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Thin profile and waterproof USB-C connector

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ABSTRACT

In the currently available form, integrating a Universal Serial Bus Type C (USB-C) receptacle into a device affects the device thickness and forces the device to have large display borders. This disclosure enables provision of a USB-C receptacle in a thin profile device underneath a display stack. The techniques, as disclosed herein, eliminate the outer shell of the USB-C receptacle and use the primary enclosure of a connected device, e.g., a phone, as the outer shell. An O-ring, attached to a ground shield/shell of the USB-C receptacle, interfaces with the primary enclosure of the connected device to maintain a waterproof seal.

KEYWORDS

- USB-C
- USB 3.1
- Type C
- Waterproof
- Thin profile
- Port

BACKGROUND

Universal Serial Bus Type C (USB-C) is a standard for connections between devices such as laptops, tablets, phones, and other devices, and peripherals/ other devices for the purpose of charging and/or data transfer. Many such devices include USB-C ports.

USB-C receptacles have several components including a printed circuit board (PCB) tongue and an outer shell. When integrated into a device, the outer shell takes up a significant

portion of Z space. This can affect the thickness of the product and require the use of large display borders.

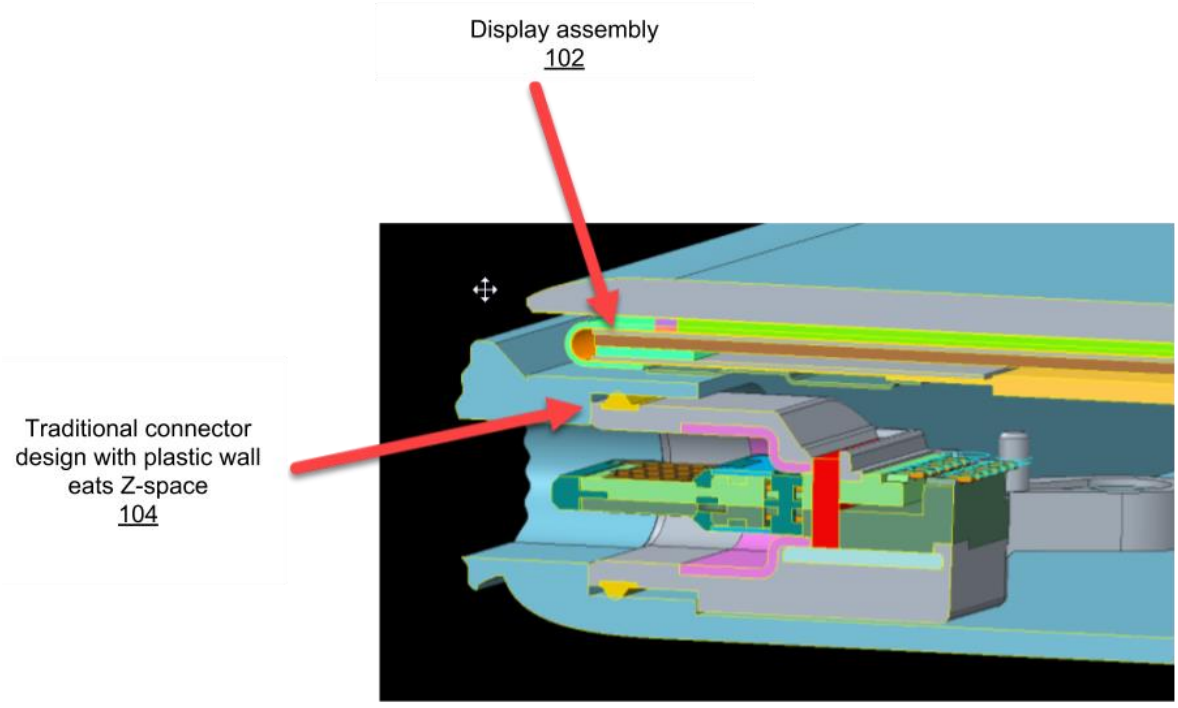

Fig. 1: Traditional USB-C receptacle with a plastic wall

Fig. 1 illustrates a traditional USB-C connector design with a thick plastic casing as its outer shell. The plastic wall (104) eats into the Z-space and forces more compressed products or increased borders around the display (102).

DESCRIPTION

Users find thin devices more appealing than relatively thick devices. Further, in many devices, the USB-C connector needs to be IP68 waterproof (ingress protection 6 for solids and 8 for liquids) within the thin-profile design. The techniques of this disclosure enable thin and waterproof connectors. USB-C connectors, implemented as described herein, enable a thin profile product, with a larger display size, and a more centered connector. The techniques use the

primary enclosure of a device as the outer shell of the connector, rather than having an additional outer shell. In other words, the primary enclosure of a device such as a phone becomes a part of the connector once the device is assembled. Further, to maintain a waterproof seal, an O-ring is attached to the ground shield that interfaces with the primary enclosure of the device.

