United States Patent [19]

Monroe

[11] **3,712,411**

[45] **Jan. 23, 1973**

[54] **LOUD SPEAKER CABINET**

[76] Inventor: **Donald V. Monroe,** 1629 N. Del Mar, Rosemead, Calif.

[22] Filed: **March 17, 1972**

[21] Appl. No.: **235,714**

[52] **U.S. Cl.** ..... **181/31 B**
[51] **Int. Cl.** **G10k 13/00,** H04r 1/28
[58] **Field of Search** ..... 181/31 B

[56] **References Cited**

UNITED STATES PATENTS

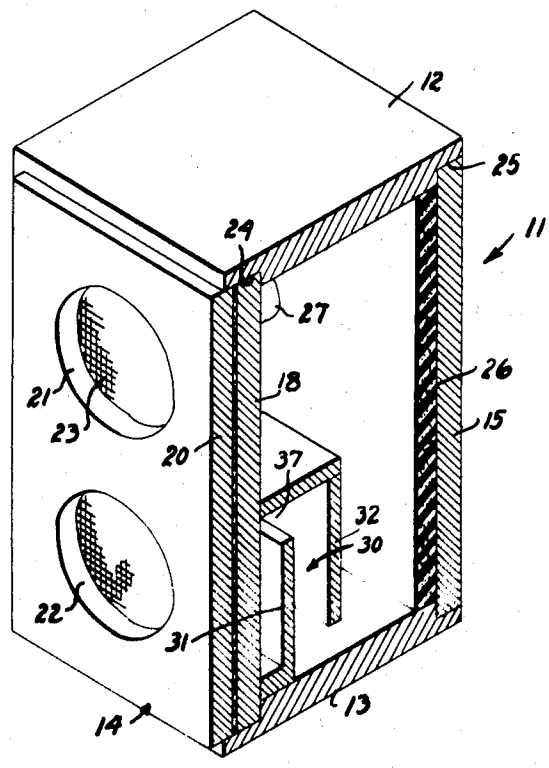
1,869,178	7/1932	Thuras	181/31 B
2,315,896	4/1943	Dumas	181/31 B
2,900,040	8/1959	Novak	181/31 B
2,971,598	2/1961	Sieler	181/31 B
3,037,081	5/1962	Carlsson	181/31 B

Primary Examiner—Stephen J. Tomsky
Attorney—Fred N. Schwend

[57] **ABSTRACT**

A loudspeaker system is provided comprising a vibration-free cabinet of minimum interior size having a relatively thick front wall including two spaced parallel sound exit apertures. A loudspeaker is attached to the rear of the front wall with its cone communicating directly with one of the exit apertures, and a sound-delay chamber of constant cross-section throughout its length is interposed between the second exit aperture and the interior of the cabinet, leading to the rear of the speaker cone. Sound waves from the two resulting sound paths reinforce each other in a slightly out-of-phase relationship which enhances the quality and depth of the resulting overall sound and utilizes the full power of the speaker. Also, microphone-speaker feedback is substantially eliminated at normal power and at locations beyond approximately one foot from the front of the cabinet.

7 Claims, 3 Drawing Figures



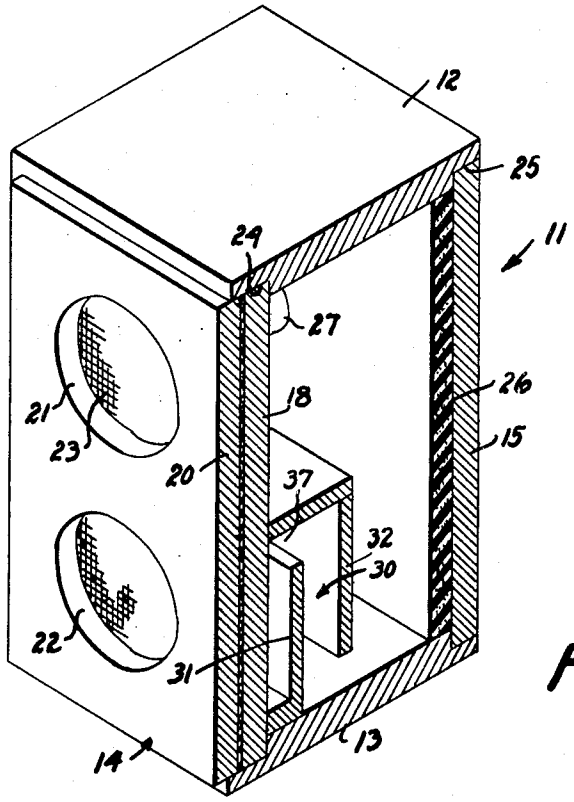


FIG. 1.

