Innovation, Sciences et Développement économique Canada
Office de la Propriété Intellectuelle du Canada

Innovation, Science and Economic Development Canada
Canadian Intellectual Property Office

CA 2821053 C 2019/01/29

(11)(21) **2 821 053**

(12) BREVET CANADIEN / CANADIAN PATENT

(13) **C**

(86) **Date de dépôt PCT/PCT Filing Date:** 2011/11/09
(87) **Date publication PCT/PCT Publication Date:** 2012/05/18
(45) **Date de délivrance/Issue Date:** 2019/01/29
(85) **Entrée phase nationale/National Entry:** 2013/06/10
(86) **N° demande PCT/PCT Application No.:** NO 2011/000317
(87) **N° publication PCT/PCT Publication No.:** 2012/064201
(30) **Priorité/Priority:** 2010/11/12 (NO20101597)

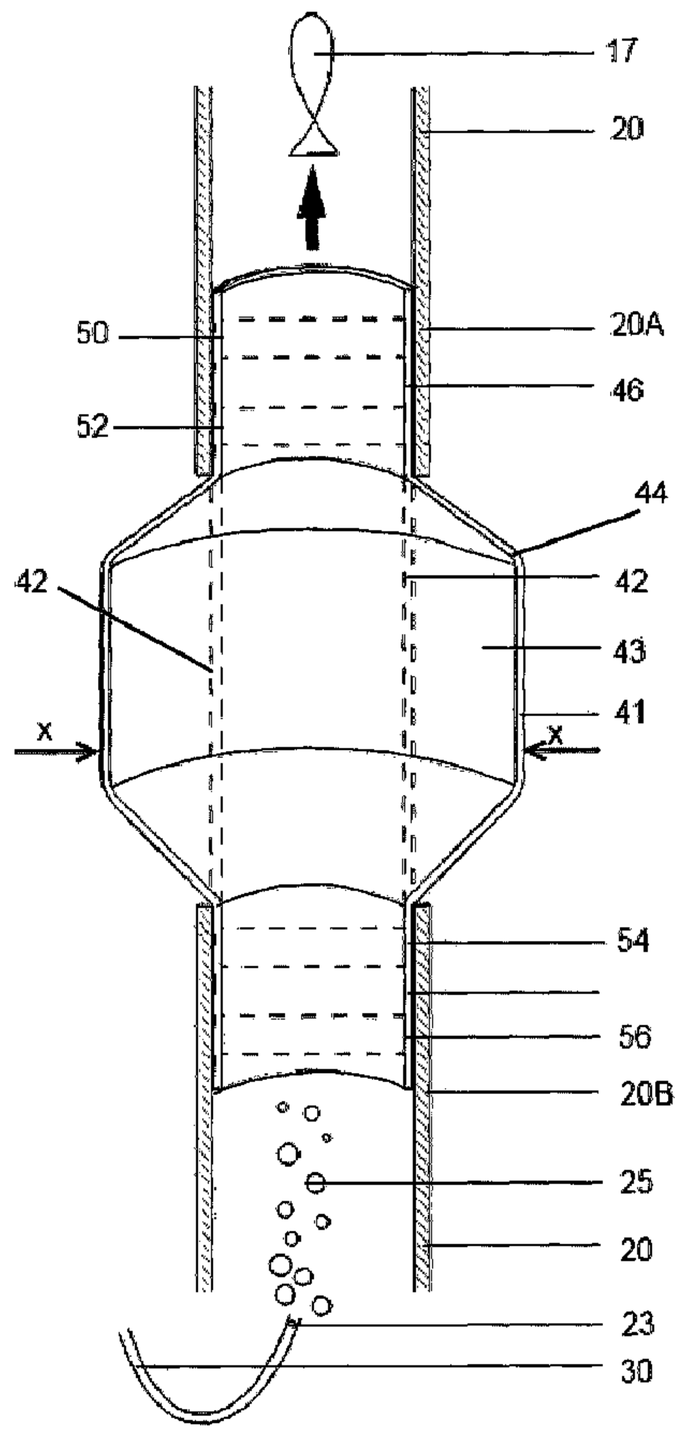
(51) **Cl.Int./Int.Cl.** ***A01K 63/10*** (2017.01), ***A01K 61/00*** (2017.01), ***A01K 63/04*** (2006.01)

(72) **Inventeur/Inventor:**
HOLMEFJORD, EINAR, NO

(73) **Propriétaire/Owner:**
LIFTUP AKVA AS, NO

(74) **Agent:** OSLER, HOSKIN & HARCOURT LLP

(54) **Titre : STRUCTURE DE SYSTEME DE POMPAGE ET UTILISATIONS DE CE SYSTEME**
(54) **Title: CONSTRUCTION OF A PUMPING SYSTEM AND USES THEREOF**



(57) **Abrégé/Abstract:**
There is described a construction for a pumping system, wherein an end of a hose is directed downwardly to a bottom region for pumping up therefrom solid particles in a mixture of water with help of a pumping arrangement. The construction is distinguished in

CA 2821053 C 2019/01/29

(11)(21) **2 821 053**

(13) **C**

(57) **Abrégé(suite)/Abstract(continued):**
that the hose comprises at least a combination of a pipe section (42) with an integral float (40, 44) which are adapted to maintain the hose (20) substantially in an upright orientation in an ocean environment, wherein the float (40) is implemented in a ring-form manner around the pipe section (42), and comprises one or more gas/air- filled chambers (43) or a float element whose density is less than that of water, wherein the pipe section (42) is coupled/joined onto the hose (20) at a suitable height over the bottom region. According to the present invention, the construction can be used in connection with an aquaculture cage in an ocean environment for pumping up sinking food waste, faeces and dead marine organisms, especially fish or, in a general pumping apparatus and system for pumping up waste such as slime and similar from a seabed (dredging).

