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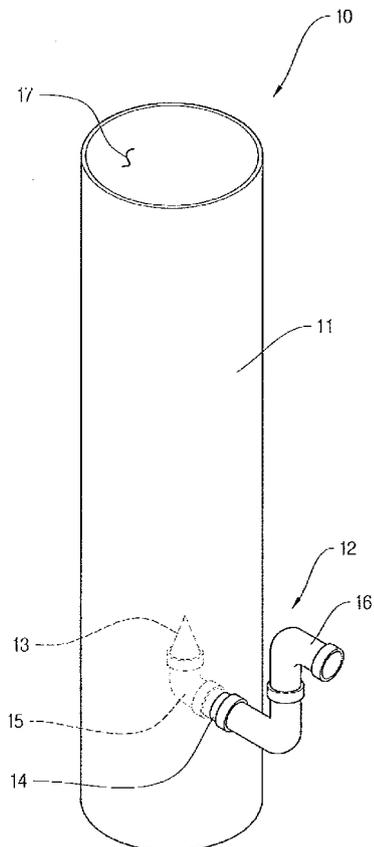
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(54) **AIR JET FOR REMOVING POLLUTING OIL**

(57) The present invention relates to an air jet for removing pollutant oil, and more particularly to an air jet capable of removing oil deposited on a small mud flat, sand or sedimentary soil in a coastal or inland area by injecting compressed air to float the oil on the water surface together with gas discharge. The air jet comprises: a hollow cylindrical air pipe open at both ends, the air pipe serving as a channel through which injected compressed air moves; a communication pipe having a diameter smaller than that of the air pipe and penetrating the air pipe to communicate the inside and outside of the air pipe, the outside of the air pipe being connected with an air hose for supplying compressed air; and an injection nozzle coupled with the communication pipe in the air pipe, the injection nozzle serving to accelerate compressed air supplied to the communication pipe and to rapidly inject the compressed air through the air pipe to an area polluted with oil.

[Figure 1]



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**Description**

[Technical Field]

**[0001]** The present invention relates to an air jet for removing pollutant oil, and more particularly to an air jet capable of removing oil deposited on a small mud flat, sand or sedimentary soil in a coastal or inland area by injecting compressed air to float the oil on the water surface together with gas discharge.

[Background Art]

**[0002]** In general, the sinking of a ship in the sea or oil spilled from the ship damages not only the marine ecosystem but also the mud flat or natural ecosystem of the coast adjacent to the area in which the oil spill occurred.

**[0003]** This oil spill has a significant problem that pollutes the seawater itself, and in addition, the spilled oil spreads to the coast by a tide to pollute the coast. Particularly, at low tide, the spilled oil remains on the tidal flat, and as a result, it pollutes the areas surrounding the coast and causes a serious problem leading to natural disasters.

**[0004]** In the case of an oil spill as described above, the area and amount of damage varies depending on the initial response to the oil spill, but in the case of an oil spill on the sea, an operation for preventing the oil floating on the sea from spreading is mainly carried out, and the oil entering the coast is left to a defenseless state, thus causing a great deal of damage.

**[0005]** However, in the prior art, there was no equipment either for effectively separating and removing oil, which entered the coast after the above-described oil spill and deposited on the mud flat or sand on the coast, or for effectively separating and removing only the oil. Thus, a great deal of time, labor and cost were required to remove the oil.

**[0006]** Also, in the process of removing the deposited oil in the areas surrounding the coast as described above, the oil that penetrated into the sand or mud flat of the areas is more difficult to remove, and thus it gradually penetrates deeper and leads to a more serious natural disaster, so that it remains as a natural disaster over several tens of years.

**[0007]** Meanwhile, in the case of the oil spill in Taean (the west coast of Korea) in December, 2007, many marine spill response companies participated in removing the spilled oil, but most of the companies mainly used water pumps and high-pressure pumps to clean up the oil spill. Also, these companies had no experience in removing oil entering the coast, and they attempted to remove the oil deposited on the mud flat or sand using water pumps or high-pressure pumps. However, the amount of oil floating on the water surface was small, and in most cases, the floated oil precipitated again due to its properties.

**[0008]** Namely, in the initial stage of oil spill, low-boil-

ing-point fractions such as methane, ethane, propane and butane first evaporate from the spilled oil.

