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(54) Title: ROTATABLE SPEAKER CONTROL WITH VIRTUAL DETENTS

(57) Abstract: A speaker includes a housing; and a grill disposed at least partially outside of said housing and being rotatable about an axis thereof with respect to said housing to control aspects of operation of said speaker. Rotation of the grill is detectable by circuitry within the speaker. Magnets provide virtual detents. A bearing element is connected to and rotates with the grill; and a blade element is disposed between the grill and the bearing element and is rotatable around the central axis of said grill. A ring portion of the blade element rotates between and in direct contact with one or more pads on the grill and one or more pads on the bearing element. The pads may be a shock-absorbing foam and may have a low-friction coating.

FIG. 1-A

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ROTATABLE SPEAKER CONTROL WITH VIRTUAL DETENTS

BACKGROUND OF THE INVENTION

COPYRIGHT STATEMENT

[0001] This patent document contains material subject to copyright protection. The copyright owner has no objection to the reproduction of this patent document or any related materials in the files of the United States Patent and Trademark Office, but otherwise reserves all copyrights whatsoever.

RELATED APPLICATIONS

[0002] This application is related to and claims priority from U.S. Patent Application No. 61/947,305, filed March 3, 2014, titled "Rotatable Speaker Control with Virtual Detents," the entire contents of which are hereby fully incorporated herein by reference for all purposes.


[0004] This application is related to U.S. Patent Application No. 29/457,272, titled "Speaker," filed June 7, 2013, the entire contents of which are fully incorporated herein by reference for all purposes.

[0005] This application is related to International Patent Application PCT/US2013/070002, filed November 14, 2013, the entire contents of which are fully incorporated herein by reference for all purposes.

FIELD OF THE INVENTION

[0006] This invention relates to speakers and control thereof. More specifically, this invention relates to a rotatable control mechanism for a speaker.

BACKGROUND

[0007] It is desirable to provide a control component or mechanism for a speaker or the like that is integrated into a component of the speaker. In this manner the appearance of the speaker may be improved, without the speaker being cluttered with controls and dials. However, incorporating a control component or mechanism into a speaker component may cause that control component to vibrate, thereby diminishing the quality of the sound produced by the speaker.
Other objects, features, and characteristics of the present invention as well as the methods of operation and functions of the related elements of structure, and the combination of parts and economies of manufacture, will become more apparent upon consideration of the following description and the appended claims with reference to the accompanying drawings, all of which form a part of this specification.

BRIEF DESCRIPTION OF THE DRAWINGS

Various other objects, features and attendant advantages of the present invention will become fully appreciated as the same becomes better understood when considered in conjunction with the accompanying drawings, provided by way of example, in which like reference characters designate the same or similar parts throughout the several views, and wherein:

FIGS. 1-A and 1-B show aspects of a speaker according to exemplary embodiments hereof;

FIGS. 2-A to 2-W show various components of the speaker dial assembly of the speaker of FIGS. 1-A and 1-B according to exemplary embodiments hereof;

FIGS. 3-A to 3-M show various aspects of the inter-connection between the components of the speaker dial assembly according to exemplary embodiments hereof;

FIG. 4 shows aspects of mounting the speaker dial in the speaker according to exemplary embodiments hereof;

FIGS. 5-A to 5-D show cross-sectional views of the speaker with the speaker dial according to exemplary embodiments hereof;

FIGS. 6-A to 6-D and 7-A to 7-F show detailed view of aspects depicted in FIGS. 5-A to 5-D; and

FIGS. 8-A to 8-I, 9-A to 9-H, 10-A to 10-C, and 11-A to 11-C are photographs showing various views of the components of the speaker according to exemplary embodiments hereof.

In the accompanying drawings, by convention and to aid readability of this document, an underlined number is employed to represent an item over or within which the underlined number is positioned or an item to which the underlined number is adjacent. A non-underlined number relates to an item identified by a line linking the non-underlined number to the item. When a number is non-underlined and accompanied by an associated arrow, the non-underlined number is used to identify a general item or collection of items to which the arrow is pointing.
DETAILED DESCRIPTION OF THE PRESENTLY PREFERRED EXEMPLARY EMBODIMENTS

GLOSSARY AND ABBREVIATIONS

[0018] As used herein, unless used otherwise, the following terms or abbreviations have the following meanings:
[0019] LED means light-emitting diode;
[0020] PCB means printed circuit board;
[0021] PSA means pressure sensitive adhesive; and
[0022] PTFE means Polytetrafluoroethylene such as, e.g., DuPont™ Teflon® brand.

DESCRIPTION

[0023] FIGS. 1-A and 1-B show aspects of a speaker according to exemplary embodiments hereof. As shown in FIGS. 1-A and 1-B a speaker 100 includes a speaker housing 102 connected, as described in greater detail below, to a rotatable speaker grill 104. The speaker grill 104 forms substantially the entire front face of the speaker. The speaker grill 104 is part of a speaker dial assembly (described herein) and is rotatable about an axis substantially through its center. The speaker grill 104 may thus effectively be used as a dial, supporting control of aspects of the speaker's functionality.

[0024] As used herein, the term "component" or "subcomponent" refers to a part that may be used alone or with other parts. A "component" may contain one or more pieces. As used herein, the term "assembly" refers to a component or collection of components or parts assembled in some one. An assembly may contain one or more components or parts or pieces.

[0025] As shown in FIG. 1-A, button 106 may be disposed substantially in the center of the grill 104. The speaker 100 preferably includes a flat base portion 108 allowing the speaker to sit on a flat surface. When the speaker grill 104 is connected to the housing 102, a gap between the grill and housing is preferably substantially uniform and, in preferred embodiments, preferably about 1.00 ± 0.40 mm.

[0026] The speaker grill 104 connects to the speaker housing using various subcomponents, described in greater detail herein, including (i) a grill subcomponent, (ii) a blade subcomponent, (iii) a bearing subcomponent, and (iv) a driver panel. The three components (i), (ii), and (iii) may be said to form a speaker dial assembly. Exemplary embodiments of these subcomponents are described here with reference to FIGS. 2-A to 2-W.

[0027] For the purposes of this description, the side of each component that faces into the inside of the speaker 100 is referred to as the "inside" or "bottom side" of that component, and
the side of each component that faces out of the speaker 100 is referred to as the "outside" or "top side" of that component. It should be appreciated that, in typical operation, the speaker rests on base on a surface, and that the components will typically be situated at a non-perpendicular angle with respect to that surface. Furthermore, it should be appreciated that the term "outside" with respect to a component is not intended to imply that that component is actually located outside the housing the speaker.

