



(86) Date de dépôt PCT/PCT Filing Date: 2016/11/24

(87) Date publication PCT/PCT Publication Date: 2017/06/01

(45) Date de délivrance/Issue Date: 2024/06/11

(85) Entrée phase nationale/National Entry: 2019/05/24

(86) N° demande PCT/PCT Application No.: NO 2016/000029

(87) N° publication PCT/PCT Publication No.: 2017/091079

(30) Priorité/Priority: 2015/11/25 (NO20151612)

(51) Cl.Int./Int.Cl. *A01K 61/60* (2017.01)

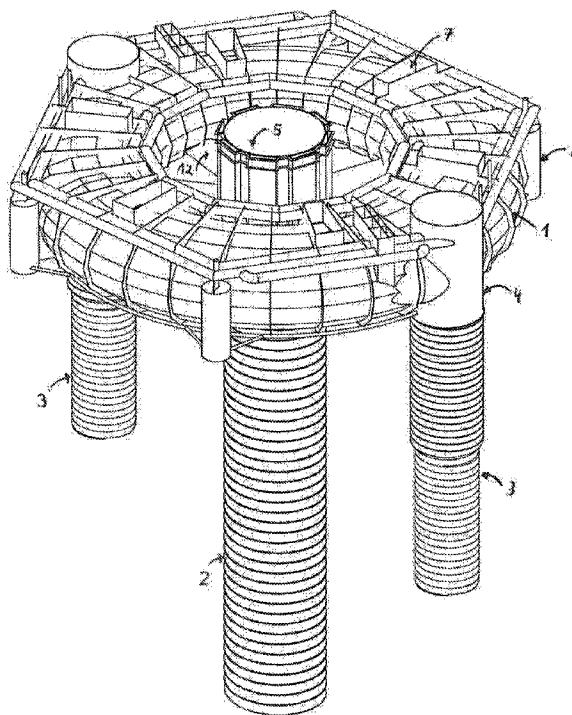
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(54) Titre : SYSTEME DE PISCICULTURE DE FORME ANNULAIRE

(54) Title: RING-SHAPED FISH FARMING SYSTEM



(57) Abrégé/Abstract:

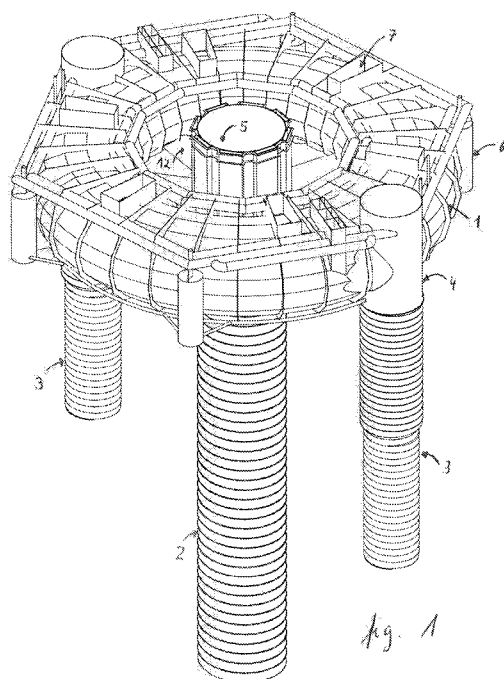
A fish farming system to be placed floating on a surface of surrounding water is disclosed. It comprises a fish habitat with a horizontally arranged, substantially ring-shaped water body for fish to live in. The ring-shaped water body in the habitat is preferably selectively isolatable from the surrounding water and kept in an adjustable flow along the ring in order to provide a virtually endless, streaming environment for the fish.

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

(19) World Intellectual Property
Organization
International Bureau(10) International Publication Number
WO 2017/091079 A1(43) International Publication Date
1 June 2017 (01.06.2017)

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| <p>(51) International Patent Classification:
<i>A01K 61/60</i> (2017.01)</p> <p>(21) International Application Number:
PCT/NO2016/000029</p> <p>(22) International Filing Date:
24 November 2016 (24.11.2016)</p> <p>(25) Filing Language:
English</p> <p>(26) Publication Language:
English</p> <p>(30) Priority Data:
20151612 25 November 2015 (25.11.2015)</p> | <p>(71) Applicant: ØPD GROUP AS [NO/NO]; Asdalstrand 171, NO-3960 Stathelle (NO).</p> <p>(72) Inventor: TUFTE, Nils-Johan; Sikavg. 2, 3940 Porsgrunn (NO).</p> <p>(74) Agent: TANDBERGS PATENTKONTOR AS; P.O. Box 1570 Vika, 0118 Oslo (NO).</p> <p>(81) Designated States <i>(unless otherwise indicated, for every kind of national protection available)</i>: DE, JP, KR.</p> <p>Published:
NO — with international search report (Art. 21(3))</p> |
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(54) Title: RING-SHAPED FISH FARMING SYSTEM



(57) Abstract: A fish farming system to be placed floating on a surface of surrounding water is disclosed. It comprises a fish habitat with a horizontally arranged, substantially ring-shaped water body for fish to live in. The ring-shaped water body in the habitat is preferably selectively isolatable from the surrounding water and kept in an adjustable flow along the ring in order to provide a virtually endless, streaming environment for the fish.

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Ring-shaped fish farming system

Field of invention

The present invention relates to aquaculture. More specifically, the present invention relates to a novel aquaculture fish habitat.

Background

For aquacultural purposes – specifically fish - there are used a number of habitat types to keep the marine organisms: both generally open, floating mesh-based pens, closed floating containers with controlled input of water and output of waste matter, and ponds on dry land.

To optimize the volume and thus the amount of life stock inside these habitats, many of them have a cylindrical, funnel or even (semi-)spherical shape (maximum volume for a given material quantity).

Some of the prior art habitats have an artificial water flow through it. The flow is induced by adding new water at one end and drawing off water at the opposite end. The flow is thus a direct consequence of the inflow and outflow of water from the habitat. As to the knowledge of the applicant, no aquaculture fish habitat is known where the in- and outflow from the habitat is independent of the internal streaming of water, which is an important life-quality aspect for many kinds of fish.

US5970917 discloses a perforated habitat of thermoplastics material with a ring shaped water body which can be completely submerged.

