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ACOUSTIC CONTROL DEVICE FOR LOUDSPEAKERS

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FIG. 1

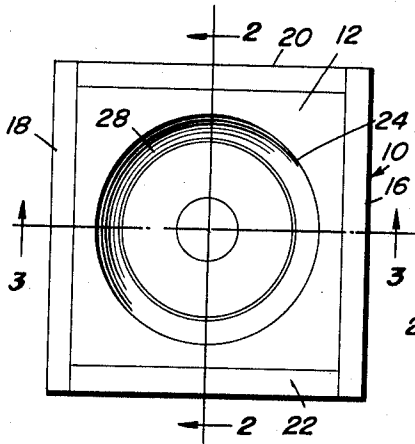


FIG. 2

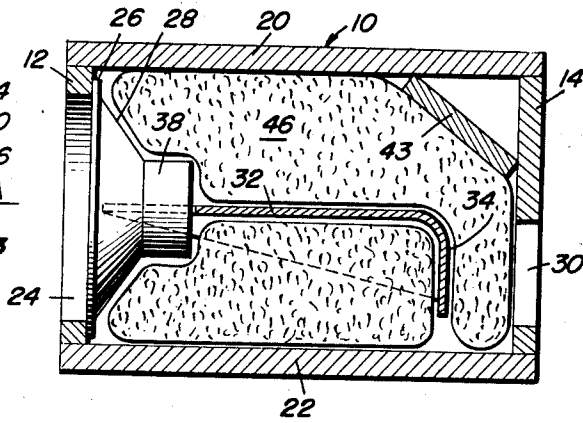


FIG. 3

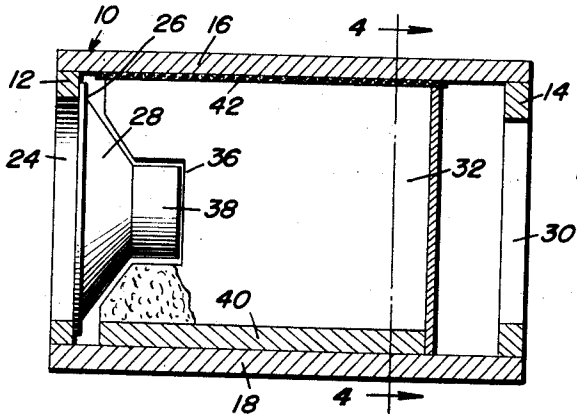


FIG. 4

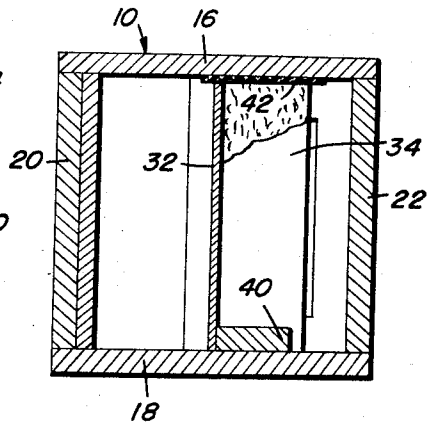
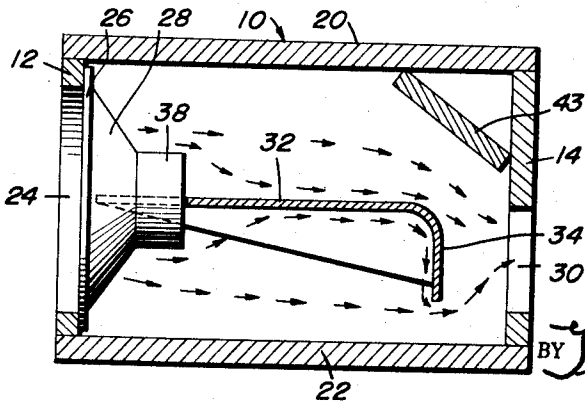


FIG. 5



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ACOUSTIC CONTROL DEVICE FOR LOUSPEAKERS

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9 Claims. (Cl. 181—31)

This invention relates to a device for controlling the sound reproduction of a cone-type loudspeaker, and it particularly relates to a device which controls the interfering sound waves set up at the rear surface of the loudspeaker by its vibrations.

Heretofore, one of the most persistent problems of sound reproduction by a cone-type loudspeaker has consisted of the so-called back-waves set up at the rear of the loudspeaker. These back-waves have acted to interfere with and even cancel some of the direct front sound waves set up by the loudspeaker resulting in distortion or even nullification, in part, of the reception. Furthermore, in order to obtain the full tonal effect throughout the audio range, it has, heretofore, been necessary to employ two or more loudspeakers together with inductance/capacitance networks; with each loudspeaker performing in a separate portion of the audio range. However, the use of said inductance/capacitance networks provided for an inherent distortion of the wave form at the so-called "cross-over" or dividing points; these points being established by the inductance/capacitance networks. In addition, in order to obtain effective low frequency response, it was, heretofore, necessary to use cone-type loudspeakers of relatively large size.