**[0009]** Then, the remaining oil fractions float on the seawater surface and pollute the surrounding environment, and the highly volatile light oil fractions gradually evaporate to the atmosphere, so that the specific gravity of the oil on the seawater surface gradually increases.

**[0010]** Moreover, heavy oil fractions such as Bunker-C oil and asphalt, which have a specific gravity higher than that of water, gradually precipitate from water or are deposited on sand, mud flats or sedimentary soil, and thus are difficult to remove naturally. In addition, the deposited oil releases toxic substances over a long period of time to cause an environmental pollution. However, there has not yet been a system capable of effectively removing the above-described deposited oil.

[Disclosure]

[Technical Problem]

**[0011]** The present invention has been made in order to solve the above-described problems occurring in the prior art, and it is an object of the present invention to provide an air jet for removing pollutant oil, in which the air jet has a compressed air-injection nozzle provided in an air pipe, whereby it can environmentally friendly remove oil deposited on a small mud flat, sand or sedimentary soil in an inland or coastal area, can shorten the number of working days, and can reduce the cost for removing the oil.

[Technical Solution]

**[0012]** To achieve the above object, the present invention provides an air jet for removing pollutant air, comprising:

a hollow cylindrical air pipe open at both ends, the air pipe serving as a channel through which injected compressed air moves;

a communication pipe having a diameter smaller than that of the air pipe and penetrating the air pipe to communicate the inside and outside of the air pipe, the outside of the air pipe being connected with an air hose for supplying compressed air; and

an injection nozzle coupled with the communication pipe inside the air pipe, the injection nozzle serving to accelerate compressed air supplied to the communication pipe and to rapidly inject the compressed air through the air pipe to an area polluted with oil.

[Advantageous Effects]

**[0013]** The air jet for removing pollutant oil according to the present invention can environmentally friendly remove oil deposited on a small mud flat, sand or sedimentary soil in an inland or coastal area, can shorten the

number of working days, and can reduce the cost for removing the oil.

[Description of Drawings]

[0014]

FIG. 1 is a perspective view of an air jet according to a first embodiment of the present invention.

FIG. 2 shows the internal structure of the air jet shown in FIG. 1.

FIG. 3 is a perspective view of an air jet according to a second embodiment of the present invention.

FIG. 4 shows a state in which the air jet shown in FIG. 1 is used.

FIG. 5 is a photograph showing removing oil using the air jet of the present invention.

[Best Mode]

[0015] Hereinafter, the construction and operation of the present invention will be described in detail with reference to the accompanying drawings.

[0016] FIG. 1 is a perspective view of an air jet according to a first embodiment of the present invention, and FIG. 2 shows the internal structure of the air jet shown in FIG. 1.

[0017] As shown in FIG. 1, an air jet 10 comprises an air pipe 11, a communication pipe 12 and an injection nozzle 13.

[0018] Herein, the communication pipe has a diameter smaller than that of the air pipe.

[0019] The air pipe 11 through which injected compressed air moves has a hollow space 17 therein and is cylindrical in shape and open at both ends.

[0020] The communication pipe 12 perpendicularly penetrates the air pipe 11 to communicate the inside and outside of the air pipe.

[0021] The communication pipe consists of a penetration pipe 14 perpendicularly penetrating the air pipe 11, a discharge pipe 15 connected with the penetration pipe 14 inside the air pipe 11, and an injection pipe 16 connected with the penetration pipe 14 outside the air pipe 11.

[0022] The injection pipe 16 is connected with an air hose for supplying compressed air, and an injection nozzle 13 is coupled to the discharge tube 15. In operation, after compressed air has been applied to the injection pipe 16, it is accelerated through the injection nozzle 13 and injected rapidly to the inside of the air pipe 11.

[0023] The air injected rapidly by the injection nozzle 13 moves fast along the space 17 of the air pipe 11 and is strongly injected through both open ends of the air pipe 11 to a small mud flat, sand or sedimentary soil in a coastal or inland area.

[0024] If the injection direction of the injection nozzle 13 is directed toward one or both open ends of the air pipe 11, the compressed air can be injected directly to a

small mud flat, sand or sedimentary soil at a high pressure.

[0025] By such a high injection pressure of compressed air, water or sand or soil will rise, so that the oil deposited on the mud flat, sand or sedimentary soil will float on the water surface by the interaction between water, the compressed air and sand or soil (sedimentary soil) while gas will be separated therefrom.

