



US008439085B2

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

(10) **Patent No.:** **US 8,439,085 B2**
(45) **Date of Patent:** ***May 14, 2013**

(54) **SEMI-RIGID FLEXIBLE DUCT**

(75) Inventors: **Steven Liebson**, Ein Sarid (IL); **Graeme Liebson**, Ein Sarid (IL); **Robert Cohen**, Ein Sarid (IL)

(73) Assignee: **Yissum Research Development Company of the Hebrew University of Jerusalem Ltd.**, Jerusalem (IL)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 736 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **12/645,517**

(22) Filed: **Dec. 23, 2009**

(65) **Prior Publication Data**
US 2010/0154914 A1 Jun. 24, 2010

Related U.S. Application Data

(63) Continuation-in-part of application No. 11/717,411, filed on Mar. 13, 2007, now abandoned, which is a continuation-in-part of application No. 11/389,623, filed on Mar. 24, 2006, now abandoned.

(51) **Int. Cl.**
F16L 11/00 (2006.01)

(52) **U.S. Cl.**
USPC **138/133; 138/125; 138/127; 138/131; 138/134; 138/149; 428/36.91**

(58) **Field of Classification Search** 138/125, 138/127, 131, 133, 134, 149; 428/36.91
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2,858,854 A *	11/1958	Daggett	138/124
3,554,237 A	1/1971	Pelley et al.	
3,861,022 A	1/1975	Hildebrandt et al.	
3,945,867 A	3/1976	Heller et al.	
4,489,759 A	12/1984	Yamamura	
4,521,368 A	6/1985	Mercer et al.	
4,570,679 A	2/1986	Schippl	
4,875,298 A *	10/1989	Wright	34/86
5,042,172 A	8/1991	Foco et al.	
5,062,219 A	11/1991	Harris et al.	
5,085,251 A	2/1992	Popelka et al.	
5,121,948 A	6/1992	Anderson et al.	
5,133,579 A	7/1992	Anderson et al.	
5,145,217 A	9/1992	Anderson et al.	
5,182,147 A	1/1993	Davis	
5,281,187 A	1/1994	Whitney	
5,526,849 A	6/1996	Gray	

(Continued)

Primary Examiner — James Hook

(74) *Attorney, Agent, or Firm* — Edward Langer Adv. and Patent Attorney

(57) **ABSTRACT**

A semi-rigid, flexible duct including a pair of coaxial sleeves, namely an inner sleeve and an outer sleeve disposed parallel to and about the inner sleeve and a resilient wound element disposed between the sleeves. Each of the inner sleeve and the outer sleeve constitutes an aluminum foil ribbon. The wound element imparts corrugations to the two-sleeves, such that the duct is extendible between a compacted configuration suitable for storage and for shipping and an extended configuration suitable for installation in a gas transport arrangement. Both the inner sleeve and the outer sleeve are of a predetermined thickness rendering the duct substantially rigid when in an extended configuration and enabling the duct to maintain its substantial rigidity upon extension from a compacted configuration. Optionally, at least one of the sleeves further includes a second, plastic layer bonded to the aluminum foil ribbon layer.

44 Claims, 17 Drawing Sheets

