old Crow, Y.T., via Fort Yukon, Alaska, doesn't expect more than three mail deliveries between now and next June, and is more anxious than many to get back on. He saw 5NF in Dawson last year, and says the Yukon needs ham radio to get the gang in QSO. 4GS is now at Whitehorse, and so is L. T. Kail, formerly of London, Ont.

G5UB will be going to the west coast soon, and after discharge from the Royal

*(Continued on page 32)*

# CLUB ACTIVITIES

*On September 6th, the Royal City Amateur Radio Association, New Westminister, B.C. held an interesting meeting. Those present are illustrated above, standing: F. Taylor, 5HA, R. McIntyre, 5BF, E. Neilson, 5AJ, B. Hughes, 5IA, T. Parnell, 4YJ, S. Craig, 5FY, J. Sibson, 5BQ, T. Goode, 5ND, C. Purvis, 5AJU; seated: C. Littlewood, 5ABQ, J. Williamson, 5ADV, N. Brittain, 5AJN, E. Risby, 5AJT and W. Sharp, 5DB.*

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The Key Klick Klub, of Toronto, held their first post-war meeting on Friday, Sept. 28, at the home of 3RH, Bob Haslett. Present were the transcription king, Bob Haslett; ex-R.C.A.F. Sgt. Dave Crichton, 3AIW; ex-R.C.C.S. Sgt. Joe Jordon, 3AIW; ex-Blitz Fire Fighter Keith Wilson, 3TH; Alf. Gillier, 3AZI, and SWL's Harry Anderson, Art Windle and Syd Prior. Several old members could not be present but we hope by our next meeting they will be with us, namely, W.O. Gord. Coleman, R.C.N.V.R., 3ANY; Bern Sandbrook, 3ATI; Cec Presant, 3AWP. Three members we have not heard from for some time are Pete Cooper, Jim Gordon and Bob Watson, all VE3's. A feature of the evening was a recording made by 3RH.

On Friday, Oct. 12, the club met at the home of Syd Prior. New rigs and high-fidelity radio amplifiers were subjects of open forum discussion.

The next meeting will be at 88 Floyd avenue on Nov. 9, when new officers will be elected. All old members are urged to attend.—Syd Prior.

The Ottawa Amateur Radio Transmitting Association held its first meeting since closing down in 1941 on Sept. 24.

The Halifax Amateur Radio Club has held meetings throughout the war with good attendance.

The Royal City Amateur Radio Association, New Westminster, B.C., has started its winter program.

The Loyalist City Amateur Radio Club, St. John, N.B., were active throughout the war, and are contemplating expanding activities.

A new radio club is in process of formation at Belleville, Ont. A preliminary meeting was held at the home of 3AJS with 3ZS, 3AOP, 3XQ, 3RW, 3AAL, 3ADJ, 3AAR, 3AAJ and 3SO attending. 3ZS won the door prize, a dynamic mike. The evening concluded with refreshments.—3AJS.

The Wireless Association of Ontario, Toronto, held a very interesting meeting on October 19, at the University of Toronto, where Mr. G. W. T. Ledger, Electronics Instructor of Western Technical School, gave a most enthusiastic paper on Vacuum Tube Voltmeters which included the display of a working model. Over 100 attended.

The next meeting of the Association will be held in Room 21, Electrical Bldg., University of Toronto, on Thursday, November 22, at 8 p.m. Mr. Hames, Canadian General Electric Company, will speak on the operations of police radio communications. All are welcome.

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### HAM-ADS

What is "The Eagle?"

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### FLASH!

Nov. 9, 1945.—Canadian Amateurs will go back on the air on Nov. 15 on 7 bands along with the U.S.A. Mr. C. D. Howe announced today. The bands Will be 28-29.7, 56-60, 144-148, 2300-2400, 5250-5650, 10000-10500, 21000-22000, all in megacycles.

# A Simple Vacuum Tube Voltmeter

By A. E. Pugh, VE4ALS

The instrument to be described has proven itself to be one of the handiest pieces of equipment that the writer has ever built. Its use over the years has shown it to be worth many times its original cost.

The circuit is quite simple. A type 30 tube with 45 volts of B on the plate gives a no-input plate current of between 1.5 and 2 ma. depending on the tube. This plate current is shown on the meter M, a 0-1 ma. instrument. The meter is connected in a reverse manner, that is, negative of B battery to positive of meter. This makes the meter read backwards. The meter needle is brought back up to zero by a voltage taken from the filment battery and adjusted by the rheostat R5.

