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Skulley

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(54) **COMFORTABLE EARPHONE CUSHIONS**

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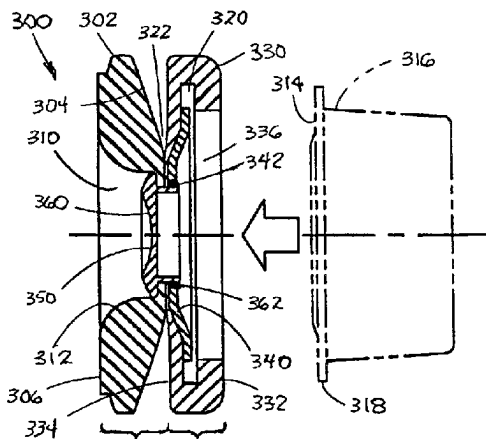
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(57) **ABSTRACT**

A cushion for a headset earphone comprises a resilient ring having opposite input and output faces, and a through-opening defining an interior surface between the two faces. The input face has structure for acoustically coupling the opening to an output face of an audio speaker, and the output face is resiliently conformable to a lateral face of an external ear of a listener, thereby acoustically coupling the opening, and hence, the speaker, to the listener's ear. The interior surface of the cushion can be configured to effectively match the acoustical impedance at the output face of the speaker to the acoustical impedance at the entrance of the listener's ear. In one possible embodiment, the ring is formed of an elastomer filled with microcapsules containing a material capable of an endothermic phase changes at a constant temperature, such that the cushion more effectively conducts heat away from the ear, thereby providing long term listening comfort. In another embodiment, the through-opening is acoustically coupled to the output of the transducer with an acoustic plug such that the cushion is flexibly articulated about the plug relative to the speaker, thereby enabling the cushion to comply more easily to the listener's ear using lower contact forces between the cushion and the ear.

