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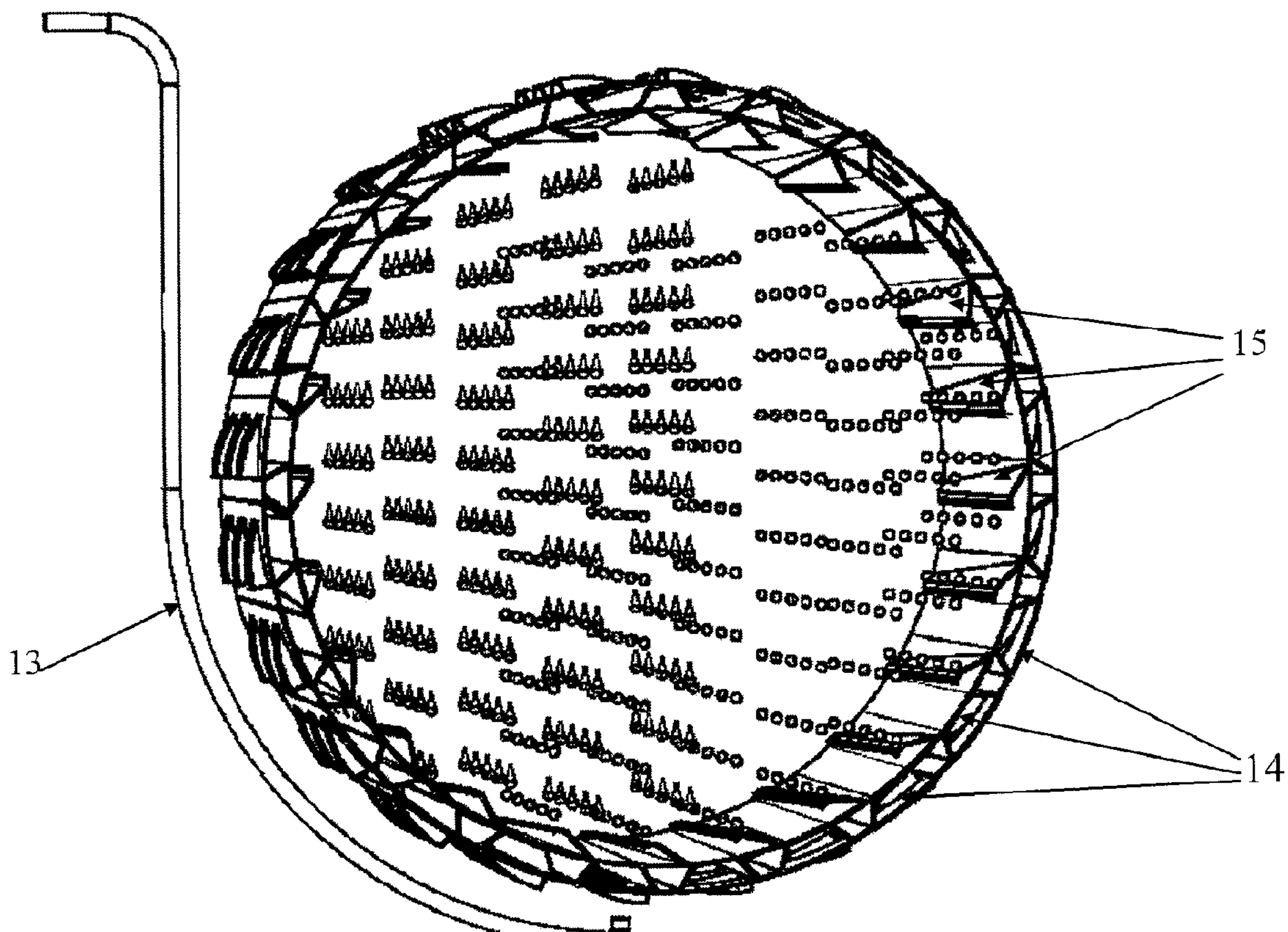
(72) **Inventeur/Inventor:**
NADON, GILLES, CA

(73) **Propriétaire/Owner:**
NADON, GILLES, CA

(74) **Agent:** NA

(54) **Titre : SYSTEME DE METHANISATION FLOTTANT**
(54) **Title: FLOATING METHANIZATION SYSTEM**



(57) **Abrégé/Abstract:**
An anaerobic methanization system for treatment of wastewater or other organic waste comprising multiple floating cylindrical methanization bioreactors almost totally immersed in water, mixing their contents by revolving on themselves by the action of air

(57) **Abrégé(suite)/Abstract(continued):**
ejected from a conduit underneath them, engaging all elements in a collective momentum, from a multiplied force, because of the constant free power of each air bubble lodged in exterior buckets and grouped as a lifting force. Interior mixing buckets facilitate the thorough mixing of the contents of the bioreactors by sinking the biogas and floating elements while raising heavy matter from the bottom to let it sink back, crossing the climbing biogas bubbles. Since the bioreactors are floating in water under ground level in a thermally insulated basin, they are less exposed to cold, making it possible to easily establish entirely homogeneous and precise temperatures that are needed for the mesophilic and thermophilic processes.

Abstract

An anaerobic methanization system for treatment of wastewater or other organic waste comprising multiple floating cylindrical methanization bioreactors almost totally immersed in water, mixing their contents by revolving on themselves by the action of air ejected from a conduit underneath them, engaging all elements in a collective momentum, from a multiplied force, because of the constant free power of each air bubble lodged in exterior buckets and grouped as a lifting force. Interior mixing buckets facilitate the thorough mixing of the contents of the bioreactors by sinking the biogas and floating elements while raising heavy matter from the bottom to let it sink back, crossing the climbing biogas bubbles. Since the bioreactors are floating in water under ground level in a thermally insulated basin, they are less exposed to cold, making it possible to easily establish entirely homogeneous and precise temperatures that are needed for the mesophilic and thermophilic processes.