NO20111316 discloses a floating, closed, straight fish habitat with hatches and vertical water supply and discharge pipes.

US2015/0150223 A1 discloses a circular fish pen with radially directed flow of intake water.

US4798168 discloses a circular fish pen with tangentially created circular flow by injecting intake water at the outer rim in tangential direction.

Summary

This patent document discloses a fish farming system to be placed floating on a surface of surrounding water, comprising a fish habitat with a horizontally arranged, substantially ring-shaped water body for fish to live in. The ring-shaped water body in the habitat is preferably selectively isolatable from the surrounding water and kept in an adjustable flow along the ring in order to provide a virtually endless, streaming environment for the fish.

In the fish farming system at least one water flow producing device with an intake and an outlet for water can be located at a first side wall of the fish habitat in order to create and maintain the flow.

Preferably at least one conduit is connected through an inlet to the fish habitat of the fish farming system to supply water from outside the fish habitat.

In the fish farming system at least one conduit is preferably arranged to be adjustable in length in order to supply water from a selectable depth below the water surface the system is placed upon floating.

The above mentioned intake of the at least one water flow producing device is preferably arranged to draw water from the ring-shaped water body in the habitat, or from the conduit inlet in order to add water to the ring-shaped water body, or - with a selectable ratio - from both.

In the fish farming system, the conduit inlet is preferably closed water-tight when water is drawn from the ring-shaped water body in the fish habitat according to the first alternative above.

Drainage points can be arranged at different heights of a second side wall of the fish habitat to remove matter from the fish habitat in the fish farming system, where the matter comprises one of a group consisting of dead fish, sediments, fish excrements and excess water. Dead fish, sediments and excrements are preferably drained at a lower drainage point, while excess water at a medium height.

At least one protrusion is preferably arranged inside the ring-shaped streaming water body in order to provide a calm water location for fish in the fish farming system.

The fish habitat in the disclosed fish farming system may comprise at least one watertight hatch.

Preferably, the fish farming system is substantially made of a non-corrosive, flexible material, for instance a thermoplastic.

Brief description of the drawing

Preferred embodiments will be described below with reference to the figures, where

- fig. 1 shows a perspective view of the inventive fish farming system, including intake and outlet pipes to the fish habitat extending further below the surface, the habitat is floating on;
- fig. 1A shows a minor view of the system with operations deck;
- figs. 2,3 show a side view of the floating fish farming system, fig. 3 even indicating the placement of the cross sectional views of figs 6, 7;
- fig. 4 shows a top view of the fish farming system;
- fig. 5 gives a bottom view of the system;
- fig. 6 shows a vertical cross section view (ref. fig. 3) through the fish farming system, disclosing the cross section of the internal space for the ring-shaped water body and details of the water inlet and water flow producing device(s);
- fig. 7 shows a horizontal cross section view (ref. fig 3) through an upper part of the fish habitat 1 and the hub arrangement;
- fig. 8 shows details of waste discharge aspects of the fish habitat 1

Detailed description of preferred embodiments

Fig. 1 provides a perspective view of an embodiment of a fish farming system floating on a water surface 9 according to the present invention. The assembly comprises a ring tube with – in this case – substantially toroidal shape (the fish habitat 1) and a number of pipes 2, 3 extending downwards (to deeper water) from the fish habitat 1.

The cross section of the ring tube need not be a circular (giving an exact torus) but can be of any suitable cross section contour. Particularly, the cross section contour could be modified to form a ‘gutter’ at the bottom in order to collect sediments.

The ring tube seen from top view may even not be a really circular structure, but assembled of a number of straight segments, giving a ring-like ‘multi-gonal’ (f. inst. hexagonal or octagonal) shape.

There are separate pipes 2, 3 extending down from the fish habitat 1 for two different functions:

- In the present embodiment, two intake conduits 3, 4 are used as supply pipes for fresh water from a selectable depth – the length down of the pipes is adjustable – through one or more inlets in the intersections 4 to the ring-shaped fish habitat.
- A single (in this embodiment) pipe 2 is suspended to the center of the fish habitat 1 by a “hub” 5 for removal of used water from the fish habitat 1. Generally, as much water as supplied through supply pipes 3 must be removed from the fish habitat simultaneously, typically through removal pipe(s) 2. The hub 5 is attached to the ring-shaped fish habitat 1 by pipe spokes 12, leading water from the fish habitat to the hub 5. The removal pipe 2 or the center pipe of the hub 5 or the spoke pipes may contain equipment for cleaning the water (filter) before it leaves the fish farming system to the environment.

One or more windows and/or hatches 7 are arranged on the top of the fish habitat 1 in order to provide access/view to the interior of the habitat. Lids for the hatches are preferably water-tight when closed or at least protect against minor organisms possibly contained in sea spray, such as salmon louse (*Lepeophtheirus salmonis*) or *Gyrodactylus salaris*.

The intersections 4 are shown open on the top. In order to avoid contamination of the water in the fish habitat 1, the intersections are normally closed by a lid, too. Also these lids are preferably water tight or at least cannot be passed by minor organisms possibly contained in sea spray.

Buoyancies bodies 6 at the outer rim of the fish farming system can be used to adjust how deep the system is submerged below the water line 9.

A platform – not shown in all drawings - can be mounted on top of the fish habitat for safe access for operating personal.

Fig. 2 provides a side view on the fish farming system. It shows essentially the same features of the embodiment as fig. 1. It is to be noted, that the waterline indicated on this and some other figures is extremely low, even taking the buoyancy bodies 6 out of function. This is typically the case only when the fish habitat 1 is substantially empty.

Furthermore, fig. 2 shows that the conduits for water intake 3 have a lower diameter in the lower section. This is a result from being length-adjustable in a ‘telescopic’ way in

order to achieve above mentioned intake of water from an adjustable depth below the surface.

Fig. 3 provides a side view very similar to fig. 2 but from a different angle. In addition, fig.3 indicates the placement of the cross sections A-A and B-B given in figs 6 and 7.