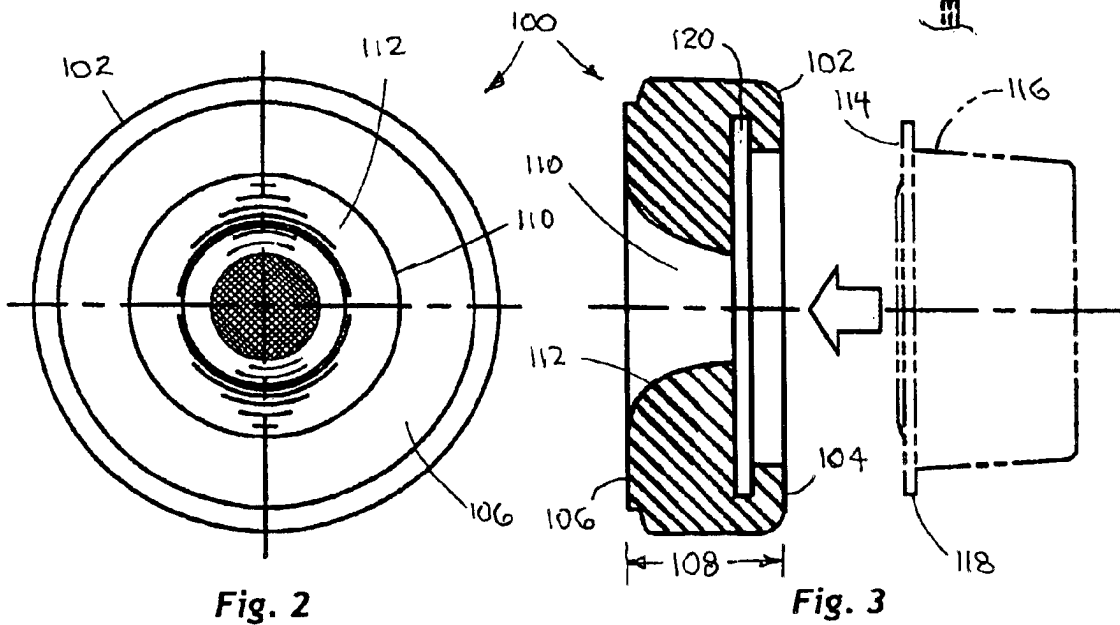
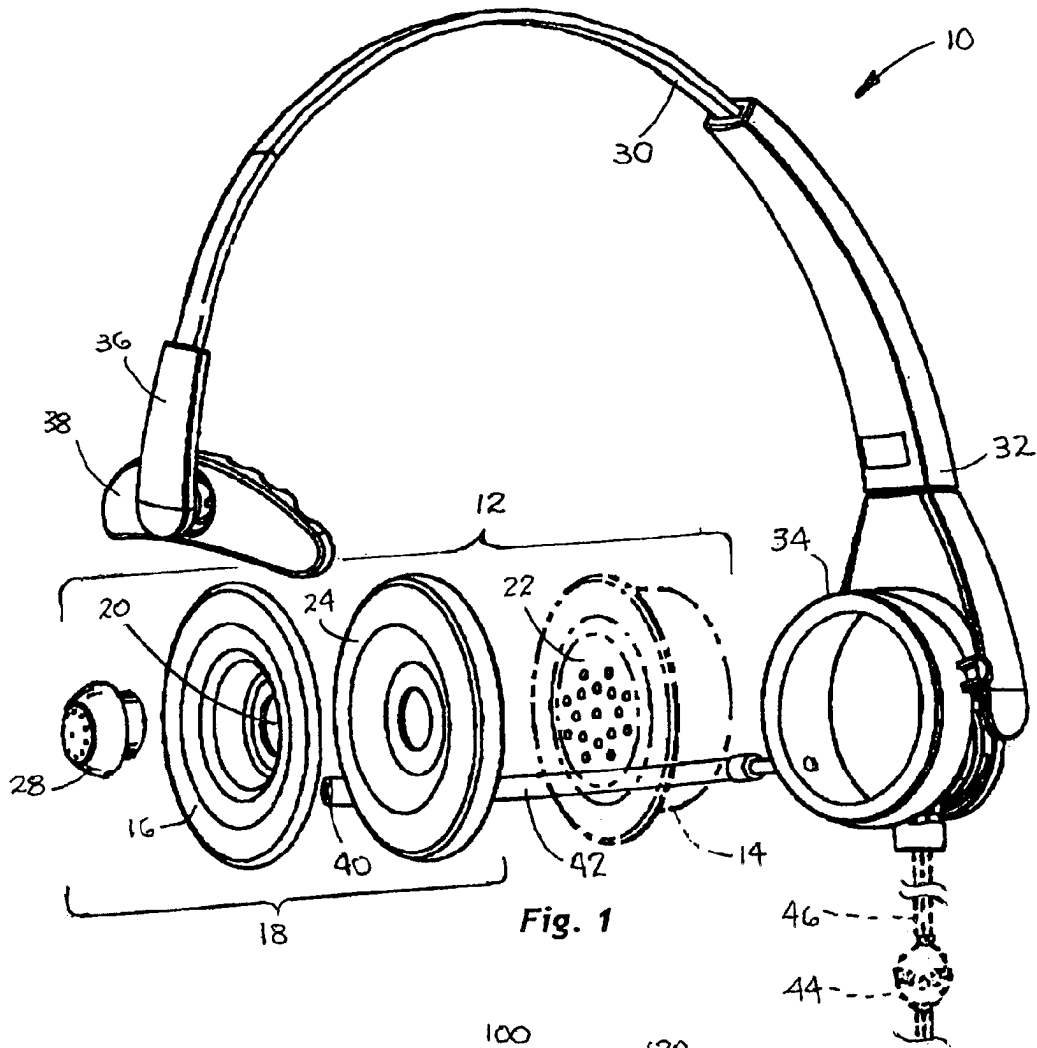
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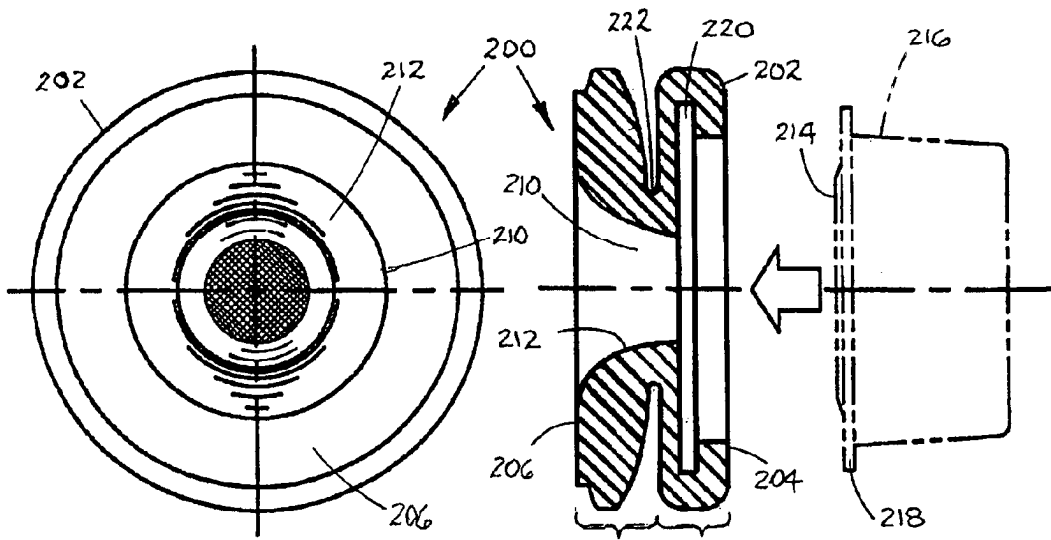