Description

The title of the invention is

FLOATING METHANIZATION SYSTEM

The invention is in the field of the treatment of wastewater or other organic waste by the process of methanization.

Up until this time, methanization processes are done in stationary hermetical bioreactors wherein different means are used to heat and mix the contents.

High costs are involved when the energy produced has to be used as a force to mix the contents when the conditions that facilitate the movement are absent. When the movement has to be applied to the mixture in a stationary structure, the force never achieves its autonomy of movement because it is too slow. The stagnating elements tend to clog, nullifying the force.

Considerable energy is also needed to maintain the very precise temperatures essential to create a favourable environment for the microorganisms to transform the material into biogas. The energy has to drive through clogged elements when the construction is fully exposed to a rigorous climate.

The new idea is an anaerobic methanization system for treatment of wastewater or other organic waste, comprising floating cylindrical methanization bioreactors, mixing their contents by revolving on themselves by the action of air ejected from a conduit underneath them.

The new approach aims to be economical with regards to the structure of the bioreactors simply because they float with their contents, in perfect relaxation.

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The invention also aims to perform well with respect to the mixing of the contents or substrate by being more economical pertaining to the energy required. Revolving in water engages all elements in a collective momentum, from a multiplied force, because of the constant free power of each air bubble lodged in exterior buckets and grouped as a lifting force.

As for the heating problems, due to the fact that the bioreactors are floating in water in a thermally insulated basin and bathing under ground level, they are less exposed to cold. Therefore, it is possible to easily establish entirely homogeneous and precise temperatures that are needed for the mesophilic and thermophilic processes.

Following is a general description of the figures that illustrate the realization of the invention: Figure 1 represents several bioreactors partially immersed in water. Figure 2 is a diagonal slice view of the inside of a bioreactor also showing the air conduit. Figure 3A represents a general perspective view of the spirit of the system. Figure 3B is a detailed view of Figure 3A, showing parts of two bioreactors and the conduits that join them with a cut showing part of the inside of one bioreactor. Figure 3C is a detailed elevation cut view of the inside of one of the bioreactors of Figure 3B, also showing the inlet and outlet conduits and the pipe used to release the biogas produced. Figure 3D is also a detailed view of the inside of one of the bioreactors of Figure 3B, also showing the air conduit. Figure 4 is a perspective view of a bioreactor with a cut showing the inside spiral that facilitates the conveying of heavy material to be ejected.

Referring to the drawings in greater detail and by reference characters thereto, there is illustrated an anaerobic methanization system that works by means of multiple pressurized cylindrical bioreactors 10a to 10z, almost totally immersed in water in a thermally insulated basin 11, and floating under ground level, as can be seen in figure 1.

To establish productivity and determine the end of the cycle, the application groups several consecutive bioreactors 10, the quantity, dimension and volume capacity of each being determined by the length of time that the different steps of the treatment will require, and the quantity of material to be treated. The first bioreactor (or biorcactors if there are several) of a series are designated as bioreactors 10a, the middle ones that can be more or less numerous are designated as 10b, 10c, 10d, etc., and the last bioreactor is designated as 10z. The process begins in the first bioreactors 10a of a series, set at the thermophilic level of temperature. These first bioreactors 10a also allow for the decantation of heavy unwanted material, such as sand and gravel. The process continues in the middle bioreactors 10b, 10c, 10d, etc., set at the mesophilic level of temperature. The last bioreactor 10z of a series, also set at the mesophilic level of temperature, serves to gauge the production of the biogas, and determine the end of the cycle. These elements are illustrated in figures 1 and 3A.

Each immersed vessel is a pressurized cylindrical bioreactor 10 equipped with flotation chambers 12 to counterbalance its weight, and that of its contents, and also provide sufficient buoyancy to facilitate flotation and maintain its horizontal level in the water. These elements are illustrated in figures 3A and 3B.

The bioreactors revolve on themselves by the action of air ejected from a conduit 13 underneath them, as can be seen in figures 2 and 3D. This air lodges into exterior rotation buckets 14, best seen in figures 3B and 3D, set as the teeth of a circular saw, and positioned along the longitudinal part of the bioreactor shell. The air acts as a flotation and rotating force to make the bioreactors revolve on themselves, thus facilitating the mixing of the contents. The air remains inside the exterior buckets 14 until, as a consequence of the rotation of the bioreactor 10, the said buckets 14 attain the surface of the water in the basin 11 where the air is released.

Other buckets 15 (see figures 2, 3B, 3D, and 4) are positioned inside the revolving bioreactors 10 facing in the opposite direction from the exterior ones 14. These interior mixing buckets 15 facilitate the thorough mixing of the contents of the bioreactors. These interior mixing buckets 15 grab and mix the contents by sinking the biogas and floating elements while raising heavy matter from the bottom to let it sink back, crossing the climbing biogas bubbles. When the biogas and floating elements arrive at the bottom of the bioreactor, they are exchanged for the heavy material which is brought up and released at the surface. In this way, the whole contents of the bioreactors are easily mixed and the biogas bubbles and light material that go up cross the heavy material that goes down by gravity. This process is best seen in figure 2.

Each bioreactor has an inlet longitudinal end and an outlet longitudinal end 16, with an inlet and outlet spout 17 in the middle point of these longitudinal ends 16. An elbow 19 joins the spouts 17 to inlet and outlet conduits 18 that drive and exhaust the contents from bioreactor to bioreactor. The spouts 17 leave the bioreactors free to swivel into or over the inlet or outlet conduits 18. The conduits 18, drawing from a surface point, could be used to maintain the position of the bioreactors 10. These elements are best seen in figures 3A and 3B.