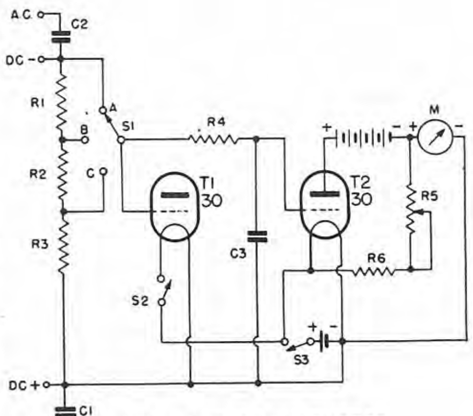
When a negative voltage is applied to T2, the plate current falls off, and the meter needle moves upward on the scale as the steady potential obtained from the filament battery becomes stronger than the plate current. This provides a direct-reading meter with upward indication of the meter needle.

The V.T.V.M. was designed to be used with a regular multiscale volt-ohm-milliameter, such as most servicemen have on the bench. In this way a good 0-1 ma. meter is not tied up all the time in the V.T.V.M. When used with the V.T.V.M. the meter should have no multipliers, shunts, or fuses connected with it, and is used as a straight 0-1 ma. meter.

The total resistance of R1, R2 and R3 is about 10 megohm, and the taps between them must be so located that the meter will read correctly on each range. Exact values cannot be given, as different meters have different systems of proportioning scales.

The instrument shows a maximum sensitivity of about 2 volts full-scale deflection when S1 is in position A. If a meter with a scale having a 2.5 volt range is available, position A may be tapped down on R1 to give full-scale deflection on the meter at that voltage. Other scales may be suited by properly proportioning R1, R2 and R3.

The meter is calibrated by connecting a known D.C. voltage to the terminals marked plus and minus D.C., and adjusting the resistances until the meter shows the correct reading. Readings are very nearly linear, well within the accuracy usually found in V.T.V.M.'s.




VACUUM TUBE VOLTMETER

R1, R2, R3, see text.
R4, 1 Megohm resistor.
R5, 1,000 ohm resistor.
R6, 800 ohm ½w. res.
C1, C2, C3, .01 mfd. mica.
S1, S.P.3.T. switch.
S2, S3, S.P.S.T. toggle.
M, 0-1 ma. meter.

When A.C. measurements are desired, the posts marked A.C. are used, and S2 closed to light the filament of T1. The meter then shows peak A.C. values. So far this instrument has not been calibrated on A.C., as no source of A.C. is available at this location. However, the A.C. readings should be fairly close to 1.4 times the D.C. readings on the same scale.

The 45 volt B battery can be of the smallest portable type, as the current drain is very small. Separate filament and plate batteries should be used to realize the full value of the V.T.V.M. A 2-volt storage cell is best for filament supply, although two 1.5 volt dry cells in series may be used together with a 15-ohm resistance to drop the filament voltage to 2 volts. However, if the meter is to be used on A.C. measurements an 8-ohm resistance will be required to limit the 3 volts to the required value, with the two filaments

(Cont'd on page 38)

# Reorganization of C.A.R.O.A.

Certain members in the Toronto area will recall a meeting held in the Botany Building of the University of Toronto on Sept. 6. To some of them, perhaps, the purpose of that meeting is not yet clear. In explanation, let it be understood that those responsible for the formation of the CAROA want it to be run for and by the Canadian amateur, which means the VEL and the VE5 as much as the VE2, VE3 and VE4. This can only be accomplished by holding elections through which all officers are chosen by the members themselves. In addition, each province must have at least one representative on a board which will have a voice in all affairs, so that the Association will not be dominated by one district—a condition which would defeat our primary purpose, namely, a national organization.

Now if you will consult the first prewar issue of XTAL, in which the constitution is printed in full, you will see that the above methods of representation are provided for. It is generally conceded, however, that an election is not feasible at the present time and may not be for some months to come. A glance at the Association's books would reveal that prewar members are still scattered all over the globe; many of them may not even be aware that we are active once more. Fortunately, this situation is rapidly returning to normal; but in the meantime the work which faces us, the effort of establishing the Association on a sound footing, demands the immediate appointment of a staff which will function with some degree of efficiency until elections can be held in the regular manner. It was felt, therefore, that by calling together all members within reach and acquainting them with our aims and proposals, that we could at least approximate an election and show that we have no totalitarian ambitions. It was a makeshift arrangement at best, but the labor pains of an organization with far-sighted ambitions are not easy; improvements will accompany maturity.

