Title: PRECISELY CONTROLLED PIVOTING AND ROTATING LOUDSPEAKER ASSEMBLY

Abstract: A loudspeaker assembly (1). This invention provides for a loudspeaker assembly (1) with a transducer (40) capable of being precisely swiveled to direct the sound to a convenient point thereby allowing the listener to select the optimal direction of sound. The present invention allows a listener to adjust a transducer (40), such as the high-range frequency component of an in-wall speaker to his or her liking, without the need to remove and re-install the speaker in the wall. The present invention is equally adaptable to the interior of a vehicle or for use as a free-standing floor speaker. The present invention provides a unique speaker with a precision pivoting and rotating transducer (40) which provides quality sound, free from any distortion created by the diffraction of sound waves.
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PRECISELY CONTROLLED PIVOTING AND ROTATING LOUDSPEAKER ASSEMBLY

TECHNICAL FIELD

This invention relates generally to a loudspeaker and in particular to a loudspeaker assembly with a precisely rotatable and pivotable transducer where the transducer protrudes through a central opening of a shell mounted in the speaker’s baffle allowing it to be positioned in any direction.

BACKGROUND ART

The home audio industry places great emphasis on convenience, and sound quality. In-wall audio speakers are at the height of their popularity. While floor speakers may at times, provide superior sound quality, the aesthetic appeal of in-wall speakers and their ability to deliver high-quality sound without the need to rearrange one’s living room to make space for the speakers, have created a significant demand for quality in-wall speakers that deliver the hi-fidelity sound of floor speakers.

Unfortunately, traditional in-wall speakers are mounted in a wall and therefore cannot simply be turned to redirect the sound as can be done with floor speakers, absent a great deal of effort and expense. One possible solution to such a dilemma is to make the transducers that comprise the in-wall speaker movable, so that the
sound emanating from the transducers can be redirected without repositioning the entire speaker assembly.

Such designs, however, face a number of inherent difficulties. One difficulty is that only through extensive trial and error can an audiophile accurately direct two or more speakers to the same spot in a room or automobile. That is, there is no precise way of measuring the swivel movement of the transducer. Another difficulty is that a speaker designed to allow transducers to rotate may inhibit the sound emanating from the transducers, thereby causing diffraction of the sound waves. In particular, when the transducer rotates, a portion of the transducer rises above the baffle surface, while naturally the opposing portion recedes within and below the surface of the baffle. The inner "wall" created by the transducer's receding below the baffle, reflects sound emanating from the transducer. This reflection causes diffraction of the sound waves resulting in reduced quality of sound reproduction.

As discussed above, pivotable and/or rotatable, together "swiveling," in-wall transducers would be an advantage over those which cannot be swiveled to maximize the sonic "sweet spot." A further advantage could be found in the ability to precisely control the swiveling of the transducer. Ideally, the transducers should be rotatable and pivotable without causing sound diffraction.

Previous attempts have been made to provide speakers with components to direct sound for optimal listening such as are described in United States Patent No. 6,070,694 to Burdett et al. (the '694 patent); United States Patent No. 5,402,502 to Boothroyd et al. (the '502 patent); United States Patent No. 5,400,407 to Cassity et al. (the '407 patent); United States Patent No. 5,133,428 to Perrson (the '428 patent); United States Patent No. 4,917,212 to Iwaya (the '212 patent); United States Patent No. 4,884,655 to Freadman et al. (the '655 patent); United States Patent No. 4,811,406 to Kawachi (the '406 patent); United States Patent No. 4,553,630 to Ando (the '630 patent); United States Patent No. 4,445,228 to Bruni (the '228 patent); United States Patent No. 4,441,577 to Kurihara (the '577 patent);
United States Patent No. 4,139,734 to Fincham (the '734 patent); United States Patent No. 4,182,429 to Senzaki (the '429 patent); and United States Patent No. 3,976,838 to Stallings, Jr. (the '838 patent).

The '694 patent describes a loudspeaker assembly with a transducer capable of being swiveled to direct the sound to a convenient point thereby allowing the listener to select the optimal direction of sound.

The '502 patent describes sound output system comprised of a baffle, a plurality of sound drivers, and a sound mirror. The sound mirror reflects a beam of sound from the sound driver horizontally and vertically while maintaining generally consistent amplitude.

