PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 7 : H04R 5/02	A2	(11) International Publication Number: WO 00/32011
		(43) International Publication Date: 2 June 2000 (02.06.00)

(21) International Application Number: PCT/US99/27708

(22) International Filing Date: 22 November 1999 (22.11.99)

(30) Priority Data:
09/198,186 23 November 1998 (23.11.98) US

(71) Applicant: SOUND ADVANCE SYSTEMS, INC. [US/US]; 3202 South Shannon Street, Santa Ana, CA 92704-6353 (US).

(72) Inventors: BERTAGNI, Alejandro; 22301 Chestnut Lane, Lake Forest, CA 92630 (US). BERTAGNI, Eduardo; 13340 Savanna, Tustin, CA 92782 (US).

(74) Agent: GRIECCI, John, A.; Sheppard Mullin Richter & Hampton LLP, 48th floor, 333 South Hope Street, Los Angeles, CA 90071 (US).

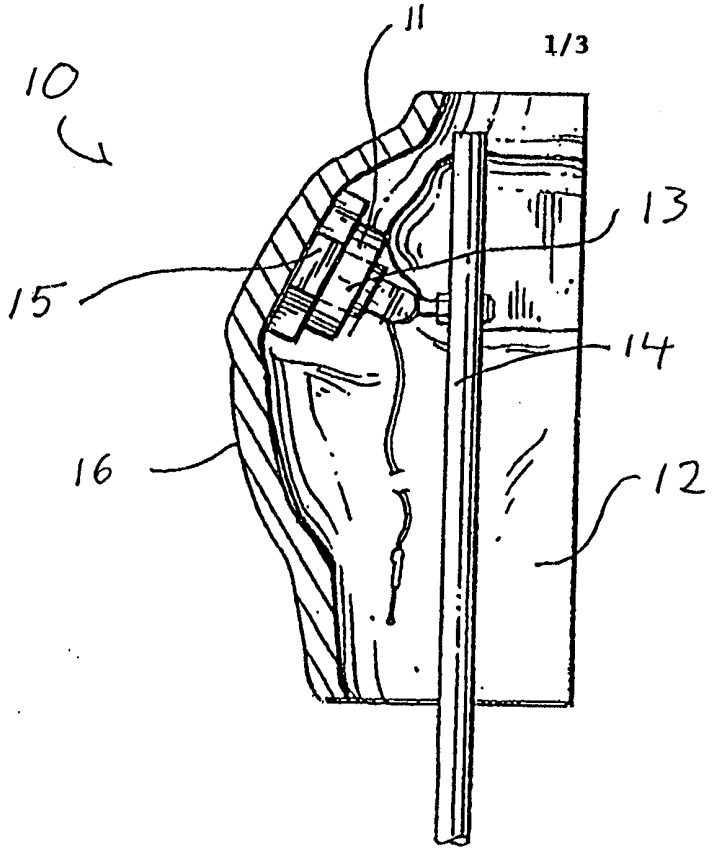
(81) Designated States: JP, KR, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
Without international search report and to be republished upon receipt of that report.

(54) Title: LOUDSPEAKER WITH STATUARY-LIKE DIAPHRAGM

(57) Abstract

A loudspeaker for statuary-like figures, the loudspeaker including a statuary-like diaphragm, such as in the shape of an upper torso. The loudspeaker includes a voice coil driver, which is mounted on a frame, and a statuary-like diaphragm, which is wholly mounted on the acoustically active portion of the driver. The loudspeaker may further include clothing draped over the diaphragm. The loudspeaker may be incorporated into a statuary-like figure including non-acoustical portions, such as in the shape of a head.



FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania
AM	Armenia
AT	Austria
AU	Australia
AZ	Azerbaijan
BA	Bosnia and Herzegovina
BB	Barbados
BE	Belgium
BF	Burkina Faso
BG	Bulgaria
BJ	Benin
BR	Brazil
BY	Belarus
CA	Canada
CF	Central African Republic
CG	Congo
CH	Switzerland
CI	Côte d'Ivoire
CM	Cameroon
CN	China
CU	Cuba
CZ	Czech Republic
DE	Germany
DK	Denmark
EE	Estonia
ES	Spain
FI	Finland
FR	France
GA	Gabon
GB	United Kingdom
GE	Georgia
GH	Ghana
GN	Guinea
GR	Greece
HU	Hungary
IE	Ireland
IL	Israel
IS	Iceland
IT	Italy
JP	Japan
KE	Kenya
KG	Kyrgyzstan
KP	Democratic People's Republic of Korea
KR	Republic of Korea
KZ	Kazakstan
LC	Saint Lucia
LI	Liechtenstein
LK	Sri Lanka
LR	Liberia
LS	Lesotho
LT	Lithuania
LU	Luxembourg
LV	Latvia
MC	Monaco
MD	Republic of Moldova
MG	Madagascar
MK	The former Yugoslav Republic of Macedonia
ML	Mali
MN	Mongolia
MR	Mauritania
MW	Malawi
MX	Mexico
NE	Niger
NL	Netherlands
NO	Norway
NZ	New Zealand
PL	Poland
PT	Portugal
RO	Romania
RU	Russian Federation
SD	Sudan
SE	Sweden
SG	Singapore
SI	Slovenia
SK	Slovakia
SN	Senegal
SZ	Swaziland
TD	Chad
TG	Togo
TJ	Tajikistan
TM	Turkmenistan
TR	Turkey
TT	Trinidad and Tobago
UA	Ukraine
UG	Uganda
US	United States of America
UZ	Uzbekistan
VN	Viet Nam
YU	Yugoslavia
ZW	Zimbabwe

LOUDSPEAKER WITH STATUARY-LIKE DIAPHRAGM

BACKGROUND OF THE INVENTION

The present invention relates generally to loudspeakers, and, more particularly, to an apparatus and a related method for producing sound from a statuary-like figure.

Statuary-like figures are widely used in both the retail sales and entertainment industries. Such figures vary from simple clothing mannequins for use in department stores windows or tabletop displays, to animated storybook characters appearing as a human, an animal, or the like, for entertaining viewers in amusement parks, zoological parks, museums, or the like.

Regardless of the intended use, such statuary-like figures are sometimes equipped with speakers to add to their effectiveness. In some cases the speakers provide the apparent spoken words or sounds of the figure, while in other cases the speakers simply carry a narrative describing information of interest to viewers of the figures.

Typical loudspeaker systems for such statuary-like figures include conventional speakers mounted in the vicinity of the figure. The speakers may be mounted in nearby structures, or may be hidden within the figure itself. Speakers that are mounted separately from the figure are generally detectable as such, because viewers can detect that the sound is not coming from the figure, but rather from a different direction or distance. Speakers within the figure, while producing sound from the right location, are disguised or concealed by the figure, and may thereby be restricted in size or placement, potentially resulting in reduced and/or distorted sound quality.

It is known, for example, to provide a human figure with a speaker mounted in the front portion of its upper torso, and to conceal the speaker by placing clothing on the torso, covering the speaker. However, clothing is generally not acoustically transparent, and thus the sound from such a speaker tends to be muted and damped by the clothing, providing lower sound quality to viewers of the figure. This is likewise true for furs, feathers or skins overlying a speaker on an animal-like figure. Furthermore, the sound produced by such a speaker is highly directional, and may be of very low quality and volume when heard from the sides or back of the figure.

It is also known to mount speakers on the outside of a dressed statuary-like figure, where the speaker is concealed by painting it with a color to match a surrounding colored portion of the figure's clothing. While the speakers' sound is not damped by clothing over the speaker, the sound is still highly directional, and is of poor quality around the sides or the back of the figure. Furthermore, such speakers are difficult to conceal well, and are typically visible to the casual observer.

An alternate form of loudspeaker, known as a planar diaphragm loudspeaker, is known for providing high quality sound from a camouflaged location. The diaphragm of such a loudspeaker is typically formed by a relatively stiff and substantially planar diaphragm that may be supported by a frame around the edges of the diaphragm. An electromagnetic driver, in the form of a voice coil assembly, is coupled to the rear surface of the diaphragm, and is also mounted to the frame. The voice coil or driver presses on a circular plate called a hammer, which, in turn, vibrates the diaphragm at acoustic frequencies to produce sound.