At the Sept. 6 meeting a mandate was obtained from the members present to reorganize. On Sept. 26 the full prewar executive met again to translate this mandate into action. The temporary Committee of Management set up late last year was disbanded, together with its associated sub-committees, and the staff listed below appointed. All appointments are to be considered valid only until such time as an election can be held. Individuals designated with an asterisk were in office when the Association suspended operations in 1941.

EXECUTIVE—President, T. G. E. Powell, VE3ZE*; Vice-president, in charge of XTAL, S. B. Trainer Jr., VE3GT*; Secretary, I. H. Nixon, VE3ACL; Assistant Secretary, L. Horsfall, VE3AOS; Treasurer, E. Bartmann, VE3VD*.

STAFF OF XTAL—Editor, T. G. E. Powell, VE3ZE*; Managing Editor, S. B. Trainer Jr., VE3GT*; Feature Editor, H. C. O'Brien; Technical Editor, G. A. Richards, ex-VE3ALC; Business Manager, P. W. Posnikoff, VE4ATR; Advertising Manager, A. H. Gillier, VE3AZI.

In addition, provision was made for several special representatives to be responsible for special assignments as the need arises.

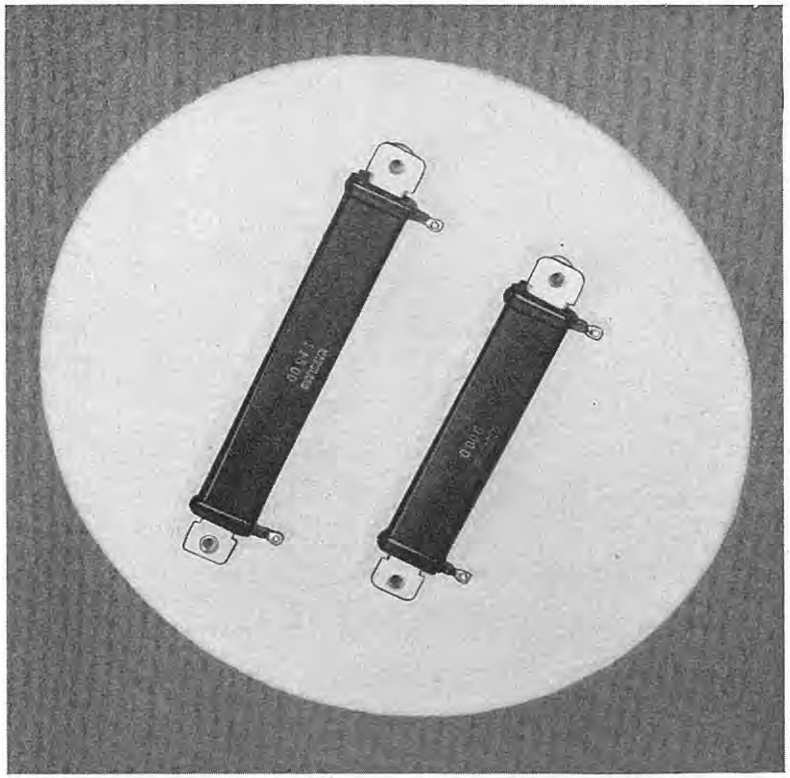
The need for a Board of Directors to represent the various parts of Canada was similarly filled in temporary fashion by appointing the members of the former Committee of Management to the new board, with the exception of P. W. Posnikoff, who is acting as Business Manager of XTAL. These members are as follows: F. M. Haines VE5MQ, M. Reade VE5IO, F. J. Heath VE4QX, J. Hooper VE3AHA, Carl Emes VE3RG, Wally Hainge VE3IB, J. C. R. Punchard VE2KK, E. H. deGrey VE2IN.

This Board will be replaced by an elected panel at the earliest opportunity in order to provide fairer representation from all districts. In the meantime, it gives an opportunity for the presentation of opinions and suggestions which might otherwise be overlooked.

And that is the way your Association will function in the next few months. Your suggestions and criticisms, but most of all your support, will bring about an organization of which we may be proud in the future. Do your part!

I. H. NIXON.





## RESONANT TRANSMISSION

*(Continued from page 22)*

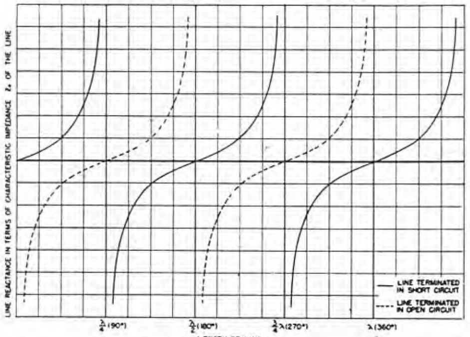



FIG 8 TRANSMISSION LINE REACTANCE PLOT

istic impedance of open two-wire line and of a coaxial line.

