Feb. 23, 1937. J. A. HAYENGA ET AL 2,072,035

SOUND DAMPING DEVICE FOR LOUDSPEAKERS

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Fig. 1.

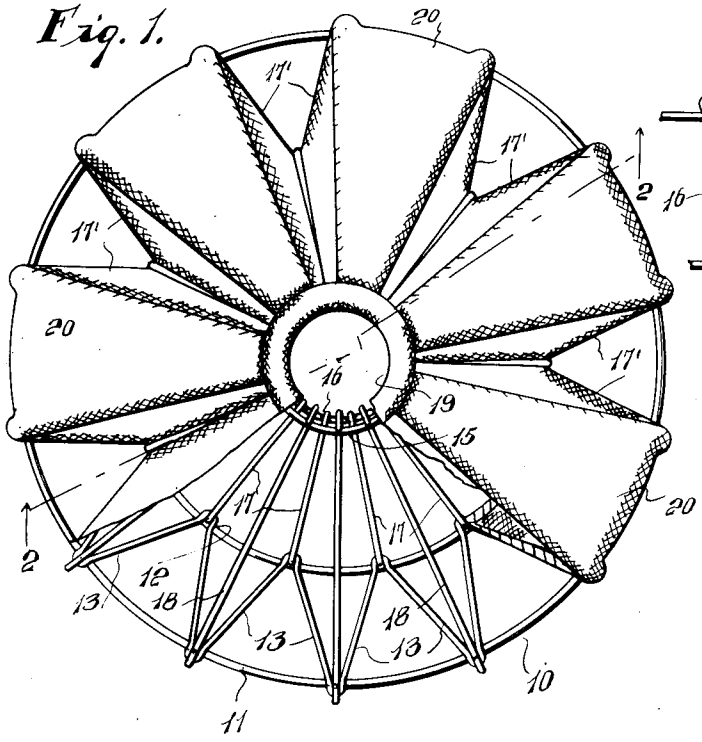


Fig. 6.

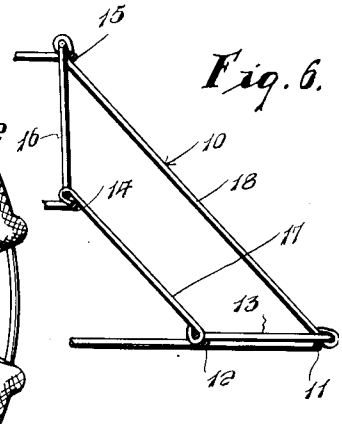


Fig. 7

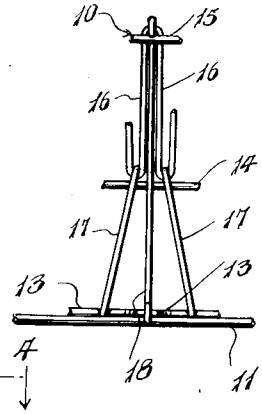
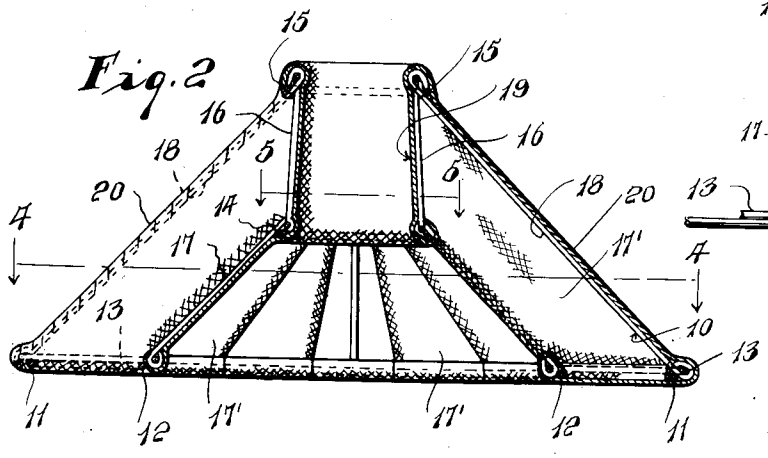


Fig. 2



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SOUND DAMPING DEVICE FOR LOUDSPEAKERS

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Fig. 3.

