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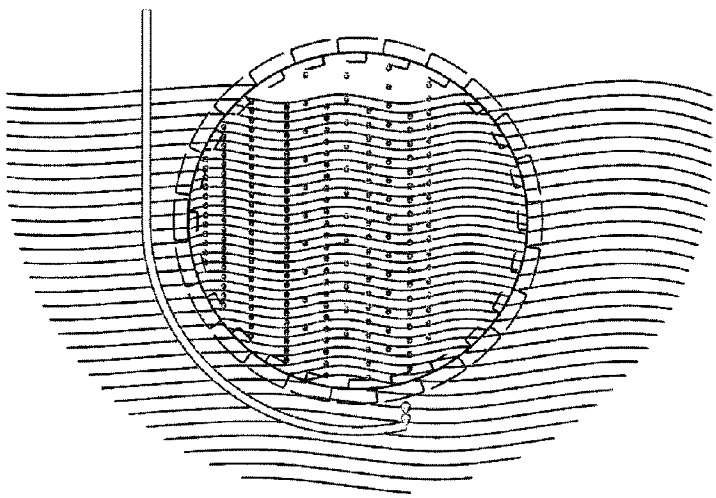
(54) Titre : APPAREILLAGES DESTINES AU FONCTIONNEMENT D'UN SYSTEME DE METHANISATION FLOTTANT

(54) Title: APPARATUSES FOR THE FUNCTIONING OF A FLOATING METHANIZATION SYSTEM



(57) **Abrégé/Abstract:**

A floating methanization system for the treatment and transformation of municipal wastewater sludge or any other organic putrescible matter into biogas and liquid fertilizer by anaerobic digestion. Several consecutive floating cylindrical bioreactors almost totally immersed in water, are bathing longitudinally in a thermally insulated basin to maintain set temperatures, mixing their contents by revolving on themselves by the action of air ejected from a conduit underneath them. The gas produced by methanization of the organic waste furnishes a source of heat and its pressure is used for the functioning of the whole system. The system includes two new types of valves, a swivelling valve and a rotary valve, and different types of new pumps, an inlet pump, swivelling valve exhaust pumps, air pumps, hydraulic pumps, rotary diaphragm pumps, heat exchangers and rotary steam engines. A double network of hoses is provided to bring the fertilizer to the users.

Apparatuses for the functioning of a floating methanization system

Abstract

A floating methanization system for the treatment and transformation of municipal wastewater sludge or any other organic putrescible matter into biogas and liquid fertilizer by anaerobic digestion. Several consecutive floating cylindrical bioreactors almost totally immersed in water, are bathing longitudinally in a thermally insulated basin to maintain set temperatures, mixing their contents by revolving on themselves by the action of air ejected from a conduit underneath them. The gas produced by methanization of the organic waste furnishes a source of heat and its pressure is used for the functioning of the whole system. The system includes two new types of valves, a swivelling valve and a rotary valve, and different types of new pumps, an inlet pump, swivelling valve exhaust pumps, air pumps, hydraulic pumps, rotary diaphragm pumps, heat exchangers and rotary steam engines. A double network of hoses is provided to bring the fertilizer to the users.

Description

The title of the invention is

Apparatuses for the functioning of a floating methanization system

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

Methanization is a process that transforms putrescible material into a biogas by anaerobic digestion. The putrescible material is mixed, in a closed tank, during several weeks. In this milieu, microorganisms are formed that will nourish themselves from the putrescible material. The products of this process are a biogas that can be refined into methane and a digestate usually dehydrated to be used as a fertilizer.

The invention being described and claimed here concerns several different apparatuses for the functioning of a *floating methanization system*, and for the disposal of the end products of the process. This is a continuation and improvement of the *floating methanization system* previously filed with the Canadian Intellectual Property Office on 16 December 2014 under application number 2,875,345. Furthermore, an application for an invention under the title *Floating Methanation system* has been filed on 12 December 2015 with the United States Patent and Trademark Office (USPTO) under application number 14/967,277. This U.S. application contains the subject matter of the original application filed in Canada on 16 December 2014, and the subject matter concerning the invention being described and claimed in this current application. The USPTO has granted a Foreign Filing license to the inventor.

Although several different apparatuses are described and claimed in this application, they should all be together in the same application because they all work together for the functioning of the *floating methanization system.* Grouping these elements together in the same application is necessary to reflect the unity of the invention.

Several problems to which the invention brings a solution have been identified and mentioned in the original application 2,875,345. These will not be repeated here but suffice it to say that the identified difficulties concern structure problems because up until now, the processors are stationary hermetical vessels. With the existing stationary structures, high costs and energy are required for mixing and heating the contents of the processors.

The invention described in the original application brings solutions to the existing problems by using floating biomethanization cylindrical processors, mixing their contents by revolving on themselves by the action of air being ejected beneath them. It is also easy to maintain the very precise temperatures for the process since the processors are floating in water and bathing under the ground level, thus not exposed to cold.

The purpose of the invention is to prevent pathogenic elements, such as municipal wastewater, sludge, and manure, from flowing back to the rivers or other waterways.

The continuation and improvements described here show how the gas produced by the methanization process is entrapped in all the processors, its pressure being raised to use it as power to several assets and new embodiments. Pressure in each vessel will be arranged in a decreasing cascade from one to one to push the sludge through all of them. The pressure of the gas will activate pumps that will supply the air to revolve the processors. The pressure of the gas will also activate hydraulic pumps to add to fluid pressure that will power sludge inlet pumps. The gas pressure will activate rotary pumps that will carry all the incoming water through some of the process stages, and all the way through a network of hoses through rivers, streams, and ditches to bring the matter as fertilizer, which most is decontaminated, to farmlands and wild land. Finally, the gas will be used to boil distilled water to run a steam engine that will drive a generator, transfer the heat into the system, and purify most of the wastewater from the cities.

Following is a general description of the drawings that illustrate the realization of the invention: Figure 1 illustrates a sectional side elevation view of an immersed processor where the exterior air conduit would make it revolve, and consequently the gas that has been sunk would go up in bubbles while the heavy material that has been risen would drop down. Figure 2 is a perspective view of a processor with a cut showing the inside. Figure 3 is a sectional perspective view of the outside of the exit end of a processor, also showing a sinking reservoir that receives heavy material to be discarded. Figure 4 represents a general view of the spirit of the system. Figure 5 shows the different pumps and other apparatuses for the functioning of the system. Figure 6 is a sectional elevation view of the primary inlet pump. Figure 7 shows a diagram of the ideal display of all the components of the system, including the hydraulic power line. Figure 8A shows sectional elevation views of the primary inlet pump, and of the first swivelling valve exhaust pump, also illustrating the hydraulic match in-between these two pumps. Figure 8B is a sectional elevation view of the second and last swivelling valve exhaust pump. Figure

9A shows a partial perspective view of a heat exchanger. Figure 9B shows a close-up partial view of the coil scrapers inside the heat exchanger tubes. Figure 10A is a cut elevation view of the inside of a swivelling valve, showing the cross-directional tunnels. Figure 10B is an exploded diagonal view of a swivelling valve, and its casing. Figure 10C is a cut top view of a swivelling valve, showing the command of rotation and the balls transfer connection. Figure 10D is an expanded cut view of the balls transfer connection of a swivelling valve. Figure 11 is a sectional elevation view of a hydraulic pump. Figure 12 shows a diagram of the hydraulic addition from one to one of each station. Figure 13A is a sectional elevation view of an air pump. Figure 13B is an expanded view of the valve portion of an air pump. Figure 14A shows an elevation cut view of a rotary pump. Figure 14B shows a perspective view of a rotary pump. Figures 14C and 14D show expanded views of the flap water valves in a rotary pump. Figure 15A shows a detailed expanded cut view of a rotary valve. Figures 15B, 15C, and 15D show detailed expanded sectional views of the inside of a rotary valve. Figure 16 shows a perspective elevation view of a steam engine. Figure 17A shows a detailed perspective elevation view of the ascending slopes of the hoses in the network of hoses. Figures 17B and 17C show detailed expanded views of the floating valve on top of the elbow and Y connections in the hoses.

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 cylindrical vessels (anaerobic digesters, bioreactors or processors) almost totally immersed in water. A sectional side view of one of these bioreactors is shown in figure 1. These processors revolve on themselves by the action of air ejected underneath them through an exterior air conduit. These elements have been described and claimed in Canadian application 2,875,345.

Each immersed vessel is a pressurized cylindrical bioreactor 10, comprising flotation chambers positioned at each end to stabilize its horizontal level. Air buckets are positioned along the longitudinal middle shell to trap air ejected through a conduit underneath the bioreactor 10, and to use this air as a force to revolve the bioreactor and mix its content. This can be viewed in figure 2. Since there are several bioreactors, the first one of a series is designated as bioreactor 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 bioreactor 10z.

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Other buckets are positioned inside the revolving bioreactors facing in the opposite direction from the outside ones to grab and mix the contents by sinking the gas, and floating elements while raising the heavy matter from the bottom to let it sink back, crossing the climbing air bubbles.

The inlet conduit 16 of the processors carries a pipe 17, coming from the top space inside the processor 10 where the gas accumulates. This pipe 17 could cross the inlet conduit 16 at the elbow 18, follow this conduit to the outside surface of the basin where the gas could be held by a pressure release valve, and used to regulate the volume of sludge contained in the processor. These elements have already been described and claimed in the original application 2,875,345 and can be viewed in figure 2. Other uses for the gas are proposed in the invention being described here. Part of the gas created from the solid and putrescible matter is used for the functioning of the system. This gas, held by a pressure release valve, is trapped in each processor to rise in pressure. This pressure can be used to pressurize the whole system, activate a chain of mechanical motions, and directed to several apparatuses for the functioning of the system.

The invention described and claimed in application 2,875,345 shows that inside the exit end of each vessel, there is a spiral channel used to convey heavy matter from the bottom through an outlet spout. As can be seen in figure 3, the exhaust plumbing elbow could carry a lower extra port 19c to let the heavy stuff fill a sinking reservoir 19d that a valve will empty from the pressure of the vessel when the said reservoir 19d has sunk to a certain level.

In addition to the floating and rotating processors, several types of pumps and other apparatuses are needed for the functioning of the whole system. A general view of the main elements is shown in figure 4.

There is a primary inlet pump 20, heat exchangers 30, a first swivelling valve exhaust pump 40, a second and last swivelling valve exhaust pump 50, air pumps 60, and hydraulic pumps 70. Rotary pumps 80, and rotary steam engines 90 are also part of the system. For illustration purposes, these have all been grouped together in figure 5.

Inlet of substance to the first processor is supplied by the primary inlet pump 20 controlled from a shut-off valve 201 that opens or closes the hydraulic line 25 (see figure 6) depending on the level of immersion of the processor. Flow from vessel to vessel goes through a shut-off valve 202 (shown in figure 2) on the inlet conduit 16 of all the processors following a cascade of decreasing pressure from one to the other. A diagram showing the ideal display of all the components of the system including the hydraulic power line 25 is shown in figure 7.

The primary inlet pump 20 (best viewed in figure 6) would preferably be positioned at the sludge level, so as not to require any suction force. This primary inlet pump 20 is made of diaphragms 21, shaped as typical vehicle tires except for the reinforcement display and the elastomer component. The said primary inlet pump 20 is acting from two hydraulic cylinders 22 and 23, attached to a middle hollow shaft 24. One cylinder 23 is following the hydraulic action of its parallel first swivelling valve exhaust pump 40, and the main cylinder 22 is driven by the hydraulic power line 25, ideally through a mechanical pilot valve 26.

The sludge flows through check valves 27, penetrates, and escapes the pump diaphragms 21 from a bottom path 28 relative to each diaphragm so that no low cavity spots will be left to retain heavy substance. This can be viewed in figure 6.

The crossed hydraulic connection 29, in-between the primary inlet pump 20 and the first swivelling valve exhaust pump 40 (best seen in figure 8A) serves to squeeze the pressure force created by the heat exchanger 30 as a vise action.

