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(54) Cavitation device

(57) A cavitation device (1) comprising a rotor (7) arranged to rotate about a rotation axis (5) and a stator (6), wherein the rotor comprises at least two circular rows of radially outwardly protruding teeth (15), the at least two circular rows of the rotor being arranged concentrically having the same radius and arranged at an axial distance from each other so that an annular cavity is formed between each two adjacent rows, wherein the stator comprises at least one circular row of radially inwardly protruding teeth, wherein the teeth of each row are arranged at a circumferential distance to each other so that a chamber is formed between each two subsequent teeth in a row, wherein the teeth of the stator are arranged to protrude into the annular cavity between the at least two rows of the rotor, so that the chambers of the at least two rows of the rotor and the chambers of the at least one stator, when axially aligned with each other, form channels extending parallel to the rotation axis of the rotor.

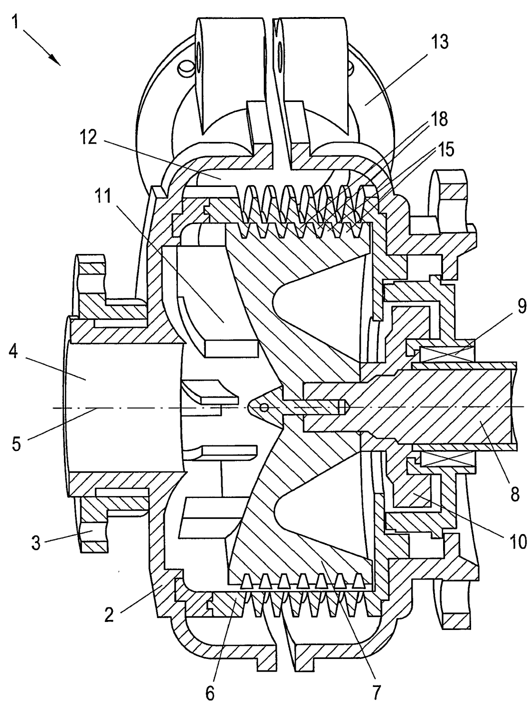

Fig. 1

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Description

FIELD

[0001] The invention refers to a cavitation device comprising a rotor arranged to rotate about a rotation axis and a stator, the rotor and the stator each comprising teeth arranged along a circle, the teeth of the rotor and the teeth of the stator having cavitation surfaces facing each other and defining a gap between them in order to induce cavitation in a liquid flowing therethrough.

BACKGROUND

[0002] Cavitation devices are used to induce cavitation in a liquid. Cavitation is the formation of vapor cavities in a liquid that are the consequence of cavitational forces acting upon the liquid. Cavitation usually occurs when a liquid is subjected to rapid changes of pressure that cause the formation of cavities where the pressure is relatively low. When subjected to higher pressure, the voids implode and can generate an intense shockwave. The maximum pressure amplitude caused by an implosion can reach several thousand N/cm^2. Since the shock waves formed by collapse of the voids are strong enough to cause significant damage to moving parts, cavitation is usually an undesirable phenomenon. However, there are numerous applications, in which cavitation is caused to happen on purpose in order to treat liquids. For example, in chemical engineering cavitation is often used to homogenize and break down suspended particles in a colloidal liquid compound. Further, cavitation may also be used in order to purify water. In cavitational purification devices the extreme conditions of cavitation can break down pollutants and organic molecules. In such applications, particles contained in the liquid are destroyed as a result of the tensile stress that is created by the negative pressure following the shockwave.

[0003] Numerous embodiments of hydrodynamic devices for the creation of cavitation are known. These embodiments comprise a casing with a liquid inlet and an outlet for the treated liquid, wherein a rotor and a stator are concentrically arranged within the casing, the rotor and the stator comprising concentric rows of cavitation elements (e.g. in the form of blades). Instead of a rotor and a stator two rotors may be used that are rotating relative to each other.

[0004] A rotor-pulsation device is described in RU 2124935 C1. The rotor-pulsation device comprises a casing having an inlet and an outlet, in which a rotor disk and a stator disk with toothed elements located on alternating concentric circles are arranged. The toothed elements of one or several concentric circles of the rotor or the stator disks are offset by an amount that provides an overlapping of open sections between adjacent toothed elements of adjacent pairs of concentric circles of rotor and stator disks, while the sections of any neighboring pair of the same disks are open.

[0005] Cavitation devices are also disclosed in RU 2150318, RU 2120471, RU 2165787 and RU 2271245.

[0006] An essential disadvantage of hydrodynamic cavitation devices such as those described above is that the cavitation intensity (cavitation quantity) is not uniform in the entire device. The known devices are constructed such that the cavitation elements, such as the toothed elements, are arranged on the rotor and on the stator in concentric rows, from the center to the periphery, and thus at different radial distances from the rotation axis of the rotor. The circular velocity of the cavitation elements increases with increasing distance from the rotation axis. Since the cavitation intensity strongly depends on the circular velocity of the cavitation element, the construction of the known cavitation devices results in that the cavitation intensity increases with increasing radial distance from the rotation axis. Under these circumstances, it is not possible to achieve a controlled cavitation process.

