Devoted to a propagation of technical data of interest to the builder and engineer. We appreciate criticisms and suggestions

The AEROVOX Research Worker

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IMPROVE YOUR REPRODUCTION

USE OF PROPER AUDIO FREQUENCY FILTER MEANS NOTABLE IMPROVEMENT

By S. FISHBERG, B. S.

Within the last two years, great advances have been made in the perfection of audio frequency amplifying systems. Transformers have been made with heavier cores and larger inductances; power tubes adequate to handle large amounts of undistorted power have appeared on the market; loud speakers with flat characteristics have been designed and manufactured. All these technical developments have brought nearer and nearer the goal of the perfect amplifier. We might define the perfect amplifier as one which would reproduce with perfect fidelity the signals fed into it. At first glance, such an amplifier would seem very desirable for use with a radio set. We must realize, however, that before the signal reaches the listener, it has passed through a microphone, several line amplifiers, some hundreds of miles of telephone wire, perhaps, the transmitter, the ether, and the receiving set. All these agencies have some effect upon the signal, and by the time it reaches the listener's ear, it is accompanied by a good deal of extraneous noise and distortion.

Most of the noises added to the signal in its journey are at 5000 cycles and higher. Experiments show that such frequencies may be eliminated from speech and music without noticeable effect. The signal suffers most distortion at the hands of the loud speaker. Most reproducers are more or less peaked at the middle and upper frequencies. This is objectionable, not only because of the resulting unnaturalness, but also because it exaggerates our extraneous noises.

What we need, then, in conjunction with our amplifier is some device which will partially or completely remove the noises which have been added to the signal without removing the original sound, and which will conpensate for the peaked characteristics of the loud speaker. Such a device is presented in the audio frequency filter. A filter is a combination of inductance and capac-

(*Continued on page* 3)

The permanent mailing list of the AEROVOX "RESEARCH WORKER" will comprise the individuals who profess interest in this issue.

If you have not already done so, send us your name and address immediately in order that your name be on file for the next issue.

BUILDING FOR PERMANENCE

FILTER CONDENSER WILL LAST FOREVER IF INTELLIGENTLY USED

By BERT E. SMITH

In the construction of Battery Eliminators at home, many builders have been sadly disappointed by having their condensers short circuit after a few weeks of use, necessitating replacement of these expensive parts, frequently destroying the rectifier tubes, and sometimes even burning out the transformers or chokes.

This loss is peculiarly annoying, because it is so unnecessary. Usually the reaction on the part of the disgusted builder is "Why the dickens don't these manufacturers rate their condensers right? No more of that kind for me!"

Of course, there are some manufacturers who over-rate their condensers, as there are people in every trade who misrepresent their merchandise. And there are some who do not properly test their product. But let us presume that we are to consider only condensers made by manufacturers of proven integrity, whose ratings are conservative, and whose goods are properly tested before being used. Even in this case a condenser which to the inexperienced eye is correct, may blow up just in time to supply a glorious interruption to a much-anticipated program. Let us take a case in point:

Assume we have a transformer with a secondary tapped in the center and delivering 550 volts on each side. We are rectifying the current with two 281 rectifier tubes. Our filter is built with a pair of chokes and *good* 600 working voltage condensers connected in the customary way.

The transformer turns out 550 volts; the rectifier tube must have *some* resistance, and therefore there should be some voltage drop there; the chokes should have resistance and again lower the voltage, but it may be the last condenser which goes out! Only 550 volts to start, at least two voltage drops, and a six hudred volt condenser blows.

(*Continued on page* 2)

Continued from page 1

Under these circumstances, one can hardly blame the builder for using hard language. And yet, it is his own fault, *for he has more than seven hundred volts across the condenser.*

This seeming paradox is caused by the difference in nomenclature betweeen A.C. and D.C. If we have 550 volts of pure D.C., we have just 550 volts—no more, no less. But when we have 550 volts A.C., we have normally steadily varying voltages from +777 to —777 and back again. But it will only do as much work as its average value either plus or minus. So we take all its many instantaneous values, square them, add them up, and take the square root. In this case it is 550.

But if we rectify this voltage, and then store it in a condenser, it will build up to a value as high as the maximum value of the peak A.C. voltage. And hence, it is possible to blow 600 volt condensers in the filter with only 550 volts out of the transformer.