The heat exchangers 30 (seen in figures 5 and 9A) are standard equipment, but these hold coil scrapers 31 inside their tubes. These scrapers 31 (seen in figure 9B) will turn occasionally to remove any sticking matter from the inside walls of the tubes. The scrapers 31 could turn by a hydraulic motor driven by the hydraulic power line. Each of them could be activated independently by dog shifters, engaging in sprockets.

The first swivelling valve exhaust pump 40 (seen in figure 8A) is a diaphragm pump identical to the primary inlet pump 20 except that it acts from a swivelling valve 41 (seen in figures 8A and 8B, and in more detail in figures 10A to 10D) that shifts the sludge direction from one diaphragm 21 to the other to retain the pressure until the stroke lets it free.

As best seen in figure 10B, the form of the swivelling valve 41, sitting in its casing 42, is conic to use the perfect fit as a sealing force to retain the entering pressure, and seal in-between the pieces. The swivelling valve 41 has two cross-directional tunnels 43 (see figure 10A), reaching each diaphragm 21, when it turns from side to side.

The swivelling valve 41 is driven to reverse its alignment at the end of each stroke of the pump action. To break the taper squeezing force of the swivelling valve 41 in its casing 42 while turning, a device of rotation 44 transfers its motion to balls 45, lugged in-between conic holes 46 of which the facing angle is perpendicular to the swivelling valve taper edge. Activating the shifting motion pushes back the conic swivelling valve 41, so that the pressure keeps the gap closed while turning with no friction. The swivelling valve 41 makes a back and forth half-rotation to prevent the winding of unwanted material. During the turning movement, the cross-directional tunnels 43 start from their full openings to a diaphragm 21, go through a surface of total obstruction to arrive finally to the other full openings to a second diaphragm 21, giving access to the reverse direction without losing anything. These elements can be viewed in figures 10A to 10D.

The second and last swivelling valve exhaust pump 50 (shown in figure 8B) is identical to the first swivelling valve exhaust pump 40 (seen in figure 8A) except that the fluid produced from its cylinder strokes transfers indirectly to the mechanical pilot valve 26 of the primary inlet pump 20 (seen in figure 6) by increasing its pressure by several hydraulic pumps 70 (shown in figure 11) along the hydraulic power line 25 by check valve systems. This can be viewed in figures 7 and 12.

The swivelling valve 41 of the second and last swivelling valve exhaust pump 50 will shift mechanically from the end of each stroke but the stroke action will be controlled according to the end of gas production from a shut-off valve 200 on its hydraulic power line 25 connection. This can be viewed in figure 7.

A flow meter is adjusted to let a measured quantity of gas escape the last processor. When the gas pressure reduces under a rated range, the last swivelling valve exhaust pump 50 will be free to operate under the processing pressure, consequently letting the last processor receive new material.

Air pumps 60, illustrated in figures 13A and 13B, supply the air to revolve the processors. They work off the pressurized gas through proportional diaphragm sizes 61a and 61b to transfer high pumping volume into big diaphragms 62, increasing the volume of air, and reducing the pressure to a level sufficient to plunge as deep as underneath the processors. A way of activating a pump is expressed in a drawing (figure 13B) illustrating a sliding valve 63, retained momentarily in one of two groove positions 64 on the main hollow shaft 65 of the air pump. Valve 63 directs the gas to inflate a first diaphragm 61a whose action will activate a middle wider air diaphragm 62, and collapse the opposite gas diaphragm 61b, then releasing its gas content.

At the end of the stroke, the running course will have compressed a bumper spring 66 before breaking the stubbing position and shift the valve back to the next groove 64 that reverses the direction.

Hydraulic pumps 70 (see figure 11) would run typically as the air pumps except the pumping force of the cylinder 71 is a stage action adding to the arriving force from the hydraulic power line 25 from check valves. In the invention, all hydraulic actions could be stages adding to each other. Alternatively, one single proportional pump could be used for the same purpose.

Another way of driving the air and hydraulic pumps could be by accessory valves available on the market.

Other than gas, the process will yield fertilizing matter and purified water destined to be brought to the farmlands and forests through networks of hoses that will be described later.

For the purpose of creating a steady ram to push the fertilizing substance through the long hoses course (kilometre wise) in the rivers, streams, ditches, and underground conduits, rotary pumps 80 have been imagined.

These rotary pumps 80 (best seen in figures 14A and 14B) have a bent shaft 81 turning in the middle of a steady bottom diaphragm spider 82a, rocking an identical top diaphragm spider 82b, making each diaphragm 84a and 84b pump consecutively. Inlet and outlet of water could be controlled by flap water valves shown in figures 14C and 14D.

The motion power of the rotary pump comes from the pressurized gas driving through ports 86a on one side of the rotary valve body 87 (shown in figures 15B and 15D) that follows the rotation of the bent shaft 81, and blows inner and smaller diaphragms 84a that force the bent shaft to turn. Ports 86b on the other side of the rotary valve body 87 are for releasing the pressure. Broken arrows in figures 15B and 15D show the flow direction of the gas, water or steam.

In the same spirit as the swivelling valve 41, where a taper contact face ensures the perfect sealing, its contact load comes from the gas pressure 88a against a flange 88b, surrounding its body 87.

Like for the swivelling valve 41, balls 89a, lodged in taper holes 89b, apply a pulling force, acting against the friction of the taper contact. This can be viewed in figure 15C.

Steam engines 90 could function on the same principle as the rotary pumps 80. They can run only by using two rotary valves 85 connected one on each diaphragm spider 82a and 82b as illustrated in figure 16. One valve will drive water to be pumped from the middle and smaller diaphragms 84b, and that water running out steadily with pressure will be boiled, and the steam will be directed from the other rotary valve to activate the outer and bigger diaphragms 84a. The rotating energy can be used to power generators that produce electricity.

Describing the whole process:

The sludge is pumped into a heat exchanger 30, from a primary inlet pump 20. This sludge is heated, and its pressure is trapped in-between a primary inlet pump 20, and a swivelling valve 41 acting into a first swivelling valve exhaust pump 40 for the purpose of killing all the germs and exploding the particles when releasing the pressure. A ratio in-between the size of diaphragms 21 of the two pumps allows the pressure to create a self-motion.

The sludge is then released at a lower pressure into the first processor to flow from one processor to the other, as many as needed until a second and last swivelling valve exhaust pump 50 releases it from the last processor because the production of gas is over.

The transfer to the first processor, used for the decantation of sand, gravel, and unwanted particles is regulated by a shut-off valve 201, mounted on the hydraulic circuit 25 of the dual pumps. This shut-off valve controls the sludge entering according to the flotation level of the processor. And so on and so forth in-between all subsequent processors until the last processor. Shut-off valves 202 (seen in figure 2), proportional and attached to the sludge inlet conduits of the processors except the first one, operate according to the flotation level of each processor.

The total gas produced is proportional in volume to all the organic waste to be processed. This pressurized gas is used for four purposes.

First, it will activate air pumps 60, ideally from the production of gas of each processor to furnish the air for rotation. Secondly, it will activate hydraulic pumps 70, adding to the hydraulic power line 25 subsequent fluid pressure from one to one. Thirdly, it will push the sludge from processor to processor in a cascade of decreasing inside pressure from one to the other. Fourthly, it will drive rotary pumps 80 that will push all the water through the system and the hose network 100.

Since that gas is still all available, it will be used to produce heat in a gas burner to boil distilled water to drive new steam engines 90 that power generators. Then, that steam will cool down in heat exchangers 30 that act as the process heat supply.

Because there is an abundance of gas, the heat exchangers 30 will also boil as much of the wastewater as possible and mix it with the purified sludge being released from the processors.

This highly fertilizing purified material, coming out of the last processor, is mixed with the purified water, pushed with a constant pressure through networks of hoses 100, following the bottom of rivers, streams, and ditches to bring the fertilizer to the farmlands. The remaining water is destined to the forests and wild land through a parallel network of hoses 100.

To create ascending slopes whenever they are needed, the hoses 100 are installed on top of a pile 101. Floating valves 102, set at the top of elbow and Y connections 103, release the gas bubbles that might still be creating although the production cycle of gas is theoretically over. These elements are shown in figures 17A, 17B, and 17C.

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

1. A floating methanization system for treatment and transformation of municipal wastewater sludge or other organic putrescible matter into biogas and liquid fertilizer by anaerobic digestion, said system comprising a plurality of floating bioreactors consecutively arranged in series; wherein a first bioreactor initially processes wastewater sludge or other organic putrescible matter also wherein to remove sand, gravel or crushed glass; a series of middle bioreactors which process and digest the wastewater sludge or putrescible matter and a final bioreactor wherein the sludge or matter is further digested; wherein the final bioreactor includes means for measuring and monitoring the end of biogas production; said system further comprising a heat exchanger for heating the sludge or matter for the destruction of harmful bacteria and pathogens; wherein each bioreactor comprising a longitudinal body to digest and provide methanization reaction of said sludge or matter within the bioreactor; each of said bioreactors further comprising a longitudinal inlet end, an inlet spout, located at a middle point of said longitudinal inlet end, connected to an inlet conduit by an inlet elbow, for purpose of receiving the matter into the bioreactor; said bioreactors further comprising a longitudinal outlet end, an outlet spout located at a middle point of said longitudinal outlet end, connected to an outlet conduit by an exhaust elbow for the purpose of exiting the matter from one bioreactor to the next bioreactor and from the last bioreactor at the end of the process,wherein pressure is created by retaining the biogas produced and wherein said floating bioreactors are almost totally immersed in warm water in a thermally insulated basin to maintain predetermined temperature for digestion and methanization conditions; wherein said bioreactors revolve on themselves by air ejected from a conduit disposed underneath said bioreactors, wherein said air is pumped into said conduits by air diaphragm pumps activated by the pressurized biogas; said air lodging in

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rotation buckets aligned as circular saw teeth outside the longitudinal body of the bioreactor, said air provoking a rotating action, mixing the contents; each of said bioreactors include mixing buckets aligned inside the body of the bioreactor; each of said bioreactors further comprise flotation chambers located at the inlet and outlet of the bioreactor for counterbalancing the weight of the bioreactors and to provide buoyancy to the bioreactors so that the bioreactors remain horizontally disposed while floating; said system further comprising a primary inlet pump, which is a dual hydraulic command diaphragm pump having a dual purpose, first to initiate and supply initial matter to be processed, and secondly, to drive said matter through the heat exchanger and squeeze the pressure created by heat against a first swivelling valve exhaust pump, said first swivelling valve exhaust pump working in combination with a last swivelling valve exhaust pump, both being two-diaphragm pumps having two functions: first to retain, control, and release the flow and pressure by transferring power hydraulically to the primary inlet pump, while the second function in which they differ, is that the first swivelling valve exhaust pump creates a vise action from the high pressure created from heating matter in the heat exchanger situated between said primary inlet pump and said first swivelling valve exhaust pump while the last swivelling valve exhaust pump retains the working pressure of the entire system and transfers said pressure to the primary inlet pump from a closed-center hydraulic circuit that increases said pressure by the action of gas hydraulic pumps from each bioreactor, said closed-center hydraulic circuit comprising a shut-off valve that commands the last swivelling valve exhaust pump to operate and let consumed matter to escape when production of biogas is over, and a shut-off valve that commands the primary inlet pump to operate when new material is needed; said methanization system further comprising biogas pipes for the capture of biogas from the inside top portion of each bioreactor; wherein

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each of said bioreactors include a pressure relief valve to control the pressure in each bioreactor; said system further including a plurality of hoses and conduits for the purpose of transporting fluids out of the bioreactor for the removal of fertilizers, juices and salts.

2. The floating methanization system of claim 1 wherein each of said bioreactors further comprises a spiral channel situated inside the outlet end of said bioreactor to convey heavy matter from the bottom of the bioreactors through the outlet spouts.
3. The floating methanization system of claim 1 wherein the first bioreactor further comprises a lower port located at the exhaust elbow of the outlet conduit, said lower port in operative connection with a sinking reservoir for evacuating heavy material from said bioreactor to said sinking reservoir further comprising a valve controlling evacuation from the pressure of the bioreactor when said sinking reservoir reaches a predetermined low level.
4. The floating methanization system of claim 1 wherein the pressure of the biogas produced within the bioreactors is used to regulate the volume of the sludge contained in the bioreactors, pressurize the entire system and provide power to activate a chain of mechanical motions for the functioning of said system.
5. The floating methanization system of claim 1 wherein the last bioreactor includes a flow control valve in connection with a pressure valve to determine the end of biogas production and command the last swivelling valve exhaust pump to evacuate process material contained within the bioreactor and to allow new material to enter the system.
6. The floating methanization system of claim 1 wherein the hoses and conduits connected to the last bioreactor by the last swivelling valve exhaust pump follow the bottom of one or more of rivers, streams, and ditches and are constructed and arranged to deliver the end products of the process to the places where they are needed.

