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Wright et al.

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(54) **DISPLAY WITH VIAS FOR CONCEALED PRINTED CIRCUIT AND COMPONENT ATTACHMENT**

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H01L 51/52	(2006.01)
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(52) **U.S. Cl.**

CPC ***G09G 3/3208*** (2013.01); ***H01L 27/3276*** (2013.01); ***H01L 51/52*** (2013.01); *G09G 2300/0426* (2013.01)

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See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2,933,655 A		4/1960	Gradisar et al.	
4,066,855 A		1/1978	Zenk	
4,085,302 A		4/1978	Zenk et al.	
4,487,993 A	*	12/1984	Becker	174/264
5,235,451 A		8/1993	Bryan	
5,276,382 A		1/1994	Stocker et al.	
5,436,744 A		7/1995	Arledge et al.	

(Continued)

FOREIGN PATENT DOCUMENTS

CN	101430473	5/2009
CN	102187272	9/2011

(Continued)

OTHER PUBLICATIONS

Drzaic et al., U.S. Appl. No. 13/253,844, filed Oct. 5, 2011.

(Continued)

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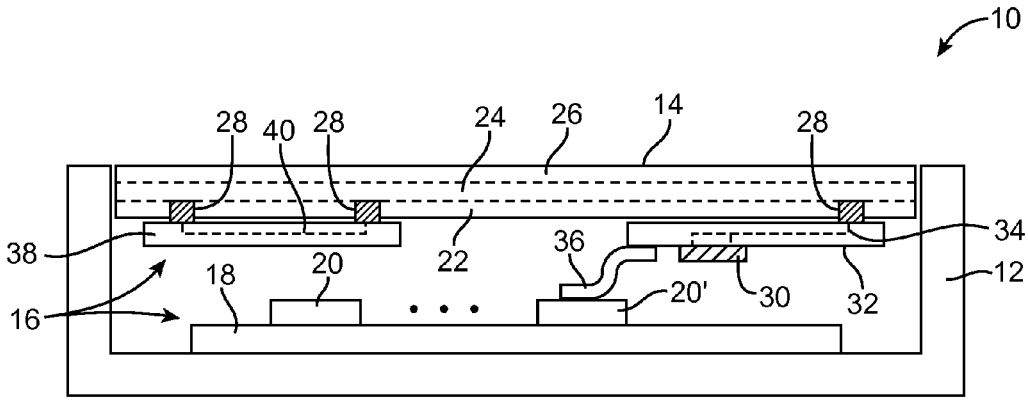
(57) **ABSTRACT**

An electronic device may include a display. The display may be an organic light-emitting diode display. The organic light-emitting diode display may have a substrate layer, a layer of organic light-emitting diode structures, and a layer of sealant. Vias may be formed in the substrate layer by laser drilling. The vias may be filled with metal using electroplating or other metal deposition techniques. The vias may be connected to contacts on the rear surface of the display. Components such as flexible printed circuits, integrated circuits, connectors, and other circuitry may be mounted to the contacts on the rear surface of the display.

28 Claims, 6 Drawing Sheets