A Few Aerovox Products

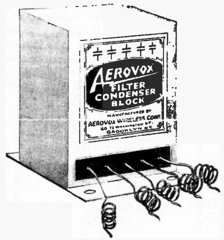
ALL Aerovox Filter condensers are non-inductively wound; are manufactured from 100 per cent pure linen paper and 86 per cent pure tin foil, and impregnated under a vacuum within 1/4" of the barometer. The dielectric compound has a melting point temperature between 60 and 70 Fahrenheit higher than ordinary paraffin usually used in paper condensers. Each Aerovox condenser section is individually coated with a moisture proof wax pitch compound of high melting point which coupled with extreme care in manufacturing results in a condenser of high insulation resistance.

TYPE BH-320—For eliminators using a transformer of no load output up to 300 Volts on each side. 14 Mfds., tapped C-2-2-8-1-1. First unit is Type 400; the second, 300; and the remainder are 200 .... $11.00

TYPE BH-420—For eliminators using a transformer of no load output up to 400 Volts on each side. 14 Mfds. tapped C-2-2-8-1-1. First two units are Type 400; third 300; and the remainder 200. $15.00

TYPE ABC-421—For A B C Power using tubes of the 350 M. A. Type. 19 Mfds., tapped C-4-4-8-1-1-1. First unit is 600; second and third 400; and last three 200 .... $25.00

TYPE AM-600—For power transformers such as the Amertran PF-52. 10 Mfds., tapped at C-2-4-4. First unit Type 400 .... $15.00



FILTER BLOCK

TYPE TH-862—For eliminators similar to R-210 Thordarson Power Compact. 12 Mfds., tapped C-2-2-2-1-4-1. First and second 800, third 600; and the last three 200 .... $18.50

FILTER CONDENSERS

Capacity		200 Type No. 202	400 Type No. 402	600 Type No. 602	1000 Type No. 1002
.05	Mfd.	$ .55	——	——	——
.1	"	.60	$1.00	$1.10	$1.50
.25	"	.70	1.10	1.35	2.00
.5	"	.75	1.40	1.85	3.00
1.0	"	1.25	1.85	2.75	4.75
2.0	"	2.00	3.00	5.00	9.00
4.0	"	3.25	5.25	9.00	16.50
6.0	"	4.25	7.25	13.00	24.00
8.0	"	5.75	9.50	17.50	——
10.0	"	6.75	11.75	21.50	——

MOULDED MICA CONDENSERS

Type 1450

Type 1450 moulded mica condensers are available in capacities ranging from .00004 to .02 mfd. at prices ranging from 35 cents for the lower values to $1.50 for the .02 mfd. condenser.

Type 1475 moulded mica condensers with grid leak mounting clips are available in capacities ranging from .0001 to .0005 mfd., all priced at 40 cents.

Type 1475

These condensers are moulded in genuine bakelite in our own plant. By a special process in the manufacture of the condenser element, the capacity is predetermined, and the finished product guaranteed within 10% of marked rating. The bakelite seals and protects the condenser against extreme temperature, moisture, or chemical action. The dielectric is of the finest grade India Ruby Mica, the plates are pure tin foil, and the condenser element is thoroughly impregnated. Compact in size, with special lugs, which allow for screw, eyelet, or soldering assembly. Soldering tabs have split, elongated slots for easy connection to solid or stranded wire.

PYROHMS RESISTORS

Aerovox Pyrohm Resistors are made in standard units to fit all resistor requirements. Type 992 units, rated at 20 watts and wound on a 7/16" x 2" tube are made in values of from 500 to 10,000 ohms at prices ranging from 90 cents to $1.10. Type 994 units, rated at 40 watts and wound on a 7/16" x 4" tube are available in resistance values ranging from 1,000 to 50,000 ohms and range in price from

Aerovox Pyrohm Resistances are made of the best grade resistance wire, wound on a refractory tube, and coated with a porcelain enamel, which thoroughly covers and protects the wire from moisture, oxidation and mechanical injury. The resistor can be used under heavy loads without injury, and will not change in value with use.