Typically, the planar diaphragm is constructed of a preexpanded cellular plastic material, such as polystyrene or STYROFOAM ®. The front,

visible side, of the diaphragm is flat, and may be disguised as a ceiling tile or section of wall. The rear of the diaphragm, where the voice coil or driver is mounted, while generally planar, has a specific contour to improve the sound quality of the loudspeaker. Such a loudspeaker, while highly advantageous for architectural uses, would suffer many of the same disabilities as conventional speakers if installed as a separate speaker within or near a statuary-like figure.

Accordingly, there has existed a need for an improved loudspeaker, and a related method, to provide high quality omni-directional sound reproduction from a statuary-like figure in a more realistic manner. The present invention satisfies these and other needs, and provides further related advantages.

SUMMARY OF THE INVENTION

The present invention provides a loudspeaker, and a related method, for producing sound as part of a statuary-like figure. In many embodiments, it provides for sound reproduction from a substantially large portion of the circumference of the statuary-like figure, or even from the entire statuary-like figure, with sound quality superior to conventional statuary-like figure speaker systems. Garments or other surface treatments (such as furs, feathers, or the like) may be added to many embodiments of the statuary-like figure, while causing less muting than would occur over a typical speaker, and the loudspeaker is readily concealable as an integrated portion of the statuary-like figure.

The loudspeaker includes a driver, which is preferably mounted to a support, such as a frame, and a diaphragm. The diaphragm is mounted to an acoustically active portion of the driver. Preferably, the acoustically active portion of the driver carries substantially the full weight of the diaphragm. The diaphragm

preferably features a contoured outer surface forming a statuary-like configuration, such that it may be incorporated in the exterior of a statuary-like figure as part or all of that figure. The contoured outer surface of the diaphragm is preferably configured to extend around the substantial portion of the figure's lateral circumference, and is preferably configured to respond modally to the driver, thus directing sound waves around a substantial portion of the lateral circumference of the figure.

An advantage of the invention is that sound is produced off the outer surface of the statuary-like diaphragm in a multitude of directions, and from a multitude of locations. Viewers of the figure may be standing in a wide range of locations around the lateral circumference of the figure, and still have the loudspeaker effectively facing them. Furthermore, the loudspeaker is naturally disguised as part of the figure, and may be further concealed through the use of clothing or other synthetic surface treatments simulating animal furs or the like, without incurring the level of detriment to the quality of sound produced by the loudspeaker.

Other features and advantages of the invention will become apparent from the following detailed description of the preferred embodiment, taken in conjunction with the accompanying drawings, which illustrate, by way of example, the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevational cross-section of a loudspeaker embodying features of the present invention.

FIG. 2 is a rear perspective view of the loudspeaker depicted in FIG. 1.

FIG. 3 is a front perspective view of the loudspeaker depicted in FIG. 1.

FIG. 4 is a top plan view of the loudspeaker depicted in FIG. 1.

FIG. 5 is a front perspective view of a statuary-like figure including the loudspeaker depicted in FIG. 1, and including garments draped over a diaphragm of that loudspeaker, and including a head affixed to a frame of the loudspeaker.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings, and more particularly to FIG. 1 thereof, there is shown a loudspeaker 10 for use with statuary-like figures. The loudspeaker includes a voice coil driver 11 and a statuary-like diaphragm 12. The driver 11 includes a housing 13 that is mounted to a preferably acoustically stationary support, such as frame 14, by any conventional mechanism. The housing typically includes electronics, magnets, and/or other components necessary to drive a second, acoustically active, portion 15 of the driver. The acoustically active portion 15 of the driver 11 is affixed to, and fully supported by, the driver. It is configured to be oscillated along a longitudinal axis between the housing 13 and the acoustically active portion.

As seen in FIGS. 1-3, the diaphragm 12 is of a statuary-like configuration. The configuration, which could be in the form of an animal, plant,

rock, or other three-dimensional image, is of human form, in the shape of a human upper torso. The diaphragm 12 is mounted to the acoustically active portion 15 of the driver 11, which preferably carries all of, or substantially all of, the full weight of the diaphragm. Most preferably, the diaphragm is not structurally restrained by any other member.

The diaphragm 12 is preferably made from a lightweight and relatively stiff material, such as polystyrene, STYROFOAM ®, or other preexpanded cellular plastic material. While the diaphragm may respond rigidly to low frequency vibration, i.e., in rigid oscillation, to the driving force of the acoustically active portion 15 of the driver 11, it is preferably configured with acoustic natural frequencies such that the diaphragm modally responds to the driver to produce sound throughout most of the audio range.