Fig. 4 gives a birds-eye view of the embodiment of the present invention. In the shown embodiment, the intersections 4 considerably intersect with the ring-shaped fish habitat 1, thus considerably squeezing the cross section of the habitat. This can result into turbulence in the habitat. In other embodiments not shown here, the intersections are a part of the fish habitat wall, located substantially on a vertical wall part of the fish habitat 1 or at least occupy a minor part of the fish habitat cross section. The intersections 4 – in addition to providing access to fresh water from the conduits 3 - provide the space for at least one device that creates and maintains a circular flow through (along) the water body contained in the ring-shaped fish habitat. This device will be explained in more detail in connection with fig 6.

The flow in the ring-shaped fish habitat may circulate clockwise through the ring – as shown or implied in some of the figures – or counter-clockwise depending on embodiment and localization/local preferences.

The center of the fish farming system, the “hole” in the center of the ring-shaped fish habitat 1 contains a “hub” 5 being a vertical center pipe and an arrangement of pipes for removal of various matter from the fish habitat 1. A number of tubular spokes 12 lead water/matter from different heights (the height aspect is not shown in the figs) to the center hub. Typically, matter heavier than water is removed through a drainage point 11 at the bottom and excess water (“excess” because fresh water has been added/will be added subsequently to the fish habitat and a corresponding quantity of water has to be removed accordingly) is removed through a drainage point above said bottom drainage point, typically at about half height of the water body in the fish habitat. Floating matter - with less density than water – can be drawn off on top of the water body by using surface cleaning means connected to even higher drainage point(s).

Fig. 5 gives an opposite view compared to fig. 4 from below. The pipe structure of the hub 5 is even more recognizable than in fig.4.

Fig. 6 shows a vertical cross section through the embodiment of the invention indicated as “A-A” in fig. 3. The cross section even gives a more detailed view on the water flow producing device(s) 10 and the hub 5 piping arrangement.

Water flow producing devices 10 – a plurality of such devices can be distributed along the rim of the fish habitat - in this embodiment is a large three-bladed propeller on a horizontal axis submerged into the water body accelerating water to flow through the ring. The velocity of the water depends on the fish species and is not further specified in this disclosure. The device is adjustable for a wide variety of velocities. Instead of a horizontal axis arrangement also a vertical axis arrangement with a centrifugal pump could be chosen which would allow having the necessary motor above the water surface.

The water flow producing device(s) take water from

- a) the water body inside the fish habitat 1,
- b) the conduit 3 in order to replenish/displace existing water in the water body of the habitat, or
- c) both sources according to an adjustable ratio.

In case of a) the conduit 3 is preferably closed water tight such that the system runs as a completely closed (isolated) system.

This inventive feature enables to run the system in a very flexible manner with a streaming velocity inside the habitat completely independent of the quantity of water taken from the surrounding water (sea). When running in modus c), the adjustable mixing ratio and the adjustable depth for the intake conduits even permits regulating temperatures in the fish habitat between surface temperature and temperature at intake point at the lower end of the conduit(s).

The water flow producing device(s) could in another embodiment also be attached to the inner rim of the ring-shaped fish habitat 1. In this case, more of the technical installations would be concentrated in the center together with the filtering means and hub structures and could even be designed as a self-contained ‘center module’ to be used in a conventional circular fish pen of suitable size and shape.

Fig 6 also shows the cross section contour of the fish habitat. In this embodiment, the contour is not circular, i.e. the habitat is not a torus by definition. The contour of the cross section can have any useful shape. Specifically, the contour can be such that it

results into a 'gutter' in and along the bottom of the ring. This gutter is preferably connected to the lowest drainage points 11 of the hub arrangement. Heavier-than-water matter to be removed - such as described above - will collect in the gutter and drawing it off from there will result into a high concentration, i. e. less water follows the matter compared to a fish habitat with a rather flat bottom.

Specific cross section contours can result into flow patterns inside the fish habitat which can give advantages in specific operational situations.

Fig. 7 shows a horizontal cross section as indicated in fig. 3 as "B-B".

Fig. 8 shows filtering means 13 preferably provided inside the vertical hub pipe 5. Alternatively, filter elements are arranged in connection with the tubular spokes 12 from the fish habitat 1 to the hub tube 5. Mechanically removable filtered matter can be removed 14 by a vacuum tool or similar to the top. Even the filter 13 itself can be lifted 14 to the top by a lifting device in order to exchange the filter 13.

The tubing/pipes 12 connecting the fish habitat 1 with the hub 5 – the tubular spokes 12 - are preferably connected to the fish habitat in a way giving a hydrodynamic advantage to avoid turbulence at the exit from the fish habitat 1 to the tubing/pipes 12.

P a t e n t c l a i m s

- 1 A fish farming system to be placed floating on a surface of surrounding
water, comprising a fish habitat, said fish habitat containing:
- 5 a. a horizontally arranged, substantially ring-shaped water body for fish to
live in, said ring-shaped water body selectively being isolatable from the
surrounding water and kept in an adjustable flow along the ring in order to
provide a virtually endless, streaming environment for the fish; and
- 10 b. tubular spokes arranged to lead water and waste matter from the ring-
shaped water body in the fish habitat to a center hub for removal from said
water body or for filtering.
2. The fish farming system according to claim 1, wherein at least one water flow
producing device with an intake and an outlet for water is located at a first side wall of
15 said fish habitat in order to create and maintain said flow.
3. The fish farming system according to claim 1, wherein at least one conduit is
connected through an inlet to the fish habitat to supply water from outside the fish habitat.
- 20 4. The fish farming system according to claim 2, wherein said at least one conduit s
arranged to be adjustable in length in order to supply water from a selectable depth below
said water surface.
- 25 5. The fish farming system according to claim 2, wherein said intake of said at least
one water flow producing device is arranged to draw water from at least said ring-shaped
water body in the habitat.
- 30 6. The fish farming system according to claim 2, wherein at least one conduit is
connected through an inlet to the fish habitat to supply water from outside the fish habitat,
and wherein said intake of said at least one water flow producing device is arranged to
draw water from at least said conduit inlet in order to add water to the ring-shaped water
body.
- 35 7. The fish farming system of claim 6, wherein said intake of said at least one water
flow producing device is arranged to draw water with a selectable ratio from both said
conduit inlet and said intake.

8. The fish farming system according to claim 6, wherein said conduit inlet is actively closed water-tight when water is drawn from said ring-shaped water body in the fish habitat.

