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**Dean, Jr. et al.**

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(54) **SYSTEMS AND METHODS FOR MONITORING METAL RECOVERY SYSTEMS**

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(56) **References Cited**

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**U.S. PATENT DOCUMENTS**

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

3,993,293 A \* 11/1976 Mukae ..... B01D 11/0207 266/80  
4,045,084 A \* 8/1977 Hsueh ..... E21B 21/14 175/69

(Continued)

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**FOREIGN PATENT DOCUMENTS**

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**OTHER PUBLICATIONS**

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(57) **ABSTRACT**

**Related U.S. Application Data**

Various embodiments provide a leaching solution monitoring module comprising a first leaching solution distribution system interface, a flow meter in fluid communication with the first leaching solution distribution system interface, the flow meter in fluid communication a 3-way pressure regulator, and a second leaching solution distribution system interface in fluid communication with the 3-way pressure regulator.

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**19 Claims, 6 Drawing Sheets**