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
18 May 2012 (18.05.2012)

PCT

(10) International Publication Number
WO 2012/064201 A1

(51) International Patent Classification:
A01K 61/00 (2006.01) *B08B 9/08* (2006.01)
A01K 63/04 (2006.01)

(21) International Application Number:
PCT/NO2011/000317

(22) International Filing Date:
9 November 2011 (09.11.2011)

(25) Filing Language: Norwegian

(26) Publication Language: English

(30) Priority Data:
20101597 12 November 2010 (12.11.2010) NO

(71) Applicant *(for all designated States except US)*: **LIFTUP AKVA AS** [NO/NO]; Eikelandsheiene, N-5640 Eikelandsosen (NO).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: **HOLMEFJORD, Einar** [NO/NO]; Svananeset 41, N-5640 Eikelandsosen (NO).

(74) Agent: **ACAPO AS**; Strandgt. 198, P.O. Box 1880, N-5817 Bergen (NO).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS,

[Continued on next page]

(54) Title: CONSTRUCTION OF A PUMPING SYSTEM AND USES THEREOF

(57) Abstract: There is described a construction for a pumping system, wherein an end of a hose is directed downwardly to a bottom region for pumping up therefrom solid particles in a mixture of water with help of a pumping arrangement. The construction is distinguished in that the hose comprises at least a combination of a pipe section (42) with an integral float (40, 44) which are adapted to maintain the hose (20) substantially in an upright orientation in an ocean environment, wherein the float (40) is implemented in a ring-form manner around the pipe section (42), and comprises one or more gas/air- filled chambers (43) or a float element whose density is less than that of water, wherein the pipe section (42) is coupled/joined onto the hose (20) at a suitable height over the bottom region. According to the present invention, the construction can be used in connection with an aquaculture cage in an ocean environment for pumping up sinking food waste, faeces and dead marine organisms, especially fish or, in a general pumping apparatus and system for pumping up waste such as slime and similar from a seabed (dredging).

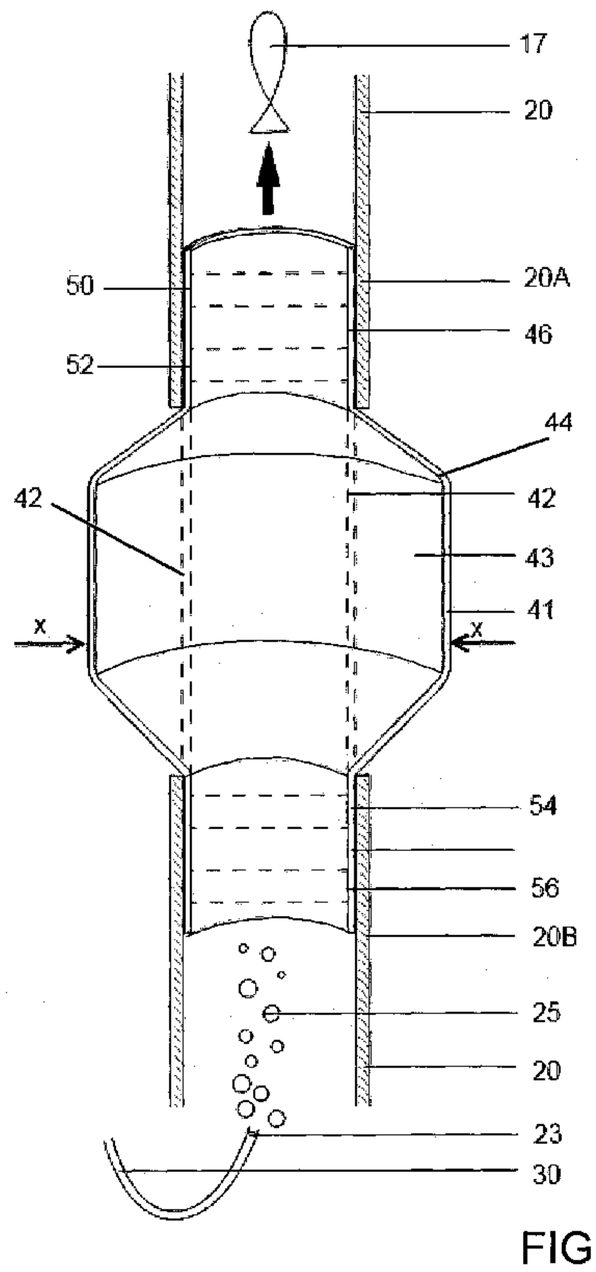


FIG. 3

WO 2012/064201 A1

WO 2012/064201 A1

SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

CONSTRUCTION OF A PUMPING SYSTEM AND USES THEREOF

The present invention is concerned with a construction for a pumping system, wherein one end of a hose is directed downwardly to a bottom region for pumping up therefrom solid particles in a mixture with water by utilizing a pumping arrangement. The invention also relates to use of the pumping arrangement.

The invention is concerned with a buoyancy member (a float) for a pumping system which includes a hose and a pumping arrangement for pumping up solid and liquid waste, and which has as an objective to stabilize the hose employed for pumping up during utilization in water.

The invention is also concerned with a construction of a buoyancy member pertaining to the pumping system.

In particular, the invention has relevance to a system which is used for sucking up sunken remains, faeces and dead marine organisms (especially fish) within a cage in the sea. However the invention can be used in all situations where there arises a need to pump up waste.

In respect of solid and liquid waste, the aforesaid remains (such as pellets), faeces and dead fish are pertinent, but also all types of waste which may, for example, be lying on an ocean floor, such as slime and other solid particles/objects are pertinent. With regard to marine organisms, fish in particular are pertinent, but other types of crustaceans and similar are pertinent.

In addition to use with cages, the invention can also be used in association with hoses which, by way of assistance from a pumping system, are operable to transport slime from a seabed up to the surface region for further treatment, also known as dredging.

In this connection, reference is made to Figure 1 which provides an illustration of a known system for sucking up waste from a bottom region of an aquaculture cage.