A reference to figure 1 will show what happens in our A.C. We have our voltage starting at zero and increasing through what is known as "sine" curve until it reaches 776 volts, then falling back to zero and increasing again in the opposite direction. Due to the fact that at times there is only a very small voltage, this 776 volts maximum alternating current will do only as much work as its average value which is 550 volts. That is, in figure 1, the shaded portions outside of the 550 volt line are useless because we require them to fill in the shaded portions inside the 550 volt line.

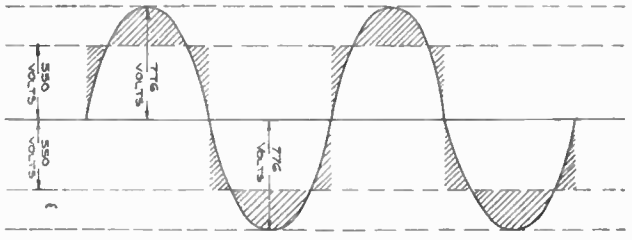
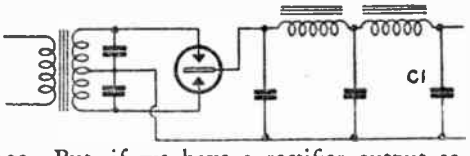


Fig. 1

Now, if we are using a full wave rectifier tube, the current coming out of it is as shown in figure 2. It is still pulsating and if our tube is a perfect rectifier, it still has the same wave formation except that everything is now on the same side of the line. It still has an average value of only 550 volts although the total will be well above 700.

Now, let us look at the output of our filter system. The filter system is put in the picture to smooth out the irregularities in the voltage and the condensers are the largest factor, by far, in doing this. They act by charging when the voltage is above the average and by discharging when it is below



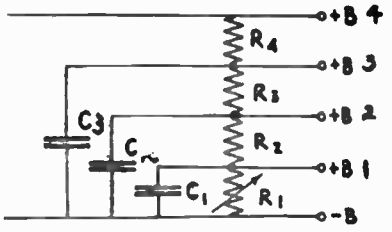
the average. But, if we have a rectifier output as shown in figure 2 and are drawing no load, the voltage will gradually build up as shown in curve A of figure 3. A small load will hold the voltage down more according to "B." This corres-

(*Continued on page* 3)

Getting Rid Of "Motorboating" in Eliminators.

Many a builder who has constructed an eliminator for himself has been very much disappointed when he hooked it up to find that his set, instead of turning out the clear music to which he is accustomed, now gives forth no sound except a shriek or a put-put-put from which this phenomena has been termed "motor-boating." In many cases, not knowing the solution of his difficulty, he has decided that his set would not work with an eliminator and has either thrown away his new eliminator or disposed of it at a loss.

Most of these occasions take place in sets where several tubes are supplied from one voltage tap and are caused by the resistance of the voltage distributor acting as a coupling resistance in the plate circuits of the tubes. For example, referring to the illustration, we will suppose that we have a



radio frequency tube and two audio frequency tubes supplied from +B2. We will also suppose that R1 and R2 total 10,000 ohms. Now, as everyone who has built a resistance coupled amplifier knows, 10,000 ohms is quite a reasonable plate coupling resistance and particularly when the amplification taking place between the audio frequency tube and the last audio frequency tube are considered, it is a very reasonable coupling resistance. The purpose of C2 is to provide a low resistance bypass for the A.C. component of the current drawn by these tubes but in many eliminators, C2 is only shown as 1 mfd. and a condenser, 1 mfd., has a resistance to a 25 cycle tone of almost 6000 ohms so the total remaining resistance is still more than 3500 ohms or enough to make trouble. If, however, we put a condenser of 6 mfd. capacity at C2, the resistance of the condenser will be 1000 ohms or less, and the total resistance will be well under 1000 ohms which makes very litttle trouble.

If, therefore, you have been having any trouble with eliminators from this standpoint, try increasing the values of condensers used as bypasses across the various sections of the eliminator. An increase in the detector bypass will frequently help a great deal both in getting rid of motor-boating and in reducing hum. In the laboratory, it was found in some cases to be absolutely necessary to use bypass values of as high as 8 or 10 mfds. to completely eliminate motor-boating.

IMPROVED REPRODUCTION

Continued from page 1

ity which offers a very high resistance to certain frequencies, and a low resistance to all other frequencies.