[0026] The oil floating on the water surface may be adsorbed with an adsorbent and collected in a collection vessel.

[0027] FIG. 3 is a perspective view of an air jet according to a second embodiment of the present invention.

[0028] As shown in FIG. 3, an air jet 20 comprises air pipes 21a and 21b, a communication pipe 22, injection nozzles 23a and 23b and a coupling member 28.

[0029] Herein, the air pipes have a diameter smaller than that of the communication pipes.

[0030] The air pipes have the respective hollow spaces 27a and 27b and are cylindrical in shape and open at both ends.

[0031] The air pipes 21a and 21b are fixedly coupled to each other in parallel by the coupling member 28.

[0032] The communication pipe 22 perpendicularly penetrates the air pipes 21a and 21b to communicate the inside and outside of each of the air pipes 21a and 21b.

[0033] The communication pipe 22 consists of: penetration pipes 24a and 24b, which perpendicularly penetrate the air pipes 21a and 21b, respectively; discharge pipes 24a and 24b, which are connected with the penetration pipes 24a and 24b inside the air pipes 21a and 21b, respectively; and a T-shaped manifold 29 which connects the penetration pipes 24a and 24b outside the air pipes 21a and 21b with an injection pipe 26.

[0034] The injection pipe 26 is connected to an air hose for supplying compressed air, and injection nozzles 23a and 23b are connected to the discharge pipes 25a and 25b. In operation, compressed air is supplied to the injection pipe 26, passed through the manifold 29, and then accelerated through each of the injection nozzles 23a and 23b, and the accelerated compressed nozzle is injected rapidly into the inside of the air pipes 21a and 21b.

[0035] The air injected rapidly by the injection nozzles 23a and 23b moves along the spaces 27a and 27b of the air pipes 21a and 21b and is strongly injected through both ends of the air pipes to a mud flat, sand or sedimentary soil in a coastal or inland area.

[0036] If the injection direction of the injection nozzles 23a and 23b is directed toward one or both open ends of the air pipes 21a and 21b, the compressed air can be injected directly on a mud flat, sand or sedimentary soil at a high pressure.

[0037] By such a high injection pressure of compressed air, water or sand or soil will rise, so that the oil deposited on the mud flat, sand or sedimentary soil will float on the water surface by the interaction between water, the compressed air and sand or soil (sedimentary

soil) while gas will be separated therefrom.

**[0038]** The oil floating on the water surface may be adsorbed with an adsorbent and collected in a collection vessel.

**[0039]** According to the above-described second embodiment, compressed air can be injected to a mud flat, sand or sedimentary soil in an area larger than the first embodiment, and thus the time required for removal of oil can be reduced.

**[0040]** FIG. 4 shows a state in which the air jet shown in FIG. 1 is used.

**[0041]** As shown therein, an air compressor 30 for generating and supplying compressed air is connected by an air hose 60 to a pressure control tank 40 for controlling the pressure of air supplied from the air compressor 30.

**[0042]** The pressure-increasing tank 40 comprises a setting valve 44 for controlling pressure, a pressure meter 42, and a plurality of supply valves 46 for supplying compressed air to the air jet 10. The supply valves 46 are connected by the air hose 60 to the communication pipe 12 of the air jet 10.

**[0043]** Compressed air whose pressure has been controlled to a suitable pressure by the setting valve 44 of the pressure control tank 40 is supplied to the communication pipe 12 by the air hose 60.

**[0044]** The compressed air is injected through the injection nozzle 13, and then moves fast along the inside of the air pipe 11 and is strongly injected to an area polluted with oil.

**[0045]** By the jetting of the compressed air, water and sand or soil rise, and the oil deposited on the mud flat, sand or sedimentary soil floats on the water surface by the interaction between water, the compressed air and sand or soil (sedimentary soil) while gas is separated and injected therefrom.

**[0046]** More specifically, oil contains carbon (84-87%) and hydrogen (11-14%) as main components and also contains small amounts of sulfur, nitrogen and oxygen. It is a liquid having a peculiar odor and is a complex hydrocarbon compound.