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7. The floating methanization system of claim 1 wherein the swivelling valve exhaust pumps further comprise a swivelling valve body of conic shape in order to use the working pressure as a sealing force, said swivelling valve further comprising two cross-directional tunnels matching two ports of a valve casing to drive pressure through one of the ports to fill a diaphragm to expand while drawing an opposite diaphragm to empty through a second cross-directional tunnel of said swivelling valve thereby creating a stroke action that generates hydraulic power because said stroke action transfers to an attached hydraulic piston, said swivelling valve turns, at the end of the stroke action, from a position of full opening to the ports of the valve casing, goes through a surface of total obstruction to arrive finally to a full opening of the opposite ports, driving the flow action in the reverse direction without losing any working pressure, said swivelling valve further comprising a rotation device that transfers a turning motion to balls disposed in-between conic holes of which a facing angle is perpendicular to a taper edge of the swivelling valve, said balls serving to break the force by a shifting motion so that pressure keeps a gap closed while the valve turns without friction, and makes a back and forth half-rotation to prevent winding of unwanted material.
8. The floating methanization system of claim 1 further comprises rotary diaphragm pumps working by the action of a rotary valve functioning with a taper contact face ensuring a perfect sealing contact from entering pressure against a flange surrounding a body, said rotary diaphragm pumps receiving motion from the entering pressure driving through ports on one side, activating diaphragms of said rotary diaphragm pumps while releasing opposite diaphragms through ports on the opposite side, said rotary valve further comprising balls lodged in taper holes to apply a pushing force, acting against the friction of the taper contact when said rotary valve is in movement when the rotary diaphragm pump is in action, said rotary

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diaphragm pumps further comprising two diaphragm spiders related together by a bent shaft turning in their middle, rocking them, and activating diaphragms to pump consecutively.

9. The floating methanization system of claim 1 further comprises steam engines, the rotating energy of said steam engines powering generators to produce electricity, said steam engines comprising two rotary valves, a first rotary valve and a second rotary valve, connected to diaphragm spiders where water is driven and pumped from smaller diaphragms of an inner circumference of said steam engines, the water sent to boil to steam, and directed through the second rotary valve, activating outer and bigger diaphragms of said steam engine.
10. The floating methanization system of claim 1 wherein the pressurized biogas dedicated to pressurize the whole system and activate several devices for the functioning of said system applies force as a cascade of decreasing pressure from one bioreactor to the next bioreactor to push sludge from one bioreactor to the next bioreactor, said pressurized biogas applying force to activate the air diaphragm pumps and the gas hydraulic pumps, said gas hydraulic pumps add hydraulic pressure to the closed-center hydraulic circuit.
11. The floating methanization system of claim 8 wherein the pressurized biogas dedicated to pressurize the whole system and activate several devices for the functioning of said system applies force as a cascade of decreasing pressure from one bioreactor to the next bioreactor to push sludge from one bioreactor to the next bioreactor, said pressurized biogas applying force to activate the air diaphragm pumps, the rotary diaphragm pumps and the gas hydraulic pumps, said gas hydraulic pumps add hydraulic pressure to the closed-center hydraulic circuit.
12. The floating methanization system of claim 1 wherein the heat exchangers comprise coil scrapers inside tubes of said heat exchangers to remove any sticking matter from said tubes.

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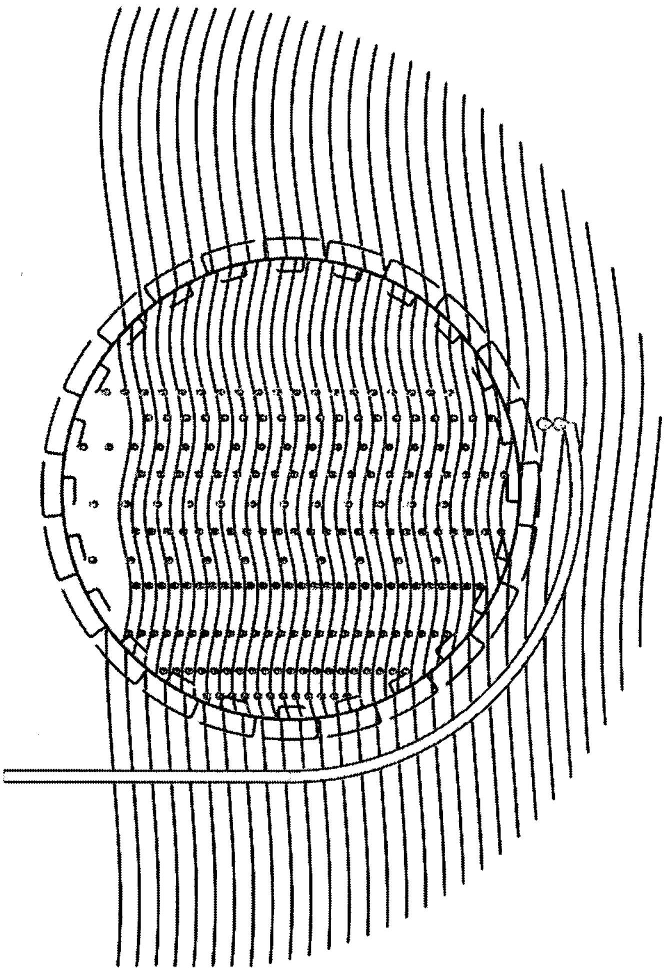