5 9. The fish farming system according to claim 1, wherein drainage points are arranged at different heights of a second side wall of said fish habitat to remove matter from the fish habitat.

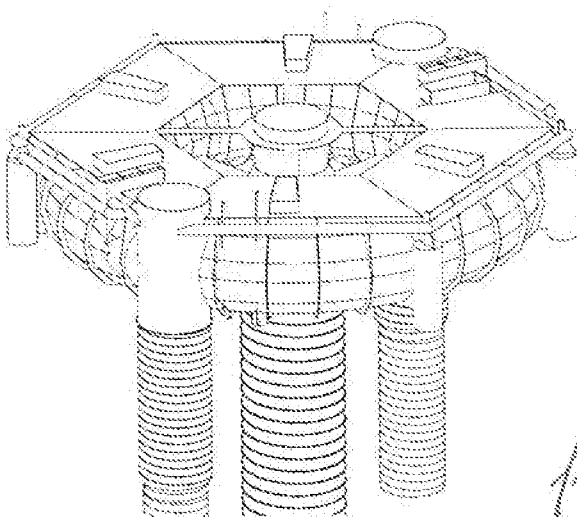
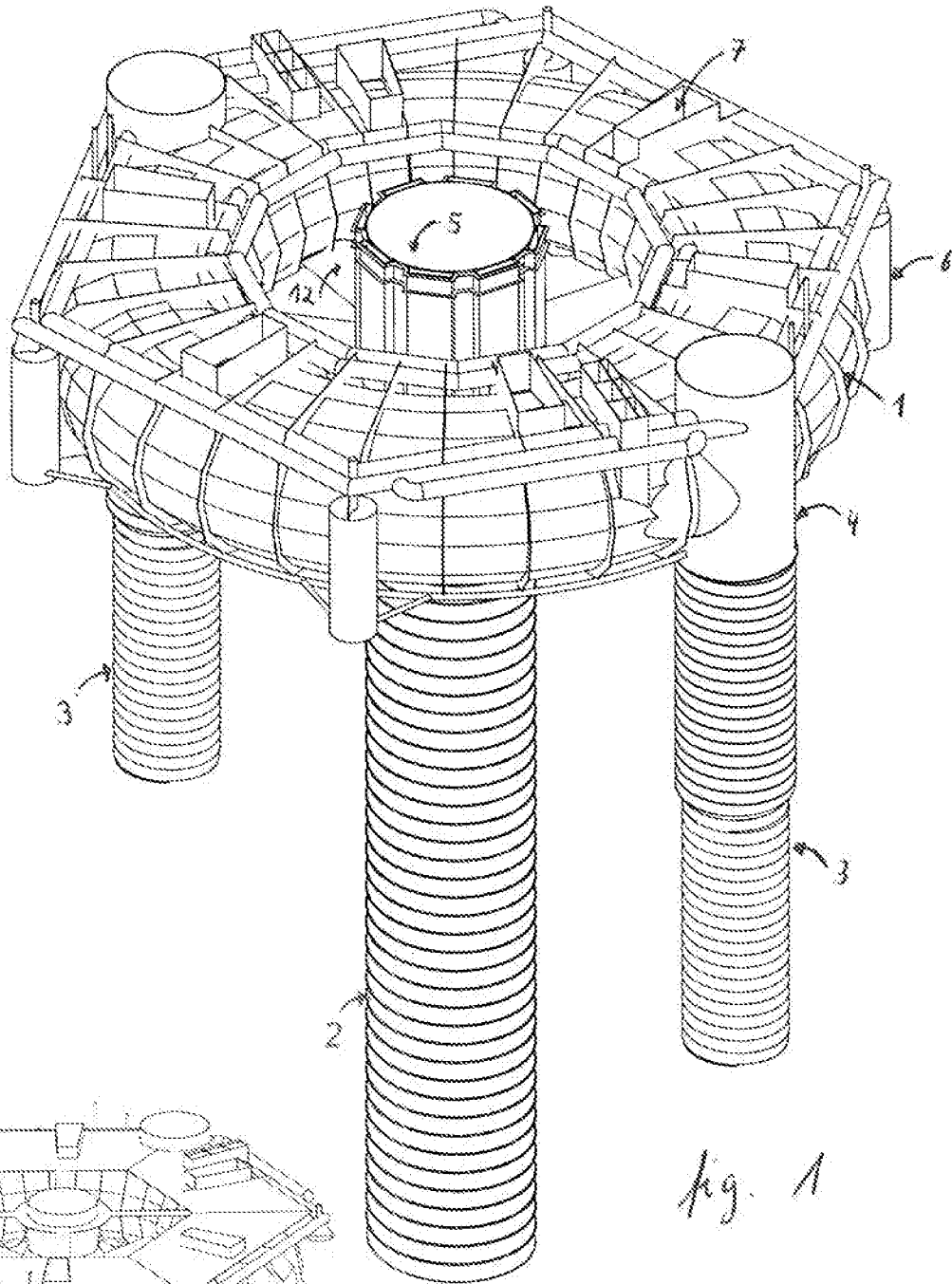
10 10. The fish farming system according to claim 9, wherein said matter comprises one of a group consisting of dead fish, sediments, fish excrements and excess water.

15 11. The fish farming system according to claim 10, wherein dead fish, sediments and excrements are drained from the fish habitat at a lower drainage point, while excess water is drained from the fish habitat at a second drainage point that is at a higher elevation than the lower drainage point.

20 12. The fish farming system according to claim 1, wherein at least one protrusion is arranged inside the ring-shaped streaming water body providing a calm water location for fish.

13. The fish farming system according to claim 1, wherein said fish habitat comprises at least one watertight hatch.

25 14. The fish farming system according to claim 1, wherein said fish farming system is substantially made of a non-corrosive, flexible material.



