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MODULAR DISPLAY PLATFORM

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ABSTRACT

Wearable computing devices, such as smart watches, may include functional components (e.g., cover glass, displays, processors, memory, storage, battery, etc.) and cosmetic components (e.g., housings, bands/straps, etc.). While it may be desirable to offer wearable computing devices with a wide variation of cosmetic components (e.g., to appeal to a larger group of customers), it may be similarly be desirable to limit variation of the functional components (e.g., to reduce design complexity and/or manufacturing costs).

Some manufacturers may accomplish the dual goals of offering a wide variety of cosmetic components and a limited variety of functional components by allowing for limited swapping out of some cosmetic components (e.g., bands or straps). However, providing variations in other cosmetic components (e.g., housing or case) may require the use of a unique lamination process for each variation (e.g., separate manufacturing processes to mount cover glass to cosmetic components, and then attaching the display). Such a requirement for separate and unique lamination processes may undesirably cause delay and increase cost and/or complexity, for example, by fracturing a lamination process volume when producing wearable devices.

As discussed in this disclosure, a wearable computing device may include a chassis configured to carry both cover glass and a display. The combined assembly of the cover glass, chassis, and display may form a modular display platform that can be easily integrated into various cosmetic components (e.g., case or housing). For instance, an upper housing and a lower housing may enclose the chassis, along with other functional components.

DESCRIPTION

In general, this disclosure describes aspects for manufacturing of wearable computing devices with common internal computing components but varying external housing components. Companies that offer a family of smart device products with various industrial designs (e.g., various 3D exterior surfaces) but common internal hardware components may be required to utilize a unique lamination process for each product's industrial design variation when following

an order of operations such as integrating the cover glass to cosmetic components and then, laminating the display to the cover glass via the unique lamination process. The unique lamination process allows for cosmetic variation in the smart device but adds significant costs and delays to the manufacture of the family of products related to that smart device. The coupling of the lamination process to the industrial design of the smart device fractures a lamination process volume into separate processes. If the order of operations is not followed, these companies will find it difficult (if not impossible) to manufacture at a desired quantity level at least some of the smart device's family of products. An alternate order of operations which manufacturers may use involves laminating the display to the cover glass via a unique lamination process and then, adding that lamination assembly comprising the cover glass and display to the rest of the product. This alternate flow increases a risk of damaging the components, influencing the industrial design of the product.

Smart watch device manufacturers, in particular, cannot achieve minimum product sizes for certain display types without impairing or fracturing the lamination process volume, a large cost driver, when introducing cosmetic variation into a product's industrial design, especially when a unique lamination process is required for each industrial design. Maintaining a suitable lamination process volume while introducing cosmetic variation into a product family of devices is difficult and current practices are inefficient and often result in implications to the smart watch size and aesthetic. This disclosure relates to manufacture of smart watches with minimum product sizes for certain display types without impairing or fracturing a display lamination process volume.

As described herein, currently available smart watch designs cause lamination volume fracturing because their manufacturing process produces a piece of cover glass securely affixed to a cosmetic component and adds, through a lamination process, a display panel to the cover glass but only after the cosmetic components have been first affixed to the glass. The aspects described herein provide a non-cosmetic component (e.g., a mechanical part) that decouples the industrial design from the lamination process by carrying the cover glass, which enables the addition of cosmetic components after the addition of the display to the cover glass through the lamination process. These aspects allow for common internal hardware to be used with various cosmetic geometry and materials, which facilitates the cosmetic variation in a product family.

The aspects described herein configure the non-cosmetic component to support classic watch gaskets for sealing and integrating cosmetic components.

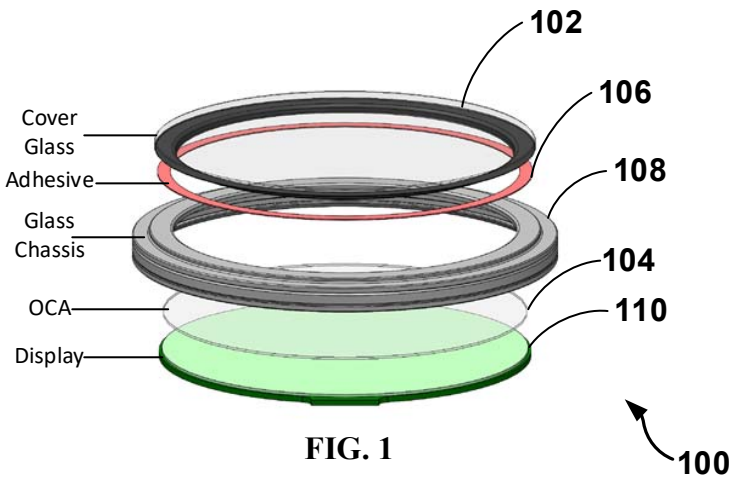

FIG. 1

Figure 1 illustrates an exploded view of modular display platform 100 and components thereof. Modular display platform 100 may be used as a universal component in a smart device, such as a wearable device. As shown in Figure 1, modular display platform 100 includes a single lamination assembly comprised of cover glass 102, adhesive 106, and glass chassis 108. The components of modular display platform 100 may be assembled by attaching cover glass 102 to glass chassis 108 via adhesive 106. Optical clear adhesive (OCA) 104 may be used to affix display 110 to cover glass 102 in a lamination process. OCA 104 is a standard adhesive component for the lamination process between display 110 and a piece of cover glass 102.