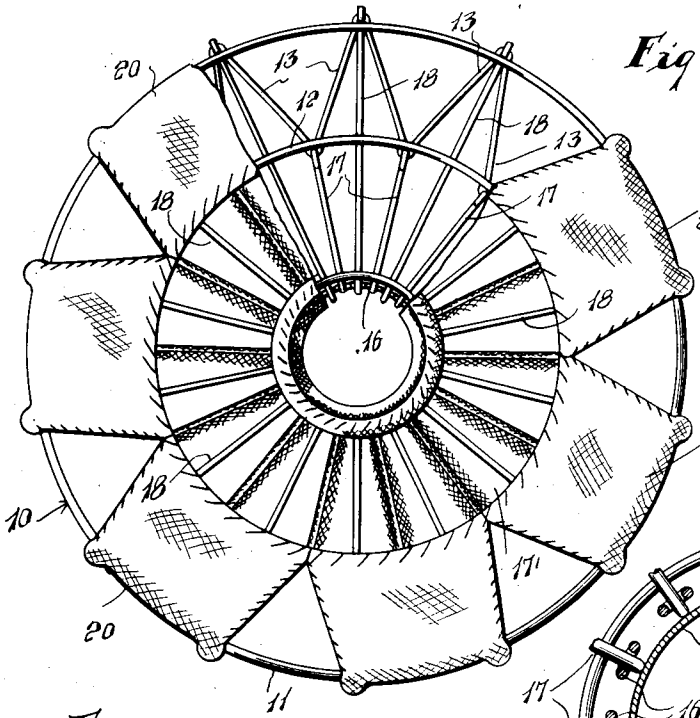


Fig. 5.

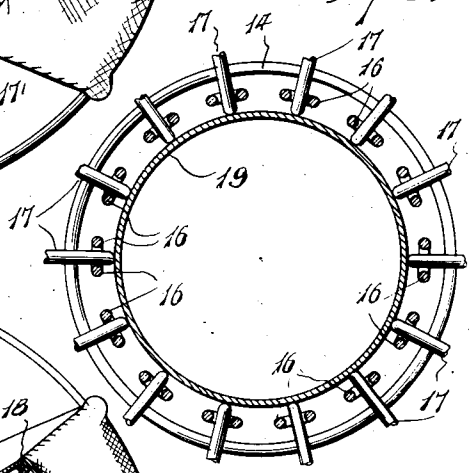
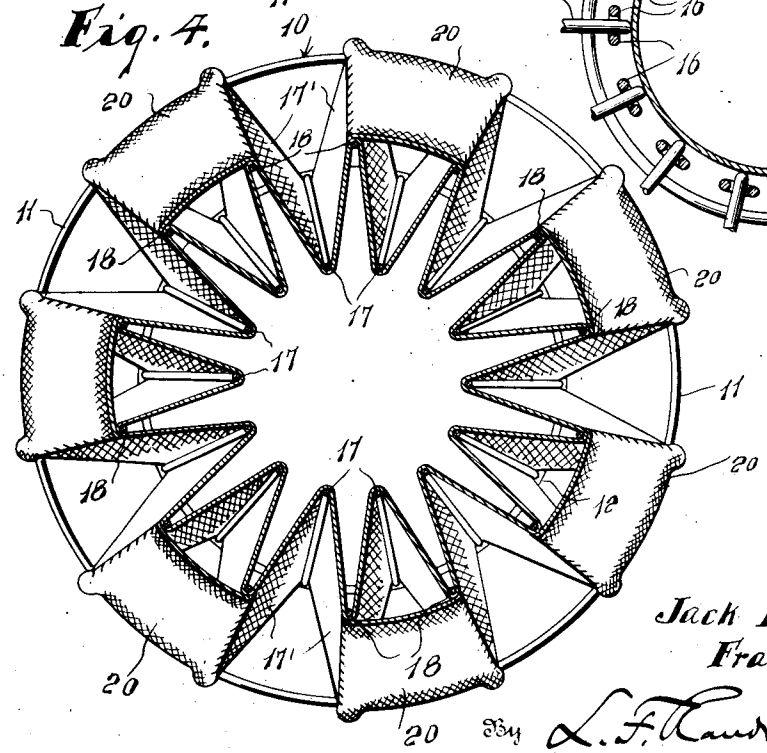


Fig. 4.



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Patented Feb. 23, 1937 2,072,035

UNITED STATES PATENT OFFICE

2,072,035

SOUND DAMPING DEVICE FOR LOUD-SPEAKERS

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Application February 13, 1936, Serial No. 63,792

10 Claims. (Cl. 181—33)

This invention relates to a sound damping device for loud speakers and the main object is to deaden the echo effects on the back of the well known cone type radio speaker and also to reduce the loss of the low notes due to the phase difference between the waves generated on the front and the rear of the speaker cone.