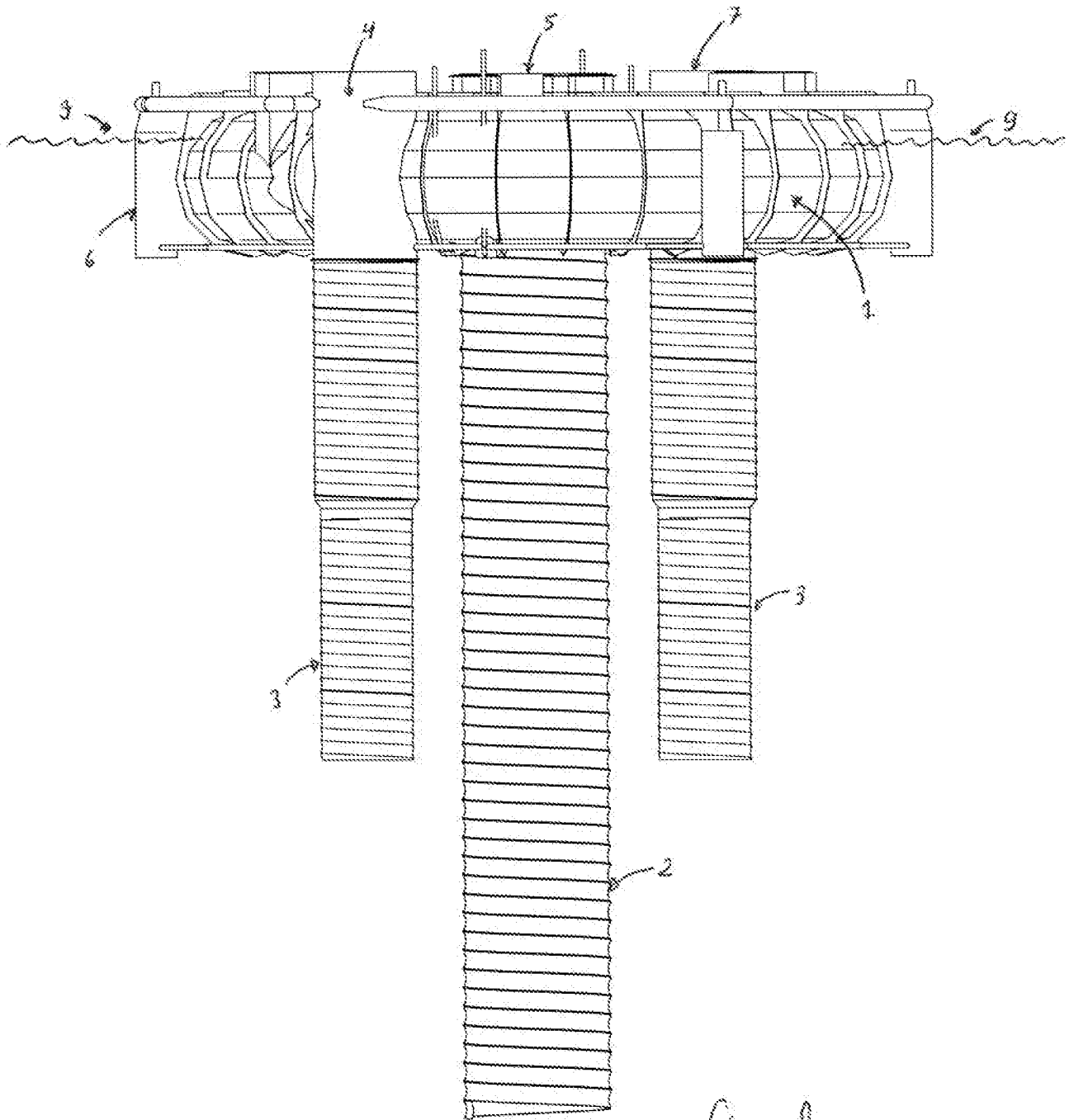
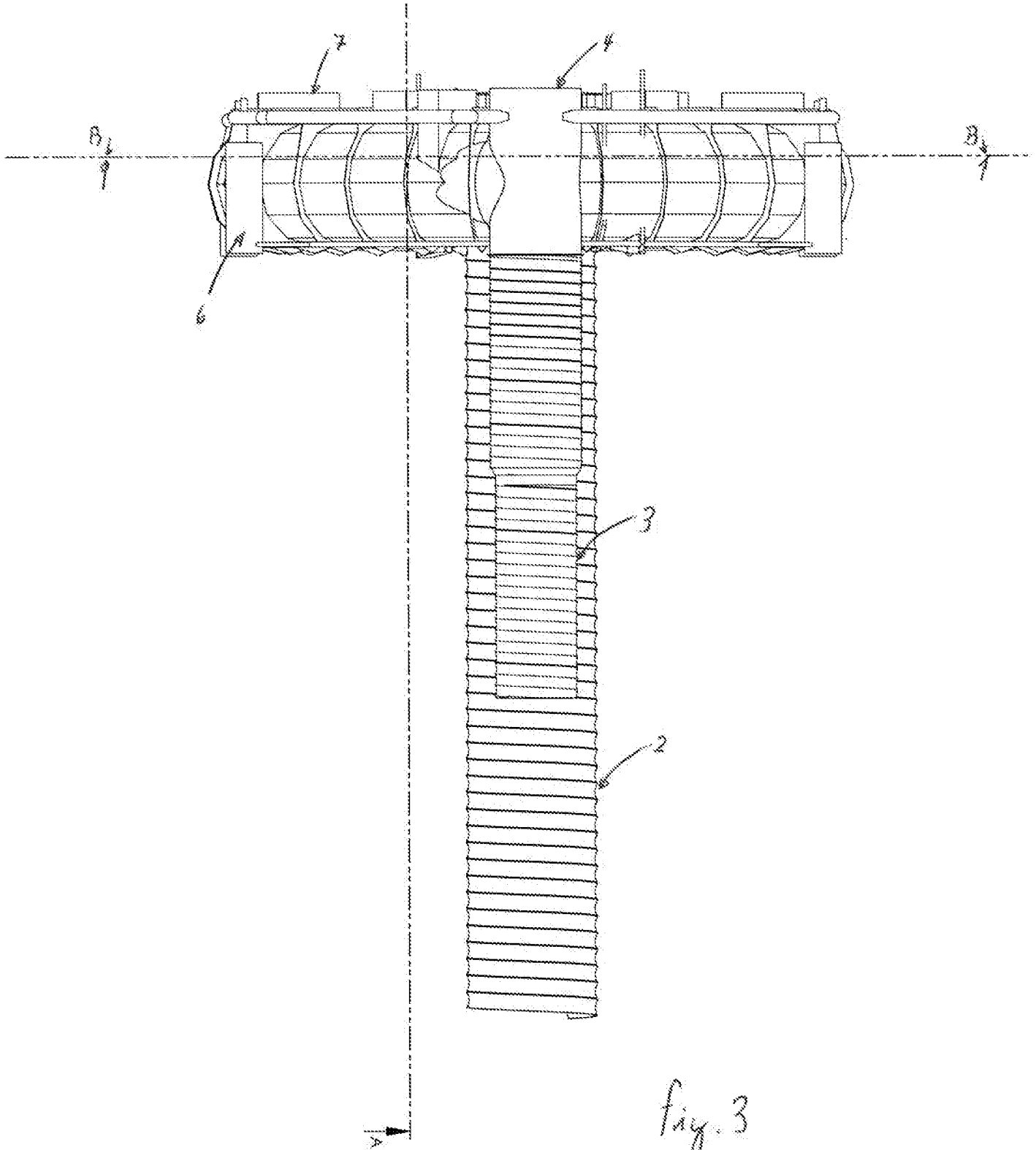