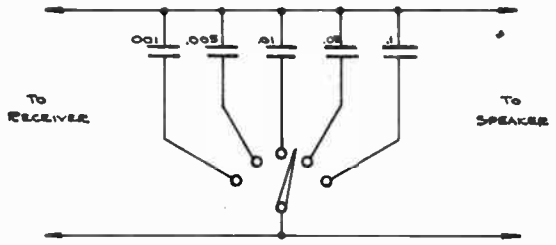


Fig. 1

Figure 1 shows a filter which is designed mainly to remove the extraneous noises which become associated with a signal. It consists of a bank of low capacity condensers connected across the loud speaker. The greater the capacity out into the circuit, the more effectively will the higher frequencies be eliminated. A variation of this filter is shown in figure 2. In this type of filter, the degree of filtering is controlled by the variable resistance R.

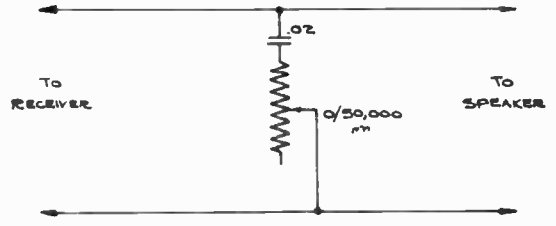


Fig. 2

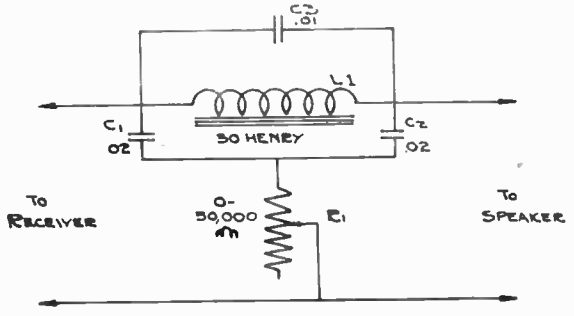


Fig. 3

Figure 3 shows a filter which is designed not only to cut off high frequency noises, but also to compensate for peaked amplifiers and reproducers. As before, the degree of filtering is controlled by the variable resistance R. Using the given constants, the filter will cut down frequencies around three thousand cycles most of all, and diminish higher frequencies somewhat. Filters of this type will go far to correct unnatural reproduction due to faulty loud speakers.

Those who are interested in experimenting with this filter will be well repaid by the interesting and curious tones that will issue from their loud speakers. As a guide to such experiment ,it may be said that increasing C1 and C2 will emphasize the bass tones, while increasing L1, and decreasing C1, C2, and C3 will bring out the higher tones.

BUILDING FOR PERMANENCE

Continued from page 2

ponds roughly to a condition when our eliminator is turned on and some current is passing through the voltage distributing resistance, but the receiver is still turned off. It is at this point that our maximum strain is on the condensers because in most cases the voltage is still above the average line. Now we turn the set on and due to the load, our current drops to C. If we could keep it always at this point, we could be

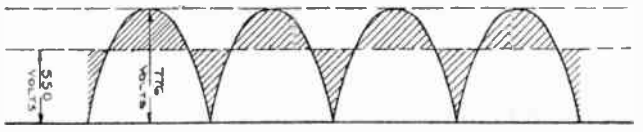


Fig. 2

able to use condensers rated at the same working voltage as the nominal value of the alternating current.

Curve "D" shows roughly what happens when we put too heavy a load on the eliminator. So much current is being

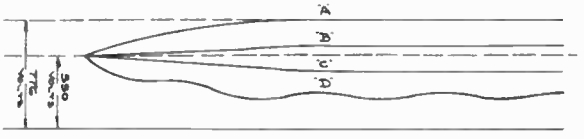
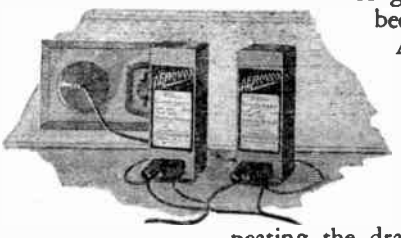


Fig. 3

drawn that the condensers have insufficient storage room to effectively iron out all the ripples, and a pronounced hum will be heard from the loud speaker. This condition can be cured by making the second condenser in the filter much larger.