The Grill Subcomponent

[0028] FIG. 2-A shows the outside or top of an exemplary speaker grill 104 (also referred to as the grill subcomponent) according to exemplary embodiments hereof, with a button 106 substantially in its center and FIG. 2-B shows the inside or bottom of the exemplary speaker grill 104 of FIG. 2-A.

[0029] The speaker grill 104 of the embodiments shown in FIGS. 2-A to 2-B is formed by two connected components, a grill component, the outside of which is external to the speaker, and an inner grill connector component, together referred to as the speaker grill or grill subcomponent 104. The grill component is preferably formed of a perforated metal.

[0030] The speaker grill 104 has an outer diameter denoted \( D_{o} \).

[0031] Preferably there is a light ring diffuser (e.g., a plastic ring) forming a substantially uniform circular region around the outer edge of the button 106, allowing light from the inside of the speaker to be seen around the outer edge of the button (FIGS. 7-C and 7-D show an exemplary diffuser ring 702 with and without the button). Preferably the light from the inside can be seen around the entire or substantially the entire outer edge of the button. As shown, e.g., in FIG. 7-E, light, e.g., emitted by one or more light-emitting elements (such as one or more LEDs or the like) inside the speaker may be used to depict or represent aspects of operation or operational states of the speaker. In one embodiment there are six LEDs that may shine substantially evenly through the diffuser, either selectively lighting up the complete ring, or performing light animations (e.g., circular animations). The lighting up of the complete ring and/or the use of animations may be selectively performed, depending on one or more operational states of the speaker. The light-emitting elements may emit light in one or more colors. The light ring is part of a double-shot part with the center button. Although the diffuser is preferably circular, other shaped diffusers may be used in some less preferred embodiments.

[0032] As shown in FIGS. 2-A to 2-C, the button 106 may be formed using a button structure 110 positioned in a hole in the center of the grill 104.

[0033] The button structure 110 is preferably thermally bonded to the metal grill. The connector 112 may be a piece of conductive foil that electrically grounds the grill to the PCB on
the faceplate (the part to which the blade attaches) with a second (preferably rectangular) piece of conductive foam (as shown, e.g., in FIG. 2-Q).

[0034] In some embodiments hereof, a hole in the center of the button structure 110 may hold a piece of capacitive/conductive foam 114, preferably cylindrically shaped and described in greater detail below, allowing a capacitive touch connection between the front (outside) of the button and circuitry disposed within the speaker housing. The conductive foam 114 may be conductively connected to a PCB on the faceplate using PSA (pressure sensitive adhesive).

[0035] In some embodiments a metal disc, e.g., an stainless steel disc, may be affixed to the back of the center plastic button, and rotates with it. The metal used for the disk (preferably stainless steel) is chosen so that it will not cause galvanic corrosion with the surface metal plating of the spring. The disc may be fastened with to the back of the center plastic button adhesive. When conductive foam is used, the conductive foam touches the disc, resulting in greater sensitivity of the button to touch over a greater area of the button. In embodiments with the metal disc attached, a user can press more of the area of the button, not just directly in the center.

[0036] In presently preferred embodiments hereof, as shown, e.g., in FIG. 7-F (discussed below) instead of conductive foam, a metal spring 115 may be used as the contact between the front PCB and the metal disc 117 (attached to the rotating center plastic button). It should be appreciated that while this structure may make some noise from vibration, it has been found that it does not make audible noise and so does not interfere with normal use of the speaker. The metal spring is preferably surface mounted to the PCB, with a wiping surface between the spring and the metal disc.

[0037] With reference again to FIGS. 2-A and 2-B, an outer ring 105 formed on the inner grill connector component of the speaker grill 104 includes a number of screw holes (in this example embodiment there are eight holes, denoted S1 to S8 in the drawings) allowing the speaker grill 104 to be fixedly connected to other components of the dial assembly, as described below. Two guide pins, denoted PA and PB, are disposed on the outer ring 105 to aid with alignment of the speaker grill 104 with another component of the dial assembly.

[0038] An inner ring 107 of the inner grill connector component of the speaker grill 104 has a number of pads disposed thereon. Preferably the pads are equally spaced. In a presently preferred exemplary embodiment there are four equally spaced pads, denoted P1 to P4, on the inner ring 107. As shown in FIGS. 2-D and 2-E, the pads may be formed of a foam backing, preferably with a low friction coating or tape. The foam is preferably chosen to absorb shock and so attenuate vibration (that would otherwise make noise). The surface smoothness provided
by the coating or tape is advantageous in that it affects the feel of the device during rotation by a user. The foam may be E.R.A. (acoustic foam). In presently preferred embodiments the foam used in the pads is 3M brand CONFOR foam (part number is CF-42SC) with Polytetrafluoroethylene (PTFE) such as DuPont™ Teflon® brand tape or coating, with the tape or coating facing outwards so that, in operation of the speaker, the tape or coating will be in contact with a metal ring of the bearing component (described in detail below). CONFOR foam is a registered trademark of Aearo Technologies. In some embodiments the pads may be formed using ultra-high-molecular-weight polyethylene (UHMWPE, UHMW) instead of PTFE (e.g., in place of Teflon). In some embodiments, a foam such as PORON brand Foam may be used in place of 3M brand (Aearo Technologies) foam as the acoustic foam backing. Those of ordinary skill in the art will realize and appreciate, upon reading this description, that different and/or other foams and/or coatings or tapes may be used for the pads, and the examples given here are not limiting. It should also be appreciated that a foam with a sufficiently low friction surface may be used for a pad, without a tape or coating.

The pads preferably have a rectangular cross section and curve substantially with the radius of the inner ring 107 on which they sit.

The inner ring 107 has an outer diameter \( D_{RG} \) and an inner diameter \( D_{IN} \). The width of the inner ring \( (DRING - D_{IN}) \) is substantially uniform around the entire inner ring 107. The pads are preferably substantially the same width as that of the inner ring. The pads preferably have the same and uniform height \( (hi) \).

FIG. 2-F shows a detailed portion of the inside of the speaker grill 104 in the section between the lines X-X' in the embodiment of FIG. 2-B.

The Blade Subcomponent

FIGS. 2-G to 2-I depict aspects of a second component or blade component/assembly 116 according to exemplary embodiments hereof, with FIG. 2-G showing the front of the blade component 116, and FIGS. 2-H to 2-I showing aspects of the back or inside of the blade component 116. In some embodiments the blade component 116 has a blade ring 118 fixedly attached to an inner blade connector component 120. The blade ring 118 has an outer diameter \( D_3 \) and may be metal, and, if so, preferably formed of stainless steel or the like. In some presently preferred embodiments hereof, instead of being formed from two components (a blade ring and an inner blade connector), the blade ring may be integrally formed as a single component with the inner blade connector component. For example, as shown in the exemplary embodiment in FIGS. 2-R, 2-S, and 9-G, the blade component 116' may be formed as a single piece (in this case, a single plastic piece with the blade molded with the faceplate, \( i.e. \), as a
faceplate with an integrated plastic blade). When formed as a single piece, an outer portion 118' of the blade component 116' corresponds to the blade ring 118. As should be appreciated, a single-piece blade component is generally easier and cheaper to manufacture.