**[0047]** The oil contains methane (CH<sub>4</sub>) and ethane (C<sub>2</sub>H<sub>6</sub>) in the uppermost layer, propane (C<sub>3</sub>H<sub>8</sub>) and (C<sub>4</sub>H<sub>10</sub>) in the middle layer, and kerosene, bunker-C oil and asphalt (residual oil) in the lowest layer in that order according to specific gravity.

**[0048]** Meanwhile, bubbles produced in liquid have a kind of energy and remove contaminants from the laundry using kinetic energy caused by, for example, the production and separation of air bubbles.

**[0049]** When an oil spill occurs, low-specific-gravity components such as methane, ethane, propane and butane evaporate into the atmosphere immediately after the oil spill, but light oil fractions, such as kerosene and gasoline, and heavy oil fractions, such as bunker-C oil and asphalts (residual oil), float on the seawater surface or are settled to the bottom of the sea. The carbon-hydrogen bond of the oil floating on the seawater surface or settled to the bottom is broken by the energy of com-

pressed air, while the oil is degassed. The degassed oil floats on the seawater surface.

**[0050]** At the same time as floating of the oil fractions, microorganisms or oil-eating superbacteria (it is known that about 20 kinds of such bacteria live in Korea, and among them, about 10 kinds live in the Yellow Sea) also float from the bottom of the sea and are highly activated. The floated microorganisms and superbacteria facilitate the cleanup of the oil spill and the recovery of the ecosystem.

**[0051]** Next, the oil floating on the water surface may be adsorbed with, for example, an adsorbent, and collected in a collection vessel.

**[0052]** FIG. 5 is a photograph showing removing oil using the air jet of the present invention. As shown therein, the air jet is introduced into water in an area polluted with oil, and compressed air is supplied to the air jet and jetted from the air jet.

**[0053]** As can be seen in FIG. 5, by the jetting of compressed air, oil floats on the water surface while gas is discharged.

**[0054]** Although the preferred embodiments of the present invention have been described for illustrative purposes, those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from the scope and spirit of the invention as disclosed in the accompanying claims.

## 30 Claims

### 1. An air jet for removing pollutant air, comprising:

a hollow cylindrical air pipe open at both ends, the air pipe serving as a channel through which injected compressed air moves;

a communication pipe having a diameter smaller than that of the air pipe and penetrating the air pipe to communicate the inside and outside of the air pipe, the outside of the air pipe being connected with an air hose for supplying compressed air; and

an injection nozzle coupled with the communication pipe inside the air pipe, the injection nozzle serving to accelerate compressed air supplied to the communication pipe and to rapidly inject the compressed air through the air pipe to an area polluted with oil.

### 50 2. An air jet for removing pollutant air, comprising:

a plurality of hollow cylindrical air pipes which are open at both ends and arranged in parallel, the air pipes serving as channels through which injected compressed air moves;

a coupling member serving to fixedly couple the air pipes to each other;

a communication pipe having a diameter smaller

than that of the air pipes and penetrating the air pipes to communicate the inside and outside of the air pipes, the outside of the air pipes being connected with an air hose for supplying compressed air; and  
 a plurality of injection nozzles coupled to the communication pipe inside the air pipes, the injection nozzles serving to accelerate compressed air supplied to the communication pipes and to rapidly inject the compressed air through the air pipes to an area polluted with oil.

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3. The air jet of Claim 2, wherein the communication pipe consists of: a plurality of penetration pipes penetrating the respective air pipes; a plurality of discharge pipes which are connected to the respective penetration pipes inside the air pipes and to which the injection nozzles are coupled; and a manifold which connects the penetration pipes outside the air pipes with an injection pipe connected to the air hose.
4. The air jet of Claim 1 or 2, wherein the injection direction of the injection nozzle is directed toward one or both open ends of the air pipe.