The diaphragm 12 is in the form of a figure having a non-functional, three-dimensional surface configuration. In this context, the term non-functional refers to the fact that the surface configuration is aesthetic and/or ornamental, and not based on controlling the modal properties of the underlying structure. The figure's oscillation, and modal vibration, directs sound waves off of its surfaces in a wide range of directions.

Preferably, the diaphragm includes a contoured three-dimensional outer, vibration-radiating surface (sound-radiating surface 16) extending around a substantial portion of the lateral circumference of the diaphragm. The vibration radiating surface and the driver are configured for acoustic frequencies such that the diaphragm modally responds to the driver to produce sound. In the depicted preferred embodiment, the sound-radiating surface faces in directions ranging over 180 degrees around the three-dimensional figure, as seen in FIG. 4, causing sound waves that radiate from the surface to be directed around substantially more than

three-quarters of the lateral circumference of the figure. Furthermore, the sound-radiating surface extends around the underlying driver 11 such that it surrounds the driver around over 180 degrees of the lateral circumference of the driver. This configuration provides for viewers to enjoy good sound quality while standing around substantially the entire circumference of the loudspeaker.

With respect to FIGS. 3 and 5, the outer, sound-radiating surface 16 of the loudspeaker 10 preferably includes upward facing portions 17, such as the shoulders of a torso-shaped figure, to provide support for garments 18, including clothing and accessories, on the figure. Garments are preferably placed on the figure such that they are wholly supported by the diaphragm 12. The garments thus can vibrate and move along with the diaphragm, without restricting the oscillation of the diaphragm, other than inertially. Because the garments oscillate with the diaphragm, they essentially become acoustically transparent, and therefore will not substantially dampen or otherwise distort the sound produced by the diaphragm.

As seen in FIG. 2, preferably, the diaphragm has an inner surface 21 opposite the outer surface, the inner surface generally following the shape of the contoured outer surface 16 so as to maintain similar diaphragm thicknesses throughout the diaphragm. In some embodiments, particularly where the outer surface extends around less than 360 degrees of the figure, this inner surface may be left exposed to radiate sound to viewers that are not faced by the outer surface. The contours of this inner surface can be designed to control the modal properties (i.e., mode shapes and frequencies) of the diaphragm, as is known for flat panel speakers. This inner surface contouring may be further enhanced to provide for control over the 3D modal properties of the diaphragm. In other words, the contouring can control not only the 1D panel displacement of flat panel vibration, but also the 3D movement of the panel as different portions of the diaphragm are moving in entirely different directions (i.e., the torso's chest may move forward

while its upward facing portions 17 move up and the side of its shoulder moves to the side).

As seen in FIG. 5, the loudspeaker 10 may be part of a larger statuary-like figure 19. Within the figure, a head portion 20 has been affixed to the frame 14, and positioned above the torso-shaped diaphragm 12. Clothing, or other nonstructural members, may cover gaps between the head and the torso-shaped diaphragm so as to give the appearance of a unified structure. Alternatively, the loudspeaker 10 may extend out of a wall to expose less than 360 degrees of statuary-like figure.

While the preferred embodiment does not include any load carrying link between the head and the diaphragm, in cases where the diaphragm and accompanying clothing are exceptionally heavy, additional support may be provided from the head (or other nonvibrating members). For example, the diaphragm can receive vertical support from a cord attached between the diaphragm and the head. This string could carry a portion of the diaphragm's weight, without substantially interfering with its laterally directed oscillation of the portion of the diaphragm attached to the string. A similar support could be derived from a web-like member extending between the upper portion of the torso and the lower portion of the head, such as through the neck region. Such a web-like member may also be used to form a connection between the diaphragm and other portions of the figure to better conceal the nature of the diaphragm.

Furthermore, other support systems may be used. For example, the diaphragm can be entirely carried by a support, such as a frame, and the driver can be suspended from the diaphragm. One possible embodiment of this would entail the diaphragm being supported by a flexible margin, preferably extending around the outer, contoured surface. The flexible margin could connect the diaphragm to

the frame. Optionally, the support system could include a shaped screen, enclosing the inner diaphragm surface, and forming part of the visible portion of the figure. Another optional possibility is that the support system could include a flat screen, such as to allow the figure to be conformingly placed next to a wall.