$.95 to $2.00. Type 996 units, rated at 100 watts and wound on a 3/4" x 6 1/2" tube are available in resistance values of from 100 to 100,000 ohms and range in price from $1.25 to $2.75.

Special tapped units to fit the requirements of all standard power units are described in folder which will be mailed free on request.

Complete Catalog of Aerovox Products May Be Had Free on Request to
Aerovox Wireless Corporation, 70 Washington Street, Brooklyn, N. Y.

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The AEROVOX Research Worker

The Aerovox Research Worker is a monthly house organ of the Aerovox Wireless Corporation. It is published to bring to the Radio Experimenter and Engineer authoritative, first hand information on condensers and resistances for radio work.

Vol. 1 April 25, 1928 No. 4

The Theory and Construction of An A. C. Peak Voltmeter

By the Engineering Department, Aerovox Wireless Corp.

IN studying the conditions within a battery eliminator, it is extremely desirable to know the peak voltages existing across the various filter condensers. The life of a condenser is affected by the D. C. voltage and also the peak A. C. voltage impressed upon it.

The voltage impressed on filter condensers in an eliminator is not steady and uniform. An alternating component exists, especially in the first input condenser. A direct current meter cannot be used to measure peak values because it will read only the d. c. component of the voltage, wave. An a. c. meter cannot be used for the following reasons:

The wave is distorted, and its peak value is not 1.41 times its r.m.s. value.

An a. c. meter would draw an excessive load from the eliminator, and thus give false readings.

The d. c. component of the wave, as well as the a. c. component, would affect the meter, introducing another source of error.

One thinks of the usual vacuum tube ripple voltmeter. This instrument, while it consumes no power, reads accurately only up to 10 volts variation or ripple*. This range is suitable for measurements on the output side of a filter, where the a. c. component of the output is 1 or 2 percent at the most. It is out of the question, however, for making measurements on the input side of the filter, where the a. c. component may be from 50 to 90 percent, as is the case in an eliminator with a 300-volt transformer, where the total fluctuation will be about 400 volts.

For such measurements, a very

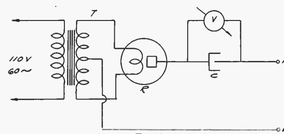


Fig. 1

different type of voltmeter must be used. It must be one which will read peak voltages ranging up to 1000 volts, consume very little power, and read correctly voltages of varying wave forms.

Such an instrument was first described by Sharp and Doyle in the Transactions of the A.I.E.E. for 1916.

The theory of this vacuum tube peak voltmeter is simple. When the voltage to be measured is applied to the instrument, current will flow into the condenser during the first quarter cycle of voltage, the charge on the condenser increasing until the potential difference between its plates equals the peak value of the wave. The condenser plates remain at this potential difference while the voltage wave goes through the rest of the cycle for discharge of the condenser, or charge of opposite polarity, is prevented by the action of the rectifier. Figure 2 shows the current and voltage through the condenser when there is no rectifier. Figure 3 shows how the rectifier prevents discharge of the condenser, by blocking the discharging current; and prevents charging the condenser to the opposite polarity, by cutting off the negative half of the voltage wave.

If a subsequent peak voltage of the same polarity and higher value occurs, more current will flow into the condenser; the potential difference across the condenser plates after any cycle corresponding to the highest peak voltage applied in the direction in which the rectifier conducts.