Fig. 4

Fig. 5

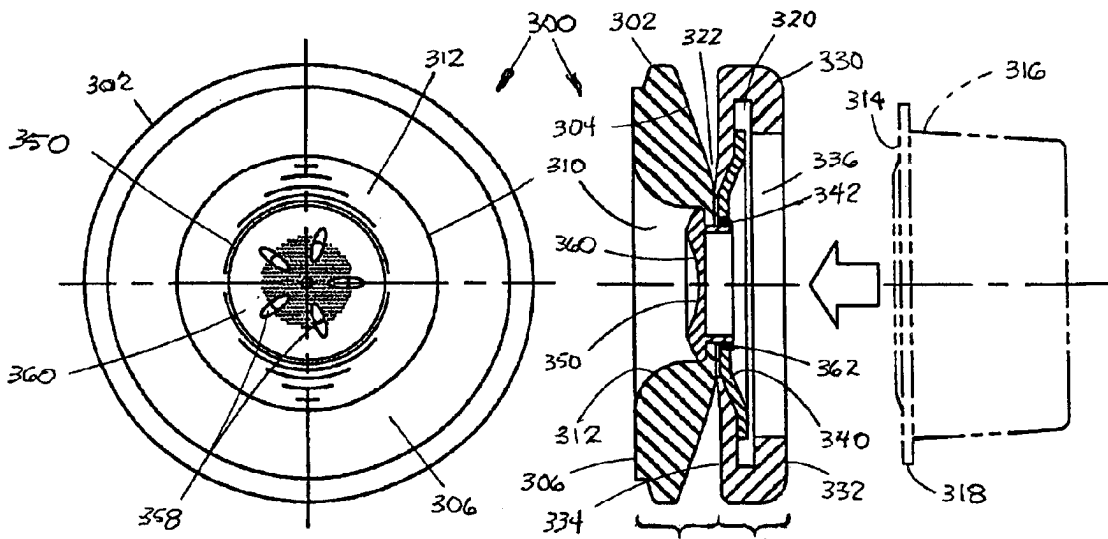


Fig. 6

Fig. 7

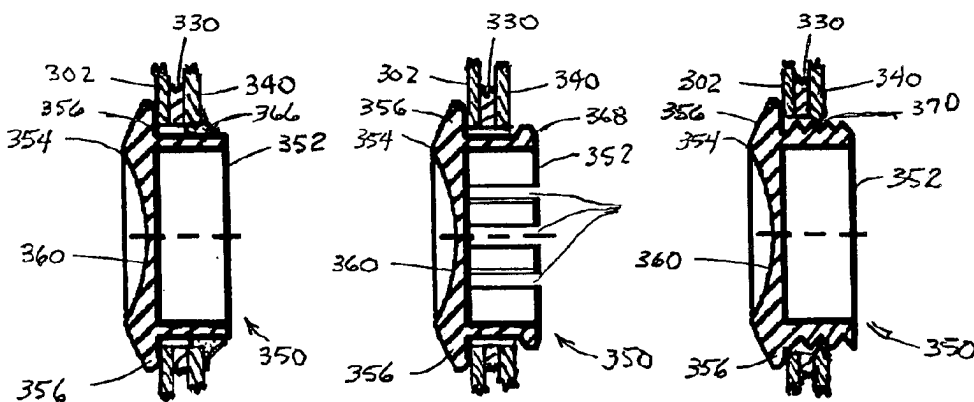


Fig. 8

Fig. 9

Fig. 10

COMFORTABLE EARPHONE CUSHIONS

BACKGROUND

1. Technical Field

This invention generally pertains to communication headsets containing earphones, and more particularly, to cushions for the earphones that provide enhanced wearing comfort.

2. Related Art

Headsets with earphones, and optionally, associated microphones, are well known and widely used in broadcast and two-way communications. Headsets provide the advantages of a hands-free listening that is isolated to the listener, i.e., the earphones closely couple the sounds they produce to the listener's ear such that, on the one hand, the sounds are relatively free from interference from other sounds present in the listener's environment, and on the other hand, such that the sounds do not escape to the listener's environment to be overheard by, or interfere with, the listening of bystanders.