From the foregoing description it will be appreciated that the present invention provides for a loudspeaker allowing a statuary-like figure to produce superior quality sound around a substantial lateral circumference of the statuary-like figure, while having little or no visual clues as to the form or location of the loudspeaker. While a particular form of the invention has been illustrated and described, it will be apparent that various modifications can be made without departing from the spirit and scope of the invention. For example, while the description of the preferred embodiment describes a human-like figure, animal-like figures, plant-like figures, and even inanimate objects such as rocks, pieces of sculpture, and the like, are all contemplated within the scope of the invention. Likewise, while the description of the preferred embodiment describes a diaphragm used in a stationary statuary-like figure, animated statuary-like figures are well within the scope of the invention.

Thus, although the invention has been described in detail with reference only to the preferred embodiment, those having ordinary skill in the art will appreciate that various modifications can be made without departing from the invention. Accordingly, the invention is not intended to be limited, and is defined with reference to the following claims.

We Claim:

1. A loudspeaker, to be mounted on a support, comprising:

a driver; and

a diaphragm mounted to the driver;

wherein the diaphragm is of a statuary-like configuration, having a vibration-radiating surface that includes a three-dimensional outer surface configuration.

2. The loudspeaker of claim 1, wherein the statuary-like configuration is an animal-like figure.

3. The loudspeaker of claim 2, wherein the figure is of human-like form.

4. The loudspeaker of claim 2, wherein the figure includes a human-like upper torso.

5. The loudspeaker of claim 2, and further including one or more garments supported by the diaphragm.

6. The loudspeaker of claim 1, wherein the diaphragm is configured with acoustic natural frequencies such that the diaphragm modally responds to the driver to produce sound.

7. The loudspeaker of claim 1, wherein the sound-radiating surface extends around at least 180 degrees of the lateral circumference of the figure.

8. The loudspeaker of claim 1, wherein the sound-radiating surface extends around the driver such that it surrounds the driver around at least 180 degrees of the lateral circumference of the driver.

NOT TAKEN INTO CONSIDERATION
FOR THE PURPOSES
OF INTERNATIONAL PROCESSING

16. A method of producing sound from a statuary-like figure, comprising:

incorporating a loudspeaker into the statuary-like figure, the loudspeaker including a driver, and a diaphragm mounted to the driver, wherein the diaphragm is of a statuary-like configuration, having a vibration-radiating surface that includes a three-dimensional outer surface configuration; and

oscillating the diaphragm with the acoustically active portion of the driver to produce sound from the diaphragm.

17. The method of claim 16, wherein an acoustically active portion of the driver carries substantially the full weight of the diaphragm.

18. The method of claim 16, wherein the diaphragm is configured with acoustic natural frequencies such that the diaphragm modally responds to the driver to produce sound.

19. The method of claim 16, wherein the sound-radiating surface extends around at least 180 degrees of the lateral circumference of the figure.

20. The method of claim 16, wherein:

an acoustically active portion of the driver carries substantially the full weight of the diaphragm;

the diaphragm is configured with acoustic natural frequencies such that the diaphragm modally responds to the driver to produce sound; and

the sound-radiating surface extends around at least 180 degrees of the lateral circumference of the figure.

21. A method of producing sound from a statuary-like figure, comprising:

incorporating a loudspeaker into the statuary-like figure, the loudspeaker including a driver mounted to a support within the statuary-like figure, and a diaphragm mounted to the driver, wherein an acoustically active portion of the driver carries substantially the full weight of the diaphragm; and

oscillating the diaphragm with the acoustically active portion of the driver to produce sound from the diaphragm.

22. The method of claim 21, wherein the statuary-like configuration includes an upper torso.

23. The method of claim 22, and further including one or more garments worn on the upper torso.

24. The method of claim 21, wherein the diaphragm is configured with acoustic natural frequencies such that the diaphragm modally responds to the driver to produce sound.