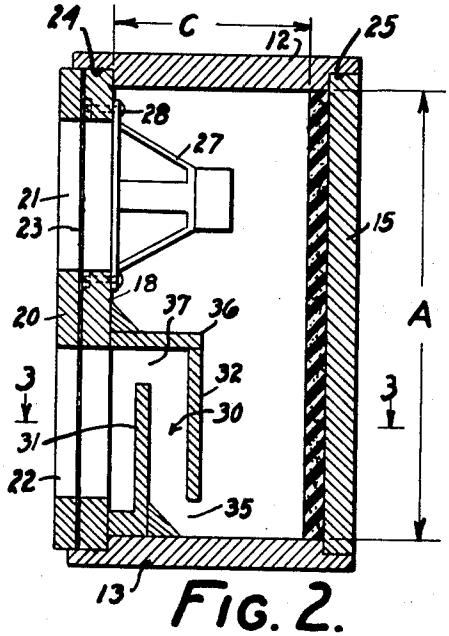


FIG. 2.

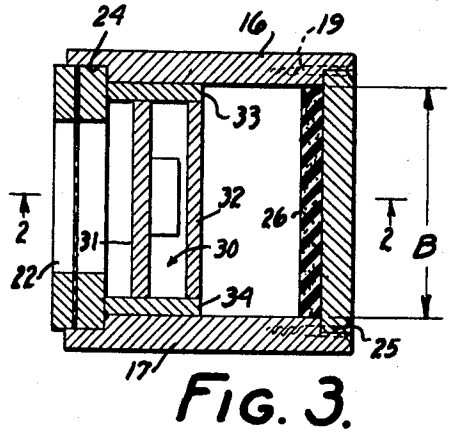


FIG. 3.

LOUD SPEAKER CABINET

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to loudspeakers and has particular reference to loudspeaker systems capable of being universally used for music, paging, and public address applications.

2. Description of the Prior Art

One of the most perplexing problems encountered in microphone — loud speaker combinations, as found, for example, in paging and public address systems, is the development of undesired feedback noise which occurs when the microphone is placed in the neighborhood of the speaker to which it is electrically connected. Although attempts have been made to solve this problem, such solutions have generally resulted in expensive construction, impaired sound quality and/or reduced power output of the speaker. Also, heretofore, in order to provide clear and faithful or authentic reproduction of sound throughout the normal audio range and at relatively full power, various expedients have been used. For example, combinations of different size loudspeakers are employed in many cases, in which larger speakers are used for transmitting lower frequency sounds and smaller speakers are used for transmitting higher frequency sounds. Such combinations have come into almost universal use for several reasons. One is that two or three of such speakers could be crowded into a smaller cabinet of prior design than could a single full-range speaker. Another is that maximum power rating increases with each added speaker, making it possible for less expensive speakers to be used.

SUMMARY OF THE INVENTION

According to the present invention, a loudspeaker cabinet is provided which substantially eliminates microphone - speaker feedback, produces a clear and authentic reproduction of substantially all sounds within the normal audio range and at all volume levels, is capable of utilizing maximum power of a single full-range speaker substantially throughout such range and is of minimum size. This is accomplished by providing a vibration-free enclosure of minimum size having a relatively thick front wall, i.e., on the order of 1¼inches thick, in which two spaced parallel sound exit apertures, on the order of 4 inches in diameter each are formed. Because of the thickness of the front wall, the exit apertures assume the form of sound conduits, each having a length of approximately one-third of its diameter.

A loudspeaker is attached behind the front wall in line with one of the sound exit apertures and a sound delay chamber having a constant cross-section throughout its length is formed intermediate the second sound exit aperture and the interior of the cabinet leading to the rear of the speaker cone. Such chamber has a cross-sectional area of substantially 6¼square inches and an effective length of substantially 5¼inches. It has been found that this size chamber is effective to slightly delay the passage of substantially all sound waves within the normal audio spectrum. The resulting two sound paths appear to reinforce each other to utilize substantially the full power of the speaker. Also, due to the resulting slight out-of-phase relationship of the two

sounds thus emanated, a slight echo effect results which adds to the depth and richness of the overall sound. This, combined with the particular size and configuration of the cabinet results in a clear and authentic or faithful reproduction of music or the like throughout substantially the entire audio range. Further, and of considerable importance, is the absence of any microphone - speaker feedback tendencies beyond a distance of approximately 1 foot from the front wall of the speaker. Apparently, this is due to the fact that the two sounds, when combined at a short distance from the front of the speaker, result in a total sound which is somewhat out of phase with the feedback characteristics of the microphone - speaker combination.