It is one object of the present invention to overcome the above as well as other disadvantages of the prior types of loudspeaker systems by providing a device which permits the use of a single, relatively small, cone-type loudspeaker which is best adapted to reproduce high frequencies while yet producing effective low frequencies which are normally only produced by relatively large loudspeakers.

Another object of the present invention is to provide a device suitable for use with a single, relatively small loudspeaker which prevents the distortion inherent in the use of two or more loudspeakers of different sizes, with their associated inductance/capacitance networks, while yet obtaining full audio fidelity in all ranges.

Another object of the present invention is to permit unaltered audio sound waves to be emitted from the front end of a cone-type loudspeaker by preventing cancellation or interference therewith by the sound waves produced at the rear of the loudspeaker while, at the same time, providing for phase inversion in whole or in part, of the low frequency sound waves at the rear of the loudspeaker, so as to bring such low frequency waves into or nearly into phase with the sound waves emitted from the front of the loudspeaker.

Another object of the present invention is to provide an improved loudspeaker acoustical control system resulting in more faithful reproduction of audio sound with relatively small, simple and easily manufactured equipment.

Other objects of the present invention are to provide an improved acoustic control device, of the character described, that is easily and economically produced, which is sturdy in construction, and which is highly efficient in operation.

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With the above and related objects in view, this invention consists in the details of construction and combination of parts, as will be more fully understood from the following description, when read in conjunction with the accompanying drawing in which:

Fig. 1 is a front elevational view of a device embodying the present invention.

Fig. 2 is a sectional view taken on line 2—2 of Fig. 1.

Fig. 3 is a sectional view taken on line 3—3 of Fig. 1.

Fig. 4 is a sectional view taken on line 4—4 of Fig. 3.

Fig. 5 is a sectional view somewhat similar to that of Fig. 2 but with the insulation omitted to more clearly indicate the paths of the rear sound waves which are diagrammatically illustrated by arrows.

Referring in greater detail to the drawing wherein similar reference characters refer to similar parts, there is shown a housing, generally designated 10, which comprises a front panel 12, a rear panel 14, side panels 16 and 18, upper panel 20 and lower panel 22.

The front panel 12 is provided with a circular opening 24 at the inner side of which is positioned the flange 26 of a conical loudspeaker 28. The opening 24 is almost of the same diameter as the flange 26, being only sufficiently smaller to permit sealing of the flange 26 around the inner periphery of the opening. Furthermore, the cross-sectional dimensions of the interior of the housing are only large enough to permit easy installation of the speaker 28. As a result, the area behind the conical area of the speaker is held to a minimum. The flange 26 is sealed around the periphery of the opening 24 and all the points of the housing are likewise sealed in order to prevent any escape of the sound waves within the housing except at desired areas. The dimensions of each side panel 16, 18, 20 and 22 are such that the length is approximately three halves of its height, that is, the ratio of the length of the panel is to its height as three is to two.

Preferably, the thickness of the panels 12, 14, 16, 18, 20 and 22 forming the housing 10 is maintained at approximately one and one-fourth inch for each cubic foot of volume enclosed within the housing. It has been found that this relationship restricts to negligibility the undesirable vibration of the panels of the housing while yet maintaining the weight of the housing substantially light. When a cone-type loudspeaker eight inches in diameter is used the panels may be three-fourths inch thick.

At the rear of the housing, the panel 14 is provided with a transversely-elongated opening 30 which is arranged at the lower portion of the panel. The opening 30 is the only opening from which sound waves generated within the housing can escape, and this opening 30 is, as can be seen from the drawing, downwardly-offset relative to the speaker 28. This requires the paths of the sound waves to bend in order to escape from the opening 30.

The opening 30 is also positioned at the so-called "null point." This "null point" it has been discovered, is that point between two approximately identical sound sources at which the sounds are either cancelled or their intensity appreciably reduced. Experiment has shown that there are several such "null points" between two sound sources of equal frequency and loudness and that these "null points" can be easily located with a sound detection device and the distances between the "null points" and the sound sources measured. Even though the distances may tend to vary somewhat with variations in the efficiency of the two sound sources and with varying frequencies, it has been established that a point at a convenient distance between the sound sources can be selected at which a relatively wide portion of the audio range of frequencies will tend to cancel each other. In the present case, the dividing of sound waves from a single

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source has a similar effect, to wit, the effect of two separate sound sources of like sound and intensity. The single source here is the rear of the speaker 28 from which two separate sound waves are emitted, as will hereinafter be more fully described. The opening 30, therefore, is so placed, that it is at the "null point" for these two sound waves.