The cage is denoted by **10**, and comprises a ring-formed frame **12** adapted for floating on an ocean surface denoted by **11**; from the ring-formed frame **12**, there is hung a ring-formed cage **14** fabricated from a well known netting material or a dense cloth. A bottom region of the cage **14** is implemented as a funnel-shaped net section **16**. Within the closed cage **14**, there are retained swimming aquaculture fish **17**. Internally, namely at a bottom of the cage's funnel-shaped section **16**, there is implemented a closed inverted collection funnel **20** (of cornet form) wherein sunken waste is collected up and concentrated.

At a bottom of the funnel is stretched an end **22** of a hose or a pipe **20** which is disposed therefrom up to the ocean surface and extends further at **24** up out of the sea **11** and eventually to a collection box **26**, wherein the mixture of waste and water is separated by way of the water draining and running back

to the sea via the pipe **27**, whereas the solid waste (fish, remains of food, etc.) and even slime, is directed to other suitable processing or destructions at **29**.

The pumping up of waste in the mixture with water occurs by way of a hose **30** for pumping of compressed air **25** (see also Figure 3) being directed down into the cage and by way of coupling the hose/pipe **20** supported to its end **22** whereat suction arises. The air is pumped into the hose **20** through an ejector nozzle **23** which is orientated upwardly vertically within the hose **20**, and the air in the form of bubbles **25** creates an upwardly-directed ejection effect such that water and waste are sucked into the bottom **22** and are lifted/are pumped up through the hose and are guided into the sieve box **26** wherein water as aforementioned is permitted to run back into the sea and the solid waste is treated further in an appropriate manner.

Simultaneously, a result thereof is that the hose **20** is rendered rigid in an upright orientation as shown in Figure 1. Before air is pumped into the hose **20**, and after a cessation of air being pumped into the hose **20**, the hose with its associated coupled ejector **23** of the hose system **30** is filled with water and at least partially collapses downwardly and folds together or folds up at a bottom region of the cage.

A major disadvantage of this is when pumping of waste is to be recommenced. When the hose **20** begins to be filled with air, major movements of the hose **20** and its associated air pumping system occurs, wherein it can be thrown forward and back when it is lifted up, namely something which can cause major damage both to the fish and equipment within the cage. Moreover, a considerable amount of pumping energy is wasted merely in lifting/raising the hose up from its folded state.

A known solution is described in a United Kingdom patent no. GB 1165520, which is concerned with an apparatus for transporting to/from a boat, and which comprises a plurality of rigid pipes, which are each maintained floating by way of floats, and the pipes are coupled together to form a more bendable hose.

Reference is made to a publication "Product Catalogue for Liftup", from year 2010 (accessible via Internet), and from Applicant's Liftups newsletter no. 1, year 2001. These describe different solutions for pumping up dead fish, faeces and feed from a collection unit by way of help from a pump which is assisted by injecting air into a vertically orientated transport hose.

A principal aim of the present invention is to provide a construction for a new system which is capable of eliminating disadvantages encountered with contemporary known systems.

In particular, it is an aim of the present invention to provide a solution which is capable of eliminating the phase wherein the hose is partially folded together after completed pumping up activities and which subsequently is raised again by injection of air, namely the hose is capable of being retained in a upright orientation in all phases.

The construction according to the present invention is characterized in that the hose comprises at least a combined pipe section with an integral float which is adapted for maintaining the hose principally in an upright orientation in the sea environment, wherein the float is implemented in a ring-form manner around the pipe section, and comprises one or more gas/air-filled chambers or a float element having a corresponding density which is lower than that of water, wherein the pipe section is coupled/joined onto the hose at a suitable height over a bottom region.

According to a preferred embodiment of the present invention, an exterior surface of the float is formed with rounded edges and corners so that the float is not susceptible to becoming ensnarled in moorings and causing associated damage.

Beneficially, the float is implemented around a central portion of the pipe section. Moreover, it is beneficial that the float is implemented as a cap which is implemented around the pipe section, and the cap defines together with the pipe one or more chambers for being filled with gas/air.

According to a preferred embodiment of the invention, the float is a float element filled with float foam, or a material with lower density than water, for example a cork material or an polystyrene material.

According to the present invention, the construction is susceptible to being employed in an aquaculture cage in the sea for pumping up sunken waste, faeces and dead marine organisms, in particular fish.

In another application, the construction is used in a pumping apparatus and system for pumping up waste from a seabed, such as slime and similar.

These beneficial embodiments of the construction, are defined in dependent claims 2 to 5.

The hose pursuant to the present invention comprises one or more buoyancy elements adapted for maintaining the hose substantially in an upright orientation in an ocean environment.

The following features are of benefit:

- the buoyancy element is a float coupled to the hose;
- the buoyancy element is a combination of a pipe section with an integral float which is arranged in a ring-form manner around the pipe section, wherein the pipe section is coupled/joined within the pipe at a suitable height above the bottom;
- an outside of the float **44** is formed with rounded edges and corners, such that the float is not susceptible to being caught up in moorings and similar and causing associated damage;
- the pumping arrangement is implemented as an air injector, wherein an air hose is adapted to be coupled into the hose at its lower end, such that injection of air causes a water flow for pumping up waste through the hose.

The floating element is implemented as a combination of a pipe section with a float, wherein the float is implemented in a ring-form manner around the pipe section.

Beneficially, there is arranged for:

- the float to be implemented around a central portion of the pipe section;
- the float to be defined as a cap which is arranged around the pipe, and the cap defines together with the pipe one or more chambers filled with a gas such as air;
- the float to be a float element including float foam, or a material with a lower density than that of water, such as a cork material or a float foam which is an polystyrene material.

For a suitable gas, air, Nitrogen, or various noble gases such as Argon, or mixtures of these gases can be utilized.

The float is implemented with recessed tracks for receiving hose clamps, and machined corners for avoiding wear from flat hoses and similar. The float's buoyancy is beneficially adapted to the weight of the hose system.

The present invention is capable of providing many advantages:

Firstly, the hose system in the pumping arrangement is orientated in an upright manner in the sea at all times. This results in the major advantage that the driving material during pumping, which is usually air, has an upward effect as soon as the pumping arrangement is started into operation, and without requiring energy for raising the hose systems which partially lies folded together.