[0043] A hole in the center of the blade component 116 or 116' allows the cylindrical piece of capacitive foam 114 or the spring 115 (both discussed above) to pass therethrough.

[0044] When formed from two components (a blade ring and an inner blade connector), the blade ring 118 may be connected to the inner blade connector component 120 by two or more connectors (e.g., screws, denoted C1 and C2 in the drawings in FIGS. 2-F and 2-G). Two pinholes (denoted PHI and PH2) are located on opposite sides of the blade ring 118 to assist in positioning / alignment of the components when the speaker dial assembly is assembled.

[0045] FIG. 2-1 shows the section of the blade component 116 between the lines Y and Y' (of FIG. 2-G) in greater detail. As shown in FIGS. 2-H and 2-I, the inner blade connector component 120 of the blade component 116 includes a circuit portion 122 on which one or more circuit boards may be mounted. The circuit board(s) may be attached to the blade connector component 120 in circuit portion 122 using screws and screw holes SB1 to SB6. Two additional circuit locations 123, 125 are located on the inside of the inner blade connector component 120. A similar circuit portion structure may be used on the single-piece blade component 116' to support mounting of one or more circuit boards on the component 116'.

[0046] A pin may be provided on the circuit portion 122 to aid in positioning the circuit board(s) on the blade connector component 120. A lens may be positioned in circuit portion 122 so that, in operation, light emitted by circuitry on the circuit board may be passed through the blade component 116 and may be seen through the front of the grill 104. A similar lens structure may be used on the single-piece blade component 116'.

[0047] Two raised screw holes in the blade connector component 120 (denoted SA1 and SA2 in the drawings) are used to connect the blade component 116 or 116' to an optical encoder circuit board, as shown, e.g., as 304 in FIGS. 3-D, 3-J, 3-K and 3-L.

[0048] When the blade component 116 is connected to the other components, the blade ring 118 on the blade component 116 will be in direct contact with the pads P1 to P4 on the inside of the grill portion. The width of the ring (denoted w4 in FIG. 2-1) is preferably less than or equal to the width \( \text{width} = D_{\text{RING}} - D_{n} \) of the inner rim of the inside grill portion. Similarly, when a single-piece blade component 116' is connected to the other components, the blade ring portion 118' of the blade component 116' will be in direct contact with the pads P1 to P4 on the inside of the grill portion.
The Bearing Subcomponent

FIGS. 2-J to 2-M depict various aspects of the bearing subcomponent 124 (or bearing 124) according to exemplary embodiments hereof, with FIG. 2-J depicting the outside of the bearing subcomponent 124 and FIGS. 2-K and 2-L depicting aspects of the inside of the bearing subcomponent. The bearing subcomponent 124 may be formed of a single piece of hard plastic or the like and has an inner ring 126 adjacent a raised outer ring 128. The inner ring 126 has an outer diameter D5 and in inner diameter D4. The width of the inner ring 126 is thus $W_{IR} = D5 - D4$. Preferably the width of the inner ring, $W_m$, is greater than or equal to the width of the blade ring 118. The bearing subcomponent 124, and the outside diameter of the outer ring 128, have a diameter denoted D6 in drawings.

Holes (denoted SHV to SH8) are positioned around the outer ring 128 of the bearing subcomponent 124 at locations corresponding to the locations of screw holes S1 to S8 in the grill component 104. Pin holes (denoted PH_A and PH_B) are located on the outer ring 128 at locations corresponding to the locations of the pins P_A and P_B, respectively, of grill component 104.

The inner ring 126 of the bearing subcomponent 124 has a number of pads disposed thereon. Preferably these pads are equally spaced and preferably there is the same number of pads on the inner ring 126 of the bearing 124 as on the inner ring 107 of the speaker grill. In a presently preferred exemplary embodiment there are four equally spaced pads, denoted P5 to P8, on the inner ring 126 of the bearing 124. As with the pads P1 to P4 on the inner ring of the speaker grill, the pads P5 to P8 may be formed of a foam backing, preferably with a low friction coating or tape, e.g., PTFE such as DuPont™ Teflon® brand with CONFOR foam backing. In some embodiments, UHMW may be used instead of PTFE, and, in some embodiments, a foam such as PORON may be used instead of CONFOR. Those of ordinary skill in the art will realize and appreciate, upon reading this description, that different and/or other foams and/or coatings or tapes may be used, and the examples given here are not limiting. It should also be appreciated that a foam with a sufficiently low friction surface may be used without a tape or coating. As with the pads on the inner ring, the foam is preferably chosen to absorb shock and so attenuate vibration (that would otherwise make noise), and the surface smoothness provided by the coating or tape is advantageous in that it affects the feel of the device during rotation by a user. The pads preferably have the same and uniform height ($h_2$). In preferred embodiments the pads (P1 to P4) on the inner ring of the speaker grill have the same height as the pads (P5 to P8) on the inner ring 126 of the bearing subcomponent, so that in preferred embodiments $h_1 = h_2$. 

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Preferably the pads P5 to P8 are located on the inner ring 126 so that when the
components are connected, they will be located substantially opposite the pads P1 to P4 on the
inner ring 107 of the speaker grill.

As noted above, and as shown in FIG. 2-M, the outer ring 128 is raised with
respect to the inner ring 126, thereby forming a lip on the outside of the bearing subcomponent
124. The height of this lip (denoted h1) is substantially uniform around the ring, and is
preferably selected such that h1 ≤ hi + h2 + Tblade, where Tblade is the thickness of the blade ring.
In this manner, when the various components are connected, the blade ring 118, and thus the
blade component 116, may rotate freely between the grill component and the bearing component
124, subject to substantially uniform pressure from the pads P1 to P8. Those of ordinary skill in
the art will realize and appreciate, upon reading this description, that the pads provide pressure
on the rotatable blade component 116, and that the thickness of the pads may affect the freedom
with which the blade component 116 may rotate. In preferred embodiments the pad thickness is
selected to allow the blade component 116 to more freely while still requiring torque to initiate
and maintain rotation. It should also be appreciated that too much pressure from the pads will
require too much torque in order to rotate the blade component 116, which may result in
undesirable tipping or moving of the entire speaker when the blade component 116 is rotated.