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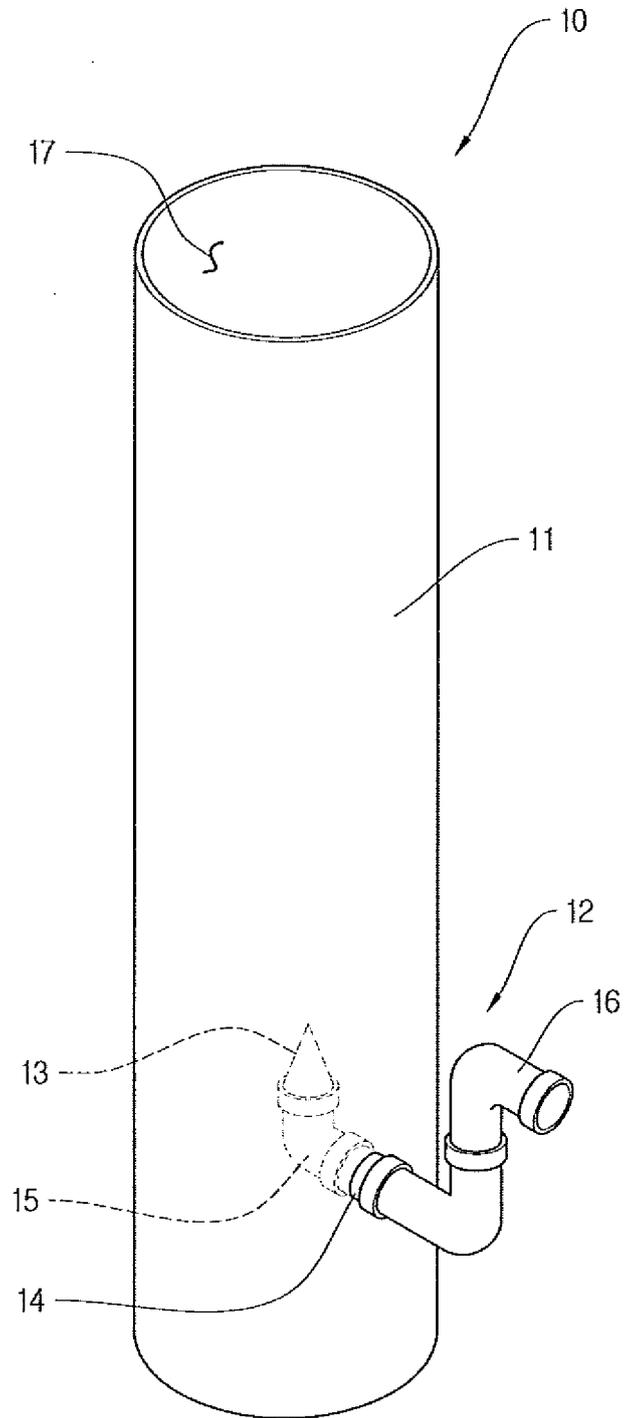
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