The inlet conduit 18 carries a biogas pipe 20, used to convey the biogas captured inside the top space of the bioreactors 10 where the biogas accumulates. This biogas pipe 20 crosses the inlet conduit 18 at the elbow 19, follows this conduit 18 to the outside surface of the basin 11 where the biogas is held by a pressure relief valve, and used to regulate the volume of sludge contained in the bioreactor. This can be viewed in figures 3B and 3C.

As can be seen in figure 4, inside the exit end of each bioreactor 10, there is a spiral channel 21 used to convey the heavy matter from the bottom of the bioreactor through the outlet spout 17.

It will be understood that the above described embodiments are for purposes of illustration only, and that changes or modifications may be made thereto without departing from the spirit and scope of the invention.

Claims

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

1. An anaerobic methanization system for the treatment and transformation of wastewater and other organic putrescible material into biogas and liquid fertilizer, comprising several consecutive floating pressurized cylindrical bioreactors (10), almost totally immersed in water in a thermally insulated basin (11), each bioreactor comprising flotation chambers (12), and revolving on itself by the action of air ejected from a conduit (13) underneath it, mixing its contents at set temperatures, and further comprising exterior rotation buckets (14), interior mixing buckets (15), a longitudinal inlet end and a longitudinal outlet end (16), an inlet and an outlet spout (17), an inlet and an outlet conduit (18), elbows (19) joining the inlet and outlet spouts (17) to the inlet and outlet conduits (18), a biogas pipe (20), and a spiral channel (21) at the longitudinal outlet end (16).

2. The anaerobic methanization system of claim 1 wherein the several consecutive floating pressurized cylindrical bioreactors (10) serve different functions depending on the stage of the process, the first ones (10a) of a series, set at the thermophilic level of temperature, are used for the beginning of the process of biogas production, and also allow for the decantation of heavy unwanted material, the middle bioreactors (10b, 10c, 10d, etc.), set at the mesophilic level of temperature, continue the process, and the last bioreactor (10z), also set at the mesophilic level of temperature, serves to gauge the production of the biogas, and determine the end of the cycle.

3. The anaerobic methanization system of any one of claims 1 or 2 wherein the flotation chambers (12) of the floating pressurized cylindrical bioreactors (10) serve to counterbalance their weight, and that of their contents, and also provide sufficient buoyancy to facilitate flotation and maintain their horizontal level in the water.

4. The anaerobic methanization system of any one of claims 1 to 3 wherein the exterior rotation buckets (14) of the floating pressurized cylindrical bioreactors (10), arranged as the teeth of a circular saw, positioned along the longitudinal part of the bioreactor (10) shell, receive and store air ejected from a conduit (13) underneath the said bioreactor (10), this air acting as a flotation and rotating force to make the bioreactors (10) revolve on themselves, easily mixing the contents.

5. The anaerobic methanization system of any one of claims 1 to 4 wherein the interior mixing buckets (15) of the floating pressurized cylindrical bioreactors (10), face in the opposite direction from the exterior rotation buckets (14), grab and mix the contents by sinking the biogas and floating elements, while raising heavy matter from the bottom to let it sink back, to blend with biogas bubbles rising from the bottom.

6. The anaerobic methanization system of any one of claims 1 to 5 wherein the inlet and outlet spouts (17) of the floating pressurized cylindrical bioreactors (10) are located in the middle point of the longitudinal inlet and outlet ends (16) of the bioreactors (10), leaving the said bioreactors free to swivel into or over the inlet and outlet conduits (18).

7. The anaerobic methanization system of any one of claims 1 to 6 wherein the spiral channel (21) of the floating pressurized cylindrical bioreactors (10), situated at the longitudinal outlet end (16) of the said bioreactors, is used to convey heavy unwanted material from the bottom of the bioreactor (10) through the outlet spout (17).

8. The anaerobic methanization system of any one of claims 1 to 7 wherein the biogas pipe (20) of the floating pressurized cylindrical bioreactors (10), used to bring the biogas captured inside the bioreactors (10) outside of the basin (11), crosses the inlet conduit (18) at the elbow (19), and follows the said inlet conduit (18) to the outside of the basin where this biogas is held by a pressure relief valve and used to regulate the volume of sludge contained in the bioreactors (10).

