US008764255B2

(12) **United States Patent**
Hack et al.

(10) **Patent No.: US 8,764,255 B2**
(45) **Date of Patent: Jul. 1, 2014**

(54) **SEMI-RIGID ELECTRONIC DEVICE WITH A FLEXIBLE DISPLAY**

(71) Applicants: **Michael Hack**, Princeton, NJ (US); **Emory Krall**, Philadelphia, PA (US); **Ruiqing Ma**, Morristown, NJ (US); **Prashant Mandlik**, Lawrenceville, NJ (US)

(72) Inventors: **Michael Hack**, Princeton, NJ (US); **Emory Krall**, Philadelphia, PA (US); **Ruiqing Ma**, Morristown, NJ (US); **Prashant Mandlik**, Lawrenceville, NJ (US)

(73) Assignee: **Universal Display Corporation**, Ewing, NJ (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **13/648,911**

(22) Filed: **Oct. 10, 2012**

(65) **Prior Publication Data**

US 2014/0098549 A1 Apr. 10, 2014

(51) **Int. Cl.**

F21S 8/08	(2006.01)
F21V 19/00	(2006.01)
F21V 21/00	(2006.01)

(52) **U.S. Cl.**

USPC **362/418**; 362/382; 362/419; 362/420; 362/432

(58) **Field of Classification Search**

None

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,769,292	A	9/1988	Tang et al.
5,247,190	A	9/1993	Friend et al.
5,703,436	A	12/1997	Forrest et al.
5,707,745	A	1/1998	Forrest et al.
5,834,893	A	11/1998	Bulovic et al.
5,844,363	A	12/1998	Gu et al.
6,013,982	A	1/2000	Thompson et al.
6,087,196	A	7/2000	Sturm et al.
6,091,195	A	7/2000	Forrest et al.
6,097,147	A	8/2000	Baldo et al.
6,294,398	B1	9/2001	Kim et al.
6,303,238	B1	10/2001	Thompson et al.
6,337,102	B1	1/2002	Forrest et al.
6,468,819	B1	10/2002	Kim et al.
6,819,036	B2	11/2004	Cok et al.
7,050,835	B2	5/2006	Hack et al.
7,128,269	B2	10/2006	Silverbrook

(Continued)

FOREIGN PATENT DOCUMENTS

WO	2004047059	6/2004
WO	2006/038171	4/2006

(Continued)

OTHER PUBLICATIONS

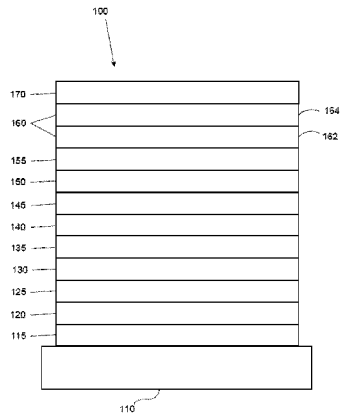
Baldo et al.,"Highly efficient phosphorescent emission from organic electroluminescent devices", Nature, vol. 395, pp. 151-154, 1998.

(Continued)

Primary Examiner — Natalie Walford

(74) *Attorney, Agent, or Firm* — Morris & Kamlay LLP

(57) **ABSTRACT**

A semi-rigid electronic device is disclosed that includes a flexible panel and a housing. The housing may have a physical dimension L, such as length, height, or a diagonal. The minimum bending device radius of the device along the dimension L may be L/pi when held at an edge. The bending radius increases the more rigid the device. The housing, electronic components, and display may each contribute to the flexibility of the overall device. The housing and/or the flexible panel may also include one or more ribs to constrain movement of the semi-rigid device.

27 Claims, 3 Drawing Sheets