Pattern(s) on the Bearing

With reference again to FIGS. 2-K and 2-L, depicting aspects of the inside of the
bearing subcomponent 124, according to some exemplary embodiments hereof the inside of the
ring 126 has a pattern 130 formed thereon around the entire inside of the ring 126. In
embodiments in which a pattern is used, the pattern 130 is preferably optically detectable and
may comprise a number of spaced apart bars (e.g., as shown in FIG. 2-L). The pattern 130 may
comprise a number of repeating sub-patterns 132. The pattern may be formed on the ring 126
using reflective metallic tape or decals or the like. As will be explained below, the pattern 130
may be used by circuitry, e.g., mounted on the blade component, to detect aspects of relative
movement, i.e., rotation, of the bearing subcomponent with respect to the blade component. For
example, the pattern 130, in conjunction with an optical sensor and other circuitry may be used
to determine a rate of rotation of the bearing subcomponent with respect to the blade component
and a direction of rotation of the bearing subcomponent with respect to the blade component.
It should be appreciated that, in operation, the bearing subcomponent 124 is fixedly connected to
the grill component 104, so that, in effect, the pattern on the bearing subcomponent 124 may be
used to ascertain and measure aspects of movement (e.g., rotation speed, duration, and direction)
of the grill component 104 relative to the speaker.
As explained below, in preferred exemplary embodiments hereof, Hall effect sensors and magnets are used (instead of or as well as the patterns and optical sensors) to detect aspects of movement of the grill component relative to the speaker. Thus, magnets and one or more Hall effect sensors may be used to detect one or more of, e.g., rotation speed, duration, and direction, of the grill component 104 relative to the speaker.

Magnets on the Bearing

Referring again to FIG. 2-K, in some less preferred embodiments, multiple magnets may be located at positions around the inside of ring 126. Preferably the magnets are equally spaced around the ring 126. In some embodiments twelve magnets may positioned, substantially equally spaced, inside the ring 126. The twelve magnets are denoted $R_1$ to $R_{12}$ in the drawing, and their positions in an exemplary embodiment are shown in the drawing in FIG. 2-K. It should be appreciated that some or all of the magnets $R_1$ to $R_{12}$ may be covered by the decals or the like used to form the pattern 130 on the ring 126. The use of the magnets on the bearing is described in greater detail below in conjunction with magnets disposed on the driver panel. While twelve magnets are shown in this example, those of ordinary skill in the art will realize and appreciate, upon reading this description, that fewer than (or more than) twelve magnets may be used. In one preferred embodiment (described in greater detail below), nine substantially equally spaced magnets may be used.

The Driver Panel

FIGS. 2-N and 2-0 depict aspects of an exemplary fourth component, the driver panel 134, with FIG. 2-N showing the outside or top of the driver panel 134 and FIG. 2-0 showing the inside or bottom of the driver panel 134. With reference to FIGS. 2-N and 2-0, holes $SH1'$ to $SH8'$ correspond positionally holes $SH1$ to $SH8$ in the blade component 116, allowing the driver panel 134 to be fixedly connected, e.g., using screws or the like, to the blade component 116. Spacer pins $SP_A$ and $SP_B$ in the driver panel 134 correspond positionally to pin holes $PH1$ and $PH2$, respectively, in the blade component 116 (FIGS. 2-G and 2-H).

Holes $SH1'$ and $SH2'$ in the driver panel 134 correspond in size and position to holes $H1$ and $H2$, respectively, in the blade component 116, allowing sound rendered by speaker drivers positioned behind those holes to pass through the components and through the speaker grill. A hole $SH6'$ in the driver panel corresponds to holes $H3$, $H4$, and $H5$ in the blade component 116, allowing sound rendered by a speaker driver positioned behind hole $SH6'$ to pass through the components and through the speaker grill.

The driver panel 134 may hold woofer and tweeter components (not shown).
MAGNETS ON THE DRIVER PANEL

[0060] In some exemplary embodiments hereof, when magnets are placed on the bearing, as described above, a number of magnets may be positioned at locations around the outside of the driver panel. In an embodiment three magnets (denoted M_A, M_B, and M_c in the drawing in FIG. 2-0) are positioned at equally spaced locations around an outer portion of the outside of the driver panel 134. The distance of magnets M_A, M_B, and M_c from the center of the driver panel 134 is preferably substantially the same as the distance of the magnets R1-R12 from the center of ring 126 of the bearing 124 so that when the components are combined to form the speaker, the magnets in the first set (M_A, M_B, and M_c) can substantially coincide with magnets in the second set of magnets (R1-R12).

[0061] As used herein throughout, magnets are said to coincide when they are positioned so that their magnetic fields interact sufficiently so that they attract (or repel) each other. It should be appreciated that two or more magnets need not touch or come into contact with each other in order to coincided.

[0062] The magnets in the first set (R1-R12) should be positioned relative to the magnets in the second set (M_A, M_B, M_c) so that their poles attract. That is, each magnet in the first set will be attracted to each magnet in the second set as they come into proximity.

[0063] As shown in FIG. 2-P, with twelve equally spaced magnets on the ring 126 and three equally spaced magnets on the driver panel 134, three of the twelve magnets (M1-R12) will simultaneously coincide with the three magnets M_A, M_B, M_c in twelve different positions. The two sets of magnets thus effectively provide apparent or virtual detents at regular intervals during rotation of the ring 126 relative to the driver panel 134. As the ring 126 is rotated relative to the driver panel 134, the magnets will move apart to positions where there are no magnets opposite each other. Further rotation of the ring 126 relative to the driver panel 134 will simultaneously bring three magnets on the ring 126 into conjunction or coincidence with the three magnets (M_A, M_B, M_c) on the driver panel. This conjunction or coincidence of the magnets with other attracting magnets provides the tactile effect of a detent to a user rotating the speaker's grill. With twelve equally spaced magnets on the ring 126 there are effectively twelve equally spaced virtual detents. Those of ordinary skill in the art will realize and appreciate, upon reading this description that magnetic detents provide virtual detents by allowing a physical detent feeling for a user without actual parts touching in a way that would make audible noise with vibration.

[0064] As used herein, the term "detent" refers, without limitation, to something that changes or regulates the flow or ease of rotation of the dial. Depending on the force with which
the dial is being rotated, a detent may stop the rotation or cause it to slow. In any case, a detent is preferably detectable by a user rotating the dial. A detent may be virtual in that, while there is a perceivable change in the flow or ease of rotation of the dial, there is no actual catch or the like stopping the movement of the dial. A virtual detent may be implemented, e.g., by magnets on the dial mechanism, as described herein.