25. The method of claim 21, wherein the diaphragm is of a statuary-like configuration, having a sound-radiating surface that includes a non-functional, three-dimensional surface configuration that forms a portion of the exterior of the statuary-like figure

26. The method of claim 21, wherein the sound-radiating surface extends around at least 180 degrees of the lateral circumference of the figure.

27. A loudspeaker, comprising:

a diaphragm; and

a means for acoustically driving the diaphragm;

wherein the diaphragm is of a statuary-like configuration, having a sound-radiating surface that includes a non-functional, three-dimensional surface configuration.

28. The method of claim 27, wherein the diaphragm is configured with acoustic natural frequencies such that the diaphragm modally responds to the driver to produce sound.

29. The method of claim 27, wherein the sound-radiating surface extends around at least 180 degrees of the lateral circumference of the figure.

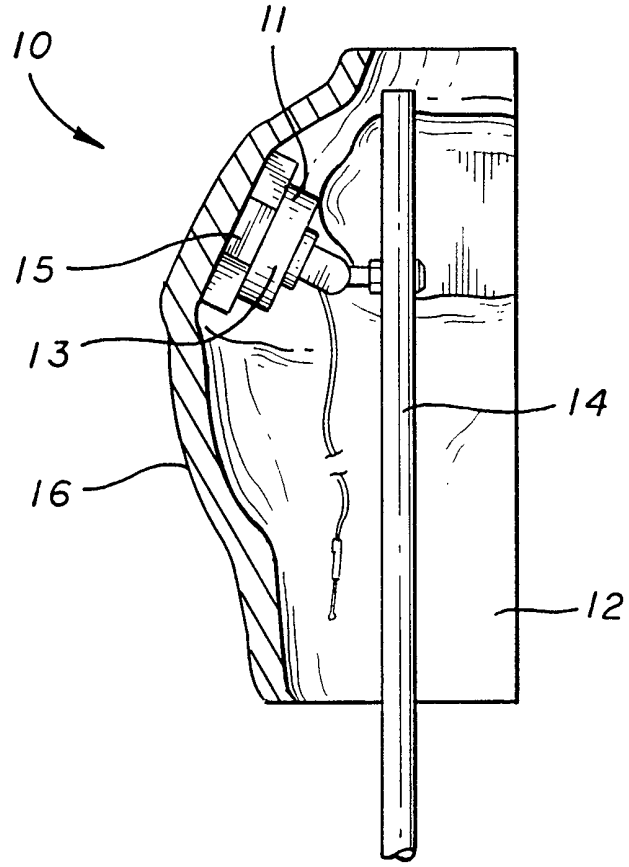


FIG. 1

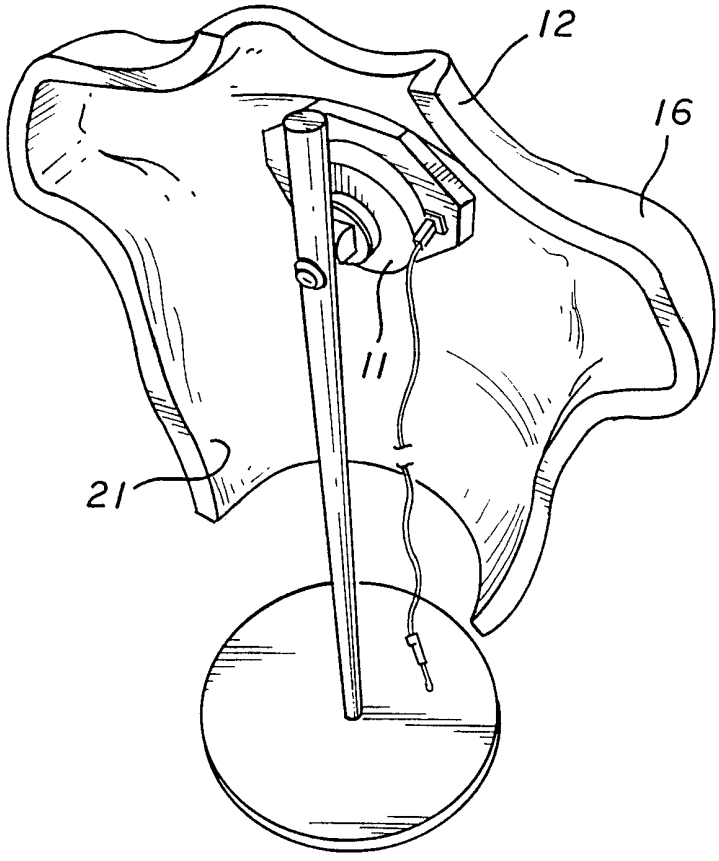


FIG. 2

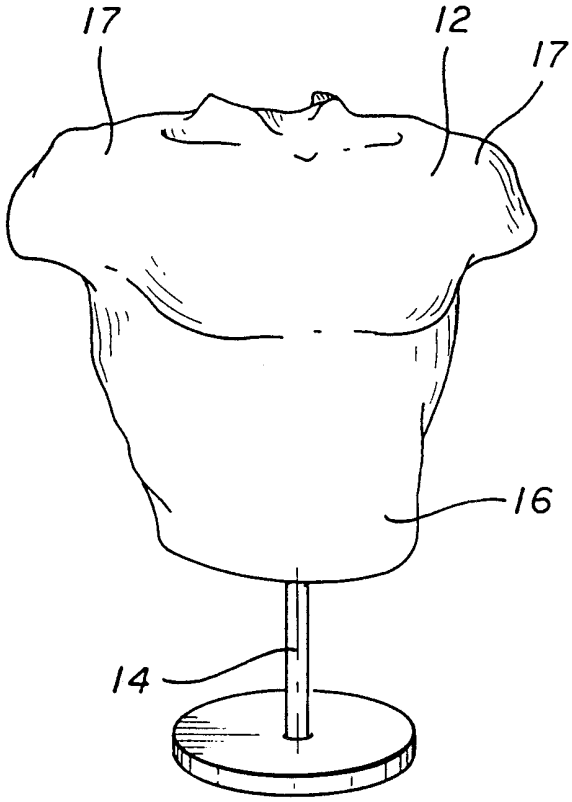


FIG. 3

FIG. 4

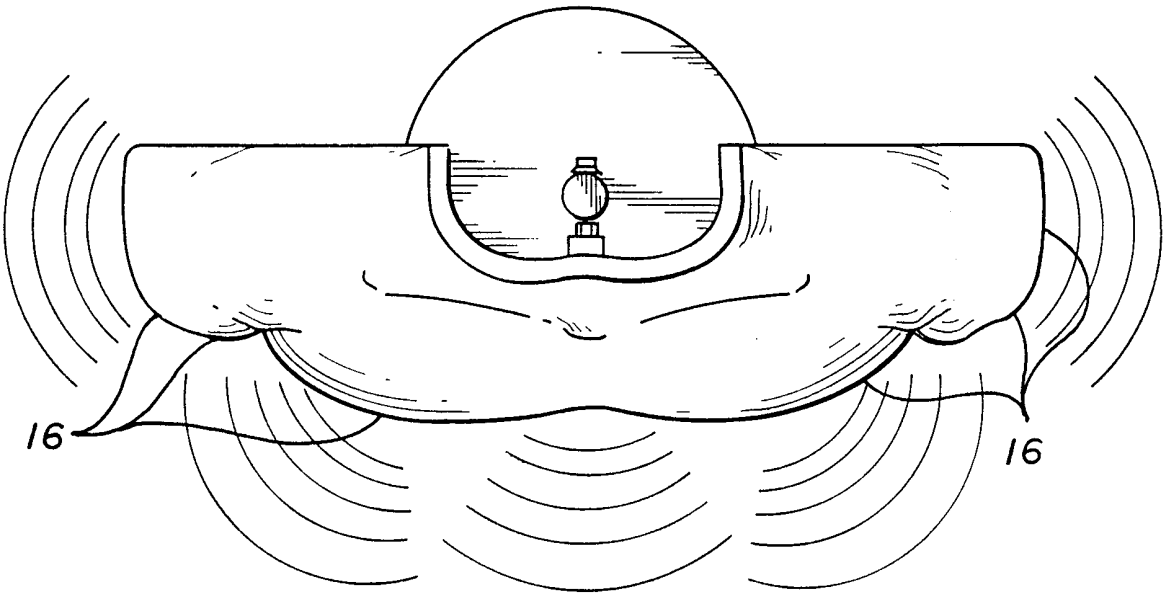


FIG. 5