The '407 patent describes a tilt adjuster for a speaker which adjusts the position of a speaker recessed in a wall. The tilt-adjuster, preferably assembled with a speaker cover, is a wedge-shaped frame with an open central portion for receiving the speaker housing; a front side including a flattened perimeter from making abutting engagement with the speaker’s housing; and a back side which attaches to the speaker’s support frame.

The '428 patent shows a direction-adjustable speaker system comprised of a sound driver disposed within a rotatable mount positioned within a housing. The mount swivels within the housing to direct the sound to a desired location.

The '212 patent describes a speaker supporting unit which includes a base and a substantially disc-shaped spacer. The spacer includes a half-round groove through which a screw can be inserted to secure the spacer to the base. The first surface of the spacer, which determines the orientation of the speaker is determined by a combination of the inclined surface of the base and the second surface of the spacer, which is varied by the relative angle between the base and the spacer.

The '655 patent describes a speaker cabinet having a pair of front wall segments and adjacent to the ends of the cabinet, and an intermediate forwardly opening cavity extending between the upper and lower front wall segments, a pair of large subwoofer speakers in
the upper and lower front wall segments; and a swiveled movable center subcabinet having a woofer, mid-range speaker and a pair of tweeters. The subcabinet has a range of swivel movement horizontally about a vertical axis.

The '406 patent describes a compound speaker system comprising a woofer, a squawker, a tweeter, and a super tweeter. The squawker, tweeter and super tweeter are attached to a plate and this assembly is rotatably positioned within the cone of the woofer. The system can be designed where the tweeter and super tweeter are at an elevated position with respect to the squawker when the assembly is rotated within the cone of the woofer.

The '630 patent describes a speaker with a tweeter angle adjusting device. The tweeter can change direction by use of horizontal and vertical adjusting knobs and which are secured to horizontal shaft and vertical shafts, respectively, through the use of interlocking mechanisms.

The '228 patent shows a stereo audio system for a motorcycle including a housing for a radio receiver and speaker-mirror assemblies, mounted on base-socket assemblies, and threaded over mounting posts screwed into holes in the handlebars.

The '577 patent describes a direction-variable speaker system for car-audio devices comprising two speaker cases containing speaker units for different reproduction bands, and an intermediate case interposed between the two speaker cases. A first pivotal shaft and a rising angle setting mechanism connect the first speaker case with the intermediate case. Between the second speaker case and the intermediate case is a second pivotal shaft as well as a twisting angle setting mechanism. By using the rising angle and twisting angle mechanisms, both speaker cases can be varied with respect to their angles in rising amount and twisting amount.

The '734 patent describes a pivoting loudspeaker with a plurality of enclosures, wherein at least one of the enclosures is pivotably mounted with respect to another of the enclosures, and a
light emitting device which is visible through an aperture only when a listener is in correct listening position.

The '429 patent shows a loud-speaker system particularly suitable for use in car stereo systems, comprising at least a tweeter, with a woofer arranged coaxially to the tweeter wherein the tweeter is adjustably mounted to the woofer in order to allow manual regulation of the position of the tweeter to that of the woofer.

The '838 patent describes a sound reproduction system comprised of a plurality of speakers, said system being mounted in a wall.

None of the devices mentioned above describe a loudspeaker assembly with a precision controlled swiveling transducer capable of rotating and pivoting in any direction.

Therefore, there is a need in the art for a loudspeaker assembly that can allow a listener to precisely rotate and pivot a transducer to obtain optimal dispersion control after installation of the speaker.

There is a further need in the art for a loudspeaker assembly which can be mounted in the baffle of an in-wall speaker and direct the sound to obtain the “sweet spot” without any diffraction or distortion of sound caused by the sound waves radiating off the sharp inner edge of the baffle created by the swiveling of the transducer.

There is still a further need in the art for a loudspeaker assembly that can allow a listener to precisely swivel a transducer to obtain optimal dispersion control after installation of the speaker within a vehicle.

There is yet a further need in the art for a loudspeaker assembly having the features of the present invention whereby the loudspeaker assembly is a free-standing floor speaker.

**DISCLOSURE OF THE INVENTION**

The present invention fulfills these needs by providing a loudspeaker assembly, comprising a baffle; a tweeter assembly
substantially abutting the baffle; and means to rotate the tweeter assembly with precision.

