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Dual Isolation to Protect Fragile Lightguide in Augmented Reality Eyewear

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ABSTRACT

Lightguides are used in augmented reality (AR) devices to redirect light to the user's eye. Lightguides are manufactured by singulating dense glass wafers into a large, flat, and thin component that spans the entire clear aperture of the lens. Such lightguides have relatively little protection under a drop or shock load. This disclosure describes a design for AR eyewear in which the fragile component of AR eyewear is protected through two separate layers of isolation from the global deformation and strain experienced under a drop test. A rigid carrier within the outer frame acts as a first layer of isolation for the lightguide and can absorb significant energy. The lightguide is mounted without physical contact between the lightguide and carrier with a well-controlled nominal gap that is filled with an isolation adhesive. The isolation adhesive prevents a hard collision between the lightguide and the carrier during impact or dynamic loading conditions generated by drops.

KEYWORDS

- Lightguide
- Waveguide
- Augmented reality
- Eyewear
- AR glasses
- Drop test
- Isolation adhesive
- Dual isolation
- Rigid carrier

BACKGROUND

Lightguides (also referred to as waveguides) are used in augmented reality (AR) devices to redirect light to the user's eye. AR glasses use high performance lightguides manufactured from dense glass wafers. These glass wafers are singulated into a large, flat, thin, and fragile component that spans the entire clear aperture of the lens. The slim and light form factor of AR eyeglasses designed for all-day wear offers relatively little protection for these rigid glass components under a drop or shock load. When subjected to drop testing, such eyewear can undergo significant deformation. It is a challenge to prevent the lightguide from experiencing high strains and failing. It is common for eyewear to be dropped multiple times over the life of a product. Lightguide failure due to such drops reduces the usable lifetime of the device and increases maintenance cost, especially given that the lightguide is a critical component of the AR display.

DESCRIPTION

This disclosure describes a design for AR eyewear in which the fragile component of AR eyewear is protected through two separate layers of isolation from the global deformation and strain experienced under a drop test. A rigid carrier within the outer frame acts as a first layer of isolation for the lightguide and can absorb significant energy. The lightguide is mounted without physical contact between the lightguide and carrier with a well-controlled nominal gap that is filled with an isolation adhesive. The isolation adhesive prevents a hard collision between the lightguide and the carrier during impact or dynamic loading conditions generated by drops (“drop load”).