(2) **Length:** Since energy travels more slowly on a wire than it does in free space, the physical length of a section of transmission line will be different from the theoretical or free space length of the wave.

To find the physical or electrical length for various types of line the following formula may be used:

$$1 \text{ wavelength} = \frac{\text{Frequency}}{984 \times K}$$

The length obtained may be multiplied by the fraction of a wavelength required. K is the factor indicating the ratio of the velocity of the wave on the line to the velocity of the wave in free space, and has the following values:

| | |
|---|---|
| Parallel lines | 0.975 |
| Parallel tubing | 0.95 |
| Concentric line (air insulated) | 0.85 |

(3) **Reactance:** Fig. 8 is a graph from which may be determined the reactance of a line section as a function of the length and the characteristic impedance.

Part 2 of this article will deal with Application of Resonant Line Sections.

## NEWS FROM MEMBERS

*(Continued from page 24)*

Navy expects to become a VE. G21N, who has been between Toronto and Washington during the war years, has left for a six months' business trip to South America, and also expects to be a VE.

## List of New Members

Wm. Snell, 1GG
G. C. Craft, 1DG
J. W. Murphy, 1HV
D. C. Smith, 1CC
G. D. Love, 1GJ
F. W. Rafferty, 1AN
Alex. Wilson, 1GU
J. L. Hamilton, 1CB
S. L. Green, 1FS
Scott Mosher, 1OG
Paul Blakney, 1JU
J. E. P. LeBlanc, 1MI
R. J. Hesler, 1KS
B. E. Getchell, 1CL
D. C. Johnson, 1OM
A. M. Bishop, 1FE
G. H. Burchell, 1IB
Harry Holden, 1AB
L. G. McKeeman, 1JP
F. W. Hyndman, 1BZ
A. G. Fish, 1AF
J. B. Bernard, 1OJ
F. W. George, 2BV
Carl Vandray, 2AK
Dr. R. Veillieux, 2CK
W. G. Stygall, 2GK
A. W. Holmes, 3IK
C. W. Dean, 3AUC
H. W. Tonkin, 3AOB
J. N. Cook, 3AMP
J. A. MacDonald, 3CK
J. Spall, 3ER
T. Bilesko, 3AGB
George White, 3ANU
Harold Jones, 3ABL
G. H. Hardy, 3NG
M. Crossley, 3AKW
Fred Sutton, 3ZL
J. E. O'Brien, 3AMO
K. T. King, 3AXQ
E. C. Houlgate, 3AJE
C. R. Snelgrove, 3GM
R. R. Trustham, 3AG
J. T. Morton, 3AJM
L. Jackson, 3AXW
E. E. C. England, 3QL
J. R. Kinch, 3AZY
A. C. Valler, 3ASV
G. F. Weedon, 3ACJ
C. Kynnersley, 3KO
Bill Winter, 3APA
R. N. Gladstone, 3APG
G. Blanchett, 3BAD
W. C. Ward, 3AEC
P. Valeriote, 3ARH
R. G. Stephen, 3UK
George Miles, 3APO
E. R. Hesse, 3DS
E. Misner, 3AUP
V. J. M. Hastings, 3ATP
A. R. MacDonald, 3ARF
C. A. Butler, 3AXM
F. G. Rice, 3BO
V. Graham, 3AXB
Roy Bennett, 3VS
R. N. Campbell, 3AEF
G. E. Haram, 3AJB
C. R. Anguish, 3LU
Ed. Hughes, 3WU
G. H. Hervey, 3ATM
R. M. Heagle, 3TY
A. D. Blachford, 3AHX
O. A. Goodwin, 3ACK
Rev. F. J. Williams, 3HK
H. S. Williams, 3NF
Chas. Olmstead, 3AHP
Gwen Burnett, 3AYL
Bruce Kelner, 3MU
T. W. Thompson, 3RU
H. E. Graham, 3AVC
J. E. Cutler, 3AJG
L. F. Clement, 3TZ
R. F. O'Neil, 3ANX
G. J. Marossi, 3APU
G. B. Gillies, 3JA
J. W. Richardson, 3FH
W. A. Horton, 3AOQ
W. E. Rogers, 3ANB
Dr. H. A. Lowrie, 3ATX
E. di Leo, 3AHS
M. H. C. Hemsworth, 3HH
J. G. Gladman, 3AXX
Arnold Yates, 3AIN
W. F. Gribble, 3ANV
E. J. Apps, 3NE
S. A. E. Groat, 3VB
G. Lancaster, 3ADI
A. J. McAleese, 3AVM
W. E. Johnson, 3ABB
A. E. Derumaux, 3JV
N. T. Barratt, 3AEM
Rev. R. K. Love, 3CI
C. W. Bailey, 3TT
Bob Ross, 3TM
G. C. Jarvis, 3AQF
L. A. Marshman, 3AMZ
L. Ewasko, 3ATD
E. J. Kernohan, 3MF
W. G. Crumb, 3AA
C. Christie, 3AZW
R. J. Kipp, 3AYV
V. Oliver, 3AXO