It has been found, in using a five inch speaker with sound exit apertures on the order of 4 inches in diameter, that it is essential to maintain the length of the opening of such openings (thickness of the front wall) at least 1¼inches in order to restrict the point at which feedback occurs to within 1 foot of such exit apertures, which is well within desirable limits and well within the limits of other speaker cabinets of which applicant is aware.

Accordingly, a principal object of the present invention is to reduce microphone - loudspeaker feedback tendencies in loudspeaker systems.

Another object is to provide a loudspeaker system capable of faithfully reproducing all sounds within the normal audio range and at all normal volume levels.

Another object is to reduce the size of a loudspeaker cabinet without impairing its sound propagating qualities.

Another object is to provide a loudspeaker system having pleasing resonance qualities throughout the normal audio range and at all normal volume levels.

Another object is to provide a simple and economically manufactured loudspeaker cabinet capable of faithfully reproducing all sounds within the normal audio range and at all normal volume levels.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view with one side section cut away, illustrating a preferred form of the present invention.

FIG. 2 is a sectional elevation view taken along line 2—2 of FIG. 3.

FIG. 3 is a sectional plan view taken along line 3—3 of FIG. 2.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

Referring in detail to the drawings, the cabinet, generally indicated at **11**, comprises top and bottom walls **12, 13**, front and back walls **14** and **15** and side walls **16, 17**. The various walls are formed of a dense material commercially available under the names "high density particle board" or "high density flake board". Such walls, except the front wall **14**, are at least **3/4** inches thick and are chosen to prevent absorption of sound and to substantially prevent any undesirable or uncontrolled vibrations from being set up in the walls which would otherwise tend to distort the sound emanating from the cabinet. Thin sheets of hard wood veneer (not shown) are bonded to opposite surfaces of the walls to prevent warpage and to reflect rather than absorb sound waves impinging thereon.

Although the side, top and front walls are rigid enough to prevent any unwanted vibrations from being set up therein, they resonate in the same manner as a violin or guitar sound box to enhance all sounds generated by the back of the speaker cone.

The front wall **14** is formed of two panels **18** and **20** having a combined thickness of 1¼inches. Two parallel cylindrical apertures **21** and **22** of 4 inches diameter each, are formed through the two panels **18** and **20**. A decorative cloth fabric **23** is interposed between the two panels to extend across the apertures **21** and **22**. Such panels are integrally secured together by a suitable adhesive which also supports the fabric **23** in a relatively taut condition across the apertures **21** and **22**.

The top, side and bottom walls are integrally secured together with a suitable adhesive and are recessed as indicated at **24** to receive the front wall **14** which is integrally secured within such recesses by a suitable adhesive to form an acoustically insulated cabinet.

The top, bottom and side walls are also recessed at **25** to receive the rear wall **15** which is removably secured in place by suitable screws **19** or the like to permit access to the interior of the cabinet. Sealing material may be interposed between the rear wall **15** and the recess **25** to insure adequate sound insulation at such point. A layer of sponge rubber **26** approximately ½inch thick and having a substantially smooth sound reflecting inner surface is suitably bonded to the inner surface of the rear wall **15** to dampen any unwanted vibrations which might possibly otherwise be set up in the rear wall. It will be noted, however, that the layer **26** will reflect substantially all sound waves generated by the speaker cone.

A 5inch heavy duty loudspeaker **27** of conventional construction and having the usual air moving cone (not shown) is secured by bolts **28** to the rear panel **18** directly in line with the upper aperture **21**. For example, such a speaker may be commercially obtained under the tradename "Trusonic Lifetime Speaker" from Trusonic Audio of Huntington, Ind. Such speaker has a cone capable of a maximum excursion of approximately ¼ inch and is rated at 40 watts, peak power.

