United States Patent [19]

[11] **3,909,557**

Kinoshita et al.

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[54] **VIBRATION DAMPENING MOUNTING SYSTEM FOR WIRE SUSPENDED LOUDSPEAKER BOBBIN**

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[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** ..... **179/115.5 VC;** 179/115.5 R

[51] **Int. Cl.²** **H04R 9/04**

[58] **Field of Search** ..... 179/115.5 R, 115.5 VC, 179/180; 181/31 R

[56] **References Cited**

UNITED STATES PATENTS

1,966,564	7/1934	Schlenker	179/115.5 VC
3,518,460	6/1970	Wood et al.	310/8.6
3,819,876	6/1974	Kinoshita	179/115.5 VC

FOREIGN PATENTS OR APPLICATIONS

607,594	9/1948	United Kingdom	179/115.5

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Attorney, Agent, or Firm—Sughrue, Rothwell, Mion, Zinn & Macpeak

[57] **ABSTRACT**

The suspension wires extending tangentially to the outer periphery of a cylindrical coil bobbin positioned within a cylindrical air gap of a magnetic circuit of a loudspeaker partially defined by the annular magnetic plate forming a portion of that circuit are fixed at one end to the circumference of the voice coil bobbin at spaced circumferential positions and are fixed to the annular plate at the opposite end by viscous resilient material.

1 Claim, 2 Drawing Figures

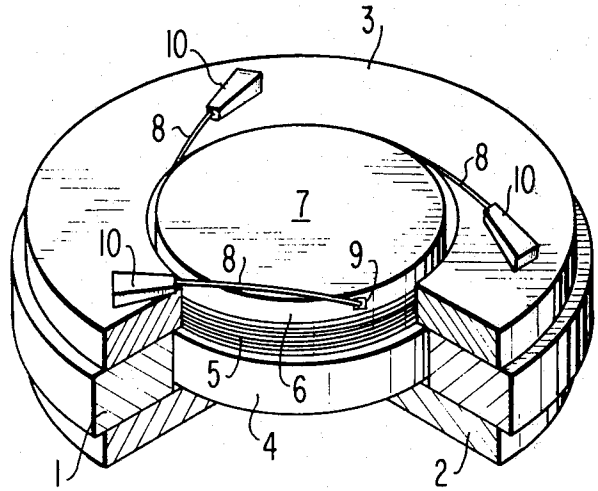


FIG. 1

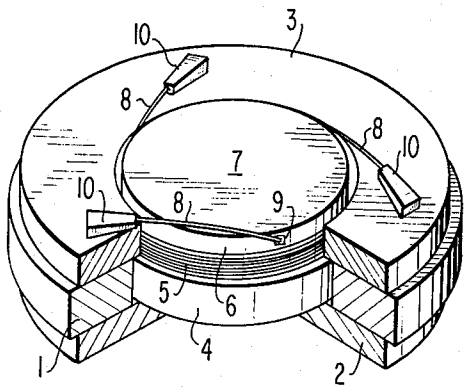
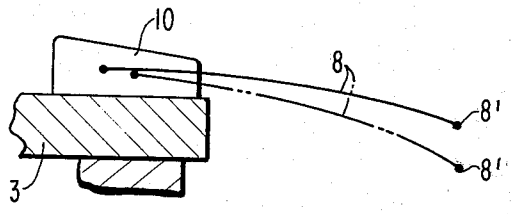


FIG. 2



VIBRATION DAMPENING MOUNTING SYSTEM FOR WIRE SUSPENDED LOUDSPEAKER BOBBIN

BACKGROUND OF THE INVENTION

This invention should be cross referenced to related patent and patent application. This invention relates to the subject matter of U.S. Pat. No. **3,819,876** issued June **25, 1974,** to Shouzo Kinoshita, entitled Loudspeaker With Improved Voice Coil Support, and application Ser. No. **362,983** filed by Shawzo Kinoshita on May **23, 1973,** and entitled "Expandable Suspension System for Loudspeaker Bobbin."

1. Field of the Invention

This invention relates to loudspeakers of the type wherein a voice coil bobbin having a voice coil wound about the bobbin periphery is disposed within a cylindrical air gap formed within the loudspeaker magnetic circuit, and more particularly, to such a loudspeaker, where a plurality of suspension wires extend tangentially to the periphery of the bobbin and are fixed at their ends, respectively, to the bobbin periphery and to the annular plate of the magnetic circuit which partially defines the cylindrical air gap.

2. Description of the Prior Art

In loudspeakers of this type, a plurality of suspension wires are distributed in uniformly spaced circumferential manner and extend in a tangential direction to the outer periphery of the bobbin and are fixed at one end to the bobbin and at the other end to an annular plate or the like which partially defines the circular air gap within which the bobbin is positioned. Loudspeakers in which the bobbin is suspended by wires of this type, have great merit in terms of the sound characteristics of the loudspeaker in comparison with loudspeakers using bobbin suspension means other than the tangential wires. However, when the bobbin vibrates along its axis in accordance with an electrical signal being applied to the voice coil, it tends to incline such that the bobbin rotates about the center of its axis. This is caused by the fact that the position of the coupling points of the suspension wires and the bobbin move relative to the direction of vibration in proportion to the amount of vibration of the bobbin. Further, this rotary power which affects the bobbin acts as a compression or expansion power between the neighboring coupling points and the bobbin is caused to resonate on its circumference, and to make matters worse, the bobbin and the diaphragm on the outside of the bobbin are transformed and distorted. Such rotation and distortion have adverse effects on the sound characteristics of the loudspeaker in addition to the resonation of the suspension wires themselves.