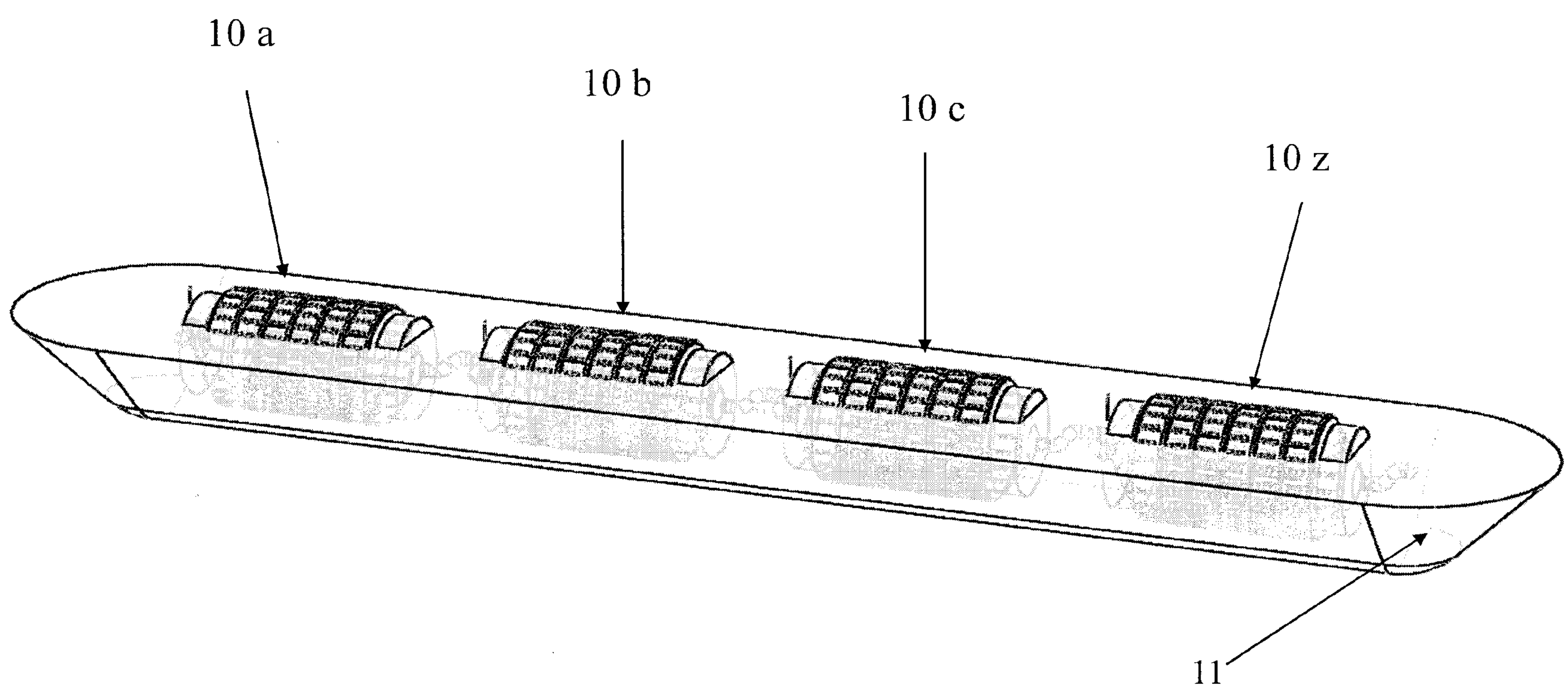


Figure 1

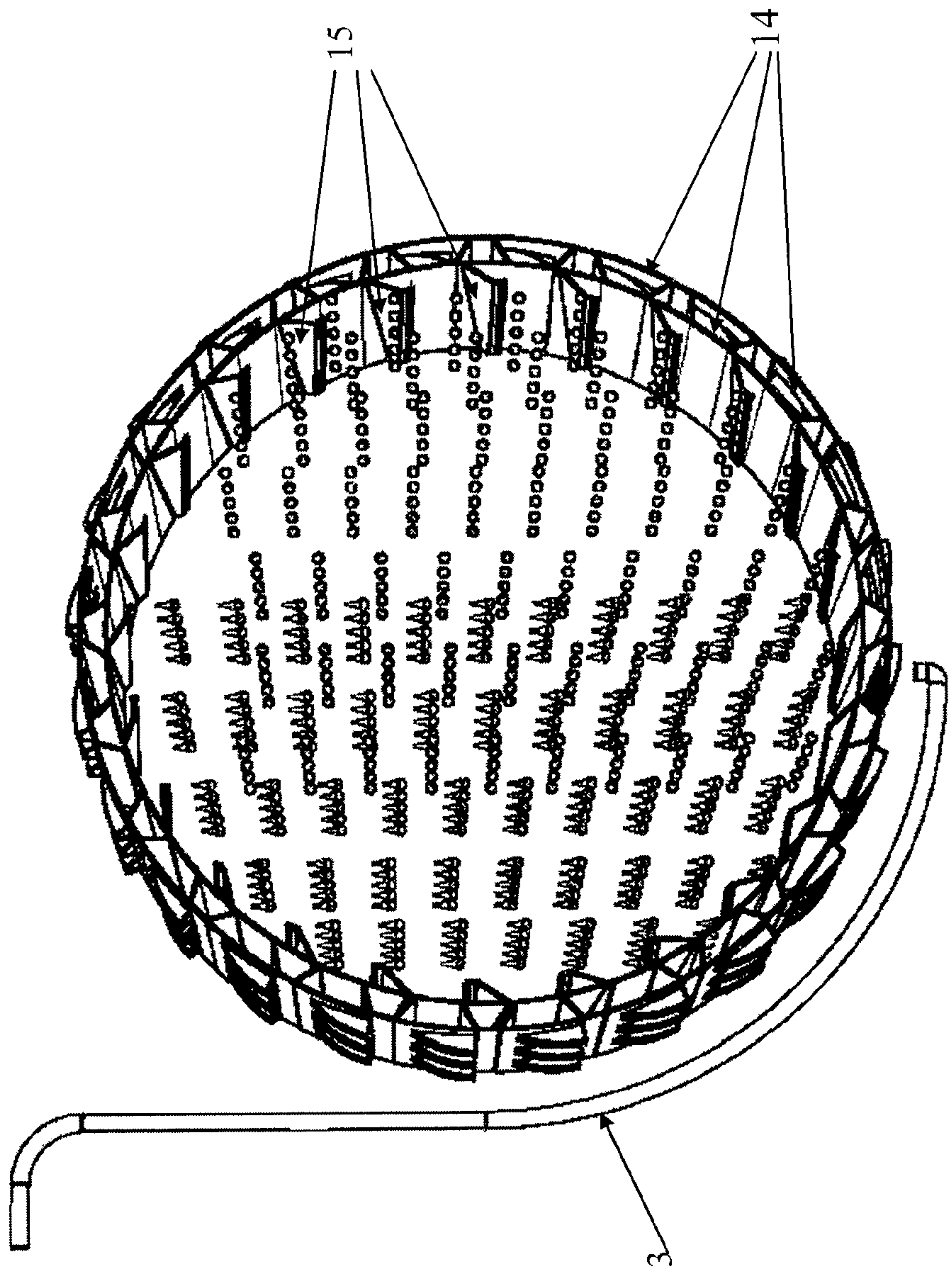


