

United  
States  
of  
America



To Promote the Progress

of Science and Useful Arts

The Director

of the United States Patent and Trademark Office has received an application for a patent for a new and useful invention. The title and description of the invention are enclosed. The requirements of law have been complied with, and it has been determined that a patent on the invention shall be granted under the law.

Therefore, this United States

Patent

grants to the person(s) having title to this patent the right to exclude others from making, using, offering for sale, or selling the invention throughout the United States of America or importing the invention into the United States of America, and if the invention is a process, of the right to exclude others from using, offering for sale or selling throughout the United States of America, products made by that process, for the term set forth in 35 U.S.C. 154(a)(2) or (c)(1), subject to the payment of maintenance fees as provided by 35 U.S.C. 41(b). See the Maintenance Fee Notice on the inside of the cover.

*Donna H. H. H.*

Performing the Functions and Duties of the  
Under Secretary of Commerce for Intellectual Property and  
Director of the United States Patent and Trademark Office



US010898860B2

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

(10) **Patent No.:** **US 10,898,860 B2**

(45) **Date of Patent:** **Jan. 26, 2021**

(54) **FLUID SEPARATION APPARATUS  
COMPRISING FLUID SEPARATION  
MEMBRANE, AND FLUID SEPARATION  
MEMBRANE MODULE**

(52) **U.S. Cl.**  
CPC ..... **B01D 63/068** (2013.01); **B01D 53/22**  
(2013.01); **B01D 53/228** (2013.01); **B01D**  
**63/06** (2013.01);

(Continued)

(71) Applicant: **ARSTROMA CO., LTD.**, Daegu (KR)

(58) **Field of Classification Search**  
CPC ..... **B01D 63/06**; **B01D 2313/50**; **B01D**  
**2053/223**; **B01D 71/24**; **B01D 69/081**;  
(Continued)

(72) Inventors: **Gwan Shig Kim**, Gyeongsangbuk-do  
(KR); **Ky Yeong Shin**, Daegu (KR)

(73) Assignee: **ARSTROMA CO., LTD.**

(56) **References Cited**

**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 565 days.

3,203,086 A \* 8/1965 Eudier ..... **B01D 53/228**  
**29/527.2**  
3,265,445 A \* 8/1966 Cronin ..... **B65G 53/521**  
**406/196**

(Continued)

(21) Appl. No.: **15/559,682**

**FOREIGN PATENT DOCUMENTS**

(22) PCT Filed: **Mar. 24, 2016**

(86) PCT No.: **PCT/KR2016/003012**

CA 3003318 11/2014  
CN 101703853 5/2010

§ 371 (c)(1),

(2) Date: **Sep. 19, 2017**

(Continued)

(87) PCT Pub. No.: **WO2016/153299**

PCT Pub. Date: **Sep. 29, 2016**

Morita Translation CA 2703799 A1 63 pages Apr. 30, 2009 (Year:  
2009).\*

(Continued)

(65) **Prior Publication Data**

US 2018/0280886 A1 Oct. 4, 2018

*Primary Examiner* — Anthony R Shumate

(74) *Attorney, Agent, or Firm* — Onello & Mello, LLP

(30) **Foreign Application Priority Data**

Mar. 24, 2015 (KR) ..... 10-2015-0040454

Mar. 24, 2015 (KR) ..... 10-2015-0040455

(Continued)

(57) **ABSTRACT**

A fluid separation apparatus comprising a fluid separation  
membrane is provided. The fluid separation apparatus com-  
prises a fluid separation membrane extending in one direc-  
tion and having a cross-section with a closed curve shape,  
wherein the fluid separation membrane has a thickness of 0.1  
mm to 2 mm, and an outer diameter of 60 mm to 360 mm  
when the cross-section is adjusted to be circular.

(51) **Int. Cl.**  
**B01D 53/22** (2006.01)  
**B01D 63/06** (2006.01)

(Continued)

**11 Claims, 90 Drawing Sheets**