FIG. 1

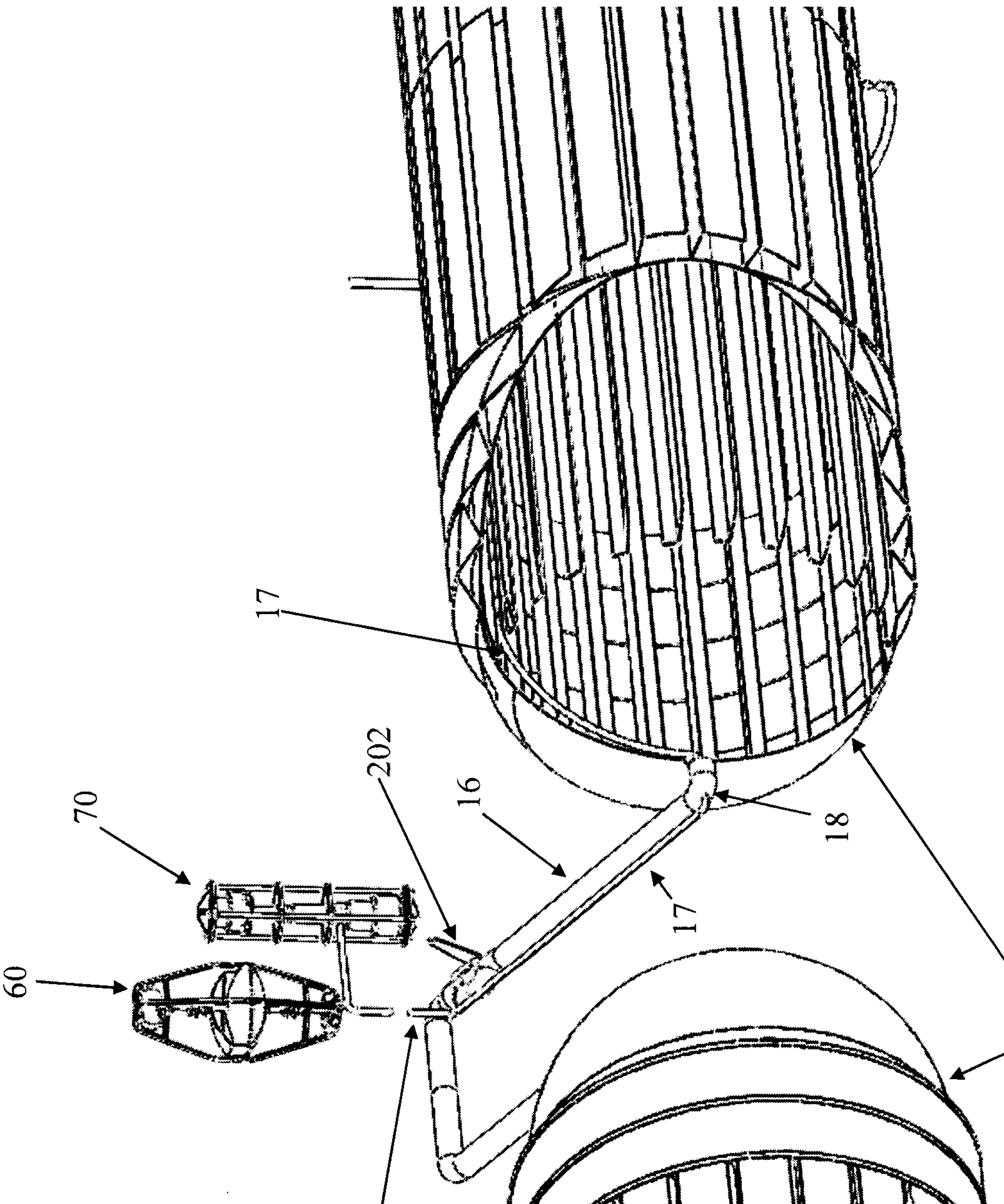

FIG. 2

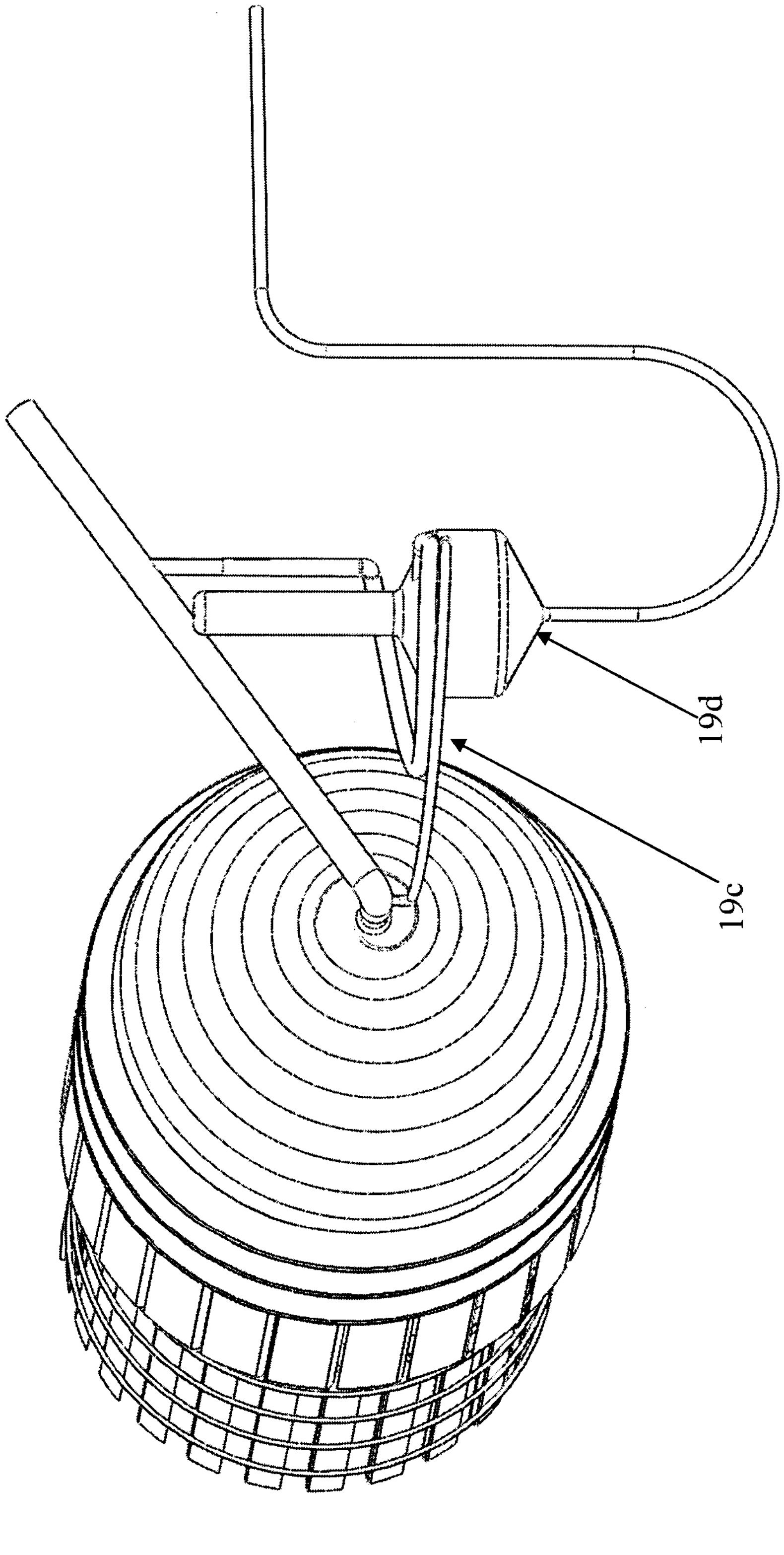

FIG. 3

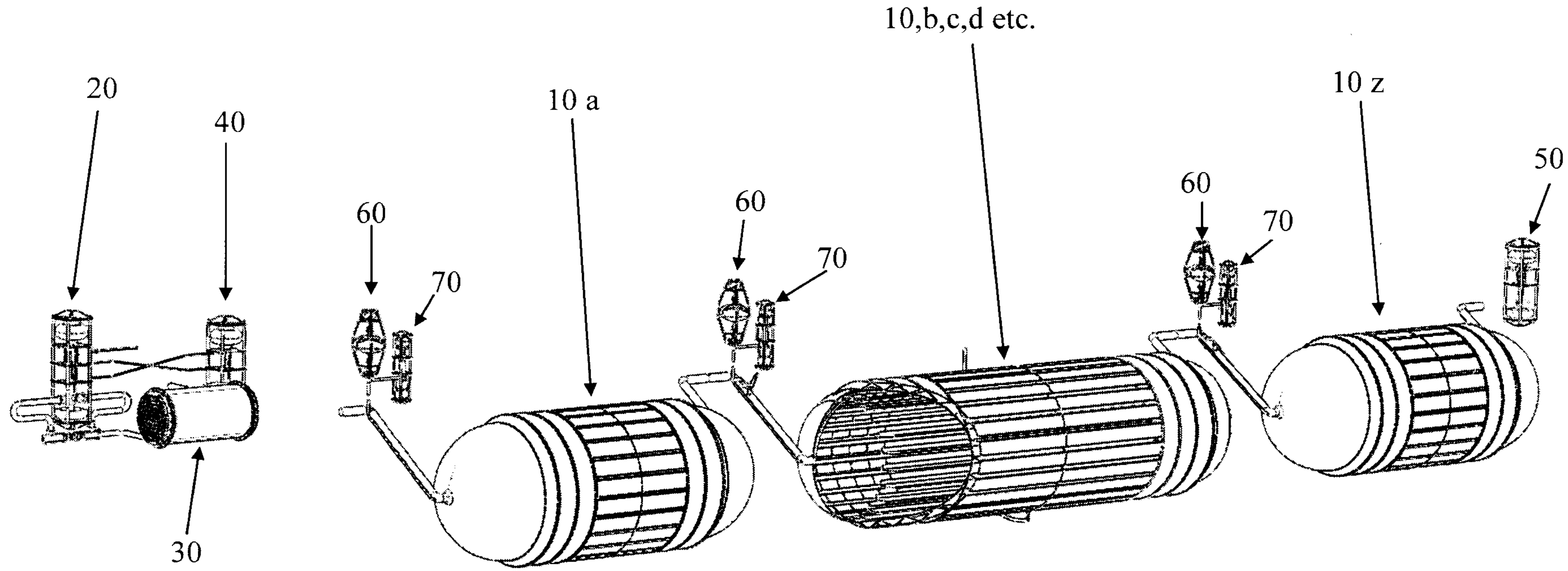

FIG. 4

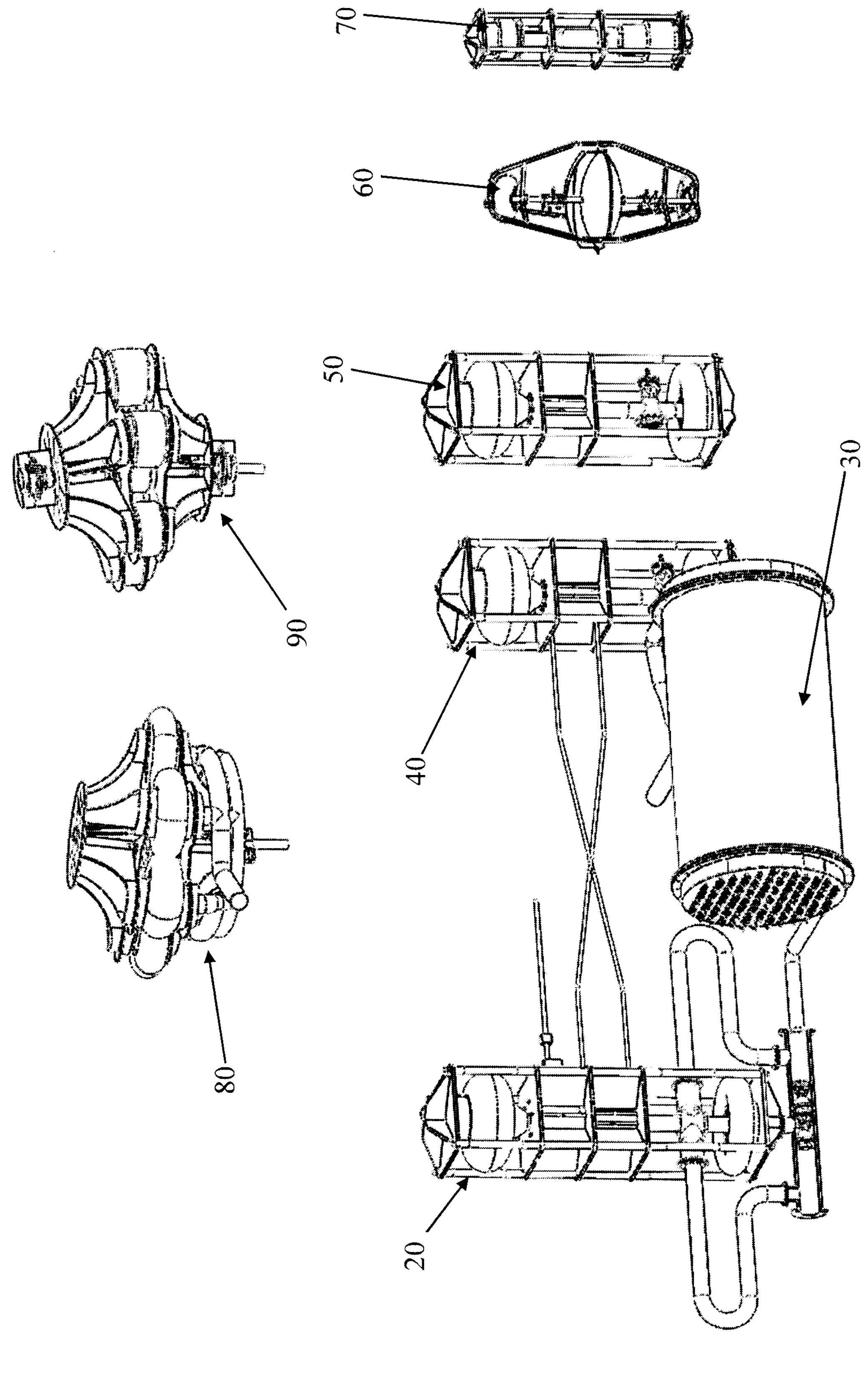