If a voltmeter which does not draw current—that is, an electrostatic voltmeter is connected across the condenser, it will, therefore, indicate the highest peak voltage which occurs during the test. An electrostatic voltmeter, however, is rather expensive, and not often found in the small laboratory. For purposes of convenience, we may substitute a d'Arsonval type volt-

**Note:—The construction of a ripple voltmeter will be described in a subsequent issue.*

"AEROVOX" MEANS "BUILT BETTER"

meter of extremely high resistance—say, 5000 ohms per volt. The resistance of this voltmeter, in parallel with the condenser, introduces a small amount of leakage in the latter, which is quite desirable, for the condenser should have enough leakage to allow the instrument to change from a higher to a lower reading promptly, but not so much leakage that it will bring the average voltage across the condenser appreciably below the peak value. In general, a leakage current of 1.0 milliampere is about the maximum tolerable.

The size of the condenser also plays an important part in determining the accuracy of the instrument. If its capacity is too small, the accumulated charge will not be sufficient to actuate the d'Arsonval meter. If it is too large, on the other hand, an excessive charging current will flow, causing a large IR drop in the rectifier tube, and throwing the readings off. A capacity of 1.0 microfarad has been found to be a proper value.

The instrument may be calibrated either on alternating or direct current. If alternating current is used, the crest factor of the voltage wave must be known. In making the calibration, the r.m.s. readings of the standard a. c. meter are then multiplied by the crest factor to obtain the peak voltage. When using d. c. to calibrate the meter, the readings of the standard d. c. meter are, of course, equal to the peak voltage.

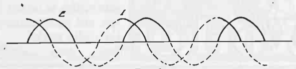


Fig. 2

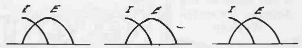


Fig. 3

A photograph of the instrument described in this article is shown in Fig. 5. The meter is a Weston Model 271, 0-1 d. c. milliammeter, which, together with several high resistances, serves as a voltmeter. The knob in the lower left hand corner controls the filament rheostat of the rectifier tube, while that in the lower right hand corner controls a switch which throws in various voltmeter resistances, thus giving the various ranges afforded by the instrument.

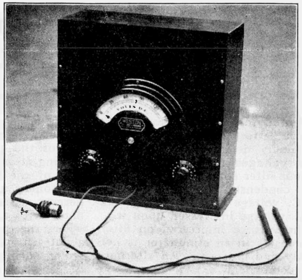


Fig. 5

With this particular set a ½-megohm resistance gives a range of 0-350 volts peak, a 1-megohm resistance gives a range of 0-700 volts peak and a 1½-megohm resistance gives a range of 0-1050 volts peak.

A typical calibration curve is shown in Fig. 4. It will be seen that it is a perfectly straight line, for the current through the rectifier is so small that the latter always operates on the straight portion of its characteristic.

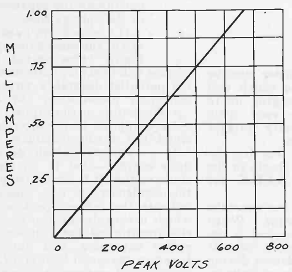


Fig. 4

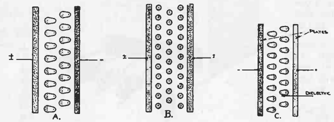
The necessary parts for building the instrument are as follows:

1 Aerovox condenser, 1-mfd type 1002
1 CX-381 Rectifier tube
1 UX socket
1 Transformer 7.5-volt 1.25-amp, center tapped secondary
1 0-1000 voltmeter, 5000-ohms per volt
1 Mounting panel
2 Binding posts

Should the builder desire to construct a voltmeter of this type which has a smaller range; or experience difficulty in obtaining a voltmeter with a resistance of 5000-ohms per volt, a suitable voltmeter may be made up by using a 0-200 microammeter (Weston Model 440, or the Sterling or Jewell equivalent, for instance) and an external resistance of appropriate value. A suitable resistance can be made with a bank of Aerovox Pyrohms, type 996, 100,000 ohms.