The advantages with this are that the hoses do not lie folded and more or less sunk together down at the bottom of the cage net when pumping commences, and the system does not experience the strongly upward forces which influence the hose and the pumping head 23 in a such a starting phase in response to the addition of the air.

Such movement of the hose and the pumping system can at exposed locations result in considerable wear and damage to the net and the hose system.

As a consequence of the pumping arrangement standing upright in the sea, there is avoided a situation that results in air functioning like a lever on the pump head and resulting in an unsatisfactory orientation of the hose in relation to the bottom of the net, something which can result in the fish distributing themselves incorrectly in relation to an entrance of the pumping arrangement which can be implemented as a cap (for example having a sombrero-type form).

When the pumping system is standing upright substantially at a centre of the net, it is easier to avoid that other apparatus such as biomass frames, underwater cameras, sensors and similar, twists and entangles themselves into the hoses and ropes of the cage system.

Several things to be mentioned are that there is often different lengths in lifting systems in smolt cages and in food fish nets as a consequence of these having mutually different depths. By way of the present invention, the buoyancy elements/floats can be deployed completely float awash or under water, and are operable to keep the hose **20** standing upright in the sea.

The float can be placed all from directly under the sea surface to longer down in the cage.

The invention will be described in more detail with reference to the accompany diagrams, wherein:

Figure 1 is an illustration of a system for pumping up pursuant to a known solution;

Figure 2 is an illustration of a corresponding system, wherein the present invention is utilized;

Figure 3 is an illustration of an elongate section of a buoyancy element pursuant to the present invention as included in a hose/pipe **20**;

Figure 4 is a perspective view of a buoyancy element pursuant to the present invention; and

Figure 5 is a cross-sectional illustration taken along the line X-X in Figure 3.

Figure 1 is described earlier as being representative of known technical state-of-the-art. In Figure 2, which is a slightly more enlarged portion of Figure 1, there is illustrated as a novel feature, namely that uppermost on the hose **20**, and completely surrounding it, is coupled a buoyancy element **40**, and which is shown in detail in Figure 3.

This buoyancy element includes an air-filled element or a tank **40** which is coupled to the hose **20**. Generally, the element can be implemented as a hollow element which is attached to and onto an outside or surrounding the hose **20**.

Following to an especially preferred solution, and as shown in Figures 3 to 5, there are amongst other things buoyancy element, formed as an independent section inserted into the hose **20** and comprising a pipe section **42** wherein there is integrated a ring-form float/float element **44** in a surrounding encircling formation. The section of pipe **42** extends through the float element **44**. On an outside, the float element **44** is formed with round edges and corners, such that the float is not susceptible to snarling in moorings and inside the cage, where it can cause damage.

The structure of the float element **44** is shown most clearly in the elongate section in Figure 3 and in a cross-section in Figure 5. The float element comprises a cap **41** which is attached or disposed outside and around the pipe section **42**. Between the cap's **41** inside wall and the pipe sections' **42** outer wall, there is established a ring-formed chamber **43** which is filled with a gas, in particular air. An outside of the float element **44** and the transitions to the pipe section **42** are correspondingly formed with rounded edges and corners.

For ensuring buoyancy, the chamber **43** can be filled with a light-weight float foam, something which is beneficial in an event that the element wall **44** is punctured and water flows into the chamber. Alternatively, the float element **44** can itself be manufactured from light floating cork- or polystyrene material.

The diagrams provide illustration of a float construction, wherein the construction comprises a pipe section **42** with a float element **44** and two outwardly projecting pipe struts **46**, **48** in mutually opposite directions. Each of these two pipe struts have substantially similar dimensions (diameter) as the hose **20**, such that the main hose **20** is divided into two portions, and de respective ends **20A**, **20B** are threaded outside the pipe struts **46**, respectively **48**, and are attached to the pipe struts with help of hose clamps (not shown) or other suitable fastening components. Thereby, there is achieved that the whole buoyancy element is integrated as a part of the hose system.

Figures 3 and 4 provide illustrations also of mounting flanges **50**, **52**, and similarly **54**, **56**, which are formed onto the outside of the pipe struts **46**, respectively **48**.

In Figure 4, there is provided possible practical dimensions for a float pursuant to the present invention. The whole construction can have a total length of approximately 105 cm, wherein the length of the float units can be 55 cm, and each pipe strut has a diameter 20 cm and a length 25 cm, and a total width can be in an order of 30 cm. The chamber will then have a volume of around 20 litres.

The float element is adapted to, and is utilized as, a part of a hose or a pipe, and can be manufactured from a plastics material of type PE (polyethylene) or other suitable material. It can be fabricated around a pipe section (for example at a spacing of 1.05 metres) which is mounted in a holder and can form a chamber in the cap which is threaded into the pipe and is welded in position such that there are gradual transitions and is devoid of sharp corners.

Although the present invention of a pumping system is described with reference to an aquaculture apparatus, it can be also be used in plants wherein waste such as slime and similar, is pumped up from a seabed. This can be, for example, a dredging apparatus, wherein the sea bed is to be lowered by removing mud, for example in an estuary, a canal or similar where ships are required to pass.

The embodiments of the present invention for which an exclusive property or privilege is claimed are defined as follows:

1. A construction for a pumping system, wherein one end of a hose is directed downwardly to a bottom region for pumping up therefrom solid particles in a mixture with water by using a pumping arrangement, characterized in that the hose comprises at least a combined pipe section with an integral float operable to hold the hose substantially in an upright orientation in a region of sea, wherein the float is implemented in a ring-form manner around the pipe section, and comprises one or more gas/air-filled chambers or a float element whose density is lower than that of water, wherein the pipe section is coupled/joined onto the hose at a suitable height above the bottom region.

2. A construction as claimed in claim 1, characterized in that the float's outer surface is formed with rounded edges and corners, such that the float is not capable of snarling itself in moorings and similar and causing damage.

3. A construction as claimed in claim 1 or claim 2, characterized in that the float is implemented around a central portion of the pipe section.

4. A construction as claimed in any one of claims 1 to 3, characterized in that the float defines a cap which is implemented around the pipe section, and the cap defines together with the pipe one or more chambers with gas/air-filling.