The means for dividing the sound waves from the rear of the speaker and confining these divided sound waves in two or more paths or channels of predetermined unequal lengths which cause the divided sound waves to cancel or partially cancel each other when they converge at the opening 30 comprises a partition 32 having a perpendicularly-offset end portion 34 at its rear end. This partition also acts as a sounding board for low frequency waves. At its front end, the board 32 is provided with a cut-out portion 36 which is just large enough to receive the rear, hub portion 38 of the speaker 28, while along one edge, it is attached and sealed to panel 18 by an adhesive block 40. At its opposite edge, the board 32 is provided with a foam rubber strip 42 which acts to releasably seal it to the inner surface of the panel 16, the panel 16 being preferably removable. The thickness of the board 32 is preferably approximately one sixty-fourth of its height and the radius of the 90 degree offset end portion 34 is preferably about one-eighth its height.

A block or baffle member 43 is provided adjacent the bend between the board 32 and its end portion 34; this block 43 acting to control the sound path on one side of the board 32 and also acting as a reflector for the sound waves in conjunction with board 32. The block 43 may be, if desired, set at various predetermined angles with respect to board 32 and panel 20. By adjusting the angle of the block 43, a variety of speakers of varying cone shapes can be used without altering other dimensions of the housing or of the board 32.

Acoustical insulation such as fiberglass is provided at 46. This insulation fills the housing and helps to greatly reduce the intensity of the higher frequency sound waves within the housing.

It has long been recognized that the vibrations of a loudspeaker cone cause a rarification of the air behind the cone while air is being pushed out in front of the cone. Conversely, the audio sound waves set up in front and behind the cone are not in perfect phase with each other. Furthermore, the higher frequency sound waves are quite directional while the lower frequency waves are much less directional. Therefore, dual or distorted sound will occur in the higher range while cancellation will occur in the lower range unless a means is provided to prevent the back-waves emanating from the rear of the cone from reaching the listener's ears, or unless these back-waves can be substantially reduced in intensity or brought into phase with the front waves before reaching the ears of the listener. This is accomplished in the present invention by the provision of opening 30 at the "null point."

The back waves in the present invention consist of primary back waves and secondary back waves. The primary back waves are set up directly by the rear of the speaker cone. These primary waves are initially substantially identical. However, since the waves are divided into separate paths of unequal distance by the board 32, as best shown in Fig. 5, and the paths meet at the "null point" at 30, the divided sound waves tend to cancel each other at that point.

In addition, the intensity of the higher frequency waves have been greatly reduced by insulation 46. The confined low frequency waves, however, cause the board 32 to vibrate setting up the secondary back waves which are almost in phase with and are similar to the front waves. Since these low frequency waves are relatively non-directional and less affected by insulation 46, they pass

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out through opening 30 and support the low frequency waves from the front of the speaker. This results in a fine bass tone even though a relatively small diameter speaker is used in a housing 20 of relatively small size. The housing 20 described is less than one-thirtieth the size of housings required for comparable bass response heretofore and the smaller size prevents the "echo" and "horn effect" inherent in larger housings.

Although this invention has been described in considerable detail, such description is intended as being illustrative rather than limiting, since the invention may be variously embodied, and the scope of the invention is to be determined as claimed.

The invention claimed is:

1. In combination, a substantially closed, generally rectangular housing, a first aperture centrally positioned in the front wall of said housing, said aperture having a cross-sectional width almost equal to the cross-sectional width of the interior of said housing, a conical loudspeaker within said housing, a flange around the larger end of said loudspeaker, said flange being in sealed engagement with the inner peripheral area of said aperture, a second aperture in the rear wall of said housing, said second aperture being offset relative to said first aperture, and an elongated sounding board in said housing, said sounding board extending from a position adjacent the center of said loudspeaker to a position adjacent said second aperture, that portion of the sounding board adjacent said second aperture being offset from the remainder of said sounding board.
2. The combination of claim 1 wherein an angular baffle member is adjustably positioned in said housing adjacent the juncture of said offset portion of the sounding board with the remainder of the sounding board, said baffle member being adapted to coact with said sounding board to provide a wave guide.
3. The combination of claim 1 wherein at least one wall of said housing is removable, said sounding board being sealed against said removable wall by a foam rubber sealing strip.
4. The combination of claim 1 wherein said second aperture is positioned at a predetermined distance from said loudspeaker, said distance being such that said second aperture is positioned at a null point for the sound waves emanating from the rear of the loudspeaker, divided by the sounding board, and meeting at said second aperture.
5. The combination of claim 1 wherein the thickness of the sounding board is approximately one sixty-fourth of its height.
6. The combination of claim 1 wherein the thickness of the walls of the housing is approximately one and one-fourth inch for each cubic foot of volume enclosed within the housing.
7. In a loudspeaker enclosure for substantially cancelling out such rearwardly moving sound vibrations as would interfere with or cancel forwardly moving sound vibrations from the loudspeaker enclosed, a loudspeaker housing comprising a square front panel having an opening therethrough substantially equal to the diameter of cone of the loudspeaker and providing a frame to which the flange of the loudspeaker cone is mounted, four rectangular side panels extending rearwardly, one from each side of said square front panel, and a rear square panel completing the enclosure, a combination partition and low frequency L shaped sounding board, the front edge of the long leg of the L of said sounding board being cut out to conform to the shape of the mid-section of the loudspeaker frame with a minimum of clearance between the loudspeaker frame and said cut out front edge, one side edge of said L shaped board being secured on one side rectangular panel, the opposite side panel being removably secured in said housing, the long L leg extending parallel to and midway between opposite side

