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Reducing warpage in foldable OLED screens

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ABSTRACT

Organic light-emitting diode (OLED) screens are becoming popular in consumer devices due to the ability to fold such screens. However, repeated folding and unfolding is known to cause bending (warpage) at the fold. This disclosure describes techniques that reduce warpage by introducing a fan at the hinge. By Bernoulli's principle, an increase in air speed along the fan axis causes a pressure differential perpendicular to the axis of the fan, e.g., across the fold. This pressure differential undoes the warpage.

KEYWORDS

- OLED screen
- OLED display
- Foldable screen
- Foldable device
- Warpage
- Screen bend
- Fan
- Hinge

BACKGROUND

Organic light-emitting diodes (OLEDs) are becoming popular as screens in consumer devices due to the ability to fold such screens. However, repeated folding and unfolding is known to cause bending (warpage) at the fold, e.g., a 3-4 mm bend away from the plane of the OLED screen.

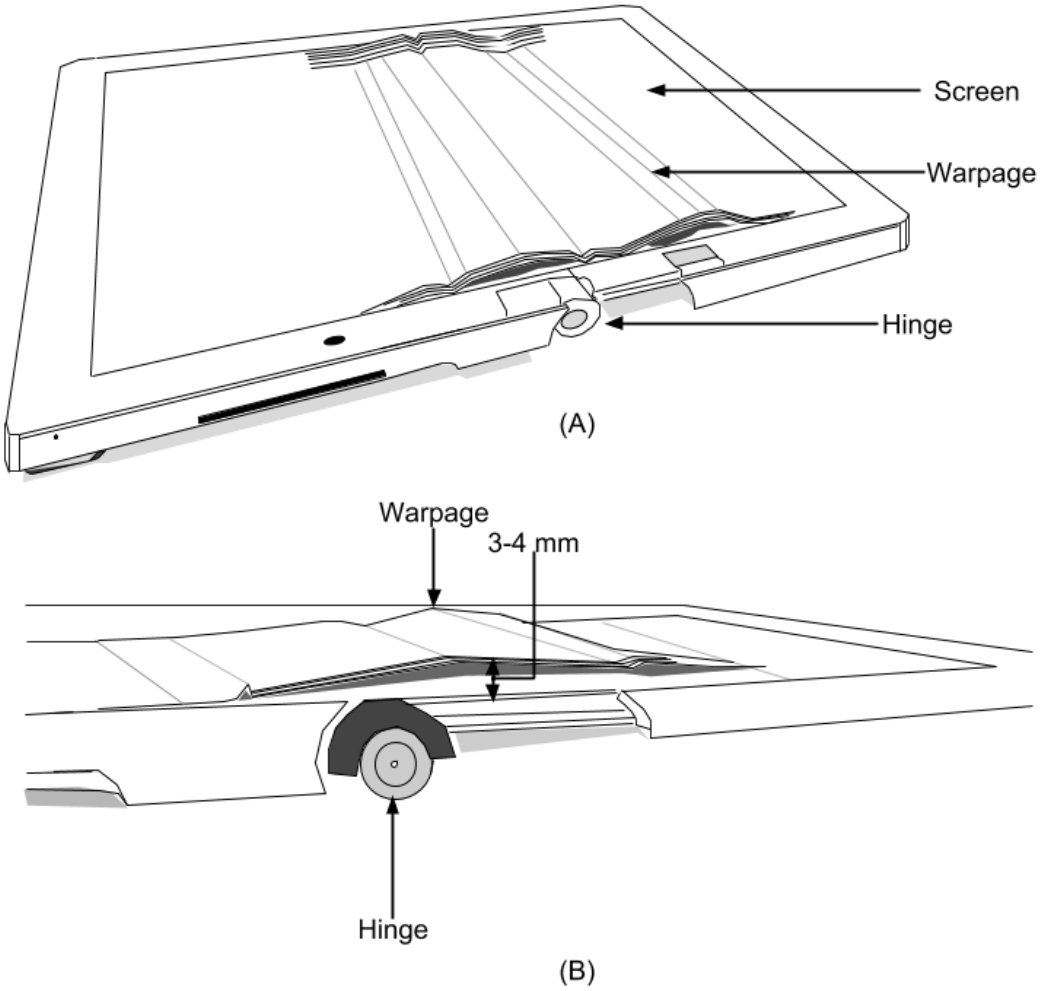

Fig. 1: Illustrating warpage in OLED screens

The warpage is illustrated in Fig. 1, which shows top (Fig. 1A) and side (Fig 1B) views of an OLED screen.