5. A construction as claimed in any one of claims 1 to 4, characterized in that the float is a float element filled with float foam, or a material which has a lower density than that of water.

6. A construction as claimed in claim 5, wherein the material is a cork material or a polystyrene material.

7. Use of a construction as claimed in any one of claims 1 to 6, in an aquaculture cage in a sea environment for pumping up sinking waste, faeces and dead marine organisms.

8. Use of a construction as claimed in claim 7, wherein the dead marine organisms are fish.

9. Use of a construction as claimed in any one of claims 1 to 6, in a pumping arrangement and system for pumping up waste from a sea bed.

10. Use of a construction as claimed in claim 9, wherein the waste is slime or mud.

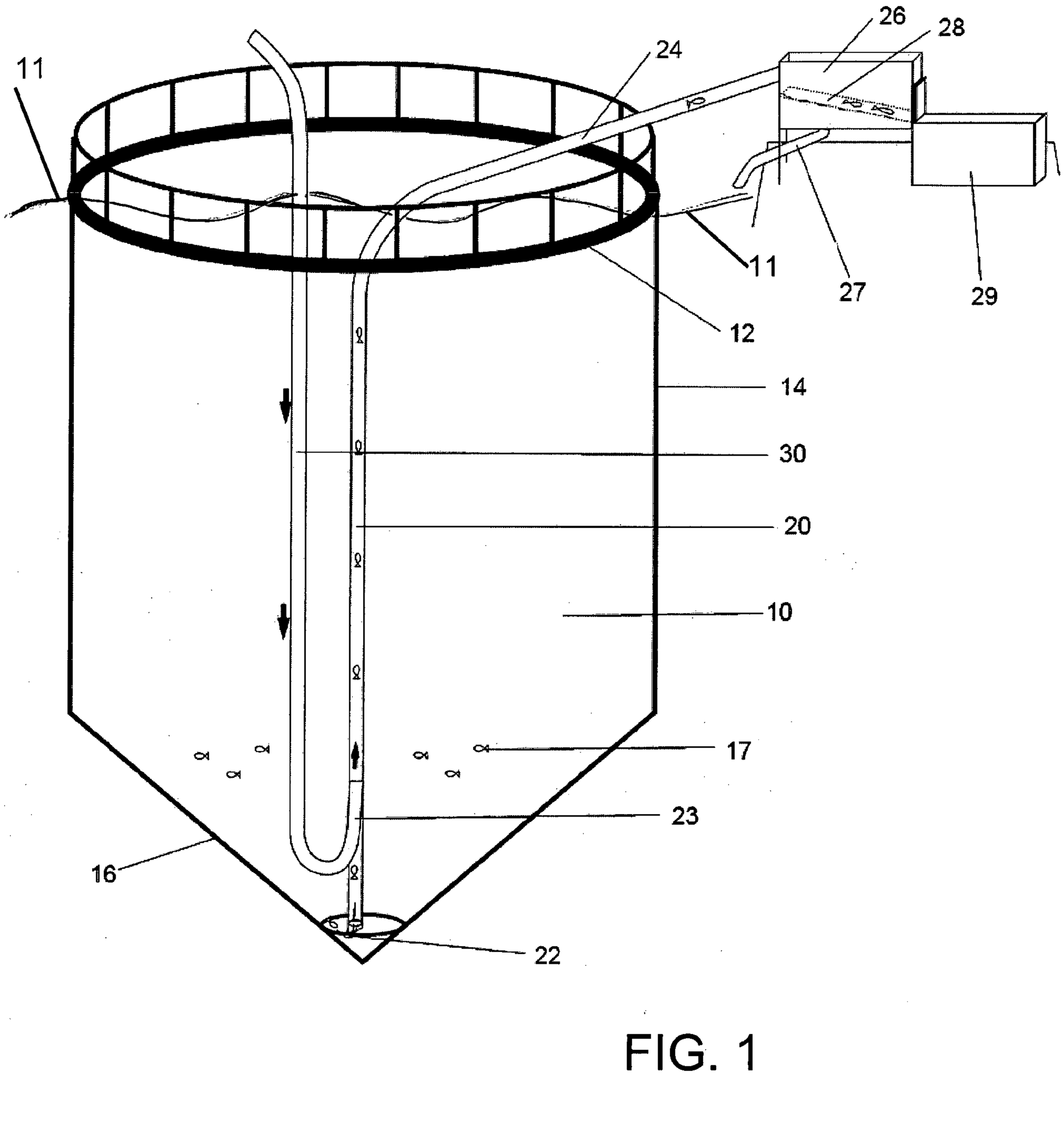


FIG. 1

