Compact Electrolytic Condensers for Midget Receivers

Type EM
Single Section
8 mfds. 450 v.
Size—1"x4⅝"

Type GM
Single Section
8 mfds. 450 v.
Size—1"x4⅝"

Type EEM
Double Section
4-4 mfds. 300 v.
Size—1"x3⅛"

The condensers shown here represent a selection of standard Aerovox units of various types designed especially to meet the requirements of modern small-size radio receivers where space is limited to a minimum. They are exactly the same both electrically and in general operating characteristics as the older type electrolytic condensers in larger size containers, and are available in a wide variety of capacities, voltage ratings and mounting arrangements for every purpose. All condensers in can containers are hermetically sealed to prevent evaporation of moisture from the electrolyte or absorption of excessive moisture from the air.

Single section units in 1" diameter can containers include Type EM, universal mounting (with mounting ring); Type GM, inverted screw mounting; Type SM, screw stud mounting; and Type MM, strap mounting.

Type EE
Double Section
8-8 mfds. 450 v.
Size—1⅜"x5"

Type GG
Double Section
8-8 mfds. 450 v.
Size—1⅜"x5"

Type MM
Single Section
8 mfds. 300 v.
Size—1"x3⅛"

Double and triple section (concentrically wound) units in 1⅜" diameter cans include Types EE and EEE, universal mounting; and Types GG and GGG inverted screw mounting. Double section (concentrically wound) units are also made in 1" diameter cans, Type EEM, for universal mounting with mounting ring.

These can container units are especially desirable in filter and bypass circuits of compact assemblies where high temperatures ordinarily limit the life of cardboard container type units. Multiple section units are adapted for use in compact spaces where individual units would occupy too much space on the chassis.

Type EEE
Triple Section
4-4-4 mfds. 450 v.
Size—1⅜"x4⅝"

Type GGG
Triple Section
4-4-4 mfds. 450 v.
Size—1⅜"x4⅝"

Type SM
Single Section
4 mfds. 300 v.
Size—1"x2⅝"

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The Most Complete Line of Condensers and Resistors in the Radio and Electrical Industries

The AEROVOX Research Worker

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Announcement on Resuming Publication

Yes, the RESEARCH WORKER is again being published. That's good news for many of us—some 65,000 to be exact, for that is the circulation our little paper has attained. Renewed publication means that "Happy Days Are Here Again" for the properly informed radio man.

To those of you already familiar with this publication, a word of explanation regarding its suspension last March is now in order. Briefly, we originally thought in terms of a technical information service to just a few thousand radio engineers, production managers and service men. But the RESEARCH WORKER attracted too much attention. The mailing list mounted steadily. The expenses of printing and mailing, let alone preparation of editorial material, exceeded all calculations—and budgets. With the general recession of radio trade last March and the need for curtailing every possible expense, we reluctantly decided upon temporary suspension. The burden was just a bit too much for the moment, even though the Aerovox plant has always had more than its share of business during these dull times.

But now the picture changes. Prospects are brighter. Business is marching ahead once more. Hence our decision to issue the RESEARCH WORKER again, so that enterprising radio men may be kept informed.

We want to make this publication still more effective. It must reflect the latest developments in radio and audio frequency engineering. There must be no commercial bias. And we want it in the hands of everyone interested in such an engineering service.

To that end, we are inviting you to contribute towards the expense of maintaining the RESEARCH WORKER. We have set the subscription price at 50 cents a year, and 60 cents in Canada. The November and December issues will be sent free and your subscription will start with the January issue.

SUBSCRIBE NOW! Send 50 cents using enclosed coin card! In this way you will be co-operating with us in maintaining this unique engineering service.

Developments in Design of Small-Size Electrolytic Condensers

By the Engineering Department, Aerovox Corporation

During the past year a number of developments have taken place in electrolytic condenser design to permit the manufacture of more compact units. Not only have the ordinary single section electrolytic condensers been made in smaller sizes but through changes in methods of winding and assembling it is now possible to house multi-section electrolytic condensers in relatively small size containers.

