



US006796139B2

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

(10) **Patent No.:** **US 6,796,139 B2**  
(45) **Date of Patent:** **Sep. 28, 2004**

(54) **METHOD AND APPARATUS FOR ARTIFICIAL GROUND FREEZING**

(75) Inventors: **George Briley**, San Antonio, TX (US);  
**Joe Sopko**, Cedar Grove, WI (US)

(73) Assignee: **Layne Christensen Company**, Mission Woods, KS (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.: **10/375,521**

(22) Filed: **Feb. 27, 2003**

(65) **Prior Publication Data**

US 2004/0168460 A1 Sep. 2, 2004

(51) **Int. Cl.**<sup>7</sup> ..... **F25D 23/12**; A63C 19/10;  
F25B 7/00

(52) **U.S. Cl.** ..... **62/260**; 62/235; 62/335

(58) **Field of Search** ..... 62/260, 235, 335

(56) **References Cited**

**U.S. PATENT DOCUMENTS**

- 4,169,356 A \* 10/1979 Kingham ..... 62/85
- 4,475,353 A \* 10/1984 Lazare ..... 62/101
- 4,860,544 A 8/1989 Krieg et al.
- 5,667,339 A \* 9/1997 Dash ..... 405/130
- 5,818,131 A 10/1998 Zhang
- 5,852,939 A 12/1998 Gazes

- 6,161,391 A \* 12/2000 Trieskey ..... 62/79
- 2001/0023594 A1 9/2001 Ives
- 2002/0023576 A1 2/2002 Swanson

**FOREIGN PATENT DOCUMENTS**

- DE 2912134 A1 3/1979
- JP 406201204 A 7/1994
- JP 02002048422 A 2/2002

**OTHER PUBLICATIONS**

Ives, Refrigeration System, Sep. 27, 2001. US PGP, all.\*

\* cited by examiner

*Primary Examiner*—William C. Doerrles

*Assistant Examiner*—Filip Zec

(74) *Attorney, Agent, or Firm*—Shook, Hardy & Bacon L.L.P.

(57) **ABSTRACT**

A ground freezing method and system which circulates refrigerated heat transfer fluid through freeze pipes in the ground at a low temperature of at least -52° C. (-62° F.) to minimize drilling for the freeze pipe installation. The heat transfer fluid is preferably aqua ammonia (ammonium hydroxide) because of its beneficial characteristics in this application. The circulating heat transfer fluid is preferably cooled by a refrigeration system that includes low and high stage cycles arranged in a cascade relationship and using ammonia or another refrigerant in the high stage refrigeration system and carbon dioxide as the refrigerant in the low stage refrigeration system.

**4 Claims, 1 Drawing Sheet**