[0065] In preferred embodiments the magnets allow for creation of a physical feeling or sensation of a dial detent without features that would make physical contact and audible noise during sound and music playback through the speaker.

[0066] Those of ordinary skill in the art will realize and appreciate, upon reading this description, that a different number of magnets may be used on both the ring and on the driver panel or on other components, e.g., as described herein, and that different numbers or combinations of magnets may give a different number of effective conjunctions of the two sets of magnets and corresponding different number of effective virtual detents.

[0067] Those of ordinary skill in the art will also realize and appreciate, upon reading this description, that different strength magnets will provide different degrees of attraction and thus different perceived virtual detents.

[0068] The magnets in the first set (e.g., those on the ring 126) are preferably each of substantially the same magnetic strength. The magnets in the second set (e.g., those on the driver panel 134) are preferably each of substantially the same magnetic strength. However, it should be appreciated that the magnets in the first set need not be of the same magnetic strength as those of the second set. In some other embodiments, one or more of the magnets in one or both of the sets may be of different magnetic strength than other magnets in the set. In these embodiments some of the apparent detents will be caused by stronger attraction than others, thereby providing a way for users to distinguish between detents.

**Alternate Embodiments**

[0069] In presently preferred exemplary embodiments hereof, instead of having magnets on driver panel and bearing, as described above, all of the magnets may be located on components of the grill assembly. As will be appreciated, this means that none of the magnets are on the audio module (which is behind the driver panel 134). In some preferred embodiments hereof there are nine (9) magnets positioned at substantially equally spaced locations in the plastic grill frame and three (3) magnets positioned at substantially equally spaced locations in the faceplate. FIG. 2-S shows an exemplary faceplate 116† having three magnets M₁, M₂, and M₃ positioned at substantially equally spaced locations thereon. As shown in FIG. 2-V, the
magnets M₁, M₂, M₃ may be positioned in pre-formed slots or holes on the faceplate 116', and may be glued therein.

[0070] In these alternate embodiments, with magnets on the faceplate, corresponding magnets may be positioned in the plastic grill frame, as shown, e.g., as magnets P₁ to P₉ in FIG. 2-V.

[0071] Similar to the example described above for FIG. 2-P, with nine equally spaced magnets on the grill frame and three equally spaced magnets on the faceplate, three of the nine magnets will simultaneously coincide with the three magnets Mₐ, Mₖ, Mₐ in nine different positions. The three magnets Mₐ, Mₖ, Mₐ are substantially 120° apart, while each of the nine magnets P₁ to P₉ is substantially 40° apart from its two adjacent magnets. The two sets of magnets thus effectively provide apparent or virtual detents at regular intervals during rotation of the faceplate relative to the plastic grill frame. As the faceplate is rotated relative to the plastic grill frame, the magnets will move apart to positions where there are no magnets opposite each other. Further rotation of the faceplate is rotated relative to the plastic grill frame will simultaneously bring three of the nine magnets on the plastic grill frame into conjunction or coincidence with the three magnets (Mₐ, Mₖ, Mₐ) on the driver panel. This conjunction or coincidence of the magnets with other attracting magnets provides the tactile effect of a detent to a user rotating the speaker's grill. With nine equally spaced magnets on the grill frame there are effectively nine equally spaced virtual detents. As previously noted, magnetic detents provide virtual detents by allowing a physical detent feeling for a user without actual parts touching in a way that would make audible noise with vibration.

Connecting the Components

[0072] FIGS. 3-A to 3-K show various aspects of the inter-connection between the components of the speaker dial according to exemplary embodiments hereof. These drawings are provided to show how the various subcomponents interconnect. In some of the drawings an intermediate subcomponent is omitted in order to aid in the description. It should be appreciated and understood that the intermediate components are not omitted in the final assembly.

[0073] FIGS. 3-A to 3-B show the interconnection of the four subcomponents - the grill subcomponent 102, the blade subcomponent 116, the bearing subcomponent 124, and the driver panel subcomponent 134. The three components: the grill subcomponent 102, the blade subcomponent 116, and the bearing subcomponent 124, for a dial assembly 300.

[0074] FIG. 3-C shows the interconnection/interaction of the grill subcomponent 102 with the blade subcomponent 116.
FIG. 3-D shows the interconnection/interaction of the blade component 116 to the bearing component 124. Note that in the drawing in FIG. 3-D the blade component 116 is shown with a circuit board 302 mounted thereon. An optical sensor 304 or the like is positioned to detect the pattern 130 on the inside of the bearing component 124.

FIG. 3-E shows the interconnection/interaction of grill component 102 with the bearing component 124, it being understood and appreciated that in a final assembly the blade component 116 will be positioned between them.

FIG. 3-F shows the interconnection/interaction of the bearing component 124 with the driver panel 134.

FIG. 3-G shows the interconnection/interaction of the blade component 116 with the driver panel 134, it being understood and appreciated that in a final assembly the bearing component 124 will be positioned between them.

FIG. 3-H shows a perspective side view of the grill component 102, and FIG. 3-I shows perspective side view of the driver panel 134.

FIGS. 3-J to 3-K show a completed speaker dial assembly 300 (FIG. 3-B) of the subcomponents described above (without the driver panel 134), and including a circuit board 302, and other circuitry components 304 mounted thereon. Connector cable 306 allows connection of the circuitry to other circuitry within the speaker.

FIG. 3-M shows a grill assembly according to preferred exemplary embodiments hereof formed with a faceplate 117 having three substantially equally spaced magnets therein and a grill frame 106 having nine substantially equally spaced magnets therein. This construction is presently preferred over the magnets in the driver panel (i.e., over the construction shown in FIG. 3-B).

FIG. 4 shows aspects of mounting the speaker dial assembly 308 in the speaker 100 according to exemplary embodiments hereof, with the speaker dial assembly 300 positioned relative to the housing component 400 and the speaker body 402.

FIGS. 5-A to 5-D show cross-sectional views of the speaker 100 including the speaker dial assembly 300 according to exemplary embodiments hereof.

FIGS. 6-A and 6-B shows a detailed view of aspects of embodiments of the speaker depicted in FIGS. 5-A to 5-B. As shown in FIG. 6-A, which corresponds to the section A in FIG. 5-B, the blade (metal ring 118) is compressed between two sliding bearing surfaces supported by the two pads (corresponding, e.g., to pads P1 in FIG. 2-B and P5 in FIG. 2-J).

Vibration and air pressure from the speaker driver(s) oscillate the grill front-to-back. The surface on the foam (e.g., the Teflon) allows the blade to slide, while at the same time
the foam segments on both sides of the blade attenuate vibration and associated sound.
Furthermore, the foam segments do not allow the Teflon surfaces to separate and resonate as hard plastic surfaces would, thereby further reducing vibration and associated sound.