Compact multi-section electrolytic condensers are produced by what is known as "concentric" winding, a method of winding known for years and used to some extent in the manufacture of wax paper condensers but only applied within about the last year to electrolytic condensers. It is our purpose here to discuss, briefly, certain characteristics of concentrically wound electrolytic condensers and their bearing on radio receiver design.

AEROVOX PRODUCTS ARE BUILT BETTER

Printed in U. S. A.

First, what is a concentrically wound electrolytic condenser? Formerly, when two or more electrolytic condensers were to be placed in a single can it was customary to wind two individual units, then place the units in a can, connecting all the negatives to the can and the positives to individual terminals on the cover.

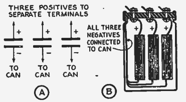

Fig. 1

This is illustrated in Fig. 1, taking as an example a three section condenser of which a common type is the 8-8-8 mfd., 450 volt unit housed in a can 3″ in diameter by 4⅛″ high—Aerovox type E 5-8-8-8 mfd.

Now if the diagram Fig. 1-A is studied it will be noted that while the three positives are separate all three negatives are connected together. This unit can very readily be wound concentrically. The method is illustrated by Fig. 2-A. We start as though an ordinary single section was to be wound. However, when the end of the first positive is reached the negative foil and separator are not cut but instead the second positive is introduced and the winding continued. When the end of the second positive is reached, the third positive is added and there is produced finally a single roll consisting of one long negative foil and three positive foils, all separated from each other, and because the three positives are wound into a single roll a very compact unit is obtained. Such a unit is called a "concentric common negative condenser" and it functions and is used exactly the same as though it were made of three individual sections as shown in Fig. 1. This is the simplest type of concentrically wound condenser. It would ordinarily be used in a double section filter circuit requiring three filter condensers. Fig. 2-A shows how the condenser is actually wound and Fig. 2-B shows how such a unit is indicated diagrammatically.

In the above example we have assumed that all three sections are identical, i.e., each section is rated, for example, 8 mfd.,—450 volt working. However, it is not necessary that all sections be identical and in fact each section can have a different rated working voltage and different capacity, and this fact adds considerably to the usefulness of this type of condenser. For example, we can combine in one unit two high voltage sections for the filter circuit and the third section can be a low voltage by-pass unit. The only limitation is the fact that all the negatives must be common.

To illustrate such a use Fig. 3 is shown. Here we have a triple section concentrically wound common negative condenser consisting of two sections rated at 450 volts working and a third section rated at 50 volts. The first two units are used in the filter circuit and the third unit acts as a by-pass across a C bias resistor connected in the cathode circuit of the power tube.

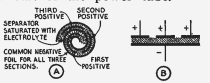

Fig. 2

The preceding two examples indicate that concentrically wound common negative (sometimes termed common cathode) condensers may consist of any number of individual sections each section having any desired capacity and any desired working voltage.

Another type of concentric unit uses a COMMON POSITIVE foil and is known as a "concentric common positive condenser." Such a condenser consists of a single POSITIVE foil and several individual negative foils and is wound as shown in Fig. 4-A and illustrated diagrammatically as shown in Fig. 4-B.

Such a condenser finds most frequent use in filter circuits where the filter choke is placed in the negative lead; Fig. 5 illustrates such a case. Apparently such a condenser is no more complex than the common negative type but in practice we find

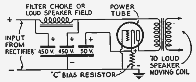

Fig. 3

that certain factors must be considered to make the circuit function properly with a concentric common positive unit.

In Fig. 5 we have indicated certain voltages which might be taken as typical of those encountered in such a circuit. At the output of the rectifier is shown a voltage of 450 volts. Assuming that the loud speaker field is used for the filter choke, approximately 100 volts may be required to give proper energizing and hence there will be a 100 volt D. C. drop across the choke and the output voltage will be 350 volts. The polarity of the voltage drop across the choke (that is, the loud speaker field) is such that the side of the choke connected to the rectifier is negative and the side connected to the output of the filter is positive. These polarities are shown on the drawing. The effect of this voltage is extremely important.

