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Interstitial Glue-Sealing Element to Enable Larger Internal Components in Wearables

Yao Xue

Clement Kondru

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ABSTRACT

Wearable devices, e.g., smartwatches, earbuds, etc., trend towards miniaturization for the purposes of aesthetics and ergonomics. However, certain components are better made of larger volume, e.g., larger batteries enable longer times between recharges. There is thus a dichotomy of requirements: miniaturization for user comfort versus larger volume for longer battery life. The shell of an earbud is typically constructed of two distinct sections, such that electronics can be inserted inside the shell before the sections are hermetically sealed together.

This disclosure describes a shell, a hermetic sealing interface, and an assembly technique for wearable devices such as earbuds. The techniques enable watertight sealing of the device while using thinner walls. The thin-wall feature enables the insertion of larger components into the wearable device or the shrinking of the volume of the wearable device, leading to better performance and/or ergonomics.

KEYWORDS

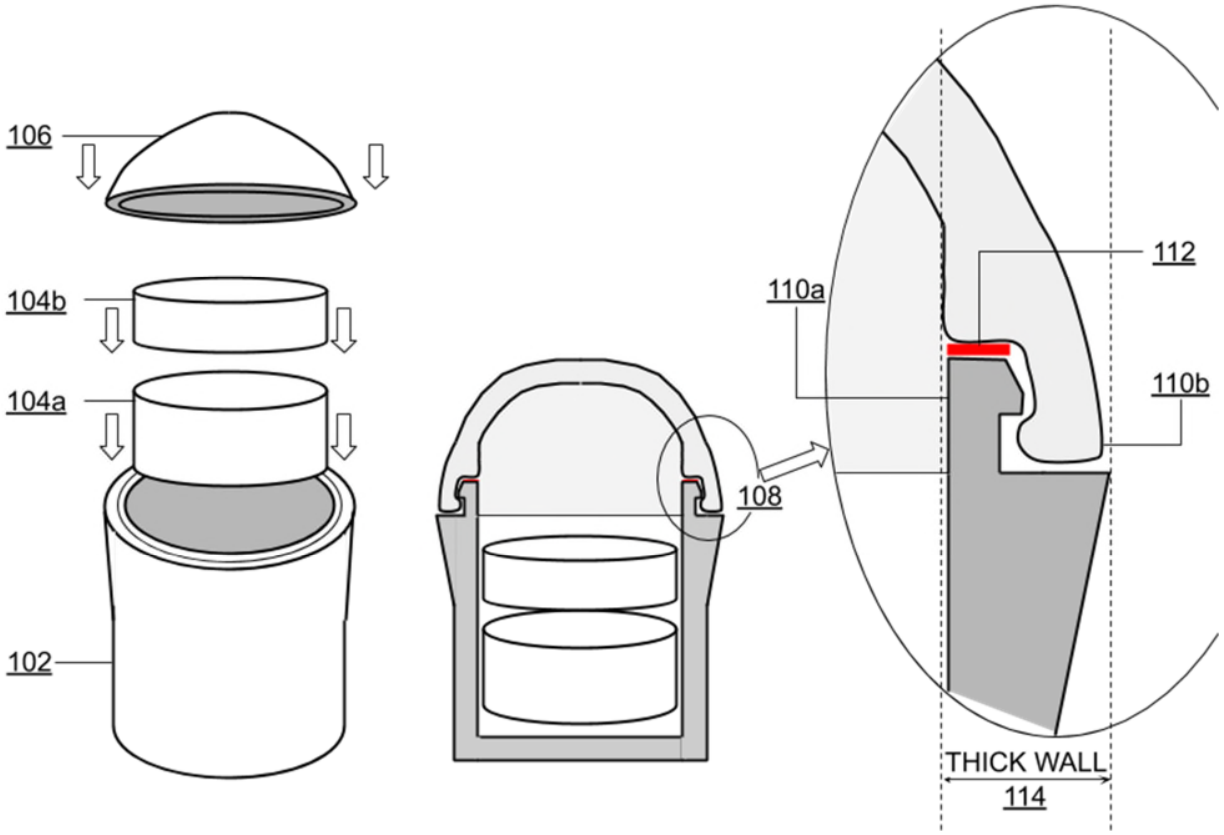
- Ingress protection
- Electronics assembly
- Interstitial ring
- Wearable device
- Earbud
- Watertight seal

BACKGROUND

In electronics, especially handheld or wearable electronic devices, there is often a need to have a hermetic volume inside the device for the purpose of ingress protection. This usually requires the interface of two parts that form the shell to mate such that the parts can be sealed together in a watertight manner.