Headsets, which can incorporate one or two earphones for monaural or stereo listening, can be classified into three general types in accordance with the type of ear-phone that they employ: 1) "In-the-ear" type earphones, sometimes referred to as "ear buds," which fit into the concha, or entrance to a wearer's middle ear, such as that described in U.S. Pat. No. 5,761,298 to M. Davis, et al.; 2) "On-the-ear" types that couple against a lateral face of the auricle, or external ear, of the wearer, such as that described in U.S. Pat. No. 5,960,094 to W. Jensen, et al.; and, 3) "Over-the-ear" types that surround and form a closed chamber over the auricle of the listener, such as that described in U.S. Pat. No. 6,295,366 to L. Haller, et al.

Headsets, particularly those of the two latter types, typically incorporate some structure, such as a yoke or headband, for forcefully maintaining the output face of the earphone in, against, or over the ear of the wearer. As a consequence, the force exerted by the earphones against the ear or head of the wearer can become uncomfortable after extended periods of wear. Additionally, the wearer's body heat can also build up in the interface between the earphone and the ear or the head of the wearer to an uncomfortable level.

SUMMARY

In accordance with the invention, a cushion for an earphone of a headset affords a wearer of the headset improved, long-term wearing comfort, including enhanced cooling of the wearer's ears and a reduction in the force needed to acoustically couple the ear-phone to the wearer's ear.

In one possible embodiment, the cushion comprises a resilient ring having opposite input and output faces, a thickness between the faces, and a through-opening defining an interior surface. The ring may be variously shaped. The interior surface of the ring may flare out between the input faces and output faces, like a horn, to match the acoustic impedance at the output face of an electro-acoustic transducer, or speaker, to that at the entrance of a listener's ear. The ring includes structure associated with the input face for acoustically coupling the through-opening of the ring to the output face of the speaker, and the output face of the ring is made resiliently conformable to the lateral face of the listener's external ear to acoustically couple the through-opening, and thus, the speaker, to the listener's ear.

of a proprietary "phase change" material that is capable of an endothermic phase change at a substantially constant temperature, which can be "pre-set," or fixed, at a particular value at the time the microcapsules are made, and before they are incorporated into the elastomer. The phase-change material imbues the cushion with a substantially enhanced specific heat and thermal conductivity, and thereby enables an earphone incorporating the cushion to be worn against the ear for longer periods of time without an uncomfortable buildup of heat.

In yet another advantageous embodiment, the output face of the speaker is provided with a flange, and the interior surface of the ring of the cushion is provided with a complementary recess located inside of the input face thereof and configured to resiliently receive the flange of the speaker in a complementary, over-center engagement. The through-opening of the ring is acoustically coupled to the output face of the speaker by inserting the output face of the speaker into the through-opening at the input face until the flange on the speaker is received and retained in the recess.

In this one-piece cushion embodiment, the cushion ring may also be provided with an exterior circumferential recess located between the output face of the ring and the interior, flange-receiving recess. The circumferential recess serves to resiliently articulate an output face portion of the cushion relative to an input face portion thereof, thereby: rendering the output face of the cushion more easily compliant to the lateral face of the listener's ear without requiring uncomfortably high contact forces between the cushion and the ear. The circumferential recess also increases the external surface area of the cushion, thereby enabling it to transfer more heat away from the interface with the listener's ear.

In still yet another advantageous embodiment, the cushion ring may be acoustically coupled to the output face of a speaker by a second resilient ring having a recess into which a flange on the speaker is resiliently inserted and retained in a manner similar to that described above. A third, rigid retainer ring is captivated within the recess in the second ring along with the flange on the speaker. A first end of an acoustic plug is inserted through the respective openings of the cushion ring, the second ring, and the third ring, and retained therein by the third ring. The plug has a flange on an end opposite to the first end that presses a first portion of the input face of the cushion ring against a corresponding portion of an output face of the second ring.

In this multi-piece cushion embodiment, a second portion of the input face of the cushion ring circumscribing the flange of the plug may be spaced apart from a corresponding portion of the output face of the second ring to resiliently articulate the cushion ring relative to the second ring and speaker, thereby increasing the external surface area of the cushion for improved heat transfer from the interface between the cushion and the ear, and rendering the output face of the cushion more easily compliant to the lateral face of the listener's ear without requiring uncomfortably high contact forces between the cushion and the ear.

By equipping a headset with at least one earphone incorporating one of the novel cushions of the present invention, a wearer of the headset can experience improved, long-term wearing comfort, including enhanced cooling of the wearer's ear and a reduction in the force required to couple the earphone to the wearer's ear.

A better understanding of the above and other features and advantages of the invention may be had from a consideration of the following detailed description of some exemplary embodiments thereof, particularly if such consideration is made in conjunction with the figures of the drawings.

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