FIG. 5

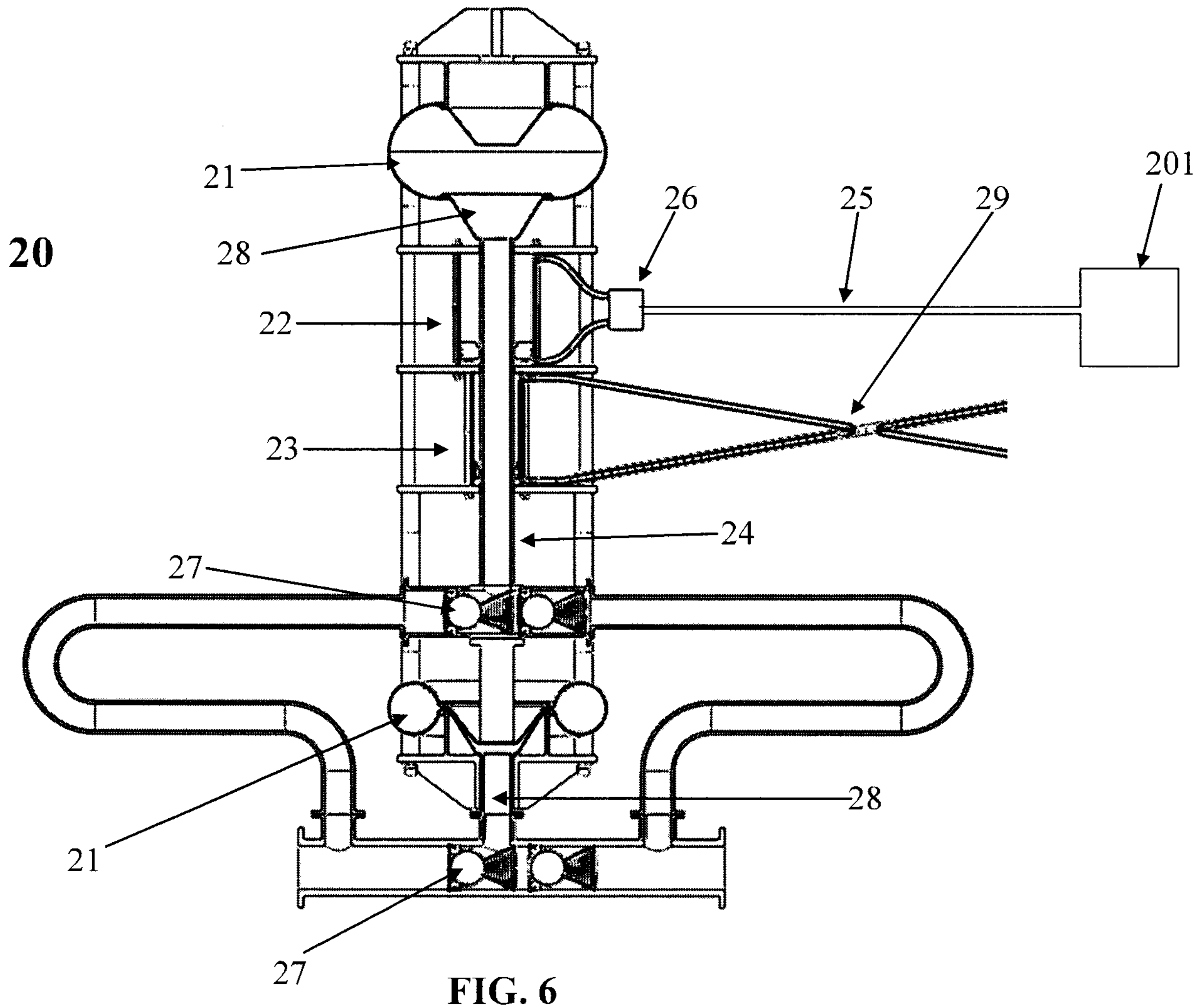

FIG. 6

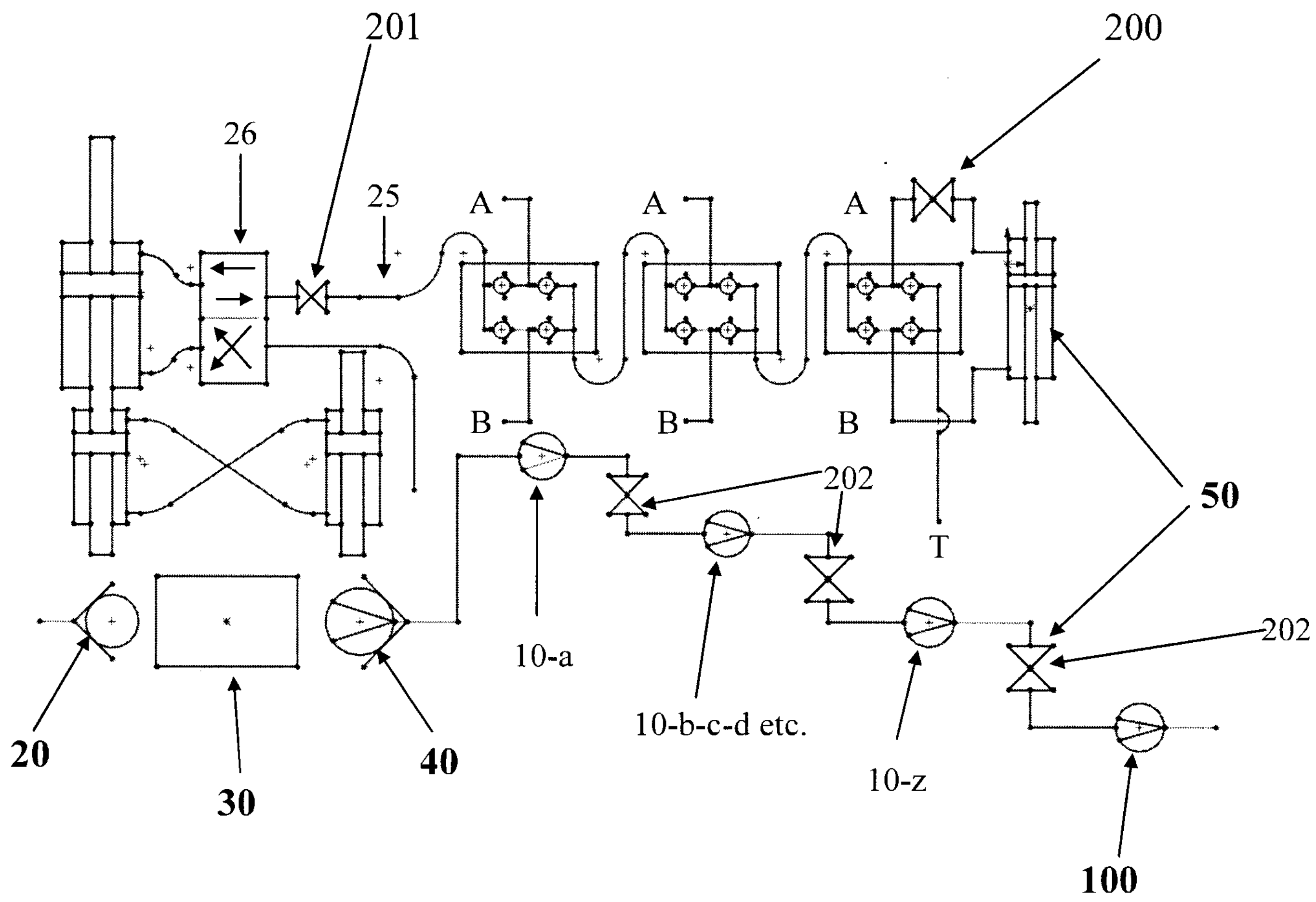
201
200
26
25
A
A
A
B
B
B
T
202
202
202
50
20
30
40
10-a
10-b-c-d etc.
10-z
100