DESCRIPTION

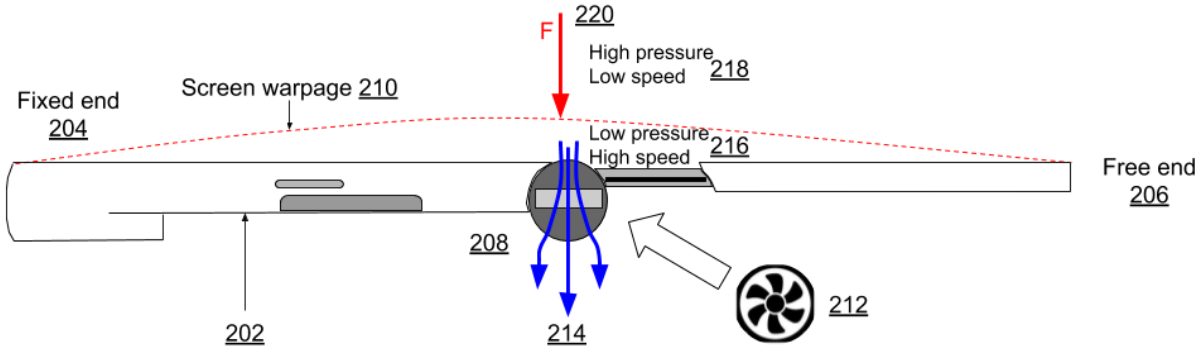

Fig. 2: Reducing warpage in OLED screens

Fig. 2 illustrates reducing warpage in an OLED screen per techniques of this disclosure. A mobile device (202) has a fixed end (204) and a free end (206) coupled together by a hinge (208). Due to repeated folding and unfolding, its OLED screen, originally a plane surface, suffers from warpage (dotted red line, 210). Per the techniques, a fan (212), or other transverse air-speed generation mechanism, is inserted at the position of the hinge. The fan, which can be of small dimensions (e.g., a few mm in each dimension) generates a transverse air flow (214), e.g., in a direction coming out of the paper, indicated by blue arrows.

Bernoulli's principle, stated mathematically, is

$$\frac{1}{2}\rho v^2 + \rho g h + p = \text{constant}$$

throughout the region of air flow. Here,

ρ is the density of air at a certain point;

v is the velocity of air at that point;

p is the pressure of air at that point;

h is the height of the point; and

g is the acceleration due to gravity, approximately 9.8 m/s^2.

In the present case of the air flow caused by the fan, the height of all points in the region of the air flow is a constant, and the density of air is also a constant. By Bernoulli's principle, the increased air velocity caused by the fan therefore causes a pressure drop (216) in the region of the air flow, e.g., in the region between the warped OLED screen and the hinge. The region above the warped OLED screen remains at zero air speed and normal pressure (218), e.g., atmospheric pressure. Therefore, a pressure differential manifests itself that causes a force *F* (220) that works to undo the warpage. In this manner, the techniques of this disclosure automatically prevent warpage of an OLED screen.

CONCLUSION

Organic light-emitting diode (OLED) screens are becoming popular in consumer devices due to the ability to fold such screens. However, repeated folding and unfolding is known to cause bending (warpage) at the fold. This disclosure describes techniques that reduce warpage by introducing a fan at the hinge. By Bernoulli's principle, an increase in air speed along the fan axis causes a pressure differential perpendicular to the axis of the fan, e.g., across the fold. This pressure differential undoes the warpage.