Figure 2

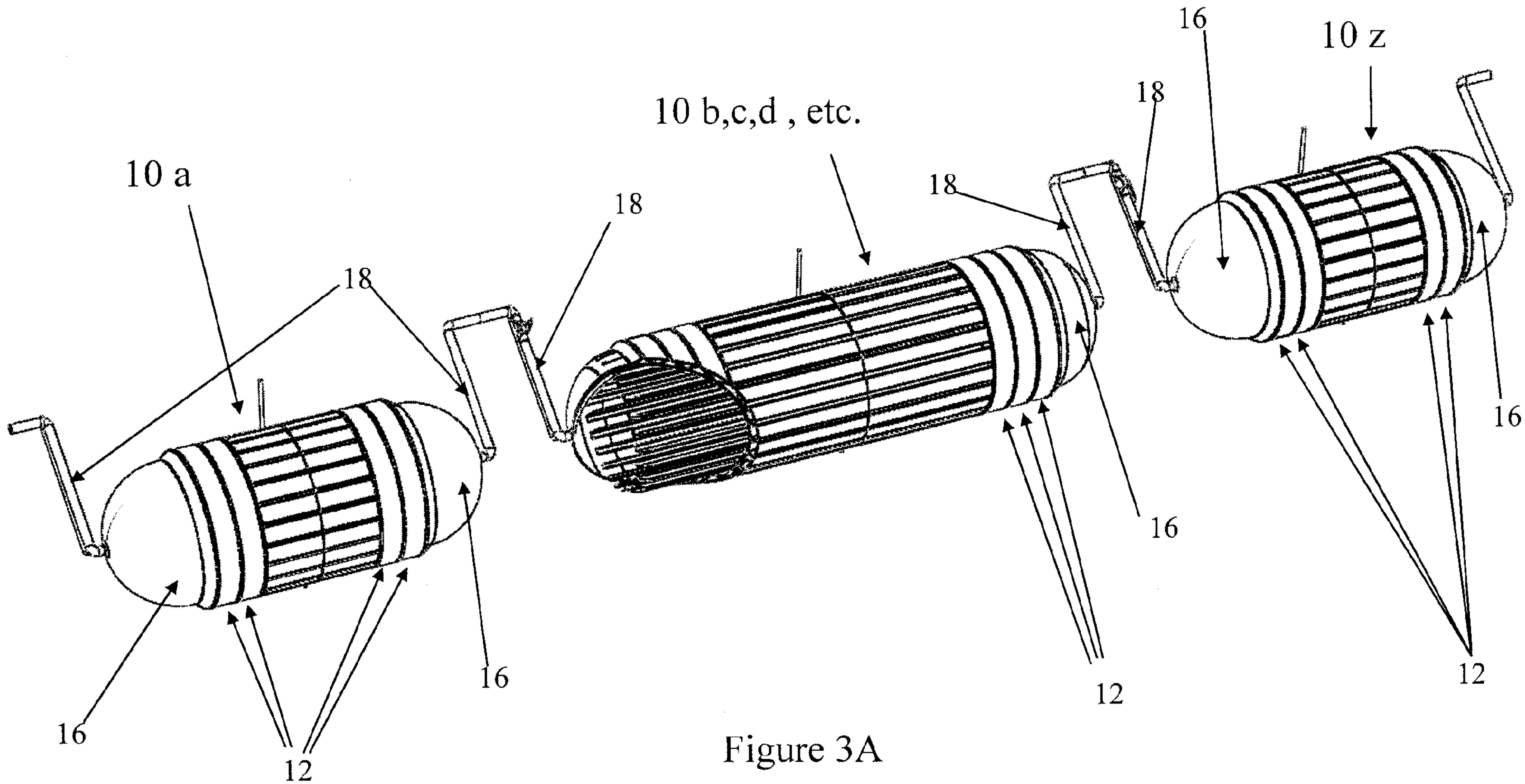


Figure 3A

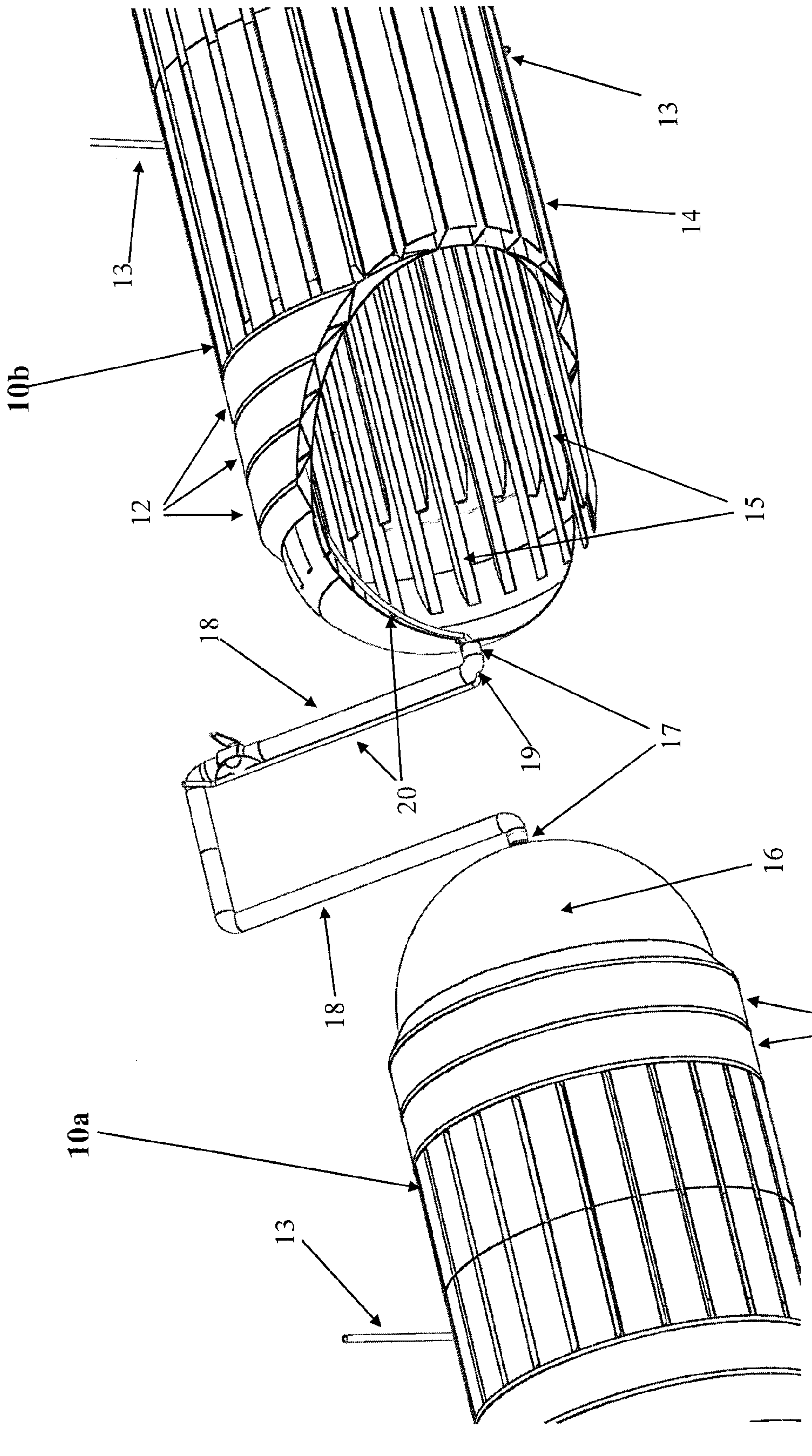