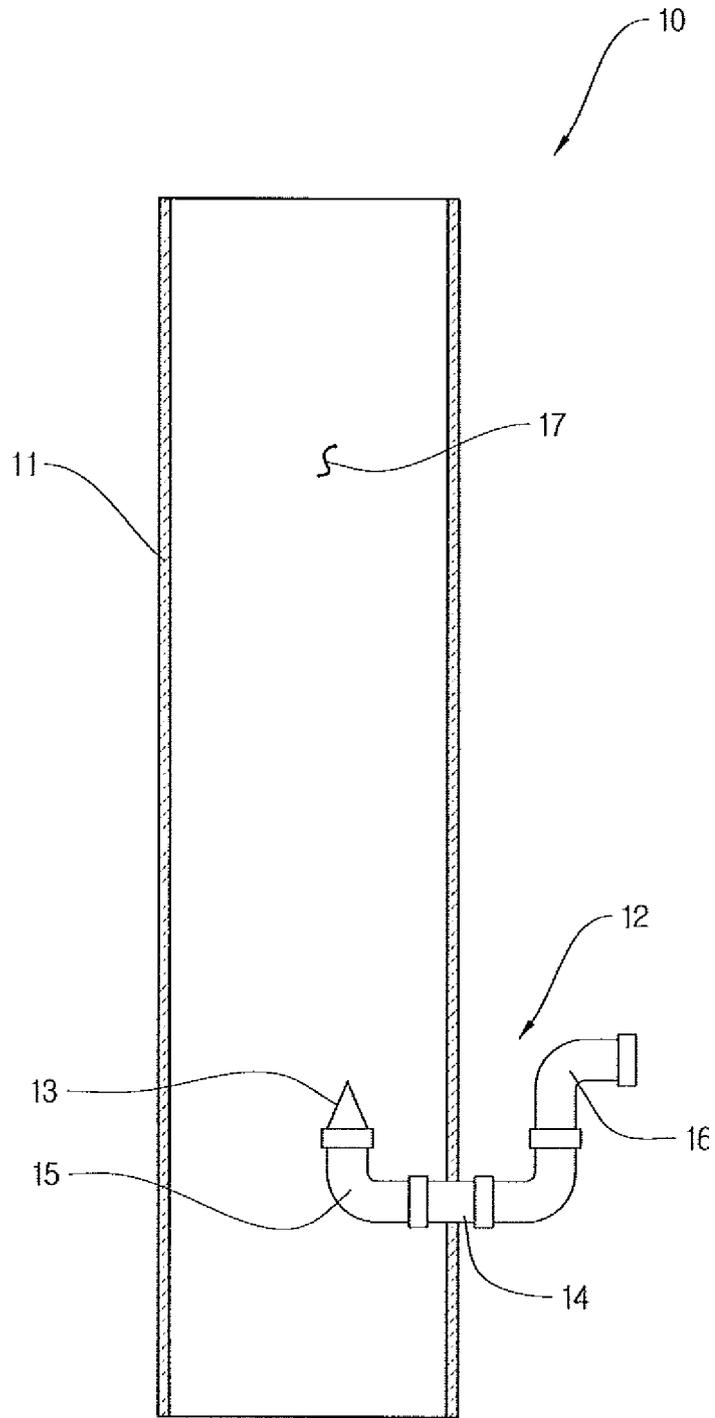
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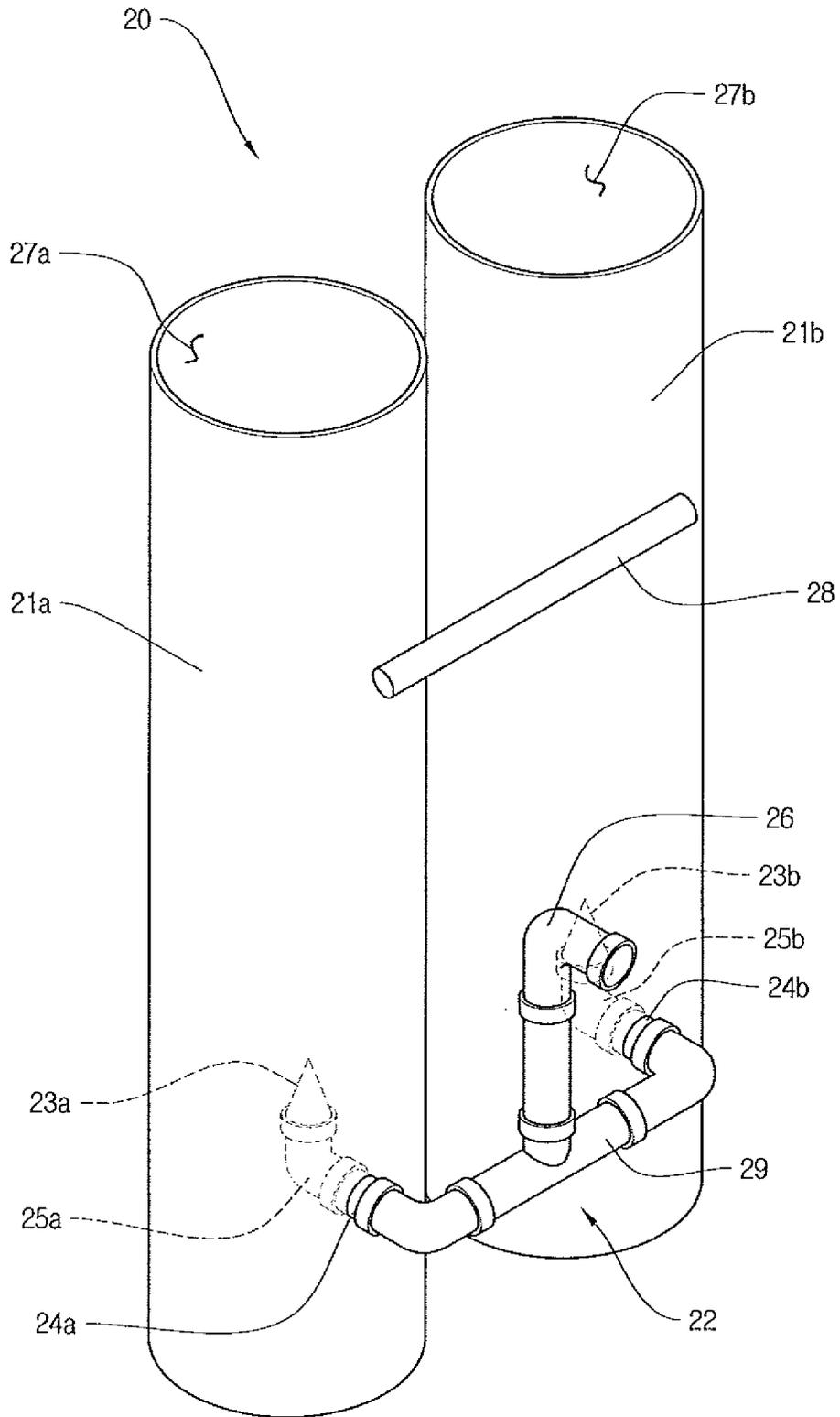
【Figure 1】