FIG. 7

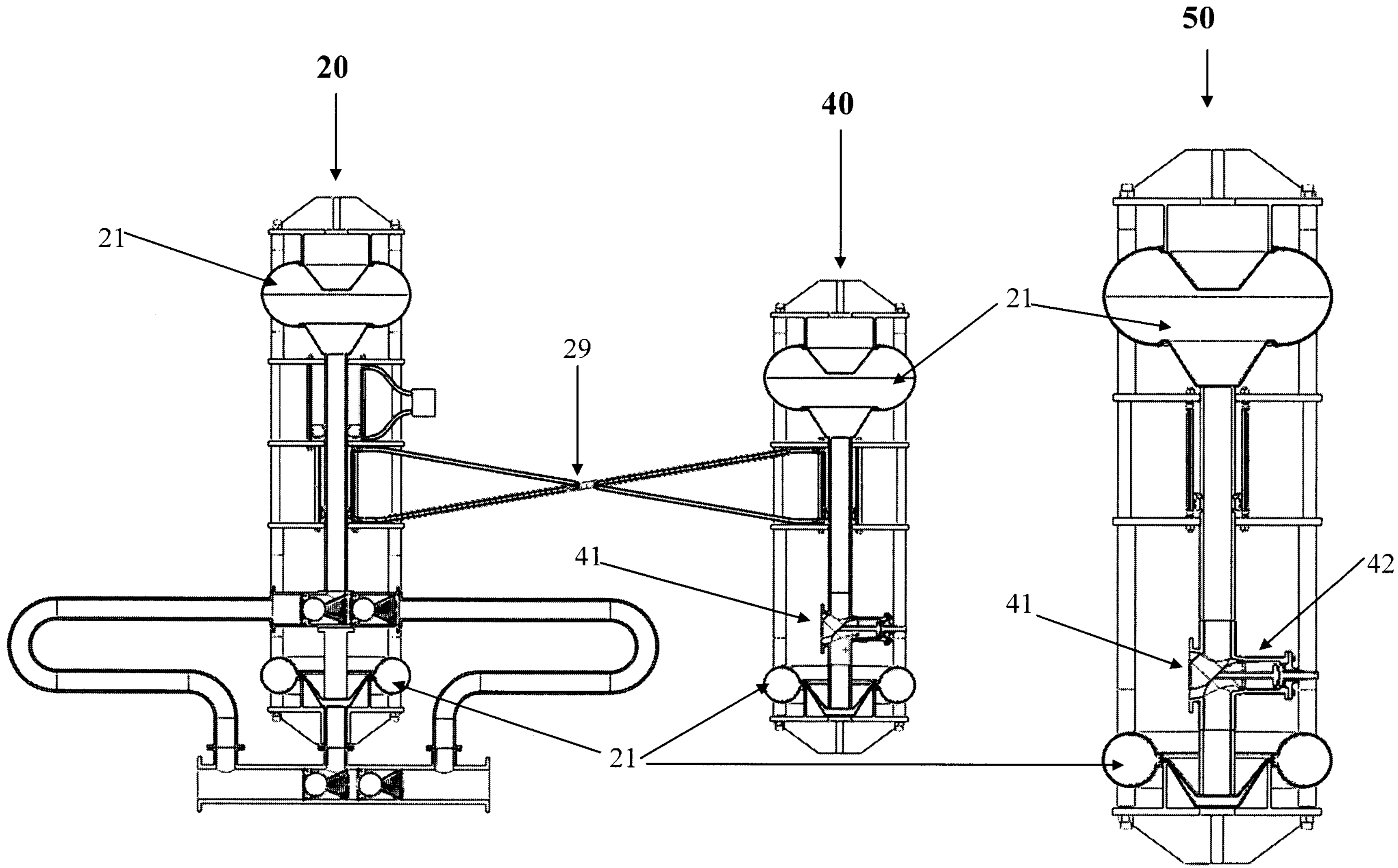

FIG. 8A

FIG. 8B

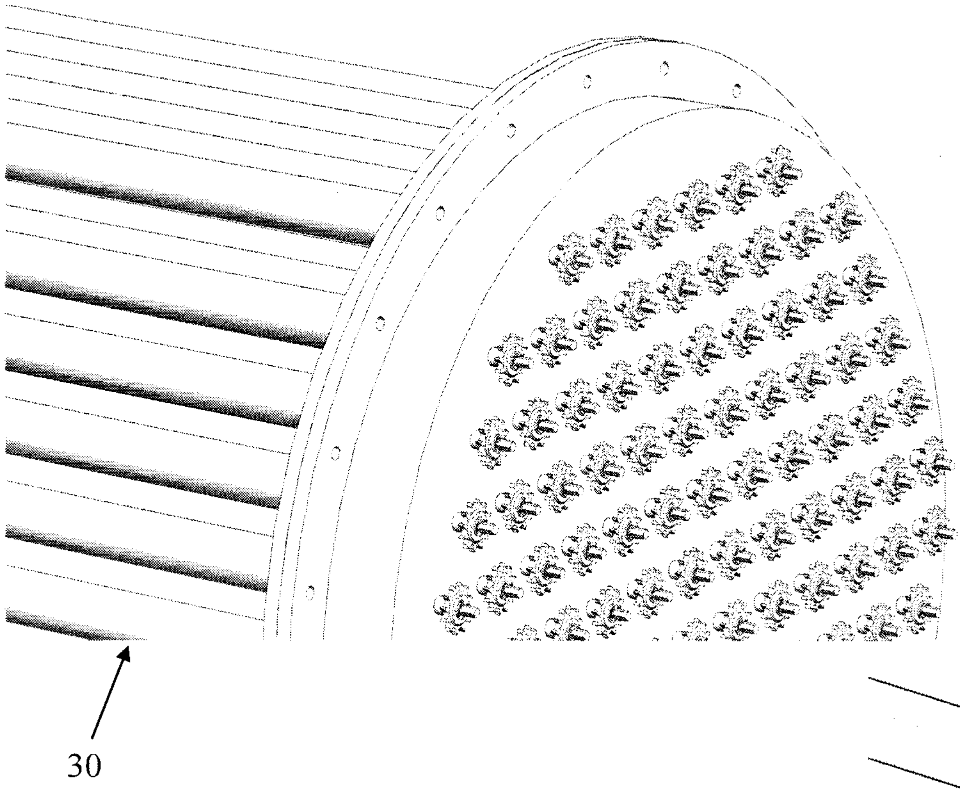

FIG. 9A

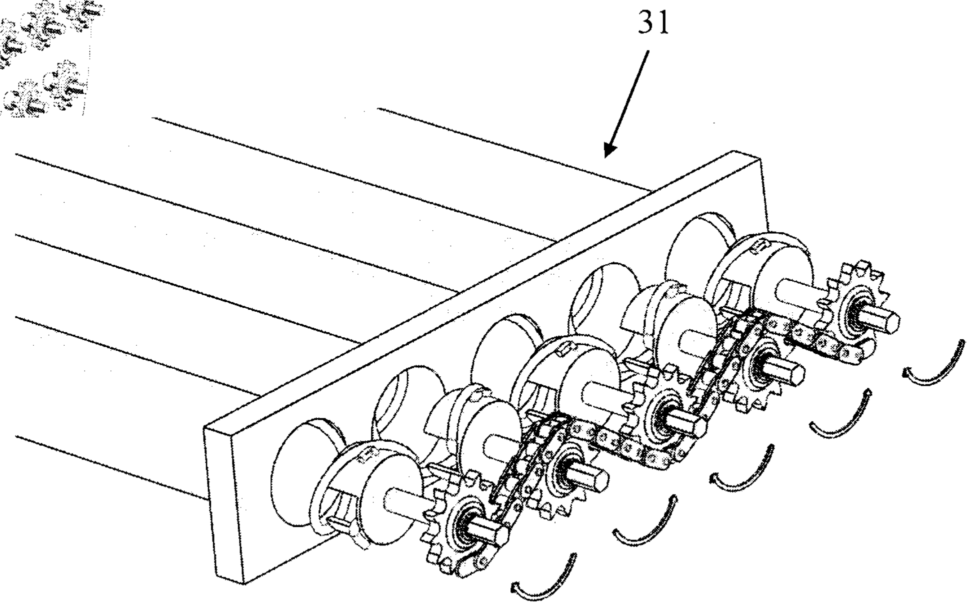

FIG. 9B

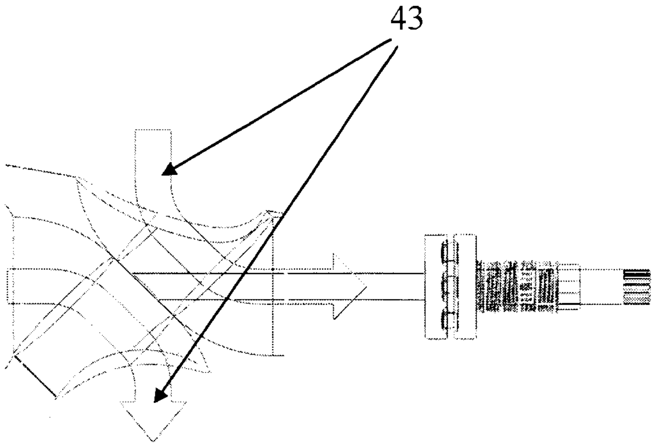

FIG. 10A

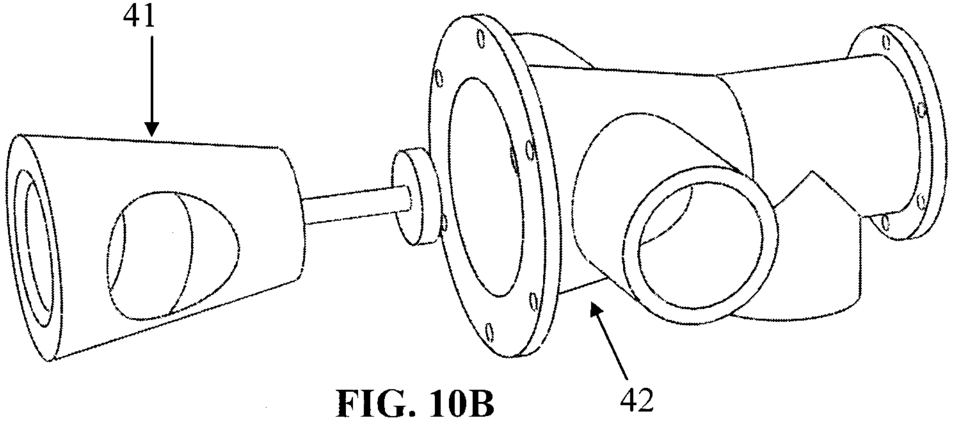

FIG. 10B

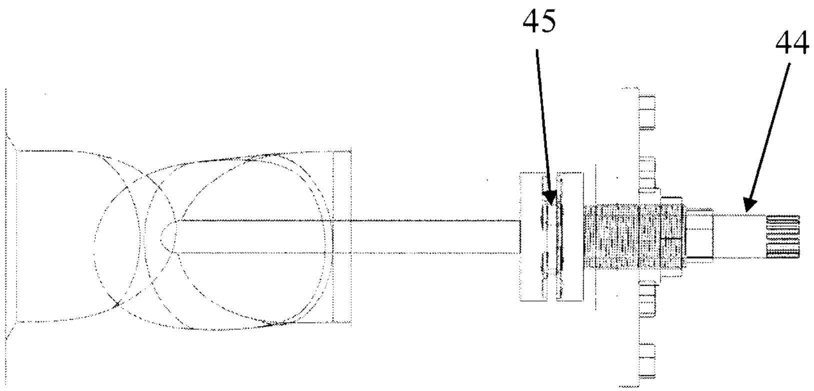

FIG. 10C

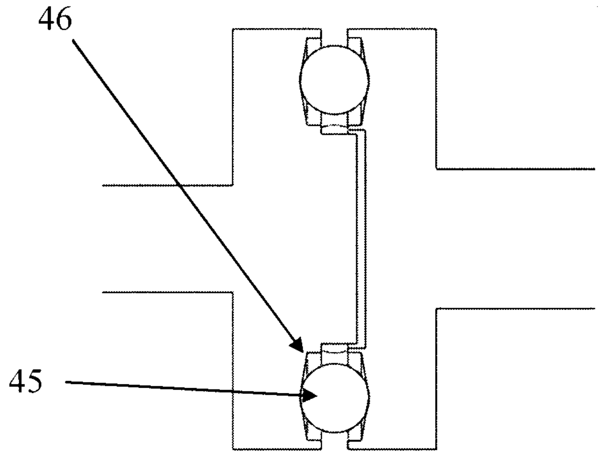