*(Continued on page 40)*

### APPLICATION FORM
**THE VE OPERATORS' ASSOCIATION**
**LEASIDE P.O., ONTARIO**

I hereby make application for (renewal) (new) membership in the VE Operators' Association. One dollar is enclosed, which entitles me to membership and subscription to XTAL for one year from the date of this application.

NAME .................................................... CALL ....................

ADDRESS ....................................................................

Proficiency Certificate No.......................... Date..............................

October 1, 1945

The Editor, XTAL,
Leaside P.O., Ont.

I wish to say I don't agree with VE3ADR's letter in which he says to leave out such articles as that of the 12,500 mile two-tube receiver. After all, it is amateur radio we are interested in. What little I know about radio is just such things that I picked up in magazines from time to time. I have bought too many radio magazines and find them too technical for the average person who wants to learn radio. Also you would have to be a millionaire. I know it is very hard to please everyone but I get a big kick in taking something out of the junk-box and making it work—more so than if it were new.

—R. F. O'NEIL, VE3ANX.

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The Editor, XTAL,
Leaside P.O., Ont.

I may be of the old school that I wish to help the ones just starting. My first call was an NC before the first world war, and have had calls VE3ASX, and the last one VE3BO. I think that you are doing just right to think of the fellow just starting. Fellows will remember me, lots of them, as their first contact. I pride myself as being a friend of and a help to the first-timer. We must have and we still need him. He is a great friend of mine, so please keep thinking of him, and it will do some of us good to look over some of the things we think we have outgrown (such as the "diaper"). Thank you, Ed. And apology to you, Harvey Reid.

—F. G. RICE, VE3BO, Big Owl.

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The Editor, XTAL,
Leaside P.O., Ont.

I have noted the article on the "Q Meter". It is my belief that amateur radio operators should become more "instrument conscious", that is, they should become familiar with the use, and construction where possible, of instruments necessary for the proper design, adjustment and maintenance of their equipment. Surely it is better to have, for example, a 50-watt transmitter, properly designed, adjusted and maintained along with the means of keeping it right, than to have a 100-watt station, poorly designed, adjusted by guesswork, and without proper means of maintaining it. Thus it seems to me that descriptions of instruments such as the "Q Meter" are very desirable.

A. R. HOLLIDAY, VE3AHI.

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The Editor, XTAL,
Leaside P.O., Leaside.

It will be one grand day when I can again renew old acquaintances over the air and meet up with, no doubt, many new hams. There may also be an element of sadness over some silent keys of those we knew and esteemed before this old world blew up.

In memory of those fine lads, let us try to make Amateur Radio worthy of the great sacrifice they made so that we might carry on in a a free land according to British tradition of honesty and fair play. I believe there is no greater brotherhood than Amateur Radio. All success to XTAL, which is a cog in the wheel.

My best wishes to all the old gang, and may the time soon come when we may be able again to chew the fat of yore.

—J. M. WHITTEKER, VE3MB

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The Editor, XTAL,
Leaside P.O., Ont.

I am the OW of VE3GK, and have had my amateur license since 1930. I might suggest that an interesting addition to your Xtal magazine would be a column on activities and interests of YL's and OW's. There must be quite a number already licensed, and many more who are interested and would like to have a license. A column for them would not only stimulate their interest in ham radio, but would increase the popularity of your magazine.

— GWEN BURNETT, VE3AYL

We would be pleased to include a YL column. Suggestions and contributions will be welcomed.—Editor.

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## HAMFEST

Note the HAMFEST program elsewhere in this issue.

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Have you sent your letter in?
Are you one of the 979 members?