As we know, all ordinary types of electrolytic condensers are polarized which means that the positive terminal of the condenser must always be connected to the positive side of the circuit. When properly connected the leakage current through the condenser is very low. However, when we connect the negative side of the condenser to the positive side of the circuit the leakage current becomes very high

and the unit acts more as a resistance rather than as a condenser.

When an electrolytic condenser is connected properly in a circuit the leakage current is low due to the effect of the film formed during manufacture on the positive foil. When the positive foil is connected to the positive side of a circuit it is this film which limits the current to a very low value. The negative foil, however, has no such film formed on its surface and hence if the unformed negative foil is connected to a positive potential a large current flows since there is no film to limit the current.

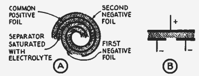

Fig. 4

Now if Fig. 5 is examined it will be noted that the effect of the 100 volt drop across the choke is to make the first negative marked A 100 volts positive with respect to the second negative marked B. If there is no film on the negative foil a current will flow from the foil A to the foil B through the electrolyte with which the separator is saturated.

This flow of current from the positive side of the choke to negative A, thence through the electrolyte to negative B and back to the other side of the choke has exactly the same effect as though a resistor were to be connected across the choke coil. The effect of this current flow is therefore to lower the effectiveness of the choke and increase the hum voltage in the output of the receiver.

Some numerical examples will serve to indicate the importance of this point. First let us list the impedances of various size choke coils at 120 cycles, the hum frequency from a full wave rectifier. The impedance of a choke is equal to 6.28 times the frequency times the inductance in henries. So calculating the impedance of several inductances we obtain the figures given in Table No. 1.

TABLE NO. 1

Inductance of Choke in Henries	Impedance in ohms at 120 cycles
10	7,560
15	11,340
20	15,120
30	22,680

Now assuming 100 volts impressed between the two negatives, let us calculate the resistance of this path for various currents. This is done simply by assuming various values of current and dividing these values into 100, the voltage. The quotient is the resistance in ohms. Table No. 2 gives the results thus obtained.

TABLE NO. 2

Resistances corresponding to various currents for an applied voltage of 100 volts.

Current in milliamperes	Resistance in ohms
0.5	200,000
1	100,000
2	50,000
5	20,000
10	10,000
20	5,000
50	2,000
100	1,000

As a safe rule we might say that the resistance connected across the choke should not be permitted to drop to less than four times the impedance of the choke. Assuming 15 henries as the choke coil inductance then the choke coil impedance is 11,340 ohms and the resistance across it should not be less than 45,360 ohms or in round numbers 50,000 ohms. From Table No. 2 it will be noted that this value of resistance will be obtained if the current is limited to 2 milliampere or less.

If we use two ordinary unformed foils for the negatives of the condenser shown in Fig. 5 the current between them will be much greater than 2 milliampere and hence the receiver will hum but if, for the negative A we used a FORMED foil then the film on this foil will limit the current usually to values much less than 2 milliampere and consequently no trouble will be experienced in the use of such a condenser. The voltage to which the film on the negative foil is formed must be equal to and preferably somewhat greater than the voltage impressed between the two negatives in order to bring about this result.

While, in a concentric common positive condenser each section may have any desired capacity, but all sections will have the same rated working voltage since a single anode or positive foil is common to all sections.

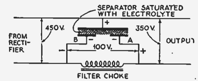

Fig. 5

In connection with the problem of servicing it is desirable that replacement units be of the same type originally used in the receiver. For example: In replacing old three section condensers, either wet or dry, it is desirable to use for the replacement unit a dry condenser using three individual sections rather than one of the concentric units described above. This will generally result in a more satisfactory performance. To be more specific, in replacing a triple section wet condenser, the best type to use is E 5 - 8-8-8, which is in a 3″ can and consists of three separate sections as shown in Fig. 1 rather than a three section concentric unit of the type shown in Fig. 2.

The above discussion will, we hope, serve to indicate to some extent the advantages of concentrically wound condensers. If all the operating conditions are known it is possible to design such condensers to meet almost any circuit conditions.