A sound delay conduit or chamber **30** of constant cross-section throughout its length is provided, opening into the lower sound exit opening **22**, and is formed by parallel walls **31** and **32** which extend across the interior of the cabinet **11** and are integrally secured to spacer strips **33** and **34** attached to the side walls **16** and **17**. Such chamber **30** has a cross-sectional opening of 1⅛inches deep and 5⅛inches wide. The chamber has an effective length of 5¼inches.

The rear chamber wall **32** is spaced above the bottom wall **13** to form a sound entrance **35** and is attached at its upper end to a horizontal wall section **36** secured to the rear panel **18** of the front wall. The front chamber wall **31** is spaced inwardly from the panel **18** and terminates below the wall section **36** to form a sound outlet **37** leading to the exit aperture **22**. All such chamber walls have smooth, non-sound absorbing surfaces.

The cabinet **11** has the following internal dimensions:

Height (A) equals 12⅛inches.
Width (B) equals 6⅛inches.
Depth (C) equals 5⅝inches.

The above dimensions and resultant interior volume of the cabinet have been found to be minimal and critical in order to provide faithful sound reproduction at all normal volume levels throughout the normal audio range and with pleasing resonance characteristics throughout such range. Preferably, these dimensions should be maintained within a tolerance of plus or minus one-eighth of an inch in order to obtain the results noted herein.

With the foregoing construction, sound at substantially all frequencies within the normal audio range is transmitted both from the front of the loudspeaker cone and from the rear thereof without noticeable attenuation at any point in such range. Apparently, although the sound waves transmitted by delay chamber **30** are slightly delayed or out-of-phase, they reinforce the sound waves emanating through the aperture **21** at some distance in front of the cabinet to fully utilize the air moving capabilities of the speaker **27**. This out-of-phase relationship creates a slight echo effect to produce a pleasing, clear and natural sound which appears to have considerable depth and in which no distortion is detectable by the human ear. Of considerable importance is the fact that microphone - speaker feedback is eliminated at distances greater than approximately one foot from the front of the speaker apertures **21** and **22**. That is, if a microphone which is connected in circuit with the speaker **27** through an amplifier is held directly in front of the aperture **21** and substantially within **1** foot of the front wall **14**, the usual high pitched feedback will be heard. If the microphone is held directly in front of the aperture **22** and substantially within 1 foot fro the front panel, a much lower pitched feedback will be heard. However, if the microphone is held in any position relative to the cabinet, but beyond a boundary of approximately 1 foot from the front wall **14**, no feedback is discernible.

It should be noted that the size and length of the sound exit apertures **21** and **22**, the size and location of the sound delay chamber **30** and the size of the interior of the cabinet are found substantially critical to the above noted elimination of feedback tendencies outside of said 1 foot boundary.

As an example of the power handling capabilities of the speaker-cabinet it has been found in actual tests that two such loudspeaker-cabinets provide adequate sound for transmission of music and voice communication to an assemblage of 200 people. Also, two such speaker-cabinets provide adequate sound for paging persons within an area of 12,000 square feet.

I claim:

1. A loudspeaker system comprising a cabinet including front, rear, side, and end walls, each of said walls being of a thickness sufficient to substantially prevent vibration thereof,

a pair of spaced sound exit apertures in said front wall,

a loudspeaker in said cabinet and attached to the front wall in communication with one of said apertures,

a sound delay chamber intermediate the other of said apertures and the interior of said cabinet,

said chamber having a constant cross-sectional area throughout the length thereof effective to delay substantially all sounds passing therethrough, and

said front wall having a thickness such that each of said apertures has a length approximately equal to one third the average distance across said aperture.

2. A loudspeaker system according to claim 1 wherein said apertures are circular and are each on the order of 4 inches in diameter and said front wall is on the order of 1¼inches thick.

3. A loudspeaker system according to claim 1 wherein said chamber extends parallel to said first wall and has an outlet opening communicating with said other of said apertures and an inlet opening communicating with said interior of said cabinet.

4. A loudspeaker system according to claim 3 wherein said delay chamber has a cross-sectional area on the order of 6¼square inches and a length on the order of 5¼inches.

5. A loudspeaker system according to claim 3 wherein the interior of said cabinet is on the order of 12¼inches high, 6¼inches wide and 6 inches deep.

6. A loudspeaker system according to claim 5 wherein said inlet opening is adjacent the said end wall remote from said first mentioned aperture.

7. A loudspeaker system according to claim 6 wherein said chamber extends across said other aperture.

* * * * *