Figure 3B

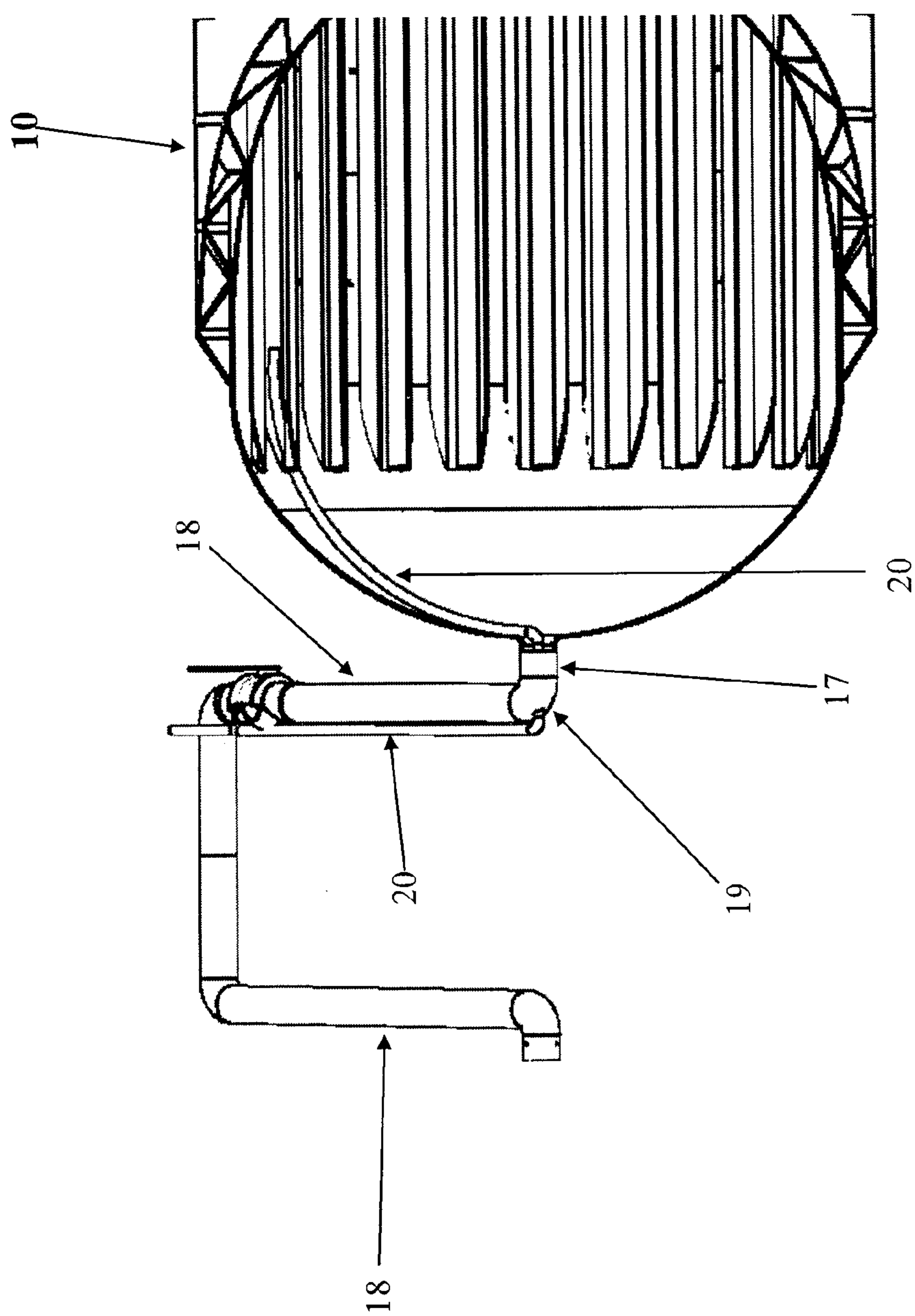


Figure 3C