fig. 2



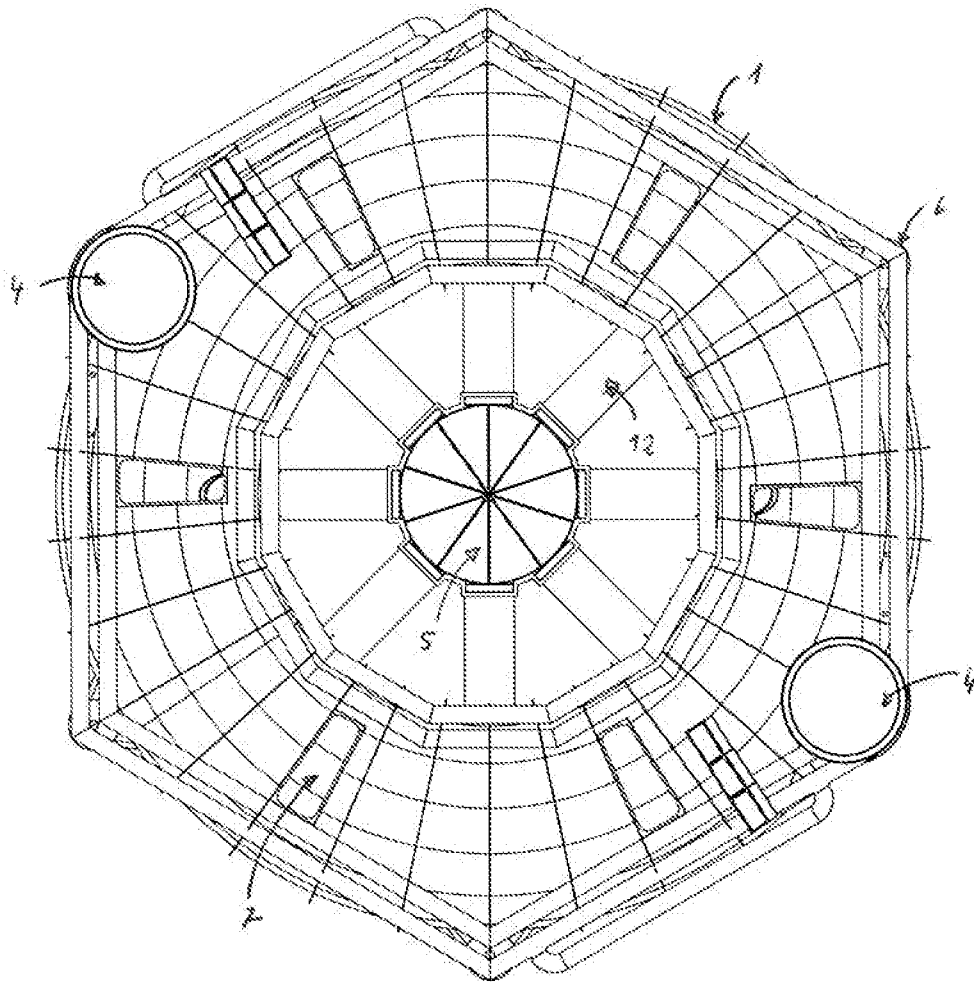


fig. 4

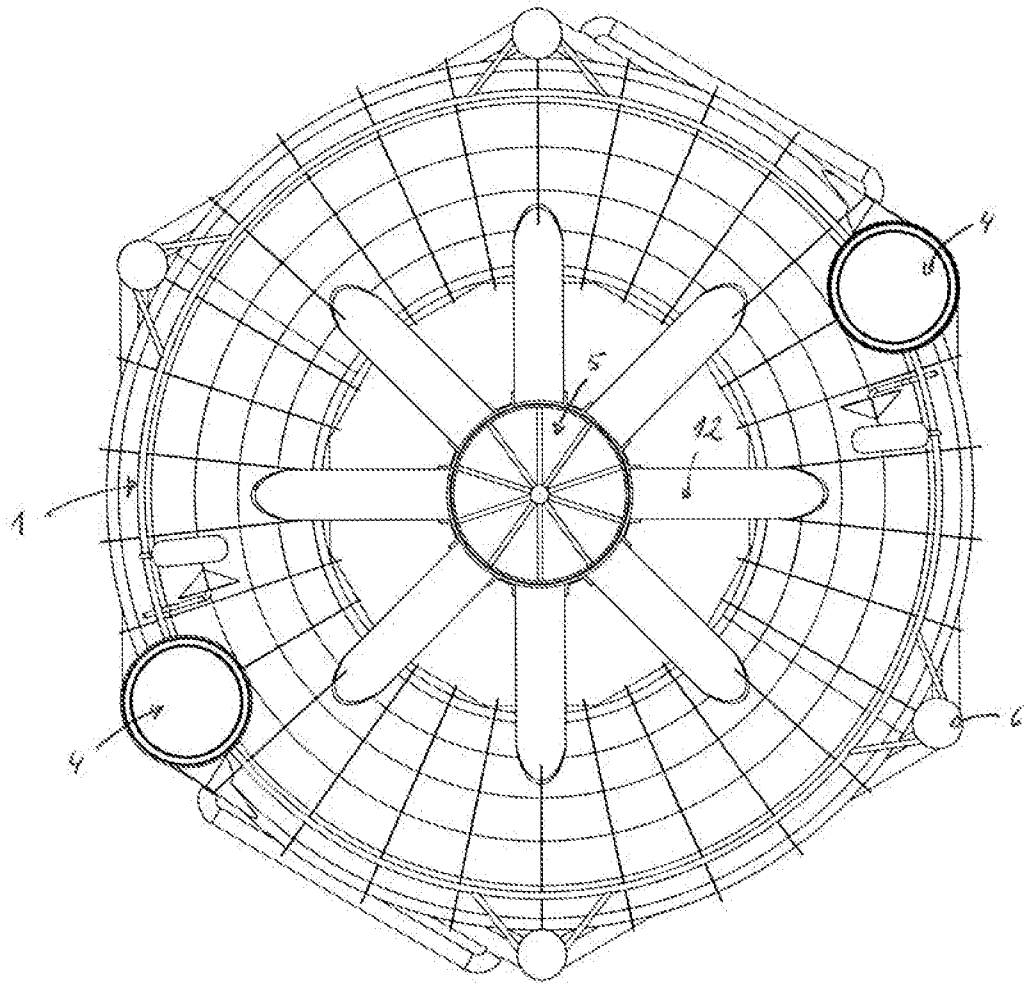


