



US008273237B2

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

(10) **Patent No.:** US 8,273,237 B2
(45) **Date of Patent:** Sep. 25, 2012

(54) **METHOD AND APPARATUS FOR ELECTROWINNING COPPER USING AN ATMOSPHERIC LEACH WITH FERROUS/FERRIC ANODE REACTION ELECTROWINNING**

(75) Inventors: **John O. Marsden**, Paradise Valley, AZ (US); **James D. Gillaspie**, Gilbert, AZ (US); **John C. Wilmot**, Anthem, AZ (US)

(73) Assignee: **Freeport-McMoran Corporation**, Phoenix, AZ (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 753 days.

(21) Appl. No.: **12/355,624**

(22) Filed: **Jan. 16, 2009**

(65) **Prior Publication Data**

US 2009/0183997 A1 Jul. 23, 2009

Related U.S. Application Data

(60) Provisional application No. 61/021,694, filed on Jan. 17, 2008.

(51) **Int. Cl.**

C25C 1/12 (2006.01)

C25C 1/00 (2006.01)

C25C 1/22 (2006.01)

(52) **U.S. Cl.** **205/580**; 205/568; 205/581; 205/583; 205/584; 205/574; 205/589; 205/604

(58) **Field of Classification Search** None
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2,792,342	A	5/1957	Tuwiner	
3,103,414	A	9/1963	Thornhill	
3,262,870	A	7/1966	Harlan	
3,264,099	A	8/1966	Johnson	
3,544,306	A	12/1970	McGauley	
3,616,277	A	10/1971	Adamson et al.	
3,632,498	A	1/1972	Beer	
3,703,358	A	11/1972	Carson et al.	
3,711,385	A	2/1973	Beer	
3,853,724	A	12/1974	Wojeik et al.	
3,876,516	A	4/1975	Pace et al.	
3,887,396	A	6/1975	Walsh et al.	
3,915,834	A	10/1975	Wright et al.	
3,956,086	A	5/1976	Wilkinson et al.	
3,972,795	A *	8/1976	Goens et al.	204/269
3,973,949	A *	8/1976	Goens et al.	205/369
3,979,275	A	9/1976	Harvey et al.	

(Continued)

FOREIGN PATENT DOCUMENTS

CA 1162514 2/1984

(Continued)

OTHER PUBLICATIONS

International Preliminary Report on Patentability (Chapter 1) for corresponding PCT Application No. PCT/US09/031312 dated Jul. 29, 2010.

(Continued)

Primary Examiner — Harry D Wilkins, III

(74) *Attorney, Agent, or Firm* — Snell & Wilmer L.L.P.

(57) **ABSTRACT**

The present invention relates, generally, to a method and apparatus for recovering metal values from a metal-bearing materials, and more specifically, a process for recovering copper and other metals through leaching, electrowinning using the ferrous/ferric anode reaction, and the synergistic addition of ferrous iron to the leach step.

5 Claims, 10 Drawing Sheets