FIG. 10D

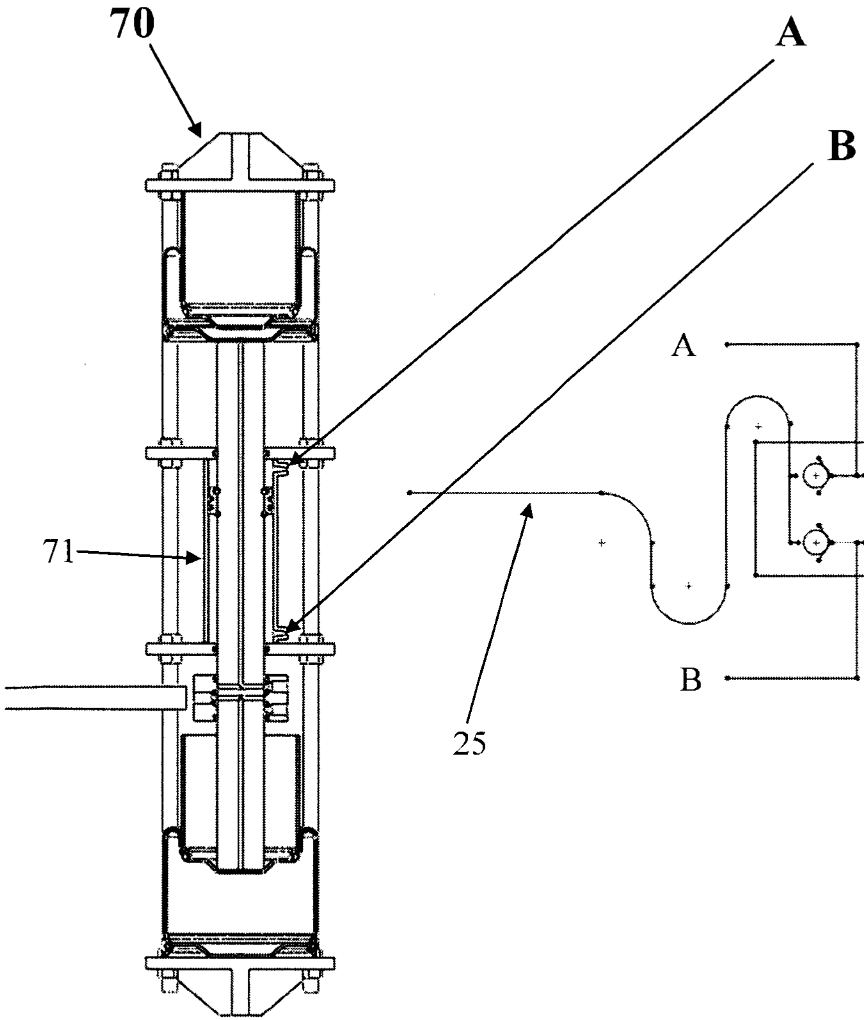

FIG. 11

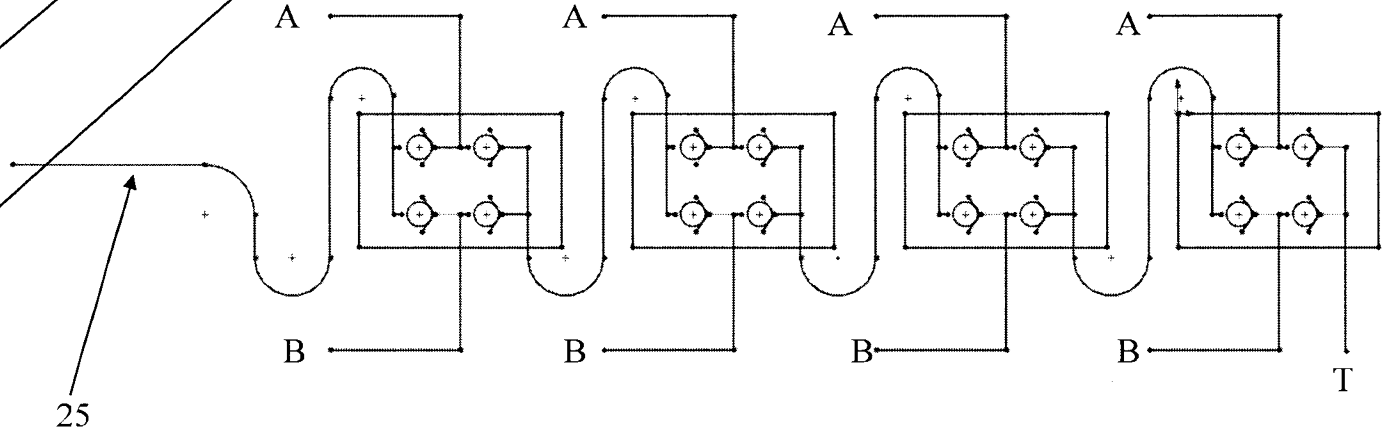

FIG. 12

60

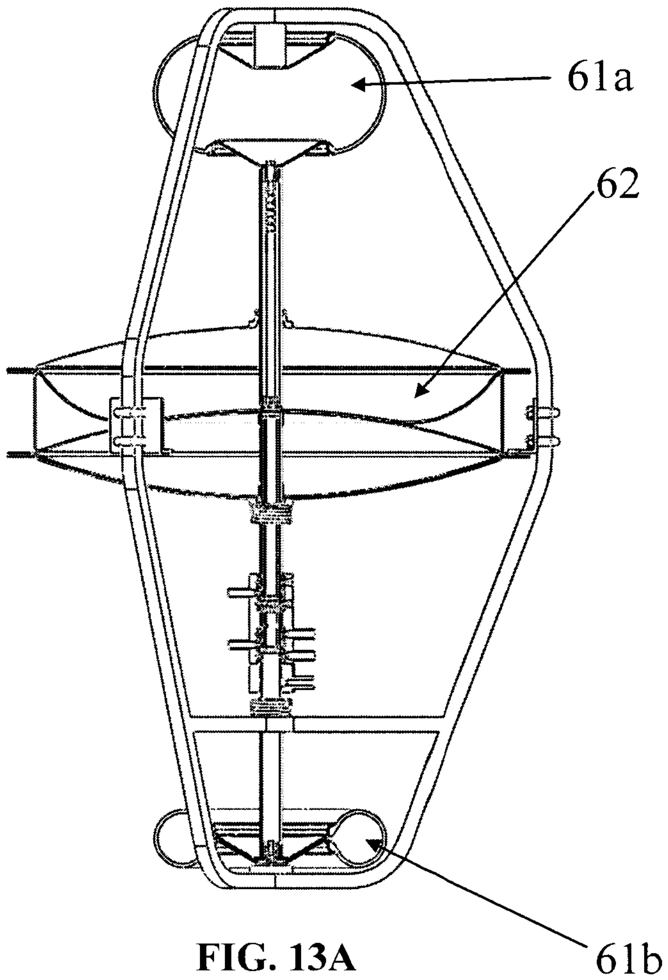

FIG. 13A

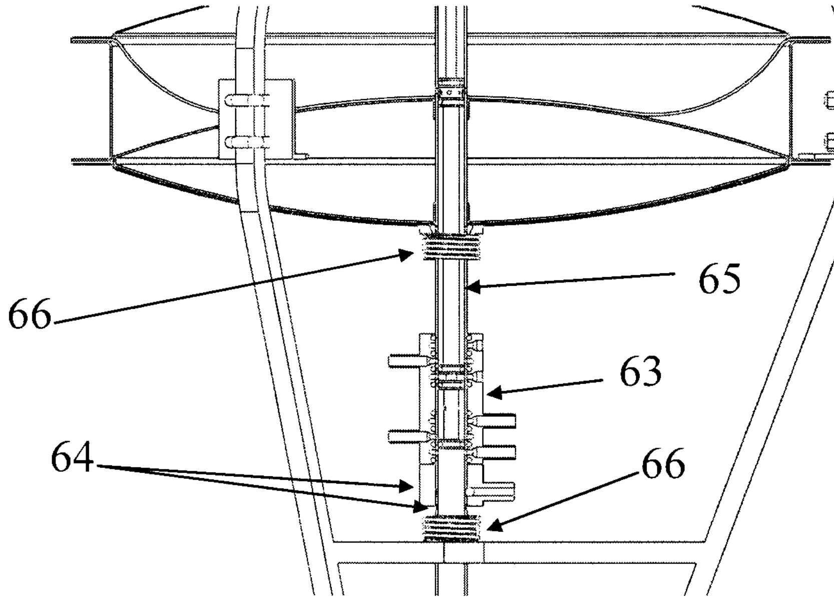

FIG. 13B

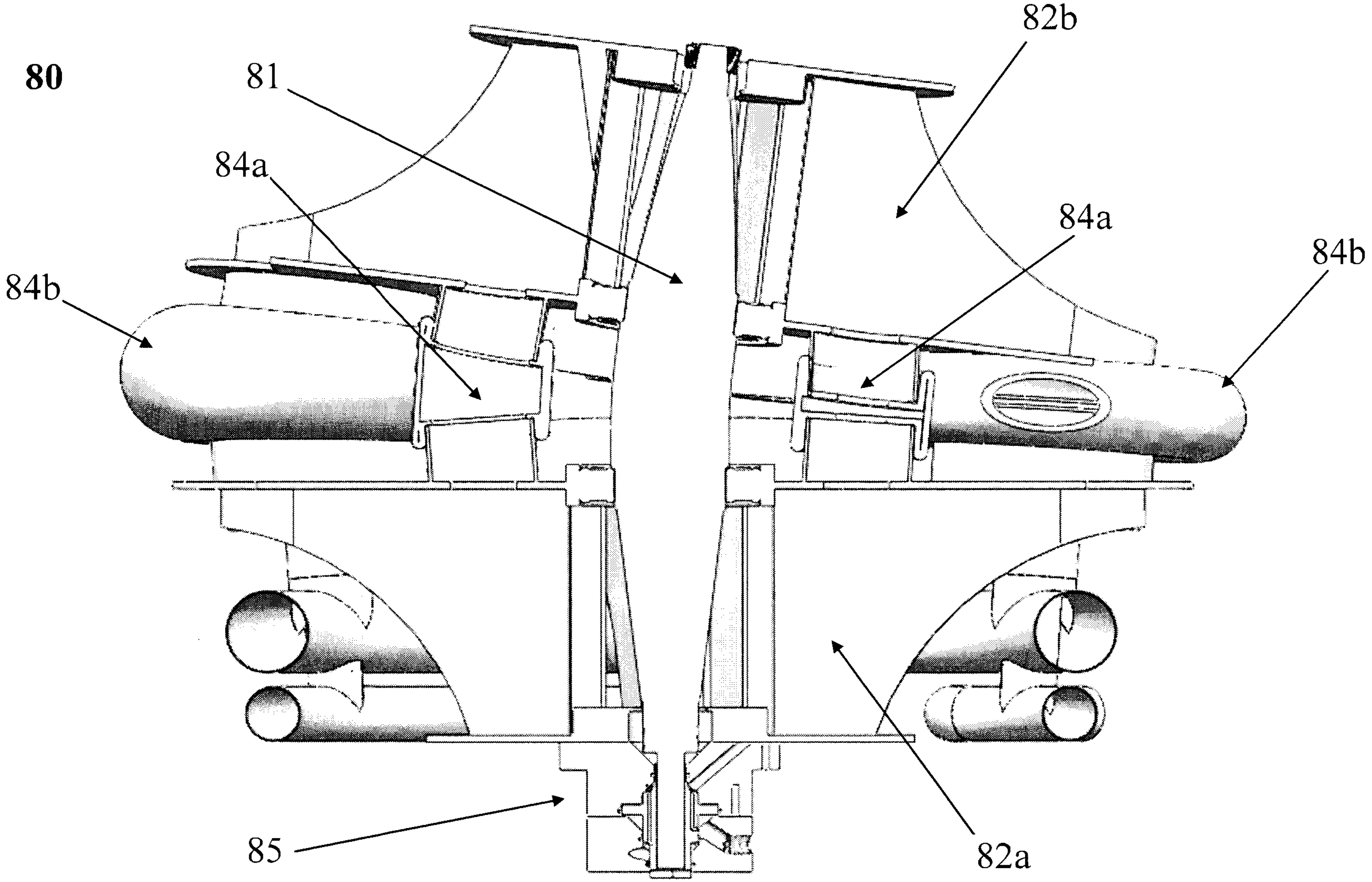

FIG. 14A

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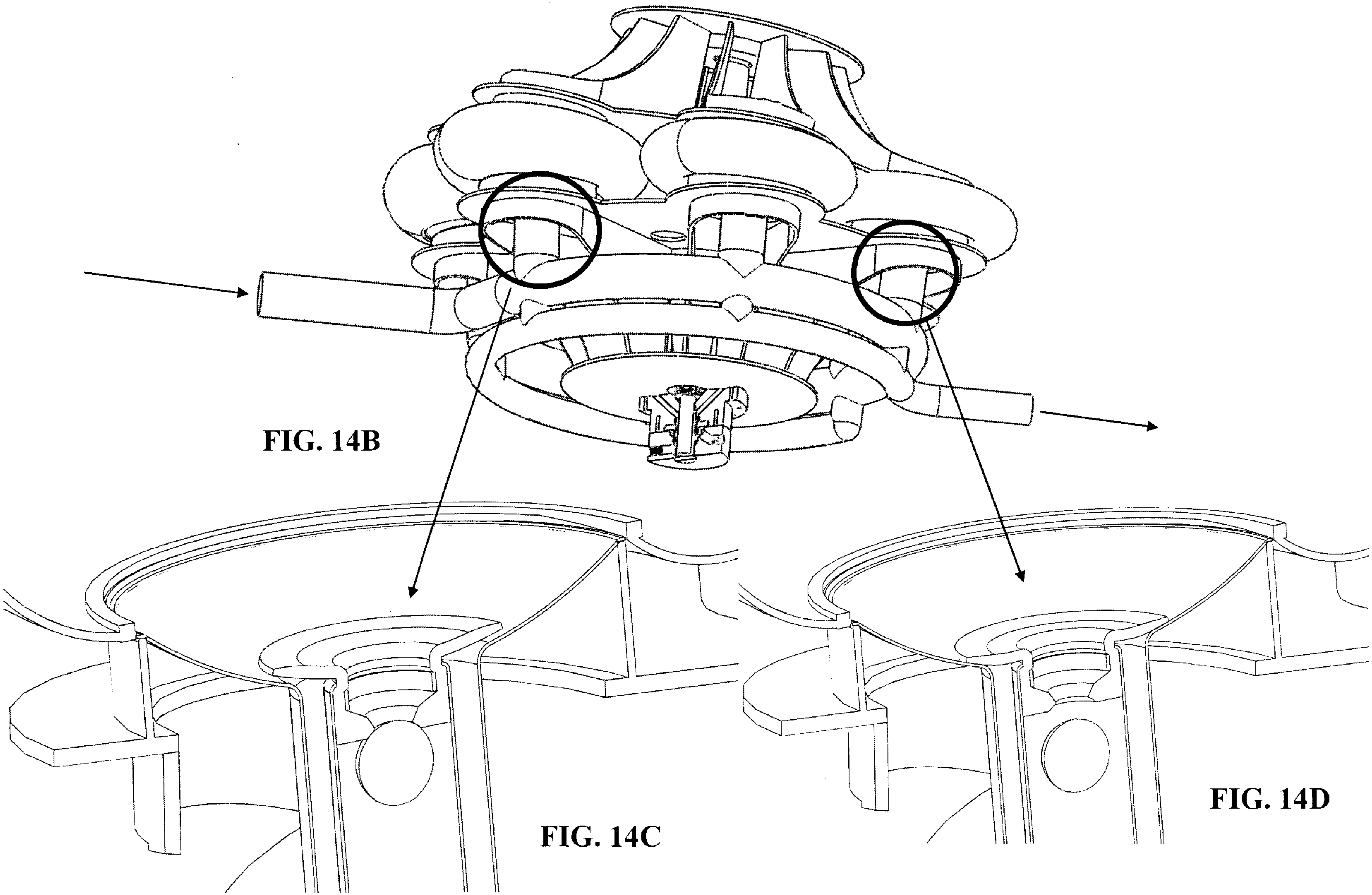