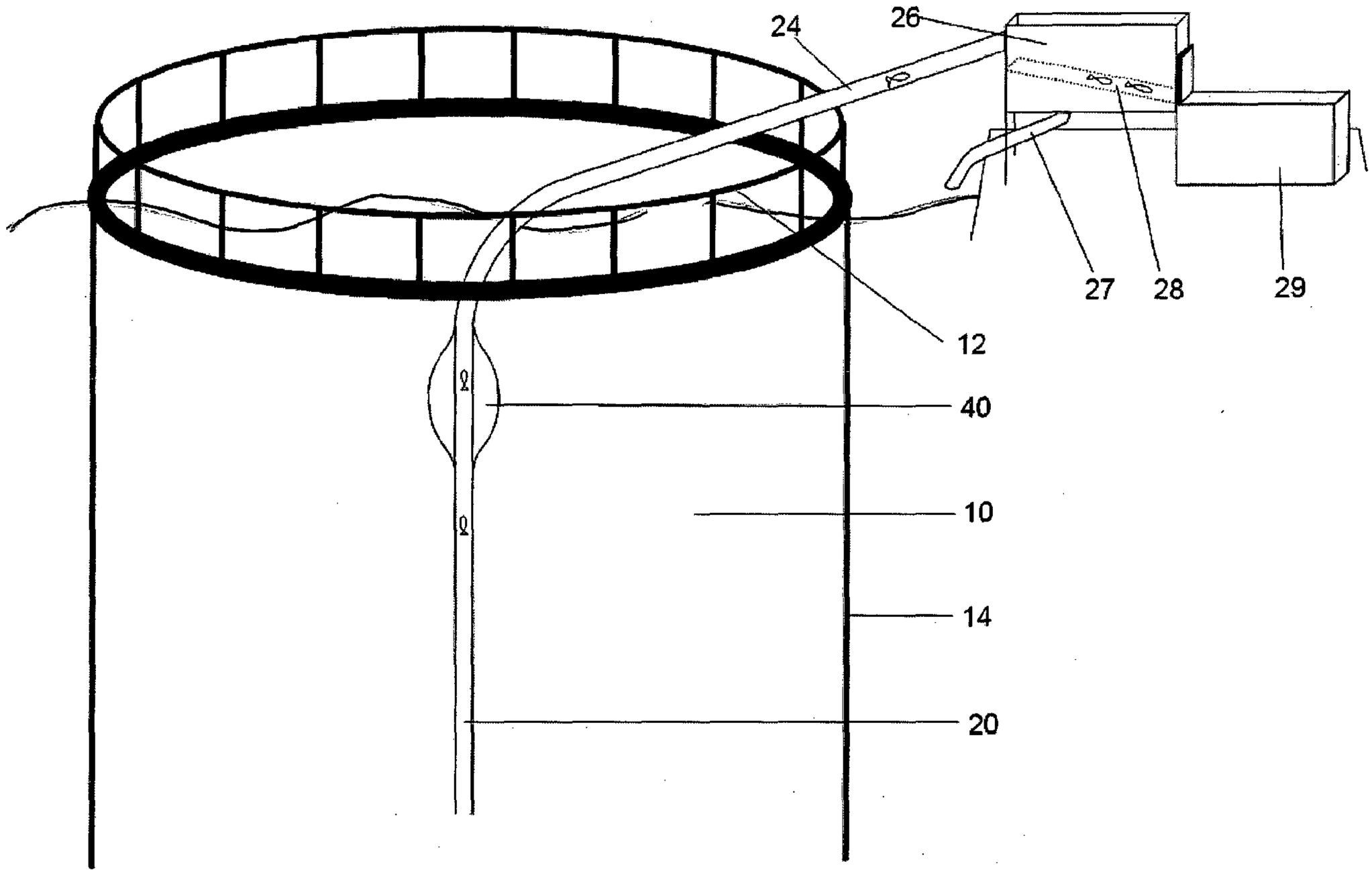


FIG. 2

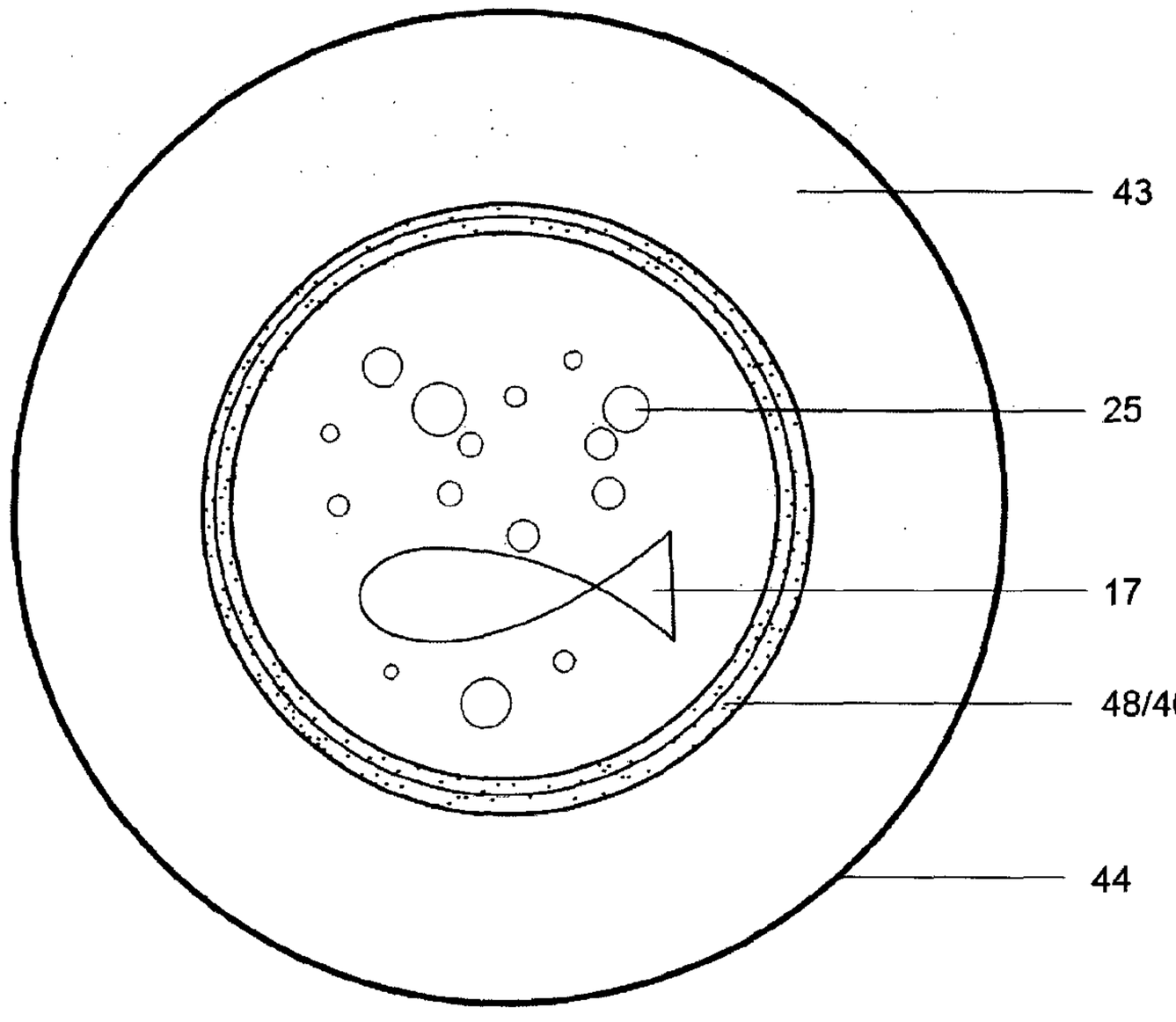


FIG. 5

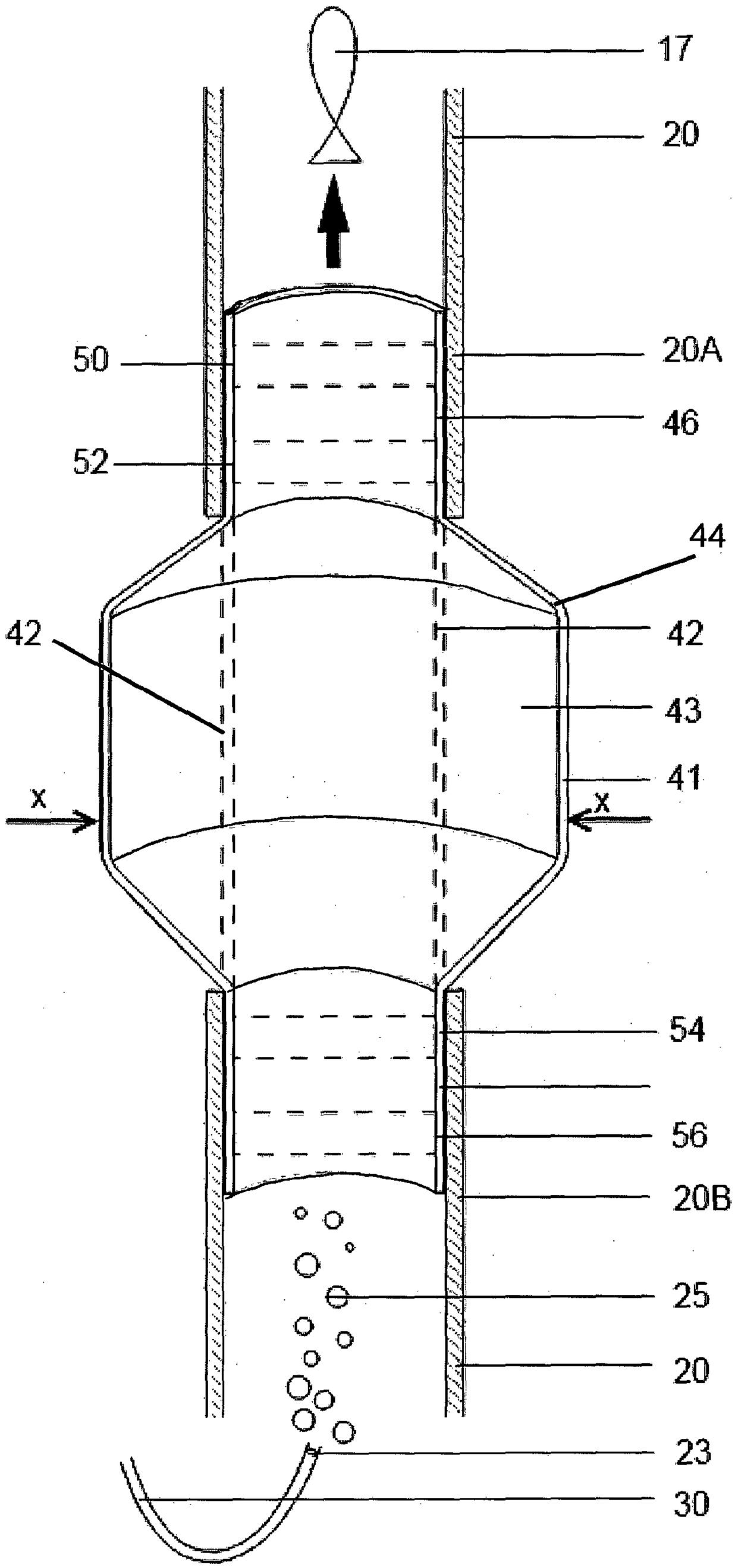


FIG. 3

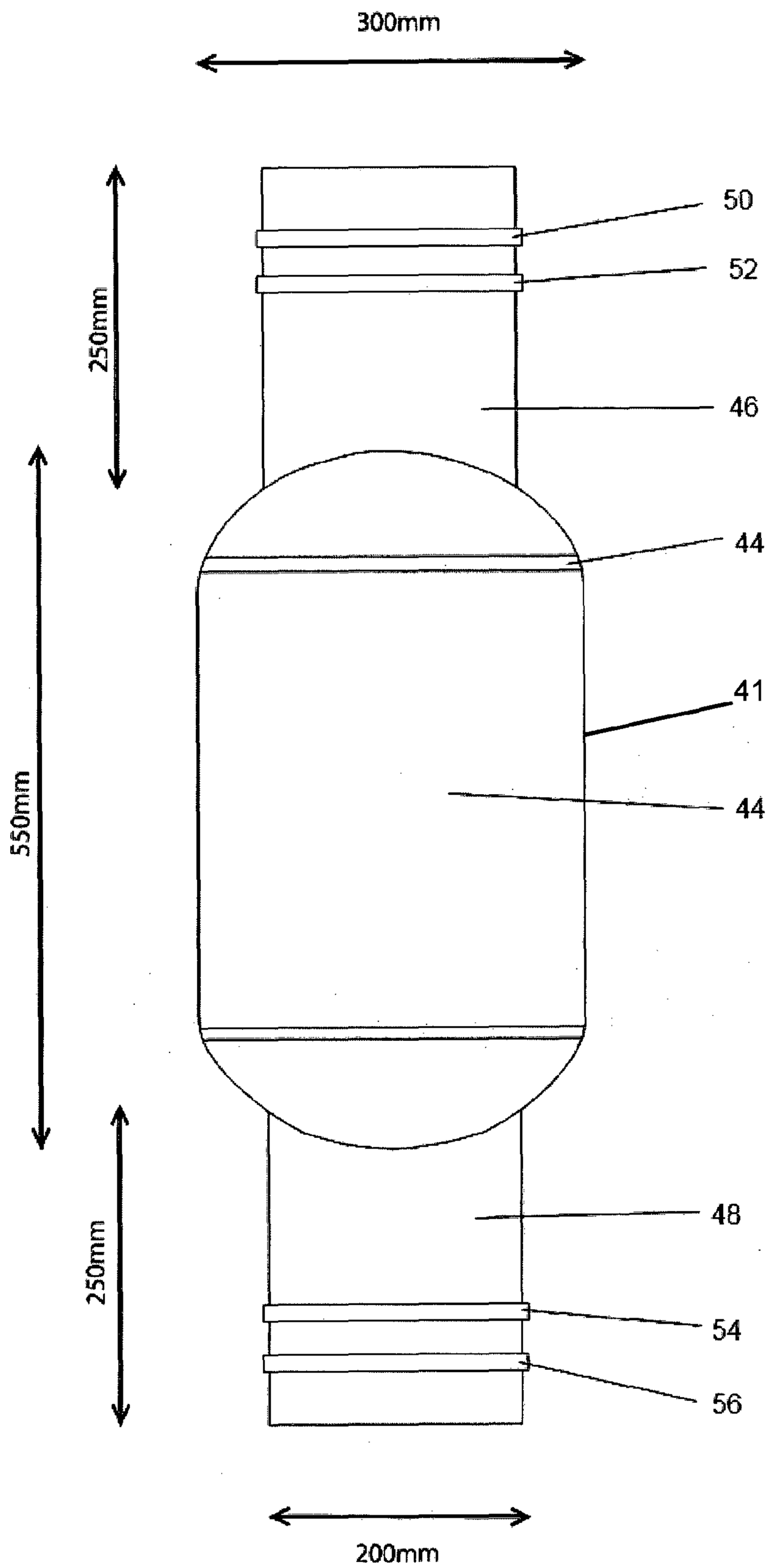
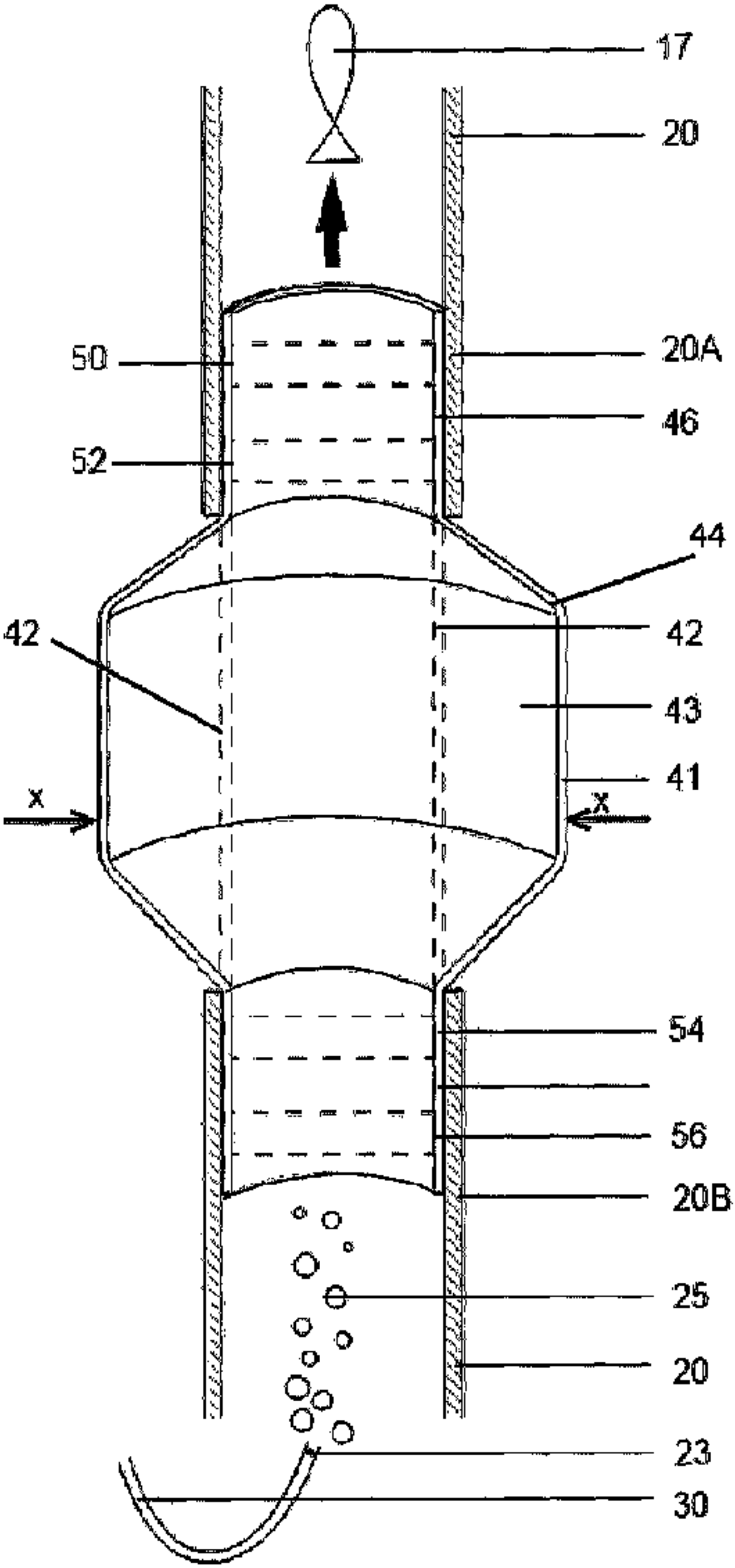


FIG. 4


17
20
50
20A
46
52
44
42
42
43
41
X
X
54
56
20B
25
20
23
30