fig. 5

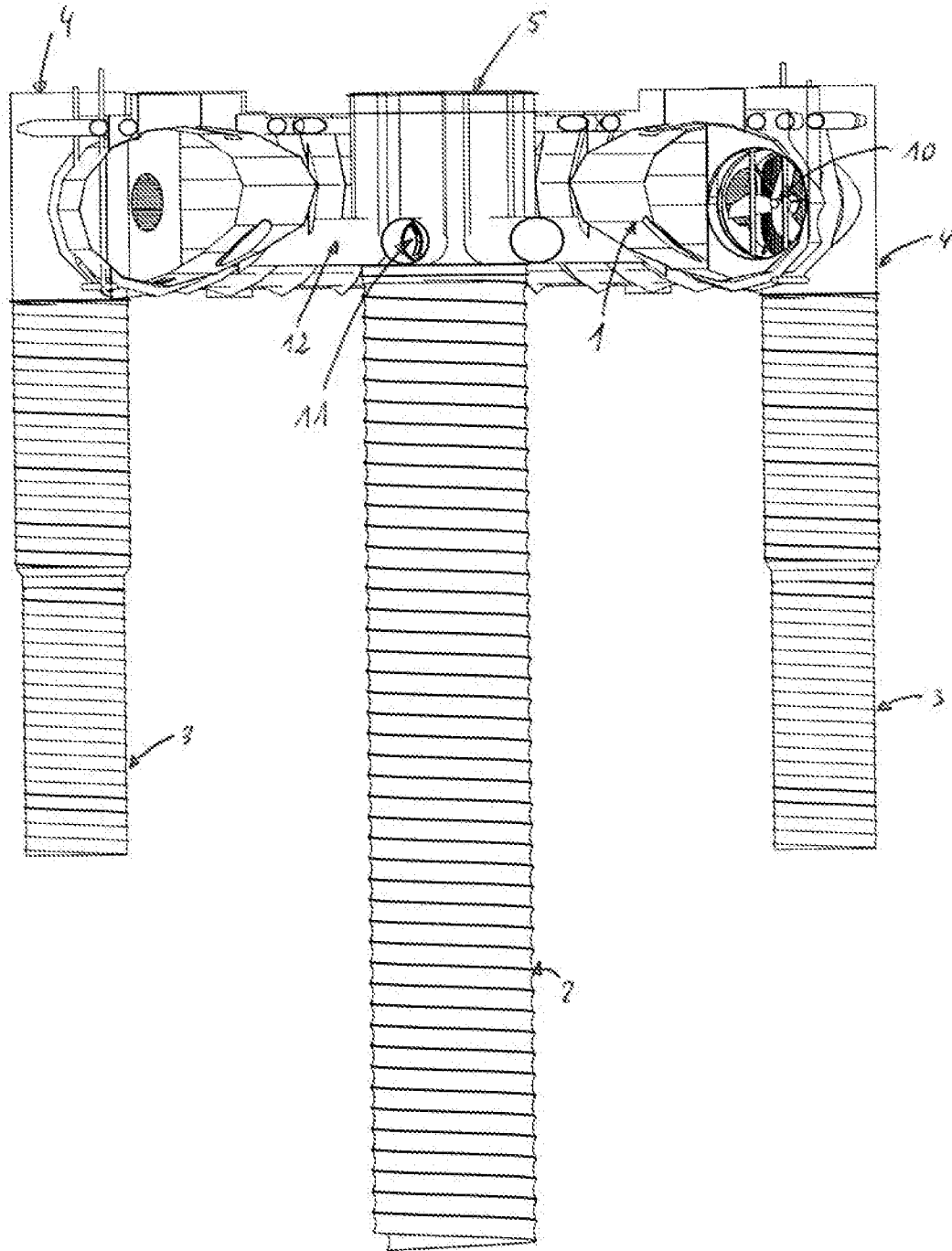
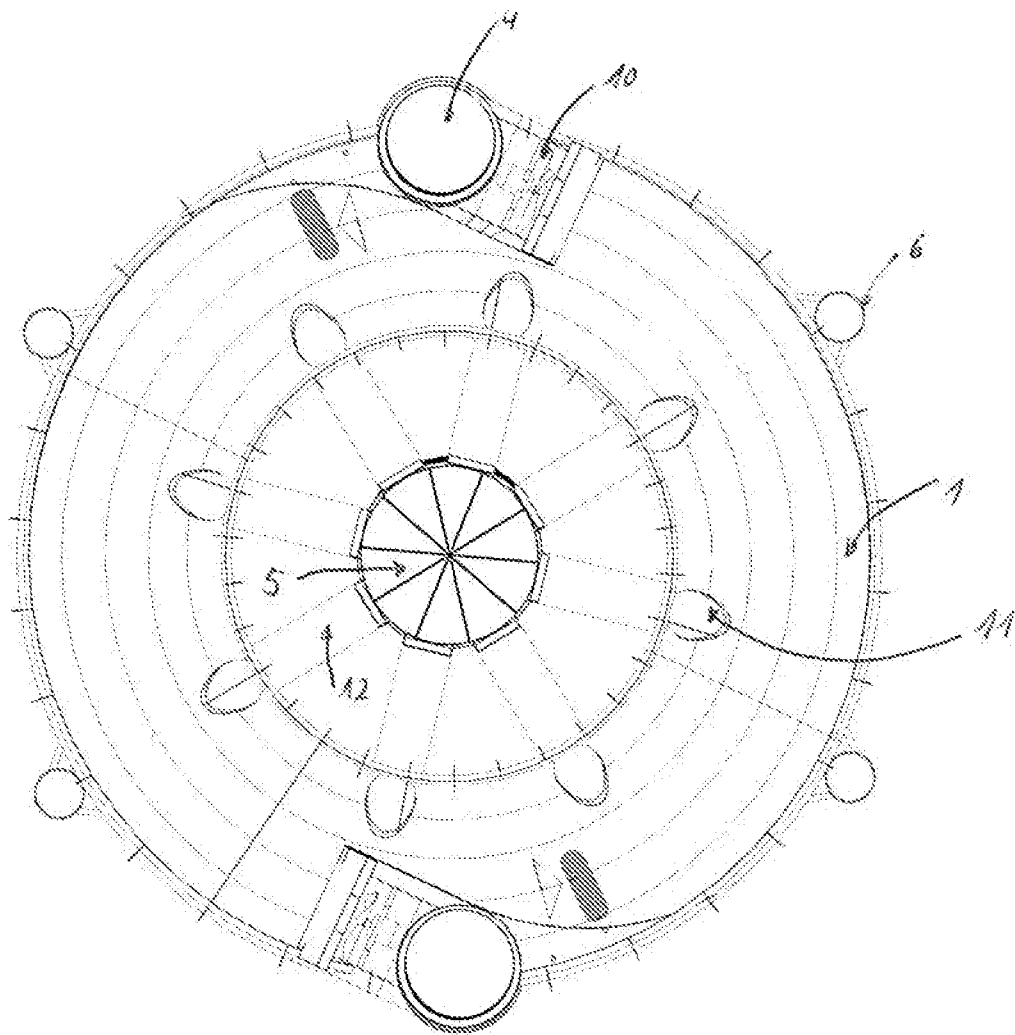