Cover glass 102 typically includes a solid piece of translucent glass configured to project graphical content generated by display 110. Adhesive 106 includes any suitable adhesive material for attaching cover glass 102 to glass chassis 108. Cover glass 102 is affixed glass chassis 108 via an adhesion process such as liquid adhesive, pressure sensitive adhesive, heat activated adhesive, or other adhesive type. In general, glass chassis 108, a non-cosmetic mechanical part, is configured to mechanically integrate cosmetic components with other non-cosmetic utilitarian components and by doing so, facilitates cosmetic variety for a smart device product. Glass chassis 108, by operating as a container for common hardware, further enables smaller product sizes for wearable devices, such as smart watches.

When adhesive 106 and optical clear adhesive (OCA) 108 attach to cover glass 102, cover glass 102 is transformed into laminated cover glass 102. The glass chassis 108 typically is manufactured (e.g., machined) of metallic material that is adapted to couple with laminated cover glass 102 and display 110. The glass chassis 108 is positioned between laminated cover glass 102 and display 110, enabling addition of one or more cosmetic components after the lamination process combines display 110 to the lamination assembly. Therefore, modular display platform 100 decouples the lamination of cover glass 102 from addition of the cosmetic components, eliminating the requirement of a separate and unique lamination process for each industrial design. In this manner, the lamination process volume cannot be fractured.

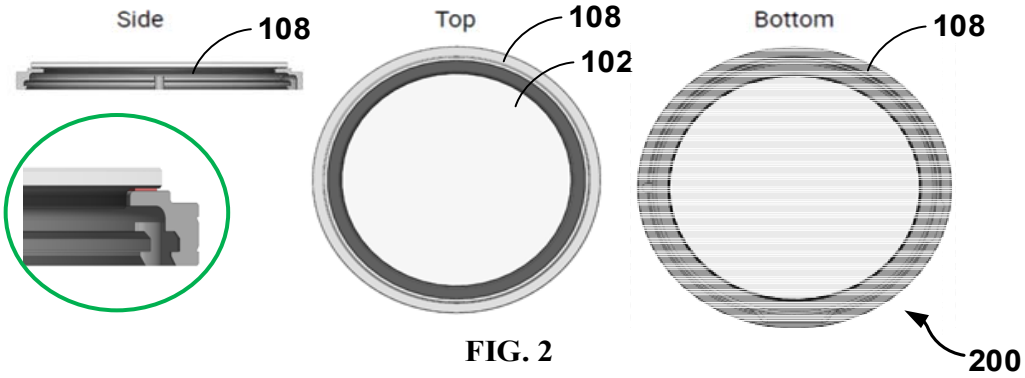

FIG. 2

Some components of modular display platform 100 (e.g., cover glass 102, adhesive 106, and glass chassis 108) can be further grouped into a lamination assembly, such as lamination assembly 200 of Figure 2. Similar to Figure 1, lamination assembly 200 is a single lamination assembly in which cover glass 102 is attached to glass chassis 108. Figure 2 illustrates a side view, a top view, and a bottom view of lamination assembly 200. Via lamination assembly 200, cosmetic components mechanically integrate with other non-cosmetic utilitarian components. Because lamination assembly 200 decouples the lamination of the wearable device from the cosmetic variation of that wearable device, lamination assembly 200 requires a single lamination process instead of a separate and unique lamination process for each industrial design. In the current order operations for manufacturing certain smart device products, providing cosmetic variation in a smart device product's industrial design often causes the fracturing of the lamination process volume. By incorporating lamination assembly 200, smart device industrial

designs may treat abstract lamination assembly 200 as an abstraction of a lamination process, eliminating or at least mitigating any risk of fracturing a lamination process volume.

Glass chassis 108 may further enable wearable devices to be designed with varied cosmetic geometry and common functional components. For instance, by utilizing the glass chassis 108 to carry components such as cover glass 102 as opposed to directly attaching cover glass 102 to cosmetic components, the common functional components can be employed in each member of a family of wearable computing devices along with cosmetic variation in that product family. In some examples, a plastic chassis may hold common functional components (e.g., common hardware including an antenna, storage, processors, etc.) within glass chassis 108.