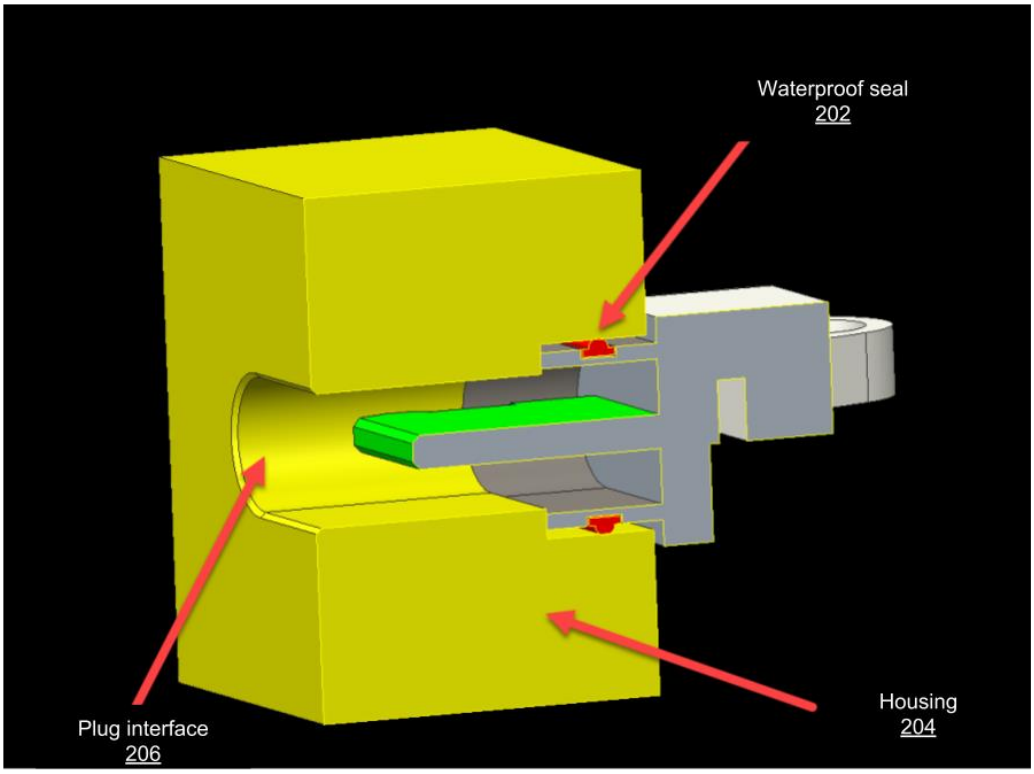

Fig. 2: Elimination of outer shell of a USB-C receptacle

Fig. 2 illustrates a cross-section of the USB-C receptacle as described herein. The figure depicts the housing (204) of the connector, the plug interface (206), and the waterproof seal (202). The primary enclosure of the connected device, e.g., a smartphone, eliminates the outer shell of the USB-C receptacle.

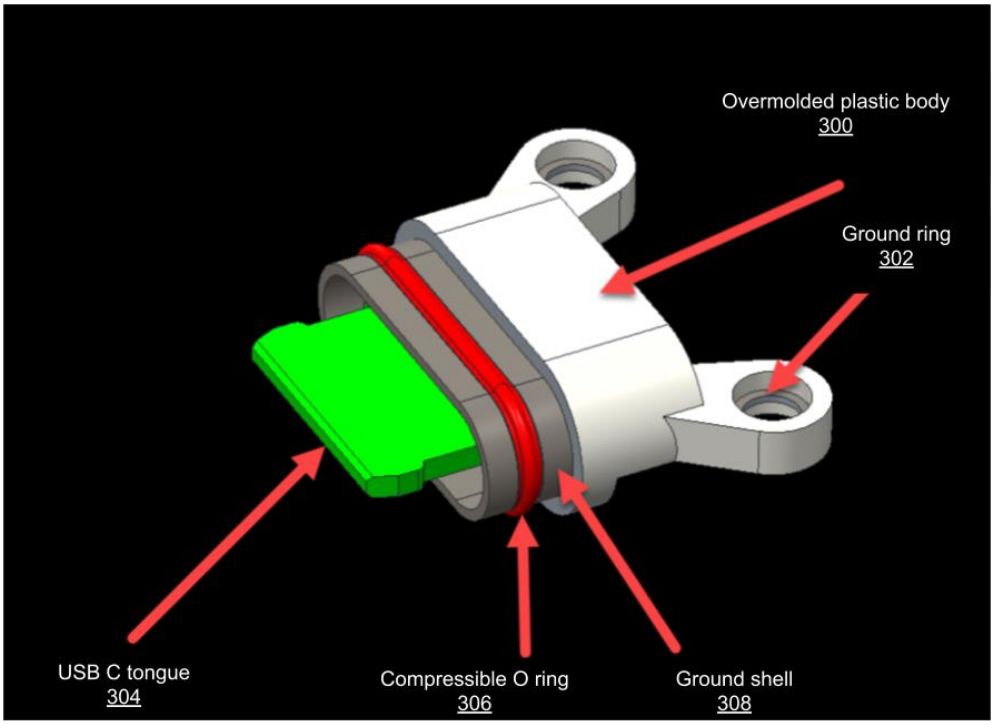

Fig. 3: Compressible O-ring achieves a waterproof design

Fig. 3 illustrates an example design of a USB-C connector. As illustrated in Fig. 3, the USB-connector includes various components - an over-molded plastic body (300); ground ring (302); a USB-tongue (304); a compressible O-ring (306); a ground shell (308); etc. The O-ring, attached to a ground shell of the USB-C receptacle, interfaces with the main enclosure of the connected device for maintaining a waterproof seal.

CONCLUSION

In the currently available form, integrating a Universal Serial Bus Type C (USB-C) receptacle into a device affects the device thickness and forces the device to have large display borders. This disclosure enables provision of a USB-C receptacle in a thin profile device underneath a display stack. The techniques, as disclosed herein, eliminate the outer shell of the USB-C receptacle and use the primary enclosure of a connected device, e.g., a phone, as the

outer shell. An O-ring, attached to a ground shield/shell of the USB-C receptacle, interfaces with the primary enclosure of the connected device to maintain a waterproof seal.