FIG. 14B

FIG. 14C

FIG. 14D

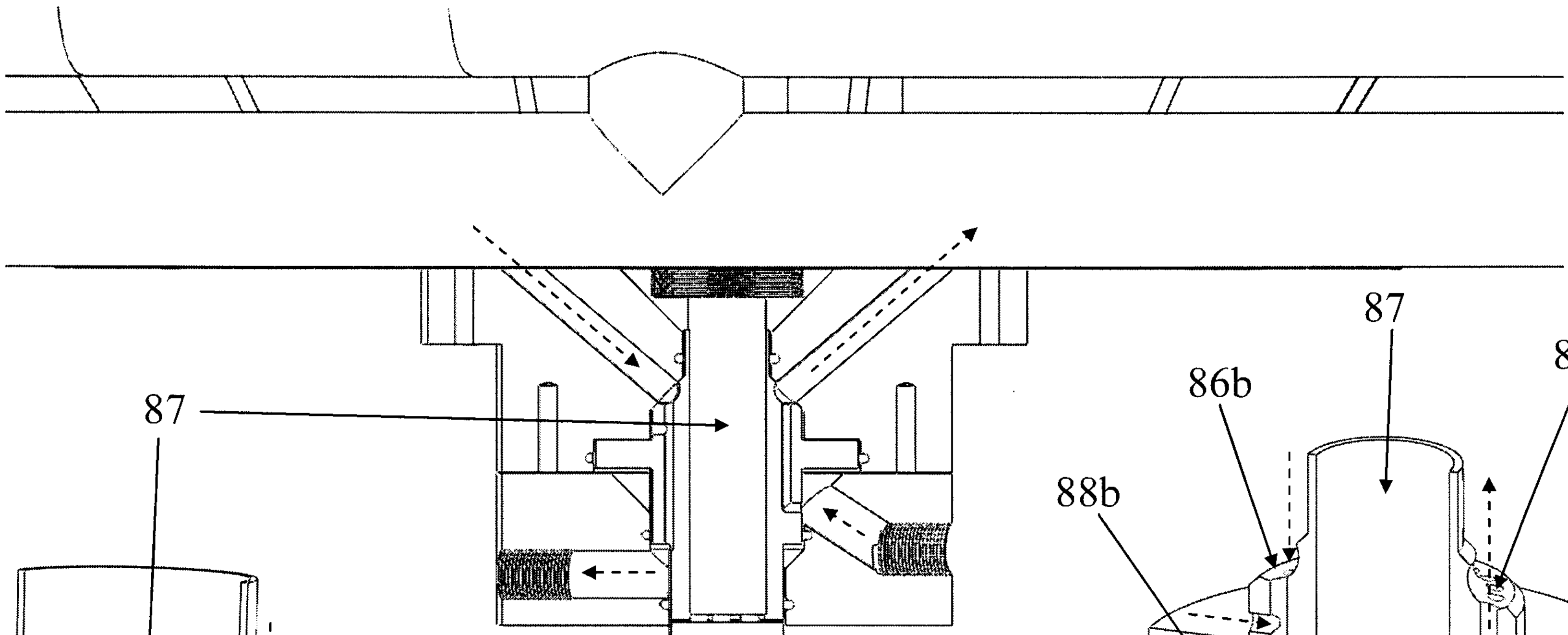

FIG. 15A

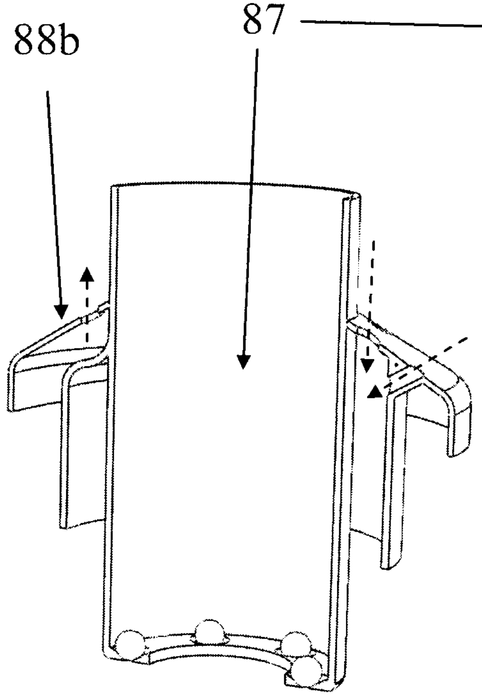

FIG. 15B

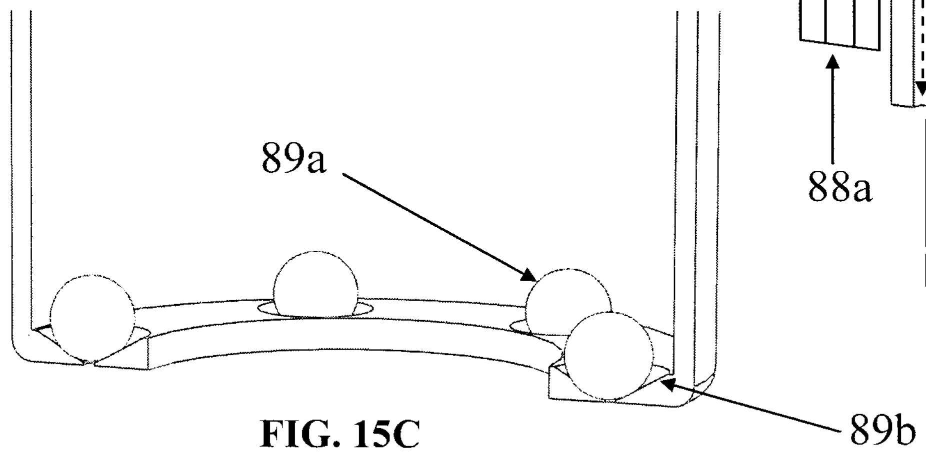

FIG. 15C

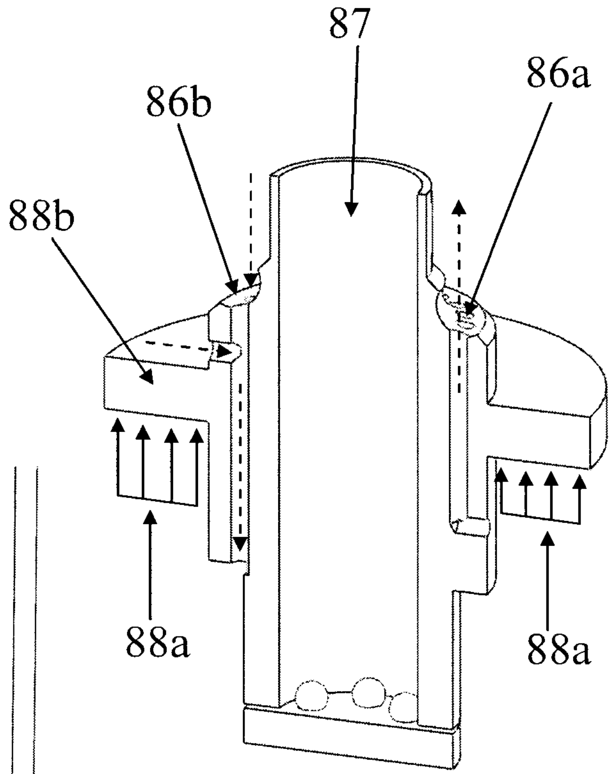

FIG. 15D

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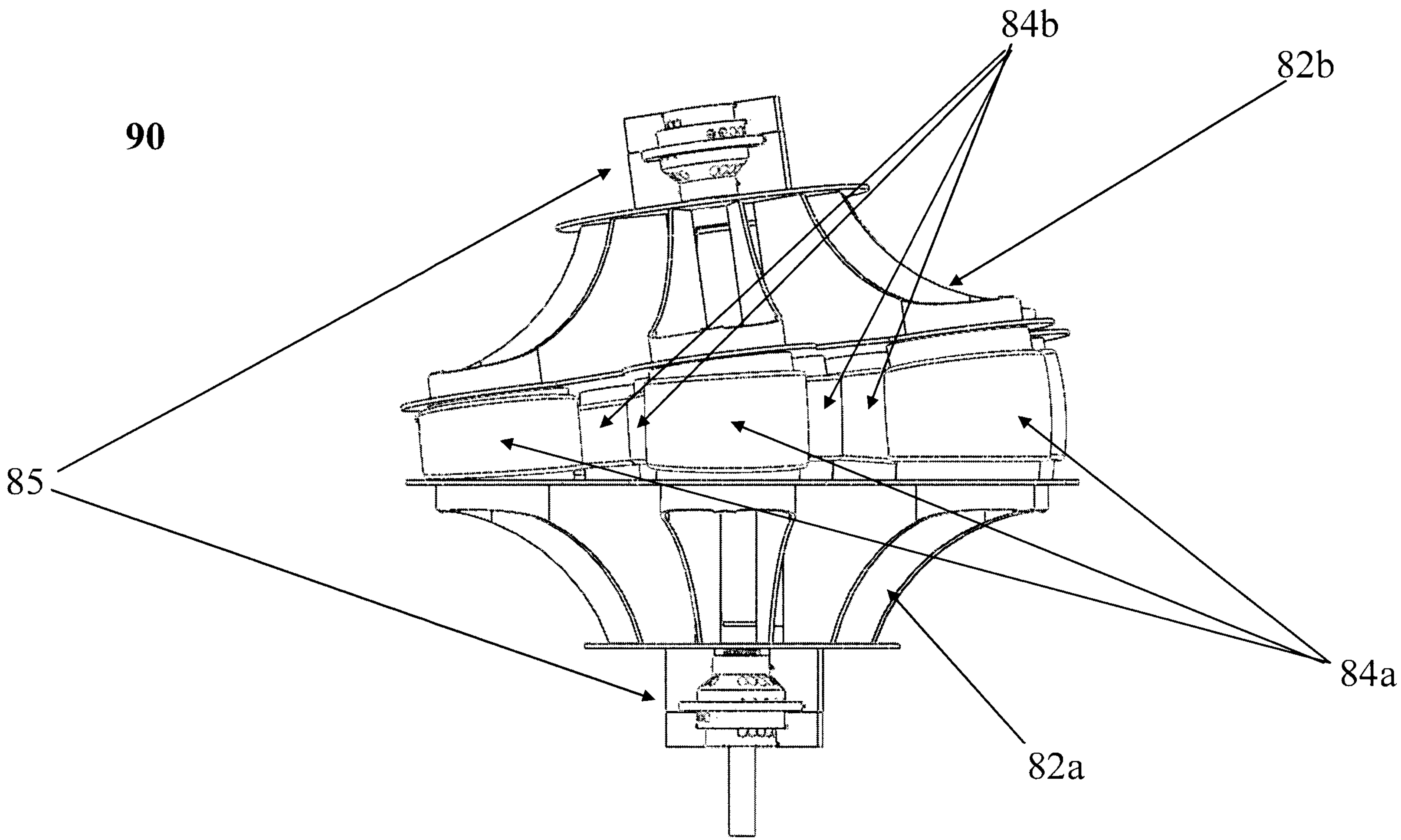

FIG. 16

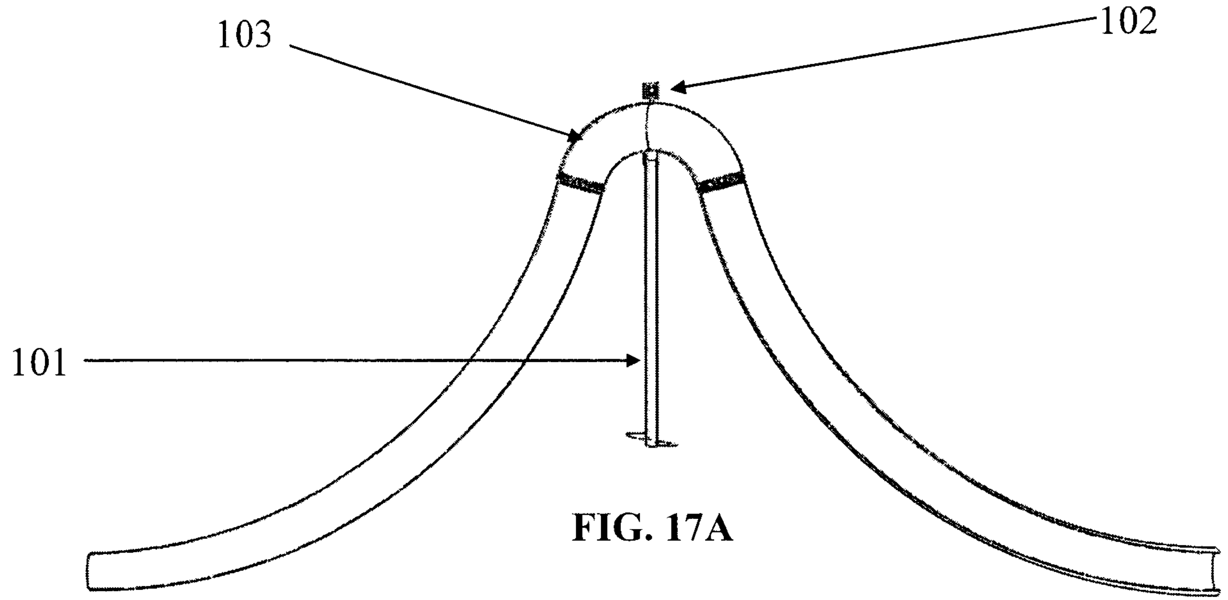

FIG. 17A

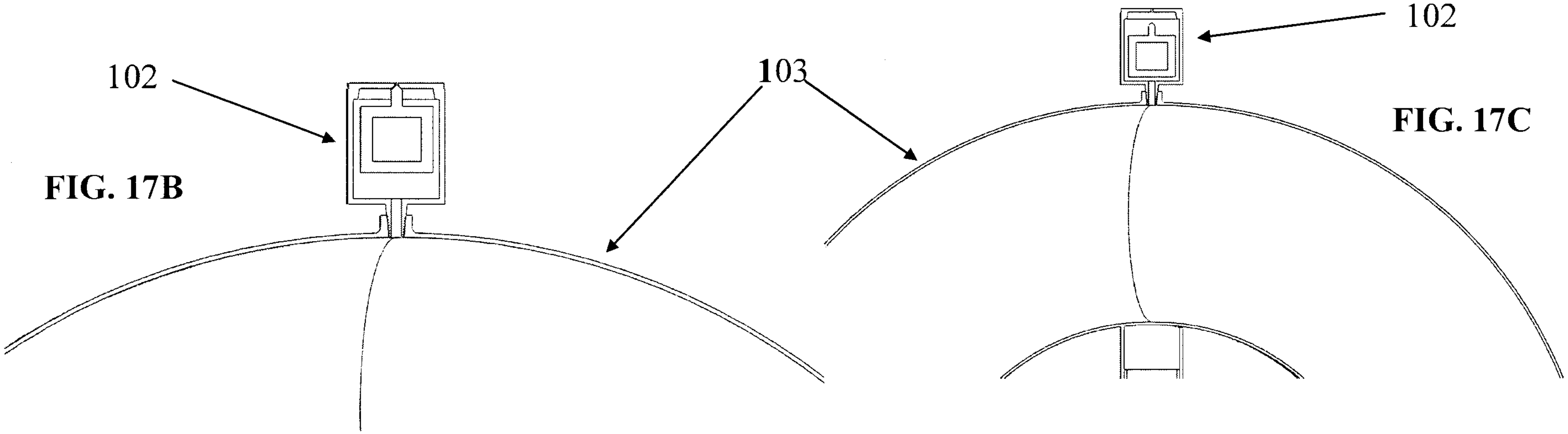

FIG. 17B

FIG. 17C