[0086] FIG. 6-B shows the pattern on the bearing passing by a sensor (such as an optical sensor) connected to circuitry in the speaker in order to determine aspects about the rotation of the bearing (and thus aspects of rotation of the grill). These aspects may include one or more of: direction of rotation, speed of rotation, acceleration of rotation, time of rotation, and distance of rotation.

[0087] FIGS. 6-C and 6-D shows a detailed view of aspects of the embodiments of the speaker depicted in FIGS. 5-C to 5-D. As shown in FIGS. 6-C and 6-D, which correspond to the sections A' in FIG. 5-C and A" in FIG. 5-D. As shown in FIGS. 6-C and 6-D, according to preferred exemplary embodiments hereof, one or more Hall effect sensors 119, preferably two Hall effect sensors, on the PCB are used to detect the movement of magnets on the bearing structure, thereby determining aspects of rotation of the grill, including one or more of: direction of rotation, speed of rotation, acceleration of rotation, time of rotation, and distance of rotation of the grill.

[0088] FIGS. 7-A to 7-B show detailed views of aspects of the speaker depicted in FIGS. 5-A and 5-B. As shown in FIG. 7-A, which corresponds to the section B in FIG. 5-B, in some embodiments hereof, capacitive foam is assembled to a copper pad on the PCB (printed circuit board) with conductive PSA (pressure sensitive adhesive). The foam takes up the tolerance between the back of the button on the grill and the PCB, and allows the grill to turn and vibrate without making noise.

[0089] An inside edge of the button mount may glide on a ring on the faceplate to keep the grill on axis in order to control radial movement. Preferably the button rotates with the grill, being fixedly attached thereto. The button will rotate on an inside edge of the faceplate, as shown in FIG. 7-A.

[0090] Those of ordinary skill in the art will realize and appreciate, upon reading this description, that the use of capacitive touch foam allows and supports functionality of button without a wired electrical connection. As the system uses no direct wiring, there is no concern with wires twisting. Brushing metal contacts would make audible noise and are also avoided.

[0091] FIG. 7-F shows a detailed view of aspects of the speaker depicted in FIGS. 5-C and 5-D. As shown in FIG. 7-F, which corresponds to the section B’ in FIG. 5-C, in some presently preferred embodiments hereof, a metal disk 117 and spring 115 may be used as the contact between the front PCB and the metal disc 117 (attached to the rotating center plastic
button). In practice it the metal spring has been found to be more reliable than the conductive foam (which, in certain implementations, did not always rebound or keep contact).

Those of ordinary skill in the art will realize and appreciate, upon reading this description, that the components described here may be considered to form two distinct and interacting parts. The grill component 104 and bearing 124, when connected, form a first part in which the blade 116 may freely rotate. The blade 116, when connected to the housing 134, forms a second part which, while connected to the first part, may rotate freely with respect to that first part. Since the housing 134 is fixed to the speaker, it is rotation of the first part (the combined grill 104 and bearing 124) that is used to control the device. When a user rotates the grill 104, then the connected bearing 124 rotates with the grill, in the same direction and at the same rate and for the same distance. Rotation of the bearing 124 (and thus of the grill 104) is detectable and detected by circuitry within the speaker that detects and measures movement of the bearing using, e.g., movement of the magnets as they pass one or more Hall effect sensors and/or movement of the pattern on the bearing as that pattern passes one or more optical sensors.

As a user rotates the grill 104, and thus the bearing 124, the magnets on the bearing move toward and away from the magnets on the housing 134. At places where the magnets on the grill coincide with those on the housing, the grill's ease of rotation will be diminished (by the magnetic attraction of the grill's magnet(s) to the housing's magnet(s)). This magnetic attraction provides a perceived and virtual detent. In some embodiments described herein there are twelve equally spaced magnets on the bearing 124 and three equally spaced magnets on the housing 134. Thus, when rotating the grill in either direction (clockwise or counter-clockwise), the user will perceive twelve virtual detents, one for every 30° turn of the grill. In some other (and preferred) embodiments described herein, there are nine equally spaced magnets on the grill frame and three equally spaced magnets on the faceplate. Thus, in those preferred embodiments, when rotating the grill in either direction (clockwise or counter-clockwise), the user will perceive nine virtual detents, one for every 40° turn of the grill.

Note that in embodiments that use the foam, the foam is always in contact with the circuitry and the circuitry recognizes the increased capacitance when a finger touches the front of the button. Thus, in such embodiments, in operation of the speaker, when a user presses the button on the outside of the grill, the user's touch provides an indication of the user's touch to the attached circuitry.

This allows the speaker to provide a button in the center of a rotatable grill without requiring directly connected wiring (which would twist when the grill is rotated) or brushings (which could disconnect and/or cause vibration).
In embodiments that use a metal spring instead of conductive foam, the metal spring 115 may be used as the contact between the front PCB and the metal disc 117 (e.g., as shown in FIG. 7-F, discussed above). In these embodiments the metal disc and the metal spring serve to maintain detection of a user's touch of the button and to provide such an indication to the attached circuitry. As should be appreciated, while maintaining contact with the metal disc 117, the metal spring 115 is preferably not fixedly connected thereto.

Exemplary Embodiments

FIGS. 8-A to 8-1, 9-A to 9-F, 10-A to 10-C, and 11-A to 11-C are images showing various views of the components of the speaker according to exemplary embodiments hereof, with FIGS. 8-A to 8-1 showing an exemplary speaker grill 104, FIGS. 9-A to 9-F showing an exemplary blade component 116, FIGS. 10-A to 10-C showing an exemplary bearing subcomponent 124, and FIGS. 11-A to 11-C showing an exemplary driver panel 134.

Thus is described a speaker system (e.g., a music player) on which substantially the entire front face is a speaker grill, with speaker drivers (e.g., one or two tweeters and one woofer) behind it. The grill turns like a dial, with apparent detents at regular intervals. A button in the center of the grill that may be used to control aspects of operation of the speaker system.

Various advantages of the speaker system and components described here include:

- The blade bearing features that allow smooth movement of a large dial while attenuating vibration.
- The use of capacitive touch foam, supporting the functionality of center control button without a wired electrical connection (since the grill turns).
- Magnetic Detents allow a perceived physical detent feeling without actual parts touching that would make audible noise with the vibration.

Where a process is described herein, those of skill in the art will appreciate that the process may operate without any user intervention. In another embodiment, the process includes some human intervention (e.g., a step is performed by or with the assistance of a human).

As used herein the words "first", "second", and so on, when used as adjectives before a term, are merely used to distinguish similar terms, and their use does not imply or define any numerical limits or any ordering (temporal or otherwise).