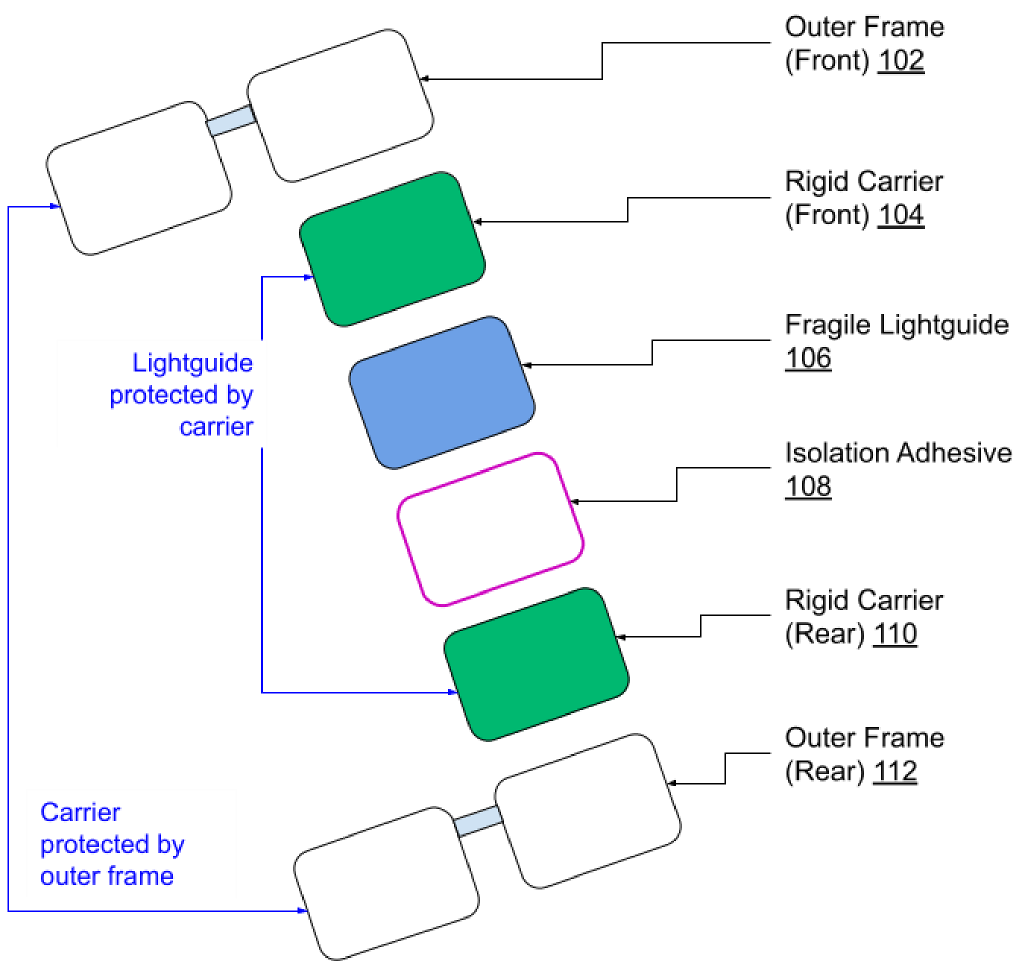

Fig. 1: Exploded view of AR Glasses with protection for lightguide

Fig. 1 illustrates an exploded view of AR glasses with protection for a lightguide that is fragile. The AR eyewear includes an outer structure of light, flexible, and visually appealing plastic, referred to as the outer frame (102). The front half of the outer frame is the component of the AR eyewear that is farthest from the user. A stiff plastic sub-structure referred to as the rigid carrier (104) is mounted within the outer frame. The rigid carrier acts as the first layer of isolation for the lightguide.

Under a drop test, the outer frame experiences significant deformation but does not translate all stress and strain into the carrier. Features between the outer frame and carrier help allow for the outer frame to deform significantly before the carrier experiences load transfer. This layer of isolation has significant damping and can absorb significant energy in a manner similar to a bumper of a vehicle.

The fragile component to be protected, the fragile lightguide (106), is bonded to the carrier in a way that adds another important layer of protection. The lightguide is mounted without physical contact between the lightguide and carrier. It has a well-controlled nominal gap that is filled with soft “form-in-place gasket” adhesive, referred to as the isolation adhesive (108). The amount/volume of adhesive, geometric pattern, areas covered in the bond, etc. all contribute to optimizing the performance during shock events (drop load).

A complex manufacturing process is necessary due to the lack of physical hard-stops on the carrier for the lightguide to land or register to. Tight tolerances are used during manufacturing to ensure a uniform amount of cushion surrounding the lightguide. The lightguide has a significant amount of travel with respect to the carrier under a drop load. This is necessary since the lightguide can be relatively heavy. The isolation adhesive prevents a hard collision between the lightguide and the carrier under a drop load. The rear half of the rigid carrier (110) lies behind the isolation adhesive and is bookended by the rear half of the outer frame (112).