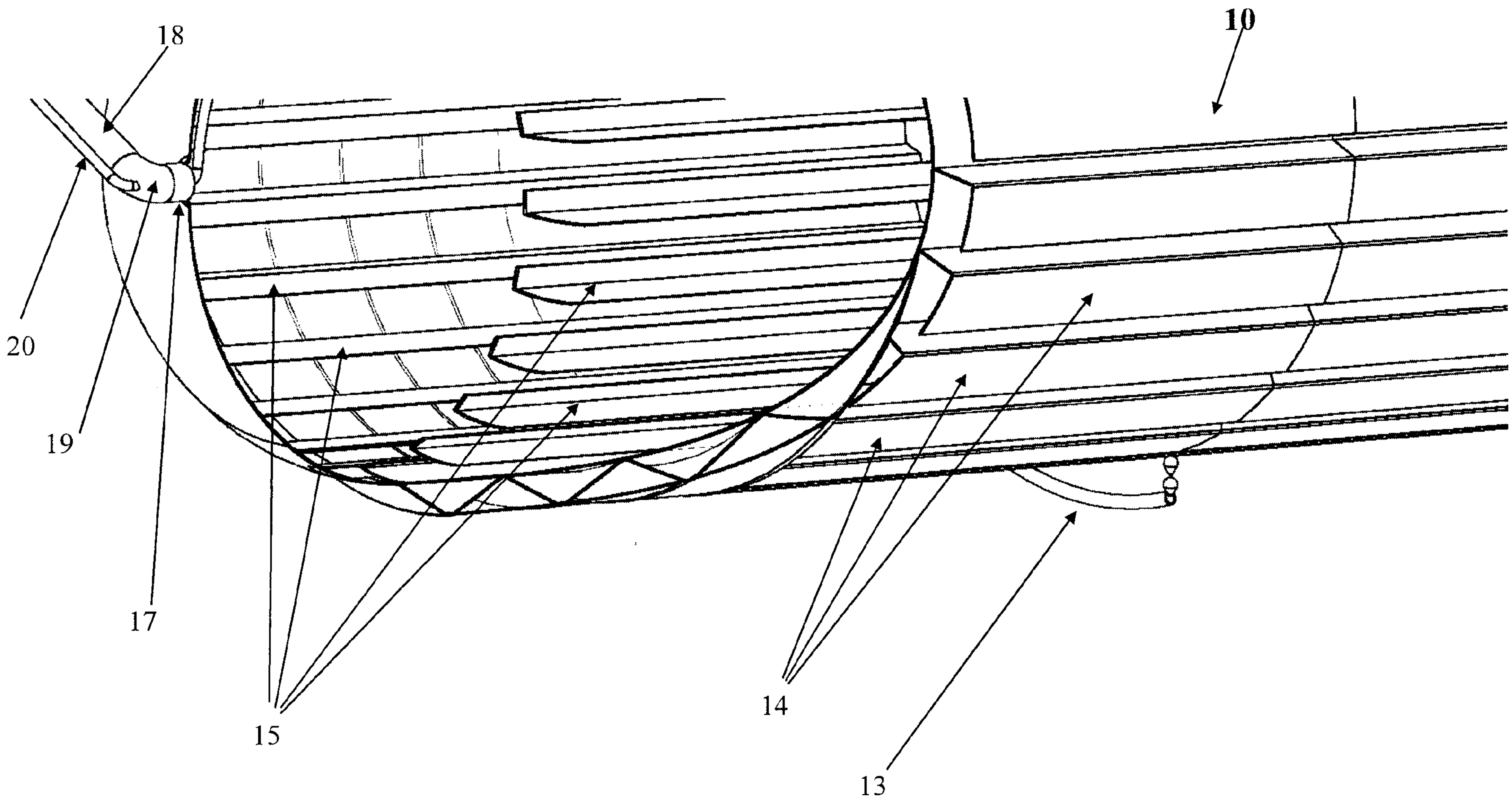


Figure 3D

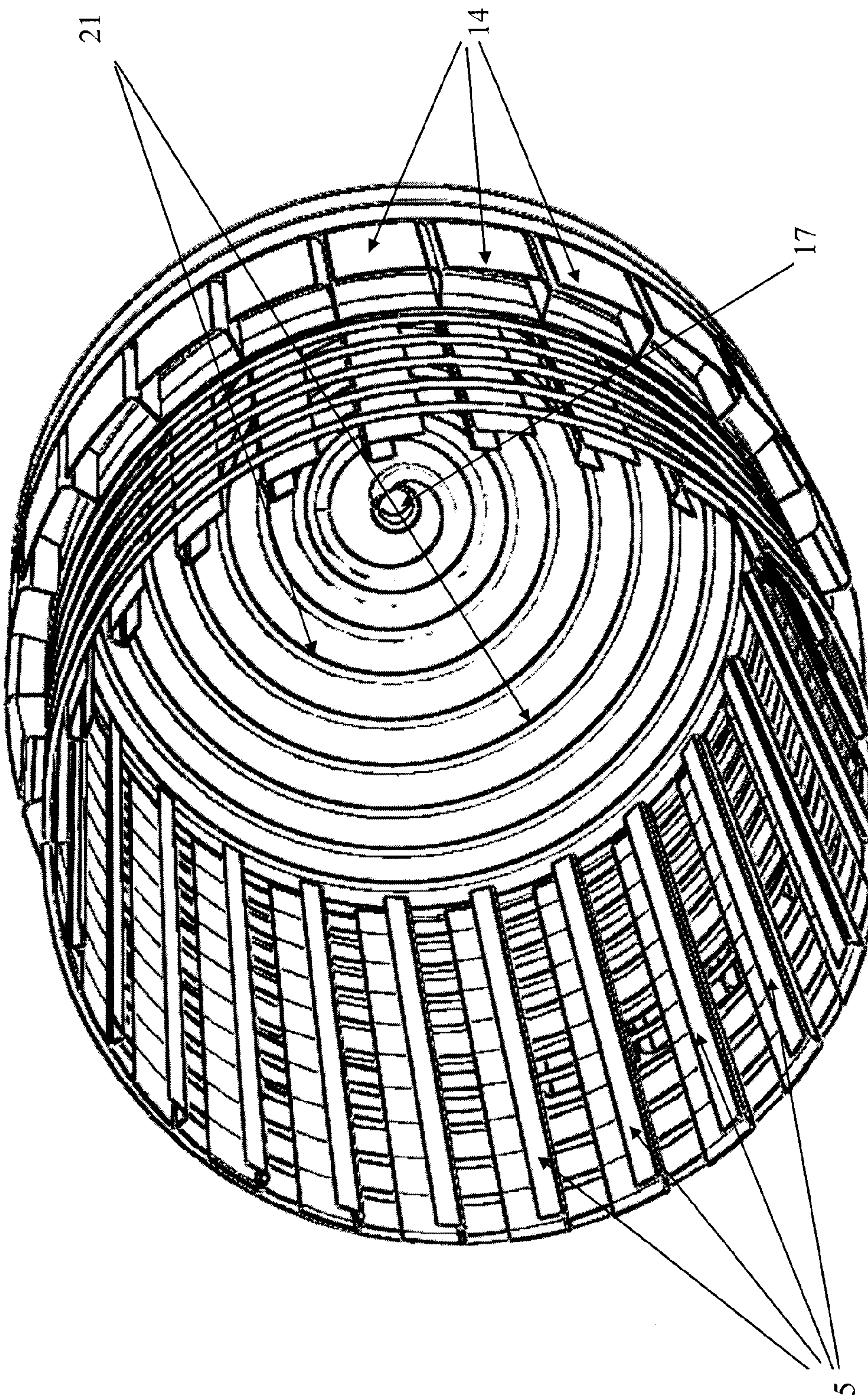