One phase of the invention concerns its use in connection with devices for the transformation of any one of several forms of energy into air waves or sound, as, for instance, in conjunction with a radio loud speaker. We find that it improves the naturalness of all tones at all volume levels sufficiently to be appreciated by the average ear; it permits a much higher volume level with a given radio set and loud speaker without the characteristics of unpleasant overloading and distortion; it increases the relative energy level of the tones in the upper audible range, that is, from the neighborhood of thirty-five hundred cycles upward and it increases the relative energy level of the tones in the lower audible range, that is, from 300 cycles downward.

Generally, the invention consists of means for diminishing the strength of the air or sound waves generated on one side of a driven vibrating member by the use of a novel sound damping device disposed in proximity to one side of said vibrating member and composed essentially of sound absorbing material.

The more specific objects and advantages will become apparent from a consideration of the description following taken in connection with accompanying drawings illustrating one operative embodiment.

In said drawings:—

Figure 1 is a rear elevation of the device, portions of the sound absorbing material being omitted to disclose details;

Figure 2 is a diametric sectional view taken on the line 2—2 of Figure 1;

Figure 3 is an elevation reverse to Figure 1;

Figure 4 is a sectional view taken on the line 4—4 of Figure 2;

Figure 5 is a sectional view taken on the line 5—5 of Figure 2;

Figure 6 is a diametric sectional detail taken through the frame and

Figure 7 is a fragmentary side elevation of the frame.

Referring specifically to the drawings, wherein like reference characters designate like or similar parts, a skeleton frame 10 is employed to mount the sound absorbing material. This frame may be of any desired material but preferably is constructed of metallic wire. It may consist of concentric rings 11 and 12 arranged in the frontal plane of the device, connected by zigzag wires 13 in the same plane.

Spaced from the rings 11 and 12 and from each other, are smaller rings 14 and 15, which are connected by means of substantially parallel wires 16. Inclined wires 17 extend from the ring 14 to the junctions of the pairs of zigzag wires 13 at the ring 12 and outer wires 18 extend angularly from the ring 15 to the junctions of the zigzag wires 13 at frame or ring 11. The various wires are rigidly joined together in any suitable manner, for instance, by soldering.

A tube 19 of sound absorbing material lines the wires 16 and rings 15 and 14. A sheet of sound absorbing material 17' is woven in accordion fashion alternately over the wires 17 and 18, its end edges being stitched together, and the inner ends of the pleats being stitched to the tube 19.

On the exterior of the device, stitched to the sheet 17' and across alternate valleys of the pleats, are closing strips 20 of sound absorbing material, such strips 20 being folded over the frontal plane of the frame 10, secured about the inner ring 12 and having their margins stitched to adjacent ends of the pleats.

The device is adapted for use in connection with a cone type radio speaker within the radio cabinet. The invention or damping device will be placed over the back of such cone type speaker with the tubular section of sound absorbing material 19 positioned snugly over and around the cone driving mechanism, and the cabinet will act as a baffle for the speaker. The sound damping device so arranged, is attached in close contact with the back of the front wall of the radio cabinet by means of screws, clips or in any suitable manner.

The sound absorbing material may be felt or other textile fabric, although no limitation is to be implied. A particular sound damping material which has been used is an all cotton bathrobe material constructed with forty-nine warp threads per inch, and forty-eight filling threads per inch, manufactured thirty-six inches wide and weighing eight ounces per yard.

It is presumed that the damping device will be placed so that there will be an open space between the outside of the same and the inner walls of the radio speaker cabinet whose average distance will be approximately equal to the depth of the convolutions of sound absorbing material on the damping device. The angle of the walls of the cabinet and the outside of the damping

device, when used in the present day speaker compartment, are widely divergent so that the action of the damping device is aided by this angular deviation.

It will be realized that the series of convolutions or pleats present a frontal area and surface angles to the sound waves leaving the vibrating member which are to be kept as low as practical.

By closing alternate convolutions on the sides away from the vibrating member with sound absorbing material, we produce relatively dead air spaces when compared to the open convolutions, valleys or pleats.