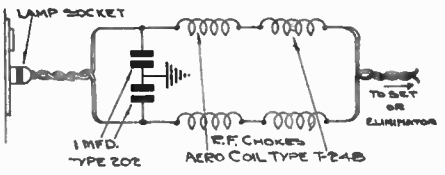
MORE SILENT OPERATION



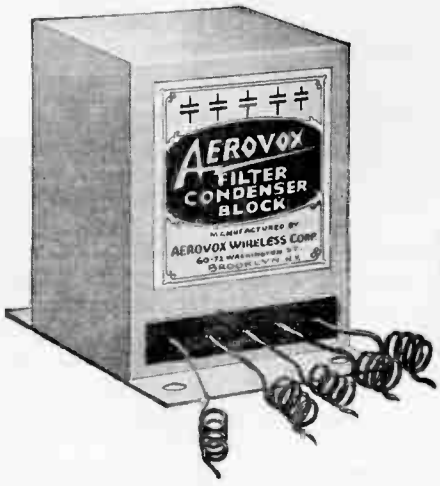
A great deal of interest has been shown in a recent Aerovox advertisement showing how to block line noises and other radio frequency disturbances from entering a set thro the power leads, and we are repeating the drawings here.

This system will prevent pickup caused by the antenna action of the electric light wires, and will frequently reduce hum. It will not, of course, stop the reception of noises through the regular antenna.

If the input to the set or eliminator exceeds 75 watts, leave out the chokes and use 2 Mfd. Condensers.



PAPER DIELECTRIC CONDENSERS



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 ¼" 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.

D. C. WORKING VOLTAGES

Aerovox Filter Blocks are made for eliminators of every size and type. Write for catalog giving complete data.

Capacity	200 Type No. 200	200 Type No. 202	300 Type No. 302	400 Type No. 402	600 Type No. 602	1000 Type No. 1002
.05 Mfd.	$ .55	——				
.1 "	.60	——	$ .80	$1.00	$1.10	$1.50
.25 "	.70	——	1.00	1.10	1.35	2.00
.5 "	.75	——	1.20	1.40	1.85	3.00
1.0 "	.90	$1.25	1.60	1.85	2.75	4.75
2.0 "	1.75	2.00	2.60	3.00	5.00	9.00
4.0 "	——	3.25	4.70	5.25	9.50	17.50
6.0 "	——	4.25	6.75	7.25	13.50	25.50
8.0 "	——	5.75	8.75	9.50	17.50	——
10.0 "	——	6.75	10.25	11.75	21.50	——

AEROVOX PYROHM RESISTORS

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.

Type 992

7/16"x2" Tube Rating 20 Watts	List Price
500, 750, 1000, 1200, 1500, 2000, 2500, 3000 ohms.	$ .90
3500, 4000, 5000, 6000, 7500, 8000, 10,000, 12,000 ohms	1.00
25,000 ohms	1.25

Type 994

7/16"x4" Tube Rating 40 Watts	List Price
1000, 1500, 2000, 2500, 3000 ohms	$1.00
3500, 4000, 5000 ohms	1.10
6000, 8000, 10,000, 12,000, 15,000 ohms	1.20
17,500, 20,000, 25,000 ohms	1.40
35,000, 40,000, 50,000 ohms	1.75

NOTE: *For Extra Taps, Type 992 and 994, Add $.15 To List Price*

Type 996

¾"x6½" Tube Rating 100 Watts	List Price
.25, .5, 1, 2.5, 5, 10, 25, 50, 100, 250, 500, 1000 ohms	$1.25
1500, 2000, 2500, 5000, 10,000, 20,000 ohms	1.50
25,000, 30,000, 35,000, 40,000, 50,000 ohms	2.00
75,000, 100,000 ohms	2.75

Intermediate values at the price of the next higher resistance.

NOTE: *For Each Extra Tap, Add $.20 To List Price*

Note: PYROHM RESISTORS are made also in special tapped units for use with B-eliminators of every type and kind. A post card will bring a complete catalog.

MOULDED MICA CONDENSERS

TYPE 1450

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.

TYPE 1450

Capacity	List Price
.00004 Mfd.	$ .35
.00005 "	.35
.00007 "	.35
.0001 "	.35
.00015 "	.35
.0002 "	.35
.00025 "	.35

Capacity	List Price
.00037 Mfd.	$ .35
.0005 "	.35
.001 "	.40
.002 "	.40
.0025 "	.45
.003 "	.50
.004 "	.50

Capacity	List Price
.005 Mfd.	$ .60
.006 "	.70
.0075 "	.85
.01 "	.90
.015 "	1.20
.02 "	1.50

TYPE 1475

Capacity	List Price
.0001 Mfd.	$ .40
.00015 "	.40
.00025 Mfd.	$ .40
.0005 "	.40

If your dealer does not stock the Aerovox unit you desire, we will be glad to ship post-paid on receipt of price shown. Give your dealer's name when ordering.