Wearable devices, e.g., smartwatches, earbuds, etc., trend towards miniaturization for the purposes of aesthetics, for user comfort, and in the case of earbuds, to enable a fit a greater range of ear sizes. However, certain components such as batteries are better made of larger volume which enables longer times between recharges. There is thus a dichotomy of requirements: miniaturization for user comfort versus larger volume for longer battery life.

As mentioned earlier, the shell, or enclosing surface, of a wearable device such as an earbud typically comprises two sections - the housing and the cap - that fit together in a watertight manner. For aesthetic reasons, the housing and the cap are better conjoined at a portion of the earbud that has a smaller diameter; however, fitting large electronics (e.g., battery, speaker, etc.) through the small-diameter housing opening is often infeasible.



(a) **(b)** **(c)**

Fig. 1: An earbud (a) Exploded view; (b) Cross-sectional view; (c) Expanded, cross-sectional view of the housing-cap interface

Fig. 1 illustrates an earbud. Fig. 1(a) illustrates an exploded view of the earbud. The shell of the earbud comprises two parts - a housing (102) and a cap (106). The housing and the cap, when conjoined, house internal electronics (104a-b). For example, internal electronics can include battery, speaker, etc.

Fig. 1(b) illustrates a cross-section of the earbud. To protect the internal electronics from water ingress, the housing and the cap typically feature a snap interface (108), also known as cantilever snap or snap engagement. The snap interface is illustrated in greater detail in Fig. 1(c), which is an expanded view of the housing-cap interface. The walls of the housing and of the cap

are molded to internally protrude (110a-b) in opposite directions, such that when pressed together, they snap into place. The housing-cap interface is sealed with glue (red, 112).

The snap interface, intended to prevent water ingress, causes a thickening of the walls (114) of the housing and of the cap. The thick walls work against both miniaturization and the ability to insert a larger component, e.g., battery, into the housing.

DESCRIPTION

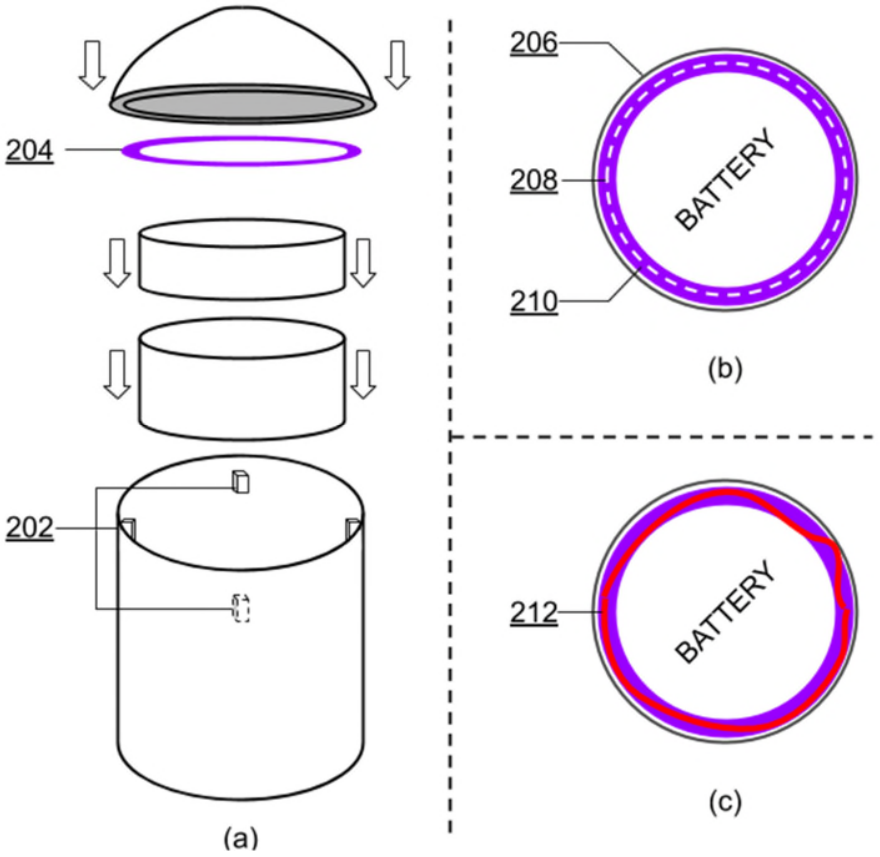


Fig. 2: Interstitial glue-sealing element to enable larger internal components

Fig. 2 illustrates the use of an interstitial glue-sealing element to enable the housing of larger internal components within the same device volume while providing a watertight seal. Fig. 2(a) illustrates an exploded view of an earbud. As illustrated, the walls of the housing and the

cap are not thicker at their interface. Rather, tiny protrusions, known as ledges or datums, are created on the inner surface of the housing, such that the housing has just enough width to enable the insertion of the electronics. As mentioned earlier, the electronics can include components such as battery, speaker, etc.