In passing through the sound damping device of the present invention, the sound waves are distorted in three main steps. First, the angle of the surface of the sound damping material and the approaching air wave is kept as low as practical so that the sound wave is deflected without appreciable reflection towards the convergent apex of the angle formed by each convolution of sound damping material. As it passes along this route, the sound wave is distorted by the friction of the sound absorbing material forming the sides of the angles. Second, as the sound wave approaches the apex of the angles formed by the convolutions or pleats of said sound absorbing materials, the compression of the air is increased until the sound wave is forced to change its direction and pass through the layers of said sound absorbing material forming the sides of the angles. Third, in one direction, after passing through the sound absorbing material, the sound wave will find free access to the outside air. In the other direction, the sound wave will be forced to pass through another layer of sound absorbing material before reaching the outside or free air. The cumulative effect of these three main actions, added to the lesser actions, such as eddy effects, etc. is to reduce the definition of the sound waves on the outside of the vibrating cone to a minimum.

It is, of course, well understood that a vibrating cone generates air waves of approximately equal intensity at the front and rear (inside and outside). However, the waves on one side are 180° out of phase with those on the other side. This means that where no baffle area is presented to augment the area of the vibrating cone, the sound waves generated by the cone are largely lost by eddying around the base of the cone and do not pass readily out in the air away from the cone. Inasmuch as the higher audible tones have greater molecular acceleration than the lower tones, and therefore, tend to travel into a more direct line from their source into the free air, the lower tones are lost to a greater extent by eddying to the back of a vibrating cone which has a restricted baffle area, than are the higher audible tones.

In practice, where the baffling area of a vibrating cone is restricted due to physical limitations or for other reasons the sound is distorted by a relative reduction of low frequency response.

The greatest difficulty in generating the higher audible tones if of course the inertia of the cone itself. However, another set of circumstances tends to reduce and distort these higher tones.

When a reflected wave rebounds against the rear of the vibrating cone in such a manner as to be in phase with the original wave being generated by the cone, the tone as produced by the loudspeaker, if sustained for an appreciable interval, will be very considerably augmented by this reflected wave. Conversely, if the reflected wave be 180° out of phase with the original wave, the tone being generated by the loudspeaker will be very considerably diminished.

Between these two extremes of phase relation, the reflected waves will tend to generate discordant tones which will be produced on the front (inside) of the cone to an appreciable extent.

Thus, it will be seen that the damping device of the present invention seeks to reduce the loss of the lower tones due to eddy effects and also to reduce the effects of the reflected waves. In practice, we find that when the damping device is efficiently proportioned, the air waves on one side of the vibrating member are so effectively diminished that the sound baffle may be extended entirely around the damping device, producting a baffle area closely approximating infinity, without the attendant resonance effects observed when the damping device is not used.

Various changes may be resorted to provided they fall within the spirit and scope of the invention.

We claim as our invention:—

1. A damping device of the class described having a wall of sound absorbing material for impingement by sound waves, said wall being of accordion shape, a loud speaker, and means of absorbent material carried by said wall and surrounding said loud speaker.

2. A damping device according to claim 1 wherein the pleats of said wall extend generally in the direction of emission of sound.

3. A damping device according to claim 1 having alternate pleats of said wall exteriorly closed at their ends by sound absorbing material.

4. A damping device according to claim 1 having sound absorbing material closing certain of the pleats at ends thereof.

5. A damping device having a tubular portion of sound absorbing material in which the driving mechanism of a loud speaker is adapted for disposition, a cone in the smaller end of which said tube is disposed, said cone having its wall of accordion shape and of sound absorbing material.

6. A damping device according to claim 5 having alternate valleys of the wall on the exterior of the cone closed by sound absorbing material.

7. A damping device according to claim 5 having elements of sound absorbing material closing alternate pleats on the exterior of the cone, said material extending across the frontal plane of the device to the depth of the pleats.

8. A damping device of the class described having a skeleton tubular portion, a tubular portion of sound absorbing material within the first mentioned portion, concentric connected rings in the frontal plane of the device, wires extending from the first mentioned portion adjacent the front and rear thereof and respectively to the inner and outer concentric rings, sound absorbing material arranged in accordion fashion over said wires and connected to the second mentioned material, the second mentioned sound absorbing material being secured to said rings.

9. A damping device according to claim 8 having sound absorbing material closing alternate pleats on the exterior thereof.

10. A damping device according to claim 8 having sound absorbing material exteriorly closing alternate pleats, the latter material being extended across and secured to said rings.

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