As used herein, including in the claims, the phrase "at least some" means "one or more," and includes the case of only one. Thus, e.g., the phrase "at least some ABCs" means "one or more ABCs", and includes the case of only one ABC.
As used herein, including in the claims, the phrase "based on" means "based in part on" or "based, at least in part, on," and is not exclusive. Thus, e.g., the phrase "based on factor X" means "based in part on factor X" or "based, at least in part, on factor X." Unless specifically stated by use of the word "only", the phrase "based on X" does not mean "based only on X."

As used herein, including in the claims, the phrase "using" means "using at least," and is not exclusive. Thus, e.g., the phrase "using X" means "using at least X." Unless specifically stated by use of the word "only", the phrase "using X" does not mean "using only X."

In general, as used herein, including in the claims, unless the word "only" is specifically used in a phrase, it should not be read into that phrase.

As used herein, including in the claims, the phrase "distinct" means "at least partially distinct." Unless specifically stated, distinct does not mean fully distinct. Thus, e.g., the phrase, "X is distinct from Y" means that "X is at least partially distinct from Y," and does not mean that "X is fully distinct from Y." Thus, as used herein, including in the claims, the phrase "X is distinct from Y" means that X differs from Y in at least some way.

As used herein, including in the claims, a list may include only one item, and, unless otherwise stated, a list of multiple items need not be ordered in any particular manner. A list may include duplicate items. For example, as used herein, the phrase "a list of XYZs" may include one or more "XYZs".

While the invention has been described in connection with what is presently considered to be the most practical and preferred embodiments, it is to be understood that the invention is not to be limited to the disclosed embodiment, but on the contrary, is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the appended claims.
WHAT IS CLAIMED:

We claim:

1. A speaker comprising:
   a housing;
   a substantially round grill disposed at least partially outside of said housing, said grill
   being rotatable about an axis thereof with respect to said housing to control aspects of operation
   of said speaker; and
   circuitry, in said housing, constructed and adapted to detect or determine aspects of
   rotation of said grill with respect to said housing.

2. The speaker of claim 1 wherein said circuitry comprises at least one Hall effect
   sensor positioned to detect movement of at least one magnet associated with said grill.

3. The speaker of claims 1 or 2 wherein said aspects of rotation of said grill
   comprise one or more of:
   a speed of rotation of said grill;
   a direction of rotation of said grill;
   a duration of rotation of said grill; and
   a distance of rotation of said grill.

4. The speaker of any of the preceding claims wherein said grill comprises a first
   grill component rotatable with respect to a second grill component,
   said first grill component having a first set of one or more magnets disposed thereon, and
   said second grill component having a second set of one or more magnets disposed thereon, and
   wherein there is at least one position of said first grill component relative to said second
   grill component in which at least one magnet in said first set coincides with at least one magnet
   in said second set.

5. The speaker of claim 4 wherein the first set has a first plurality of spaced magnets
   disposed on a first circle on said first grill component.
6. The speaker of claim 5 wherein the first plurality of magnets are substantially equally spaced.

7. The speaker of claims 4-6 wherein the first set consists of three substantially equally spaced magnets.

8. The speaker of any one of claims 4-7 wherein the magnets in the first set are substantially of the same strength.

9. The speaker of any one of claims 4-8 wherein the second set has a second plurality of spaced magnets disposed on a second circle on said second grill component.

10. The speaker of claim 9 wherein the diameter of the first circle is substantially the same as the diameter of the second circle.

11. The speaker of any one of claims 4 to 10 wherein the magnets in the second set are substantially of the same strength.

12. The speaker of any one of claims 4-11 wherein the second set consists of nine substantially equally spaced magnets.

13. The speaker of any one of claims 4-12 wherein there are at least nine positions of said grill relative to said housing in which at least one magnet in said first set coincides with at least one magnet in said second set.

14. The speaker of any one of claims 4-13 wherein there are at least nine positions of said grill relative to said housing in which at least three magnets in said first set coincides with at least three magnets in said second set.
15. The speaker of any one of claims 4-14 wherein the first component comprises a grill frame and wherein the second component comprises a faceplate.

16. The speaker of any of the preceding claims further comprising a button disposed substantially in the center of the grill, wherein the button is electrically connected to circuitry within the speaker by a metal disc and at least one spring.

17. The speaker of claim 16 wherein said grill rotates freely about said at least one spring.

18. The speaker of any one of claims 16-17 wherein said button is positioned in a diffuser that allows light from inside of the speaker to be seen from outside the speaker around an outer edge of the button.

19. The speaker of claim 18 wherein the diffuser comprises a ring.

20. The speaker of claims 18 or 19 wherein the diffuser comprises a plastic ring.

21. The speaker of any one of claims 18 to 20 wherein the diffuser forms a substantially uniform circular region around the outer edge of the button.

22. The speaker of any one of claims 18 to 21 further comprising:
circuitry disposed within said speaker, said circuitry comprising one or more light-emitting elements, wherein said light-emitting elements are positioned to emit light through said diffuser.

23. The speaker of claim 22 wherein said one or more light-emitting elements comprise one or more LEDs.

24. The speaker of claims 22 to 23 wherein at least some of said one or more light-emitting elements emit different colors from each other.
25. The speaker of any one of claims 22 to 24 wherein said one or more light-emitting elements are used to depict one or more aspects of operation of the speaker.

26. The speaker of any one of claims 22 to 25 wherein the one or more light-emitting elements shine substantially evenly through the diffuser.

27. The speaker of any one of claims 22 to 26 wherein the one or more light-emitting elements selectively light up substantially the entire region formed by the diffuser around the outer edge of the button.

28. The speaker of claim 27 wherein said one or more light-emitting elements selectively light up substantially the entire region formed by the diffuser around the outer edge of the button based on an operational status of the speaker.

29. The speaker of any one of claims 22 to 28 wherein the one or more light-emitting elements selectively animate substantially the entire region formed by the diffuser around the outer edge of the button.

30. The speaker of any one of claims 22 to 29 wherein the one or more light-emitting elements selectively animate substantially the entire region formed by the diffuser around the outer edge of the button based on an operational status of the speaker.

31. The speaker of any one of claims 22 to 30 wherein there are at least six light-emitting elements.

32. The speaker of any one of the preceding claims wherein said circuitry constructed and adapted to detect or determine aspects of rotation of said grill with respect to said housing comprises: at least one Hall effect sensor positioned to detect aspects of movement of one or more magnets on said grill.
33. The speaker of claim 32 wherein said circuitry comprises: at least two Hall effect sensors positioned within said housing to detect aspects of movement of one or more magnets on said grill.