panels, a yieldable strip of resilient sheet material providing a sealing contact between said opposite removable side panel and the opposite edge of said L shaped sounding board, the short leg of the L being connected to the long leg by a radius approximately one eighth of its height and terminating a short distance from one of said opposite side panels and spaced from said rear square panel, a block angularly extending across the angle between said rear square panel and the side panel opposite the side panel toward which said short L leg extends, a rectangular breather opening in said rear square panel rearward of said short L leg and of somewhat less area than the area of said short L leg, said rectangular breather opening being slightly closer to said side panel toward which said short L leg extends than said short L leg is.

8. In a loudspeaker enclosure for substantially cancelling out such rearwardly moving sound vibrations as would interfere with or cancel forwardly moving sound vibrations from the loudspeaker enclosed, a loudspeaker housing comprising a square front panel having an opening therethrough substantially equal to the diameter of cone of the loudspeaker and providing a frame to which the flange of the loudspeaker cone is mounted, four rectangular side panels extending rearwardly, one from each side of said square front panel, and a rear square panel completing the enclosure, a combination partition and low frequency L shaped sounding board, the front edge of the long leg of the L of said sounding board being cut out to conform to the shape of the mid-section of the loudspeaker frame with a minimum of clearance between the loudspeaker frame and said cut out front edge, one side edge of said L shaped board being secured on one side rectangular panel, the opposite side panel being removably secured in said housing, the long L leg extending parallel to and midway between opposite side panels, a yieldable strip of resilient sheet material providing a sealing contact between said opposite removable side panel and the opposite edge of said L shaped sounding board, the short leg of the L being connected to the long leg by a radius approximately one eighth of its height and terminating a short distance from one of said opposite side panels and spaced from said rear square panel, a block angularly extending across the angle between said rear square panel and the side panel opposite the side panel toward which said short L leg extends, a rectangular breather opening in said rear square panel rearward of said short L leg and of somewhat less area than the area of said short L leg, said rectangular breather opening being slightly closer to said side panel toward which said short L leg extends than said short L leg is, and fiberglass acoustical insulation material filling said housing on both sides of said L sounding board to said angular block.

9. In a loudspeaker enclosure for substantially cancelling out such rearwardly moving sound vibrations as would interfere with or cancel forwardly moving sound vibrations from the loudspeaker enclosed, a loudspeaker housing comprising a square front panel having an opening therethrough substantially equal to the diameter of cone of the loudspeaker and providing a frame to which the flange of the loudspeaker cone is mounted, four rectangular side panels extending rearwardly, one from each side of said square front panel, each side panel having a length rearwardly approximately three halves its width, and a rear square panel completing the enclosure, a combination partition and low frequency L shaped sounding board, the front edge of the long leg of the L of said sounding board being cut out to conform to the shape of the mid-section of the loudspeaker frame with a minimum of clearance between the loudspeaker frame and said cut out front edge, one side edge of said L shaped board being secured on one side rectangular panel, the opposite side panel being removably secured in said housing, the long L leg extending parallel to and midway between opposite side panels, a yieldable strip of resilient sheet material providing a sealing contact between said opposite removable side panel and the opposite edge of said L shaped sounding board, the short leg of the L being connected to the long leg by a radius approximately one eighth of its height and terminating a short distance from one of said opposite side panels and spaced from said rear square panel, a block angularly extending across the angle between said rear square panel and the side panel opposite the side panel toward which said short L leg extends, a rectangular breather opening in said rear square panel rearward of said short L leg and of somewhat less area than the area of said short L leg, said rectangular breather opening being slightly closer to said side panel toward which said short L leg extends than said short L leg is, an fiberglass acoustical insulation material filling said housing on both sides of said L sounding board to said angular block.

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