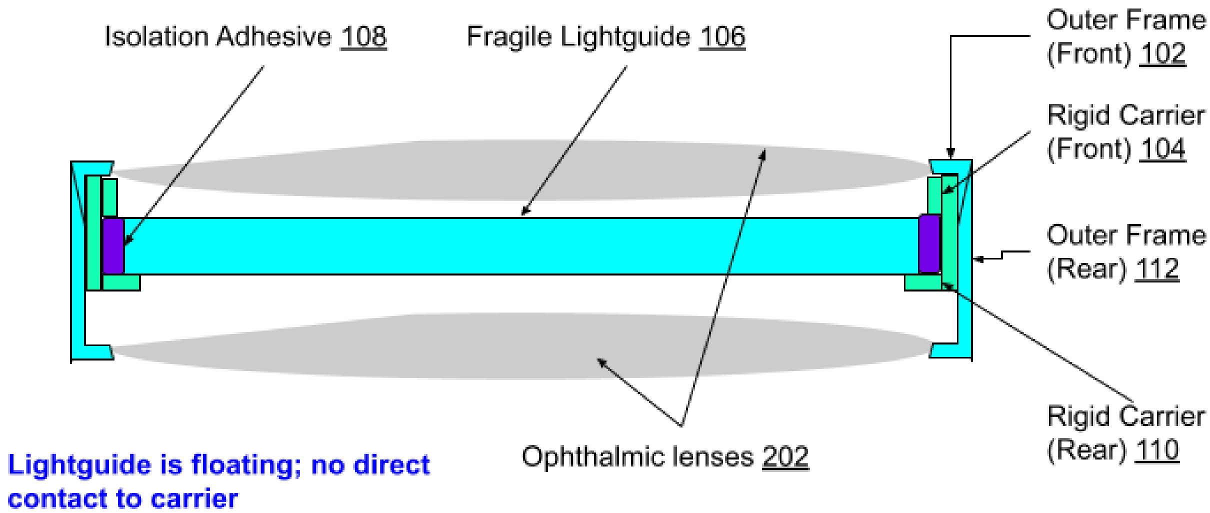

Fig. 2: Cross-section view

Fig. 2 illustrates a cross-section view of AR glasses with protection for a fragile lightguide. The isolation adhesive ensures that the fragile lightguide is always floating and is not in direct contact with the rigid carrier frame. If necessary, ophthalmic lenses (202) can be fitted in the AR eyewear and become a part of the rigid carrier structure. The front and rear parts of the rigid carrier are encased in the front and rear part of the outer frame respectively.

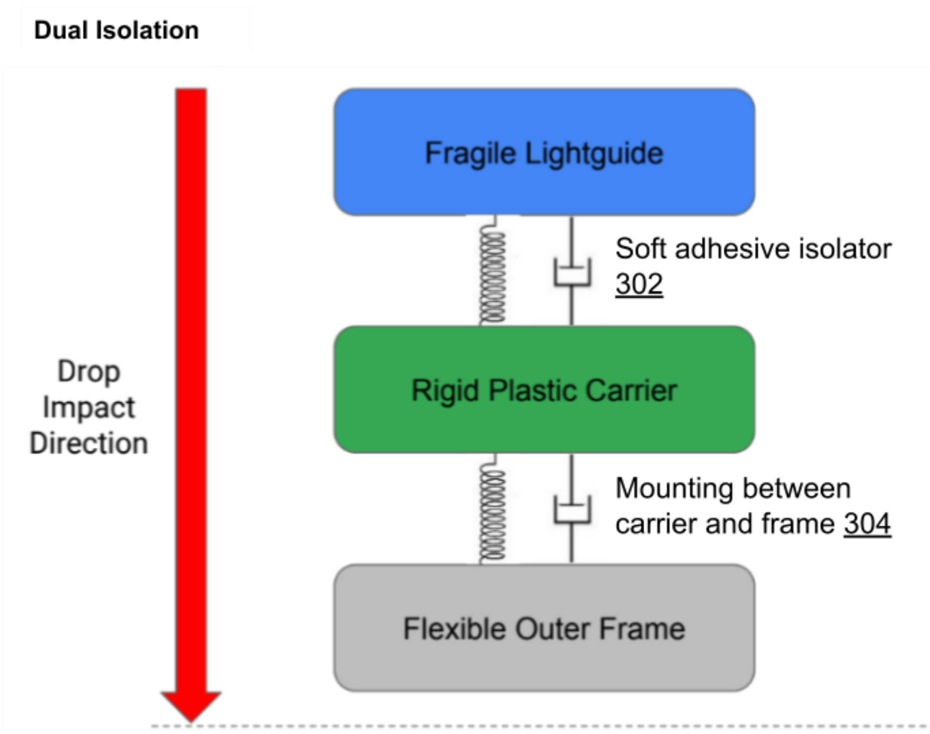

Fig. 3: Dual isolation

Fig. 3 illustrates dual isolation to protect fragile lightguides in AR glasses. The fragile lightguide is isolated from the rigid carrier by a soft adhesive isolator (302). If the AR eyewear is dropped, the flexible outer frame is the first component to experience the impact. The mounting between the carrier and the frame (304) ensures that the impact is experienced by the outer frame. The soft adhesive isolator further isolates the lightguide from the force of the impact.

CONCLUSION

This disclosure describes a design for AR eyewear in which the fragile component of AR eyewear is protected through two separate layers of isolation from the global deformation and strain experienced under a drop test. A rigid carrier within the outer frame acts as a first layer of isolation for the lightguide and can absorb significant energy. The lightguide is mounted without physical contact between the lightguide and carrier with a well-controlled nominal gap that is filled with an isolation adhesive. The isolation adhesive prevents a hard collision between the lightguide and the carrier during impact or dynamic loading conditions generated by drops.

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