It is an object of the present invention to provide a loudspeaker in terms of an improved structure in which the rotating vibration or oscillation of the bobbin caused by the axial vibration thereof and the resonation between the bobbin and the suspension wire is diminished.

SUMMARY OF THE INVENTION

The present invention is directed to a loudspeaker which employs a cylindrical bobbin having a voice coil wound about its periphery with the bobbin disposed within a cylindrical air gap of the magnetic circuit and suspended by a plurality of suspension wires which extend tangentially to the outer periphery of the bobbin and are fixed at one end to the periphery of the bobbin and at the other end to a fixed magnetic annular plate which forms a part of the magnetic circuit and partially defines the cylindrical air gap. In such a loudspeaker, the improvement comprises a mass of viscous resilient material which surrounds the ends of the wire at their point of attachment to the annular plate and, in fact, acts as the means for fixing the outer ends of the wires to the annular plate.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view, partially cut away, of a loudspeaker incorporating the wire suspension means of the present invention, in one form.

FIG. **2** is a sectional, elevational view of a portion of the loudspeaker of FIG. **1.**

DESCRIPTION OF THE PREFERRED EMBODIMENT

In explaining one embodiment of the present invention in accordance with the drawings, particularly, in FIG. **1,** an annular magnet **1** is associated with a discal yoke **2** which is secured on one end face of magnet **1** while an annular magnetic plate **3** is secured on the other end face of the same magnet **1** and cooperates with a columnar pole which is secured to the yoke **2** so as to define with the annular plate **3,** an annular or cylindrical air gap of a predetermined width. Thus, the air gap is defined by the inner periphery of the plate **3** and the periphery of pole **4.**

Positioned in concentric manner about the upper end of pole **4,** is a cylindrical voice coil bobbin **6** which has a voice coil **5** wound about its periphery in conventional manner. The cylindrical assembly consisting of bobbin **6** and voice coil **5** wound thereabout has an inner diameter slightly larger than the diameter of pole **4** and an outer diameter slightly smaller than the inner periphery of the plate **3** and is disposed such that it is able to move freely in an axial direction within the air gap formed between the pole **4** and plate **3.** Numeral **7** designates a cup-shaped diaphragm which is attached to the end of bobbin **6** remote from pole **4.**

Further, a plurality of suspension wires **8** (in the illustrated embodiment, the number of which is **3**) are circumferentially spaced at equal distance about bobbin **6** and extend generally tangentially with respect to the periphery of the bobbin. Each suspension wire **8** is made of a material having a high resiliency such as berrylium-copper alloy. The suspension wires **8** extend in a tangential direction with predetermined spacing between the suspension wires. One end of the suspension wire **8** is secured to the outer peripheral surface of the bobbin through a suitable connecting member **9,** while the end portion of the wire is fixed to the upper surface of plate **3** by a mass of viscous resilient material **10** which completely surrounds the inner end of the wire **8** at its point of attachment to plate **3.** Viscous material **10** may be silicone rubber.

In the loudspeaker as constructed above, when the bobbin **6** has an electrical signal current applied to the voice coil **5,** the power resulting therefrom causes the bobbin **6** to move in the axial direction, and the suspension wires **8** are transformed due to the resiliency of the wires and simultaneously shift in the direction of the axis of suspension of each suspension wire as illustrated in FIG. **2,** wherein the points **8'** which are the points that the wires **8** are coupled to the bobbin move parallel to the axis of bobbin **6,** thus there is no deterioration

in the sound characteristics due to any possible rotation of bobbin **6.** Further, there results little transformation or deformation of the bobbin **6** due to the compression and expansion which normally would occur due to the rotative power of the energized coil acting on bobbin **6.** Still further, the resonation of the suspension wire **8** itself is effectively prevented because it is resiliently held by the layer of viscous resilient material **10** at the point of attachment to annular plate **3.**

A shift in position of the attachment point **8'** of wire **8** to the bobbin **6** is readily seen by contrasting the initial full line position to the dotted line position of one of the wires **8,** FIG. **2.**

While the invention has been particularly shown and described with reference to a preferred embodiment thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention.

What is claimed is:

1. In a loudspeaker including an annular fixed magnetic plate partially forming a magnetic circuit and partially defining with its inner periphery, a cylindrical air gap, and a cylindrical bobbin having a voice coil wound about its periphery and being suspended within said cylindrical air gap by means of a plurality of suspension wires which extend tangentially to the outer periphery of the bobbin in the same direction and are fixed at their inner end to the bobbin and at their outer end to said annular plate at respective circumferentially spaced positions, the improvement comprising: a mass of viscous resilient damping material surrounding the outer end of each wire and solely fixing each wire outer end to said annular plate for suppressing movement of said wires along their axes and for dampening rotative movement of said bobbin.

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