fig. 6



B-B

fig. 7

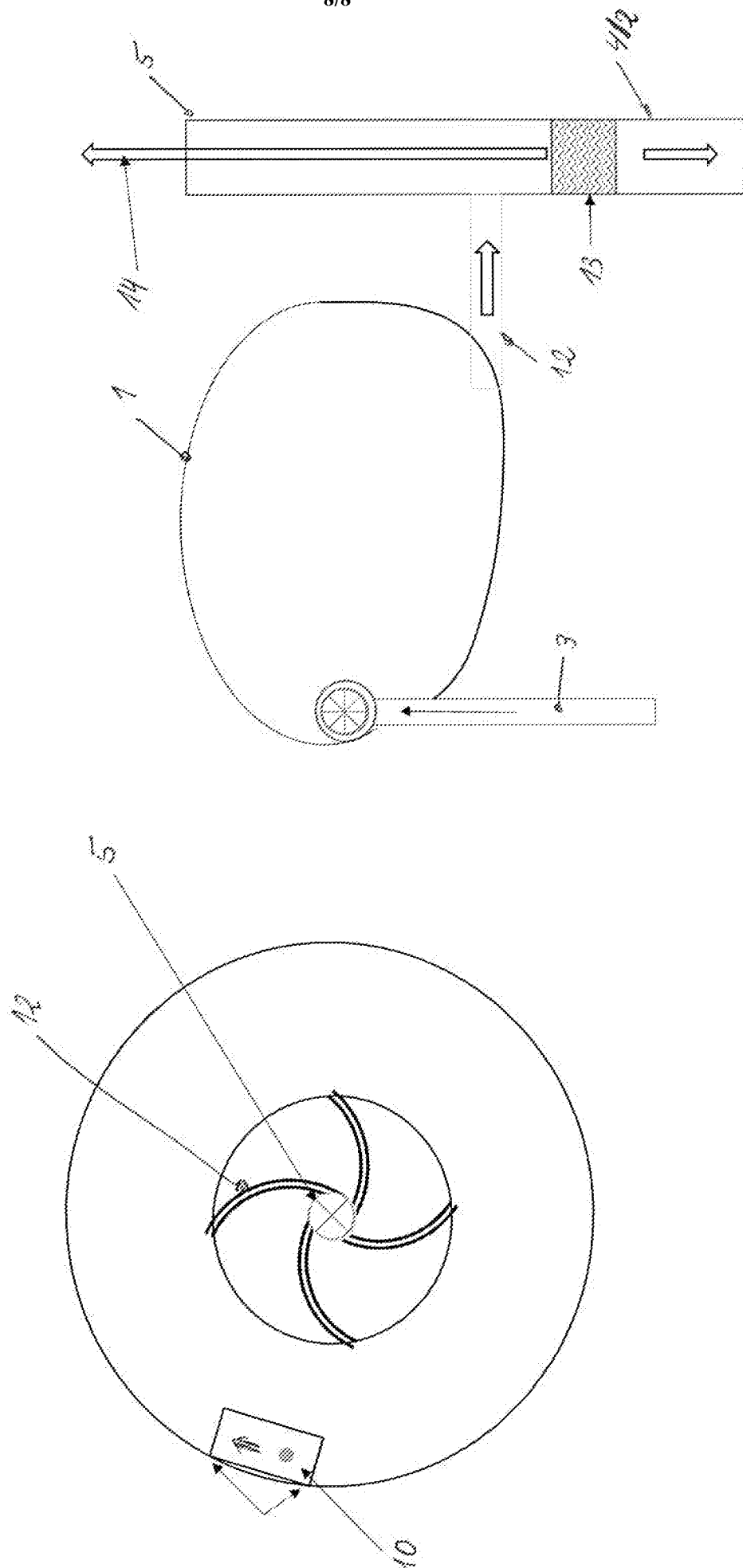


Fig. 8