In an alternate form what is provided is a precisely controlled loudspeaker assembly, comprising a baffle; a tweeter assembly substantially abutting the baffle and comprising a cover ring including a central opening; a transducer positioned adjacent the ring such that sound from the transducer radiates through the central opening; a shell; and a yoke for moveably mounting the ring and the transducer within the shell; and means for precisely swiveling the tweeter assembly.

In an alternate embodiment, the rotation means further comprises teeth at the base of the yoke designed to interdigitate with grooves located on the shell.

In another alternate embodiment, the invention further comprises a means to pivot the tweeter assembly.

In another alternate embodiment, the loudspeaker assembly pivots and rotates without causing sound diffraction by the baffle.

Therefore, it is an object of the present invention to provide a loudspeaker assembly that can allow a listener to precisely swivel a transducer to obtain optimal dispersion control after installation of the speaker.

It is further object of the present invention to provide a loudspeaker assembly which can be mounted in the baffle of an in-wall speaker and direct the sound to obtain the “sweet spot” without any diffraction or distortion of sound caused by the sound waves radiating off the sharp inner edge of the baffle created by the swiveling of the transducer.

It is an additional object of the present invention to provide a loudspeaker assembly that can allow a listener to precisely swivel a transducer to obtain optimal dispersion control after installation of the speaker within a vehicle.

It is a further object of the present invention to provide a loudspeaker assembly having the features of the present invention whereby the loudspeaker assembly is a free-standing floor speaker.
These and other objects, features, and advantages of the present invention may be better understood and appreciated from the following detailed description of the embodiments thereof, selected for purposes of illustration and shown in the accompanying drawings.

**BRIEF DESCRIPTION OF THE DRAWINGS**

**FIG. 1** shows a top view of the preferred embodiment of the loudspeaker assembly.

**FIG. 2** shows a side view of the loudspeaker assembly with a high-frequency transducer and the precision controlled tweeter assembly.

**FIG. 3** shows an exploded view of the precision controlled tweeter assembly.

**FIG. 4** is an isometric view of the assembled tweeter assembly.

**BEST MODE FOR CARRYING OUT THE INVENTION**

The loudspeaker assembly 1 of the present invention is generally comprised of a baffle 10 having at least one cavity, a precision controlled tweeter assembly 20 comprised of a cover ring 30, a transducer 40, a yoke 50, yoke connectors 55 and a tweeter shell 60 which is mounted underneath the baffle 10 of the loudspeaker assembly 1. The baffle 10 is generally made of plastic and is generally rectangular in shape. Depending upon the size of the cavity, a high-frequency transducer 40, mid-range frequency transducer, or low-range frequency transducer, are capable of being inserted within the loudspeaker assembly. The larger size cavity 70 retains the low-frequency transducer, commonly known as the woofer. The smallest cavity retains the swiveling high-frequency transducer 40, commonly known as the tweeter. The woofer is usually positioned at the lowest end of the loudspeaker assembly. This configuration can be seen in **FIG. 1**. In the preferred embodiment, the high-frequency transducer 40, or tweeter, is the transducer capable of being precisely swiveled,
that is rotatable and pivotable. However, in alternate embodiments, any of the transducers are capable of being swiveled.

In the preferred embodiment of the present invention, the loudspeaker assembly is an in-wall speaker permanently affixed within a wall opening or within a ceiling opening. However, in an alternate embodiment, the loudspeaker assembly comprises a stand-alone floor speaker. Although the dimensions of the loudspeaker assembly may be somewhat larger than those described in the preferred embodiment, the orientation of the components and manner of swiveling the transducer is identical to that of the in-wall loudspeaker assembly. In yet another embodiment, the loudspeaker assembly is mounted within the interior of a vehicle. In this particular embodiment, the baffle 10 actually becomes part of the ceiling, side door, or other portion of the interior of the vehicle. The cover ring 30 and the transducer 40 therein protrude outward from the plane of the vehicle’s interior surface thereby allowing an occupant of the vehicle to easily adjust the direction of the tweeter assembly 20 thereby directing the sound within the vehicle to his or her preference.