Proper Condenser Ratings Important for Trouble-Free Operation

IN the purchase of filter condensers there are many pitfalls in the path of the inexperienced set builder. He finds condensers rated by "flash test," "D. C. working voltage" and "A. C. working voltage." In most cases he has no idea what voltage will be applied to the condensers beyond the fact that he hopes to get 180 or 500 or some odd number of volts out of the eliminator and in preparation for this he has purchased a transformer with an output voltage somewhat higher. He is very prone to fondly imagine that if his output voltage is, we shall say, 180 volts, a condenser rated at 200 D. C. working volts should be safe for his filter. When they blow it is immediately decided that the condenser was improperly rated, or that some mysterious power, vaguely called "peaks" or "surges" is responsible.



Contrary to most popular opinion, the action takes place in the dielectric or insulating material, not in the electrodes or plates.

Reference to figure "B" above will give some idea of the normal condition of the atomic structure in a condenser carrying no charge. The plates contain an equal number of electrons and the atoms of which the dielectric consists are in a more or less regular form with the electrons revolving in circular orbits around the central proton.

When a charge is applied to one of the electrodes, that electrode contains less than its normal number of electrons and the opposite plate more than its normal number. Like water, electricity seeks to maintain a normal level and accordingly the electrons in the atoms of the dielectric are attracted to the positive plate and are repelled from the negative plate where there is a superfluity of electrons. As a result their orbits are distorted, resulting in the assumption by the atoms of a shape shown in conventional form in figure "A." If the polarity of the charge is reversed the atomic structures of the dielectric pass through the condition "B" to that shown in "C"—a complete reversal of form. Each time the polarity of the charge is reversed a similar reversal of the distortion of the atom occurs. The friction of this movement generates heat and if the reversal is sufficiently frequent and its amplitude is sufficiently great, sufficient heat may be generated to melt the material with which the condenser is impregnated. It is also possible that the rapid motion may loosen some of the electrons so that they will pass to the positive plate, resulting in a breakdown of the condenser.

Now we come to a point bearing on actual construction. Let us consider the material of which the dielectric is composed. If the atoms are very dense and firmly held together, there will be very little motion and hence very little heat will be generated. On the other hand, if the structure of the atoms is loose, there will be a great deal of motion and a great deal of heat generated. Air is a good example of the first and a condenser utilizing air as a dielectric has extremely small losses and will operate continuously on an alternating current of very nearly the same value as the D. C. potential at which it is tested. Mica is the best dielectric ordinarily used in fixed condensers and has comparatively small losses. A mica condenser can usually be operated continuously at 75% of its test voltage.

A definite standard for paper condensers is very difficult to ascertain since many classes of paper with greatly varying electrical characteristics are used and the operating conditions depend entirely upon the quality of the paper. For example, the best condensers have pure linen paper as a dielectric. This material is the best of the papers obtainable and its losses are sufficiently low to enable such condensers to be regularly used on alternating current having an r.m.s. value of one-sixth to one-fifth of the flash test.

On the other hand, wood pulp paper such as is used in most of the European filter condensers due to its cheapness, is the poorest dielectric. Its losses are very high and it cannot be relied upon for continuous operation under A. C. stresses greater than one-tenth its test voltage. Incidentally, wood pulp paper has another great disadvantage. Condensers are usually wound on a cylindrical form and are then pressed flat. Wood pulp paper is very brittle and apt to crack, while linen paper will stand a great deal of crushing and squeezing without affecting the continuity of its surface.

The first condenser in a properly designed filter should have an A. C. working voltage very near the transformer output. For example, if a transformer in a full wave rectifying system delivers 500 volts on each side, the first condenser in the filter should be rated at least 500 A. C. working volts.

The other filter condensers have progressively far less strain—the proportion of a. c. combined with the d. c. drops to a very small percentage, and there is a voltage drop which varies proportionately to the load across each of the filter chokes. The later filter condensers, therefore, may be successively rated lower and lower until the last one need have a rating only slightly higher than the combined maximum "B" and "C" voltages supplied by the eliminator.

If such ratings are used, however, great care must be taken that the eliminator is never turned on without the load, because without current flow the voltage across the last condensers will be as much as 100% higher than under load.

Bert E. Smith