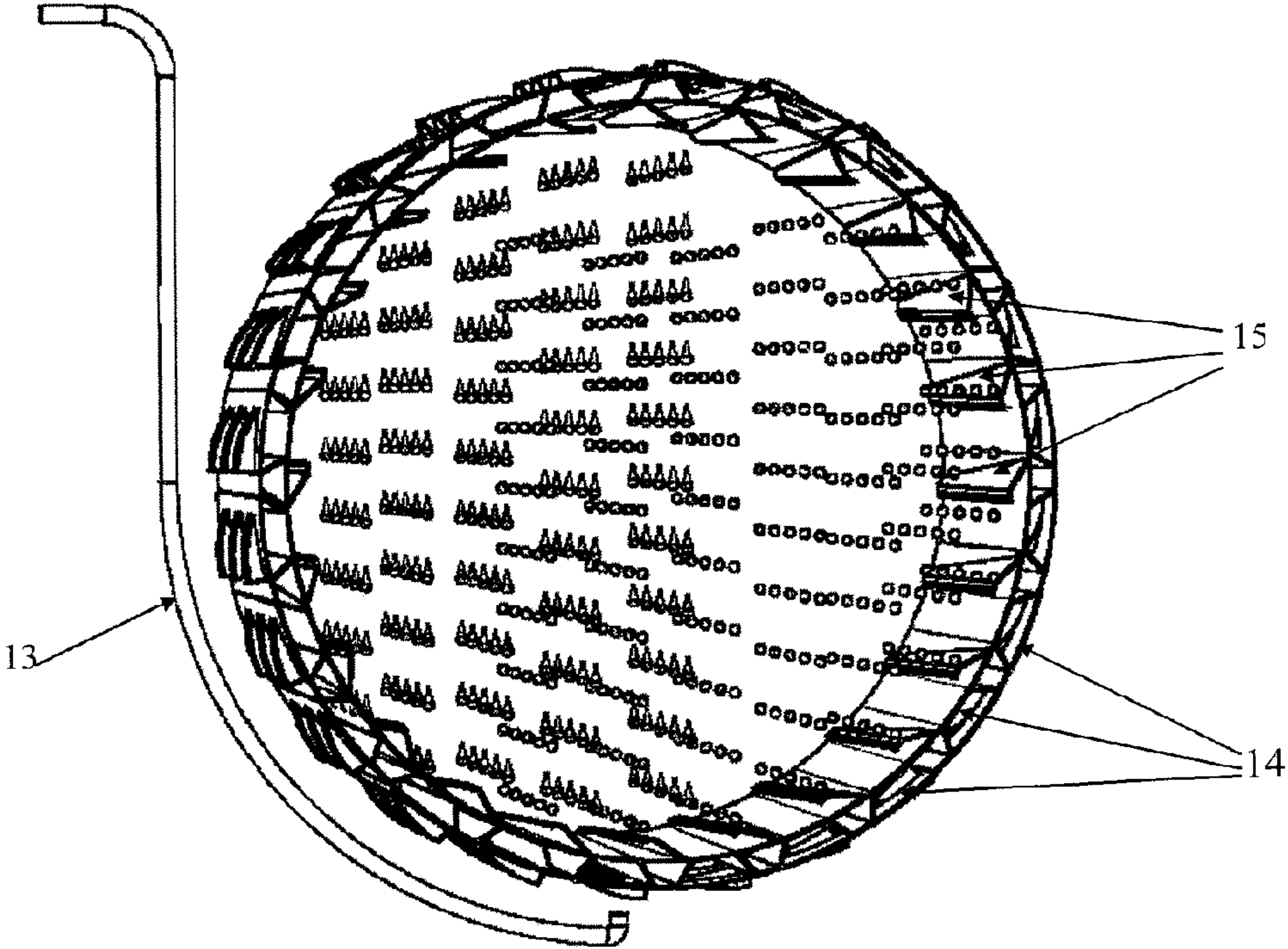


Figure 4



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13
14