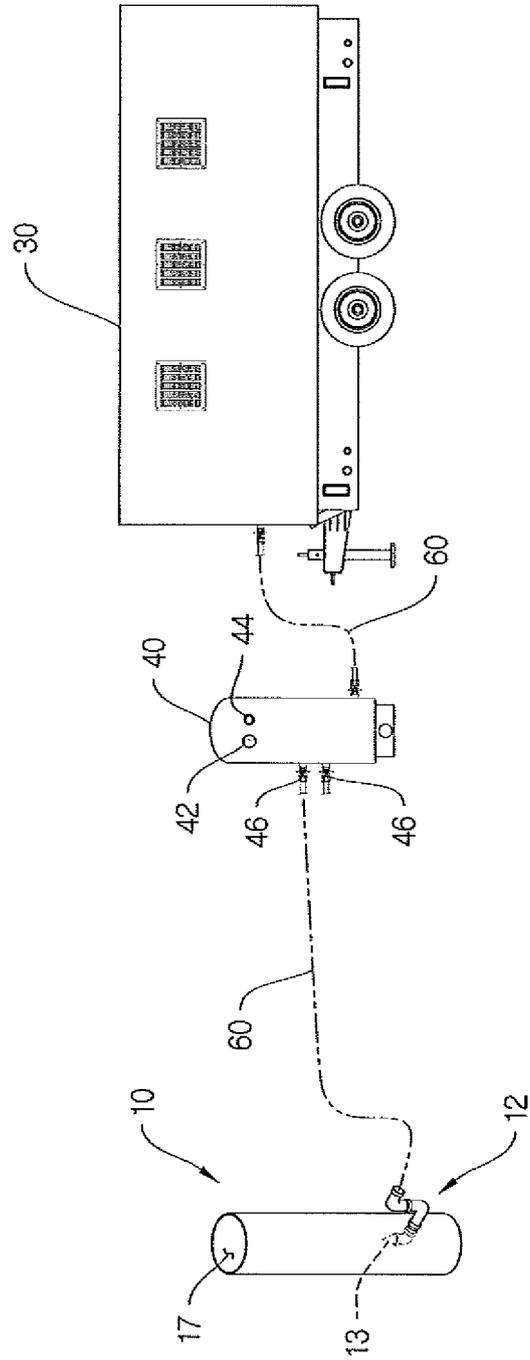
【Figure 2】



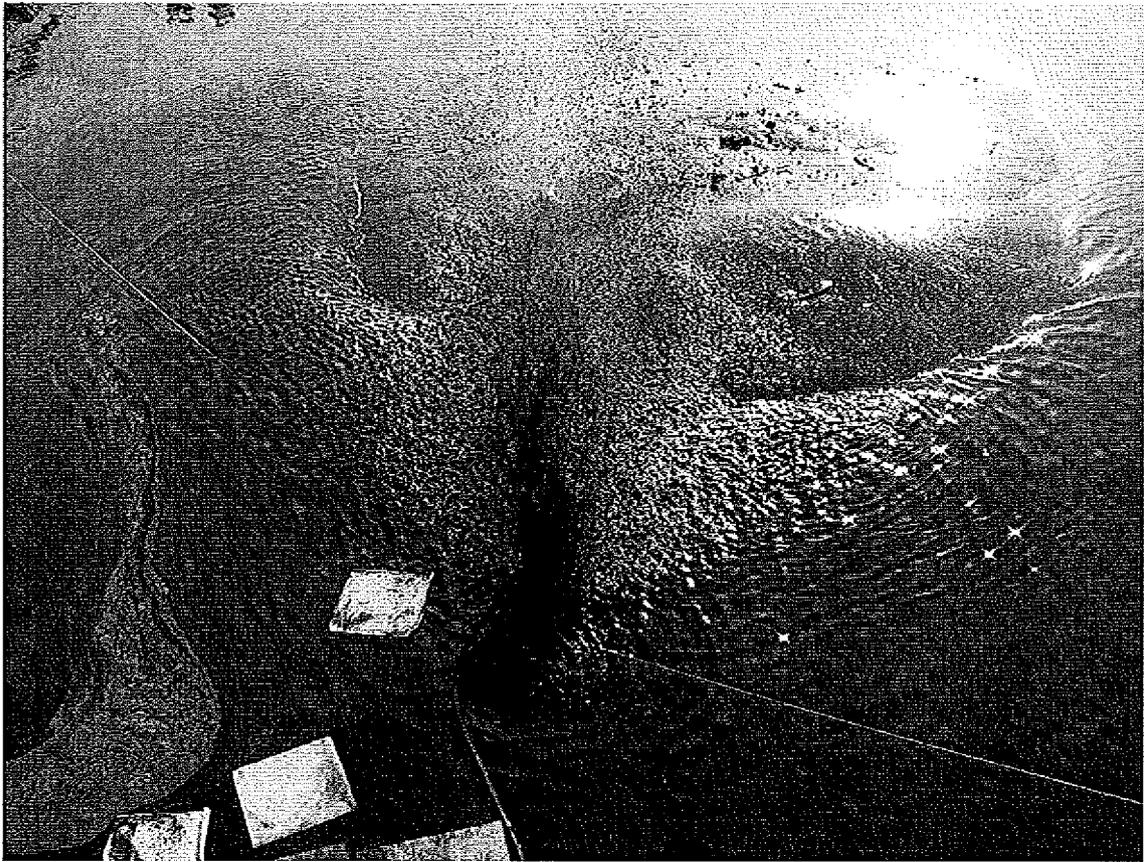
【Figure 3】



【Figure 4】



【Figure 5】



## INTERNATIONAL SEARCH REPORT

International application No.

**PCT/KR2010/002899**

A. CLASSIFICATION OF SUBJECT MATTER <b>E02B 15/04(2006.01)i, B08B 5/02(2006.01)i</b> According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) E02B 15/04; C02F 1/74; C02F 7/00; C02F 1/40; B63B 35/00; C02F 3/22  Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Korean Utility models and applications for Utility models: IPC as above Japanese Utility models and applications for Utility models: IPC as above  Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) eKOMPASS (KIPO internal) & Keywords: , ,		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2004-290863 A (NARASAKI SEISAKUSHO:KK et al.) 21 October 2004 - Report, the claims, figures (1-3)	1-4
A	JP 11-156390 A (SAKAKURA YASURO) 15 June 1999 - Report, the claims, figure (1)	1-4
A	KR 10-2005-0108262 A (GENTRO CO., LTD.) 16 November 2005 - Report, the claims, figure (1a)	1-4
A	KR 10-0245131 B1 (SON, EUL TAEK) 15 February 2000 - Report, the claims, figures (1, 2)	1-4
<input type="checkbox"/> Further documents are listed in the continuation of Box C.		<input checked="" type="checkbox"/> See patent family annex.
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed		"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family
Date of the actual completion of the international search <b>24 JANUARY 2011 (24.01.2011)</b>		Date of mailing of the international search report <b>24 JANUARY 2011 (24.01.2011)</b>
Name and mailing address of the ISA/KR  Korean Intellectual Property Office Government Complex-Daejeon, 139 Seonsa-ro, Daejeon 302-701, Republic of Korea Facsimile No. 82-42-472-7140		Authorized officer  Telephone No.

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## INTERNATIONAL SEARCH REPORT Information on patent family members

International application No.

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Patent document cited in search report	Publication date	Patent family member	Publication date
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JP 11-156390 A	15.06.1999	NONE	
KR 10-2005-0108262 A	16.11.2005	NONE	
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