34. The speaker of claims 32 or 33 wherein said at least one Hall effect sensor is positioned to detect movement of magnets in the second set of magnets.

35. The speaker of any one of claims 32 to 34 wherein said aspects of movement of magnets in the second set of magnets are used to determine aspects of rotation of said grill with respect to said housing.

36. The speaker of claim 32 to 35 wherein the aspects of movement of said magnets comprise one or more of: (i) direction of movement; and (ii) an amount of movement; (iii) a speed of movement; and (iv) a duration of movement.

37. The speaker of any one of claims 4 to 36 wherein magnets in the first and second sets of magnets are positioned so that they substantially coincide with and attract each other in multiple positions of the first component with respect to the second component.

38. The speaker of claim 37 wherein said rotation is affected by being impeded by attraction of said magnets in said first said to magnets in said second set.

39. The speaker of any one of claims 4 to 38 wherein magnets in said first set of magnets and magnets in said second set of magnets provide a number of virtual detents.

40. The speaker of any of the preceding claims further comprising:
   a bearing element connected to and rotating with the grill; and
   a blade element disposed between said grill and said bearing element and rotatable around said central axis of said grill.

41. The speaker of claim 40 wherein
said grill comprises a first one or more pads disposed on inside locations thereof; and
said bearing element comprises a second one or more pads disposed thereon, and wherein
a ring portion of said blade element rotates between and in direct contact with said first one or more pads on said grill and said second one or more pads on said bearing element.

42. The speaker of claim 41 where said first one or more pads are substantially equally spaced around said grill.

43. The speaker of claims 41 or 42 wherein the second one or more pads are substantially equally spaced around said bearing element.

44. The speaker of any one of claims 41 to 43 wherein the first one or more pads are disposed substantially opposite said second one or more pads.

45. The method of any one of claims 41 to 44 wherein the first one or more pads comprise a first four pads and wherein the second one or more pads comprise a second four pads.

46. The method of any one of claims 41 to 45 wherein each of the pads comprises a foam portion.

47. The speaker of claim 46 wherein the foam portion comprises a shock-absorbing foam.

48. The method of claims 46 or 47 wherein at least some of said pads comprise a low friction coating or tape on said foam portion.

49. The method of claim 48 wherein the coating or tape of each of the pads is in contact with the ring of the blade element.

50. The method of claim 48 or 49 wherein the coating or tape comprises a polytetrafluoroethylene (PTFE) or ultra-high-molecular-weight polyethylene (UHMW).
51. The speaker of any one of claims 40 to 47 further comprising:
   a driver panel connected to the blade element.

52. The speaker of claim 48 wherein said driver panel comprises:
   one or more speaker drivers connected thereto.

53. The speaker of claim 49 wherein the driver panel comprises three speaker drivers
   connected thereto.

54. A speaker comprising:
   a housing;
   a substantially round grill disposed at least partially outside of said housing, said grill
   being rotatable about an axis thereof with respect to said housing to control aspects of operation
   of said speaker;
   a bearing element connected to and rotating with the grill; and
   a blade element disposed between said grill and said bearing element and rotatable
   around said central axis of said grill and independent of said rotation of said grill.

55. The speaker of claim 54 wherein
   said grill comprises a first one or more pads disposed on inside locations thereof; and
   said bearing element comprises a second one or more pads disposed thereon, and wherein
   a ring portion of said blade element rotates between and in direct contact with said first
   one or more pads on said grill and said second one or more pads on said bearing element.

56. The speaker of claim 55 where said first one or more pads are substantially
   equally spaced around said grill.

57. The speaker of claims 55 or 56 wherein the second one or more pads are
   substantially equally spaced around said bearing element.
58. The speaker of any one of claims 55 to 57 wherein the first one or more pads are disposed substantially opposite said second one or more pads.

59. The speaker of any one of claims 55 to 58 wherein the first one or more pads comprise a first four pads and wherein the second one or more pads comprise a second four pads.

60. The speaker of any one of claims 55 to 59 wherein each of the pads comprises a foam portion.

61. The speaker of claim 60 wherein the foam portion comprises a shock-absorbing foam.

62. The speaker of claims 60 or 61 wherein at least some of the pads comprise a low friction coating or tape on the foam portion.

63. The speaker of claim 62 wherein the coating or tape of each of the pads is in contact with the ring of the blade element.

64. The speaker of claims 62 or 63 wherein the coating or tape comprises a polytetrafluoroethylene (PTFE) or ultra-high-molecular-weight polyethylene (UHMW).

65. The speaker of any one of claims 54 to 64 further comprising:
   a driver panel connected to the blade element.

66. The speaker of claim 65 wherein said driver panel comprises:
   one or more speaker drivers connected thereto.

67. The speaker of claim 66 wherein the driver panel comprises three speaker drivers connected thereto.

68. A method of controlling a speaker, the speaker having:
(a) a housing;
(b) a substantially round grill disposed at least partially outside of said housing, said grill being rotatable about an axis thereof with respect to said housing;
(c) a bearing element connected to and rotating with the grill; and
(d) a blade element disposed between said grill and said bearing element and rotatable around said central axis of said grill and independent of said rotation of said grill,
the method comprising:
(A) determining at least one aspect of rotation of said grill with respect to said housing; and
(B) based on said determining, controlling an aspect of operation of said speaker.

69. The method of claim 68 wherein said at least one aspect of rotation of said grill is selected from one or more of:
(i) a direction of rotation of said grill; and (ii) an amount of rotation of said grill; (iii) a speed of rotation of said grill; and (iv) a duration of rotation of said grill.

70. The method of claim 68 or 69 wherein said determining in (A) uses at least one Hall effect sensor in said speaker to detect movement of at least one magnet associated with the grill.
FIG. 1-B
FIG. 2-L
FIG. 2-M
FIG. 2-P
FIG. 3-B
FIG. 3-L
FIG. 3-M

GRILL FRAME (9 MAGNETS)

FACEPLATE (3 MAGNETS)
FIG. 7-B
FIG. 9-B
FIG. 9-D
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER
IPC (2015.01) H04R 1/02
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED
Minimum documentation searched (classification system followed by classification symbols)
IPC (2015.01) H04R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
Databases consulted: Esp@cenet, Google Patents, FamPat database

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
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<td>Y</td>
<td>Entire document</td>
<td>2,4-15,32-39</td>
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Further documents are listed in the continuation of Box C. See patent family annex.

* Special categories of cited documents:
  "A" document defining the general state of the art which is not considered to be of particular relevance
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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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Date of the actual completion of the international search: 07 Jun 2015
Date of mailing of the international search report: 07 Jun 2015

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