An interstitial ring (purple, 204), also known as mid-frame, is inserted after the electronics (and before the cap), such that the ring rests on the ledges. Fig. 2(b) illustrates a top view of the earbud after the electronics (208) and the interstitial ring (210) have been inserted into the housing (206). In Fig. 2(b) the circumference of the electronics is illustrated by a dotted, white line to indicate that the electronics lie below the ring, e.g., the ring overhangs the electronics. To fuse the cap to the housing, glue (red, 212) is applied on top of the interstitial ring, as illustrated in Fig. 2(c).

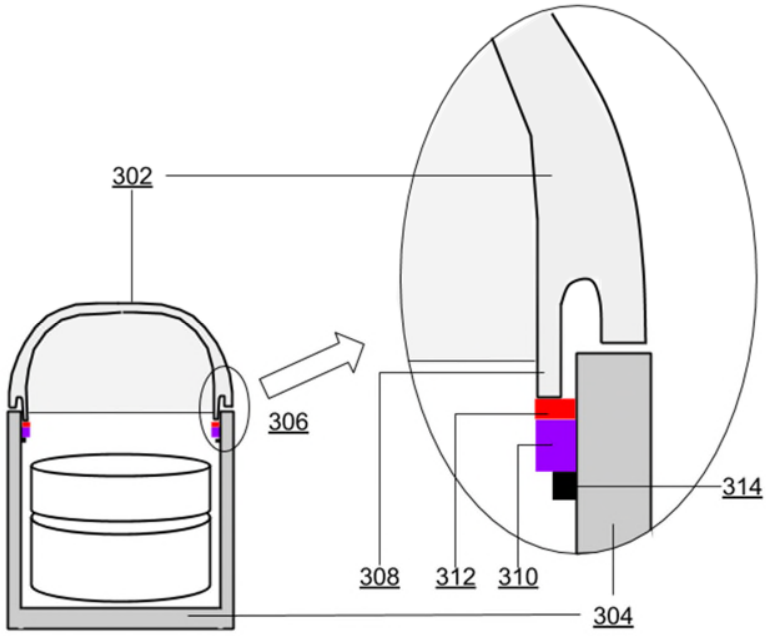


Fig. 3: Cross-section of an earbud, with interstitial gluing element

Fig. 3 illustrates a cross-section of an earbud, with an interstitial gluing element, per the techniques of this disclosure. The cap (302) is shaped at its edge such that at the housing-cap

interface (306), a rib (308) of the cap fuses with the interstitial ring (310) through a gluing layer (312). As explained earlier, the interstitial ring is seated on a ledge (314) of the inner surface of the housing. In this manner, the cap and the housing (304) are hermetically conjoined without thickening of the walls of either the cap or the housing.

The thinner walls enable the insertion of larger electronic components, e.g., battery. The relatively broad interstitial ring that rests on the ledge enables the application of adequate amounts of glue to ensure a watertight housing-cap joint. Despite its breadth, the interstitial ring does not prevent the insertion of large-volume electronics, as the interstitial ring is inserted after the electronics. The thin-walled housing and cap described herein improves the aesthetics of the earbud, improves user comfort, and enables a fit across a greater range of human ear sizes.

In this manner, by adding an interstitial element between the cap and the housing, the techniques of this disclosure move the primary gluing and datuming features away from the housing and onto the cap and interstitial element. Larger components, e.g., speaker, battery, etc., are assembled before the interstitial element is inserted, thereby assuring that the large components enjoy a larger housing opening without gluing and datuming features.

CONCLUSION

This disclosure describes a shell, a hermetic sealing interface, and an assembly technique for wearable devices such as earbuds. The techniques enable watertight sealing of the device while using thinner walls. The thin-wall feature enables the insertion of larger components into the wearable device or the shrinking of the volume of the wearable device, leading to better performance and/or ergonomics.