The hi-frequency transducer 40 to be swiveled is contained within a tweeter assembly 20 comprised of cover ring 30, a transducer 40, a yoke 50, yoke connectors 55 and a tweeter shell 60. The cover ring 30 has a central opening 35 to enable sound emanated from the transducer 40 to radiate through the cover ring 30. The tweeter assembly 20 comprising the cover ring 30, a transducer 40, a yoke 50, yoke connectors 55 and a tweeter shell 60 can be seen in the exploded view of FIG. 3. The precision controlled transducer 40 protrudes through the central opening 35 of the cover ring 30 and is secured therein between the cover ring 30 and yoke 50 by conventional means such as a plurality of screws. A protective covering can be placed over the central opening 35 in the cover ring 30 to protect the transducer 40. The cover ring 30 and transducer 40 contained therein, can be swiveled in any direction. The baffle 10, is gradually introduced to the tweeter assembly 20 by a recessed inner wall 100. The sloping angle of the inner wall 100 is designed to prevent the
transducer 40 from emitting sound waves into the underside of the baffle 10.

Positioned immediately below the cavity that retains the tweeter assembly 20 and the transducer 40 contained therein, is a shell 60 which is mounted within the loudspeaker assembly and substantially behind the baffle 10. The shell 60 is of a circular shape to conform to the shape of the cavity under which it is positioned. Its diameter is smaller than said cavity and the shell 60 is secured to the baffle 10 by conventional affixing means. The shell 60, depicted in FIG. 3 is approximately 2 inches deep and defines a hole in its bottom surface for allowing wires from the transducer 40 to exit the shell 60 and connect to various electrical components situated within the loudspeaker assembly.

The cover ring 30 and the transducer 40 are secured within the shell 60 by a yoke 50. The base of the yoke 50 is provided with teeth designed to operatively interdigitate with grooves located on the inner circumference of the shell 60. The shell 60 and yoke 50 are connected together by a pressure fit, snap-on mechanism. The tooth and groove interactivity provides precision control of the rotation of the tweeter assembly. For example, a right speaker can be rotated three "clicks" clockwise, and the accompanying left speaker can be rotated precisely in step with the right speaker, at three "clicks" counterclockwise. The tweeter assembly 20, once rotated to its preferred position can then be pivoted to a desired angle by depressing the tweeter assembly 20 such that it pivots along the axis defined by the axle 65. The yoke 50 is secured to the cover ring 30 by traditional means, such as screws in combination with the yoke connectors 55 or a strong adhesive.

The tweeter assembly 20 containing the transducer 40 can be swiveled either manually or by other means such as a remote controller, which transmits signals to a receiver embedded within the loudspeaker assembly.

Accordingly, it will be understood that the preferred embodiment of the present invention has been disclosed by way of example and that other modifications and alterations may occur to
those skilled in the art without departing from the scope and spirit of the appended claims.
What is claimed is:

1. A loudspeaker assembly, comprising:
   a baffle;
   a tweeter assembly substantially abutting said baffle; and
   means to rotate and pivot said tweeter assembly with precision.

2. The loudspeaker assembly of Claim 1, wherein said tweeter assembly comprises a cover ring including a central opening; a transducer positioned adjacent said ring such that sound from said transducer radiates through said central opening; a shell; and a yoke for mounting said ring and said transducer within said shell.

3. The loudspeaker assembly of Claim 1, wherein said rotation means comprises teeth at the base of said yoke designed to interdigitate with grooves located on said shell.

4. The loudspeaker assembly of Claim 1, wherein said pivoting means comprises rotation about an axle positioned on said yoke.

5. The loudspeaker assembly of Claim 1, wherein said loudspeaker assembly rotates and pivots without causing sound diffraction by said baffle.

6. A loudspeaker assembly capable of precise positioning, comprising:
   a baffle;
   a tweeter assembly substantially abutting said baffle and comprising a cover ring including a central opening; a transducer positioned adjacent said ring such that sound from said transducer radiates through said central opening; a shell; and a yoke for moveably mounting said ring and said transducer within said shell; and
means for precisely rotating and pivoting said tweeter assembly.

7. The loudspeaker assembly of Claim 6, wherein said precise rotation means comprises teeth at the base of said yoke designed to interdigitate with grooves located on said shell.

8. The loudspeaker assembly of Claim 6, wherein said pivoting means comprises rotation about an axle located on said yoke.

9. The loudspeaker assembly of Claim 6, wherein said loudspeaker assembly rotates and pivots without causing sound diffraction by said baffle.