## XTAL

This issue of XTAL is being sent to all VE's recorded by the Department of Transport as of December, 1939. It is intended to send out the Christmas issue also to all of you. However, starting with 1946 XTAL will only be sent to members of the Association. Membership for one year is only $1.00, which includes XTAL. Elsewhere in this issue please use the application form for membership.

Let's make our VE Association really strong. Send in your membership NOW. You won't want to miss the coming technical articles and other features.

Also, please don't forget . . material of all kinds is welcome for publication. . articles, photos, news, etc. etc.

**ACT NOW**

## A SIMPLE VACUUM TUBE VOLTMETER

*(Continued from page 28)*

permanently connected together, and a switch placed in the grid lead of T1 to disconnect it from the circuit on D.C. measurements. If A.C. measurements are not required, T1 may be left out of the circuit.

The uses to which a V.T.V.M. may be put are too varied to be detailed here, but one useful application is worthy of mention. When aligning the various stages of a superhet which has A.V.C., connect negative input to the V.T.V.M. through a half-megohm resistor to the cap of the I.F. or R.F. tube, tune the set to a steady station, or use an oscillator, and align the stages for maximum deflection of the meter. This resistor should be placed right at the grid cap of the tube to prevent detuning effects. Many other uses will present themselves after the instrument is used a few times.

Editor's Note: It might further the accuracy of the V.T.V.M. described to introduce a degenerative cathode resistor in the minus lead to the meter to make the circuit insensitive to differences in tube characteristics, or alternatively, a variable shunt across the meter to compensate for differences in tubes. McMurdo Silver's articles in July and August 1945 QST suggest a diode rectifier cannot be used successfully in the position shown in this instrument without extensive efforts at compensation.

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## Q METER

*(Continued from page 16)*

reference to a commercial Q meter or equivalent.

Next issue of XTAL will conclude this article. In it will be described: Measurement of inductance and distributed capacity of standard coil; measurement of capacity of output terminals and standard condensers; methods of operation; comparison of results with those on commercial instruments; further curves.

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**If contributions and articles to XTAL are typed, please double space to assist our printer.**

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**When purchasing, please mention XTAL.**

## New Members

*(Continued from page 34)*

E. J. Silver, 3AXN
R. H. Parker, 3HU
C. H. Sovereign, 3AWN
F. J. Koepke, 3WF
E. E. McIntyre, 3VV
W. J. Malott, 3IE
A. A. Edwards, 3ANS
T. R. Backus, 3AHG
Fred Swart, 3JE
G. L. Foster, 3YJ
Gordon Ruth, 3GC
Earl Kimble, 3ADC
Lewis Coombs, 3OO
I. H. Merritt, 3AHB
J. A. Clarke, 3ALI
R. E. Reynolds, 3ACG
D. A. Cooper, 3JH
H. W. Bishop, 3WP
W. Kirkwood, 4AEQ
Dr. J. J. Dobry, 4DR
W. A. Stunden, 4GS
L. C. Gorley, 4ABO
W. J. B. Marsden, 4AOZ
A. E. Pugh, 4ALS
Len Ewert, 4EV
H. L. McNaughton, 4LH
H. Green, 4AIO
A. P. Davis, 4HV
J. D. Roberts, 4VA
R. D. B. Sheppard, 4RS
Fred Taylor, 5HA
J. A. Hunt, 5TX
R. J. Tate, 5DV
Eric Risby, 5AJT
Clare Purvis, 5AJU
J. Williamson, 5ADV
Al Pearsall, 5RQ
J. H. Walsh, 5AGO
F. D. Milne, 5AHQ
A. L. Ainsworth, 9BE
D. Hunter Jr., VP1AA

**Associate Members**

N. A. Frannsen
W. J. Rosputnek
F. C. Ingles
M. Fedorick
R. Michaud
Ray Burns
J. E. Kennedy
G. G. Elliott
Cliff Rodwell
H. S. Audley
Harry Harman
Jim Christie
G. E. Flewelling
H. O. Powell
D. Graham
Fred Henderson
R. W. Corran
H. Kenmare
D. J. Pym
L. T. Kail
J. A. Flemming
Chas. Bowler
F. Tomlinson
D. Williamson
J. M. Clarke
A. E. Martin
J. O. McKeown
Saul Yablo
S. W. Turner
Lloyd Galbraith
Arthur Lavery
P. P. Dow
A. McKenzie
H. S. Dawson
K. G. Budden
G. E. Hore
Kinstone Reed
O.S.C. Boettger