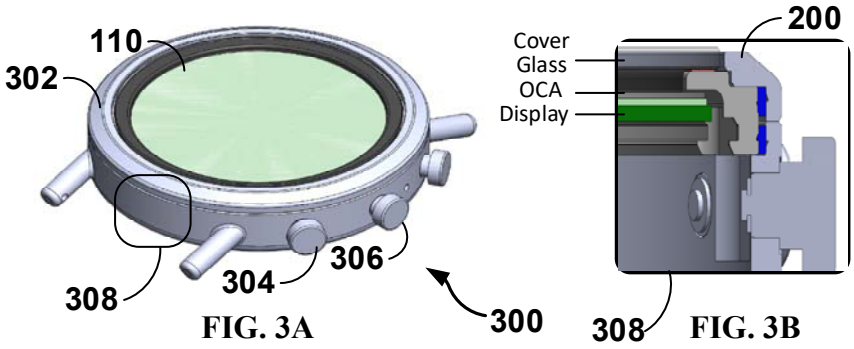

Figure 3A illustrates manufactured wearable device 300 with cosmetic case 302 coupled to glass chassis 108 of lamination assembly 200. To assemble manufactured wearable device 300, glass chassis 108 of lamination assembly 200 mechanically integrates cosmetic components with other non-cosmetic utilitarian components. To provide cosmetic variation in the design of manufactured wearable device 300, display 110 and lamination assembly 200 form modular display platform 100 into which any number of cosmetic components may be integrated.

Cosmetic case 302 may refer to a container (e.g., a housing) that seals and secures additional cosmetic components into lamination assembly 200 and protects wearable device 300 (e.g., by waterproofing). Different ornamental features of cosmetic case 302 further provide at least a part of the cosmetic variation in a product family of smart watch devices. Cosmetic case 302 is available in many shapes, such as round, square, oval, tonneau, hexagonal, and rectangular. Where cosmetic case 302 include multiple parts (e.g., a top and a bottom), the parts

of cosmetic case 302 may be sealed together using any suitable aspect (e.g., adhesive, compression gasket, etc.).

The cosmetic case 302 attaches to a ring (which may be known as a bezel) surrounding the lamination assembly 200 and holds one or more external components (e.g., crown, pushers, etc.). While some of the external components may provide some functionality, there are a number of ornamental features such that these external components may be considered cosmetic components. Instead of a separate lamination process for each industrial design of manufactured wearable device 300, a single lamination process across an entire product family of manufactured wearable device 300. As an example, cover glass 102 (i.e., the "crystal") of the lamination assembly 200 may be a transparent cover made of glass, plastic or synthetic/authentic gem stones (e.g., Sapphire) and operative to protect the smart watch 300 (e.g., internal hardware components) and reduce glare. Instead of a separate lamination process for each variation of cover glass 102 and/or other cosmetic components, a single lamination process is applied to different designs of cover glass 102 and/or other cosmetic components.

Some external components provide physical controls for operating manufactured wearable device 300. If manufactured wearable device 300 is a smart watch, the physical controls may control content being displayed, acknowledge alerts/notifications, and/or issue control directives for various applications running on the smart watch. Examples of physical controls include, but are not limited to, buttons (e.g., pusher 304), dials (e.g., crown 306), and the like. For example, pusher 304 is a component for invoking some functionality on the smart watch but (as illustrated) typically is a metal button whose appearance can be designed in a plurality of ways. As another example, crown 306 is a component for setting the time and date and typically is a metal button whose appearance can be designed in a plurality of ways. The crown 306 and the pusher 304 usually differ in some respect; for instance, the crown 306 may be rotated about an axis while the pusher 304 may be pushed.

Wearable device 300 may include a strap, band, or other component configured to attach wearable device 300 to a user. For instance, where wearable device 300 is a smart watch, the smart watch may include a strap configured to attach the smart watch to a wrist of a user.

Figure 3B illustrates a partial view 308 of an interior of manufactured wearable device 300 where parts of cosmetic case 302 are visualized. In the partial view 308, the parts of

cosmetic case 302 encase parts of glass chassis 108 (e.g., via a gasket) and attach to parts of the above-mentioned external components such as the physical controls on the exterior of cosmetic case 302. By having the lamination assembly 200 as a modular component of a manufacturing process for manufactured wearable device 300, the attachment of cosmetic components to glass chassis 108 is decoupled from any lamination.

It is noted that the techniques of this disclosure may be combined with any other suitable technology or combination of technologies. As one example, the aspects of this disclosure may be combined with the technology described in U.S. Patent Application Publication US2012/0118628A1. As another example, the aspects of this disclosure may be combined with the technology described in U.S. Patent Application Publication US 2019/0045642 A1.