[0007] In order to increase the overall performance of the known cavitation devices, it would be necessary to increase the power of hydrodynamic oscillations; the power of hydrodynamic oscillations depends on the flow speed of the liquid flowing by the non-uniform disk surfaces. This is achieved by increasing the number of rotations of the rotor. Known models generate cavitational flow in the whole volume of the liquid, but the power of hydrodynamic oscillations in it is restricted by the fact that the maximum circular velocity occurring at the outer peripheral region of the rotor must not exceed a specific limit value. When increasing the movement speed of the liquid relative to solid surfaces of the rotor or the stator by more than 25 m/s, there is a sharp increase in cavitationa1 erosion that leads to accelerated wear of the rotor and the stator. Therefore, the rotation speed of the rotor cannot be increased to exceed the limit value occurring at the outer peripheral region of the rotor, while in inner regions closer to the rotation axis of the rotor, the full potential of the cavitation device is not tapped.

[0008] Another essential shortcoming of known cavitation devices is the occurrence of beats (unstable pulsations) of pressure of the processed liquid and beats of current intensity in the circuit of the electromotor drive while operating under cavitational or close-to cavitational modes. This shortcoming is caused by the fact, that in known cavitation devices the quantity of cavitation elements of the rotor and the stator multiples by 2,3 or 5. When the gaps of the cavitation elements coincide while the rotor is spinning, there is an emission of resonant pulsating flows of the treated liquid going out in radial direction. This leads to pulsations of hydrodynamic rotational resistance of the rotor; pressure pulsations (in the range of $\pm$30% and more) in output pipes of the device; and current/flow intensity pulsations (in the range of $\pm$30% and more) in the electrical circuit of the electromotor drive. As a result, there is a decrease in efficiency of the cavitational force on the processed liquid, an increase in energy capacity of the process, a worsening of conditions, and a shortening of the working life of the cavitation device.

SUMMARY

[0009] Therefore, it is an object of the instant invention to provide an improved cavitation device that overcomes the shortcomings of the prior art cavitation devices.

[0010] In order to solve this object, the invention provides a cavitation device of the initially defined type, wherein the rotor comprises at least two circular rows of radially outwardly protruding teeth, the at least two circular rows of the rotor being arranged concentrically having the same radius and arranged at an axial distance from each other so that an annular cavity is formed between each two adjacent rows, wherein the stator comprises at least one circular row of radially inwardly protruding teeth, wherein the teeth of each row are arranged at a circumferential distance to each other so that a chamber is formed between each two subsequent teeth in a row, wherein the teeth of the stator are arranged to protrude into the annular cavity between the at least two rows of the rotor, so that the chambers of the at least two rows of the rotor and the chambers of the at least one stator, when axially aligned with each other, form channels extending parallel to the rotation axis of the rotor.

[0011] The inventive construction results in that all cavitation elements (i.e. the teeth of the rotor and the teeth of the stator) are located at the same radial distance from the rotation axis, so that uniform conditions with regard to the creation of cavitation are observed in the entire cavitation device. This allows to adjust the cavitation parameters in the desired manner and in particular an optimization of the cavitation intensity.

[0012] In the context of the instant invention, the terms "stator" and "rotor" serve to differentiate between two elements that have a rotational speed relative to each other. In some embodiments the stator may be static, while the rotor rotates relative to the stator. However, the term "stator" does not mean that the stator must necessarily be a static element. Rather, in some embodiments of the invention, both the rotor as well as the stator may be arranged in a rotatable manner. In particular, the rotor and the stator may be driven to rotate in opposite directions.

[0013] In the inventive device cavitation is induced by the following mechanism. During rotation of the rotor, in the moment when the teeth of the stator overlap the chambers between the teeth of the rotor there is a sharp increase in pressure (direct hydraulic shock). In the moment when the chambers between the teeth of the stator overlap with the chambers of the teeth of the rotor, thereby forming channels extending parallel to the rotation axis, a sudden decrease in pressure occurs, followed by the slowing down of the movement speed of the liquid and the formation of hydrodynamic cavitation in the liquid. In the course of hydrodynamic cavitation there is a formation of fields of cavitational bubbles and cumulative micro-streams with a diameter of 5-200 microns, moving at speeds 50 to 1500 m/s. When the liquid moves through the gaps between the teeth, the movement speed decreases, pressure increases, and the cavitational bubbles implode due to the bypass channels in the working chamber of the device. Pressure in implosion points of cavitational bubbles can reach $1{,}5 \times 10^3$ MPa. When the teeth of the rotor overlap the chambers between the teeth of the stator, the solid particles contained in the liquid are destroyed as a result of wedging forces of cavitational micro-streams, and also under the influence of considerable pulling stresses, arising on the surfaces of the solid particles.

[0014] With the inventive device, the cavitation intensity may be adjusted in a simple manner. The cavitation intensity depends on the value and the frequency of pressure pulsations, arising when the rotor teeth overlap the chambers of the stator. The frequency of these pulsations can easily be increased by increasing the number of teeth in the circular rows of teeth of the rotor and the stator. The number of teeth in a circular row is only limited by the minimum width of teeth required for their structural stability and by the width of outlet channels in the stator necessary for the complete outlet of the processed liquid. Further, the frequency of these pulsations can be increased by increasing the rotating speed of the rotor. The rotational speed of the rotor is only restricted by the parameters of the bearing block of the rotor shaft (lubrication conditions, permissible temperature and necessary resource of frictionless bearings) and should not exceed 50 Hz (3000 rpm).

[0015] As mentioned above, the minimum configuration of the cavitation device comprises at lest two rows of teeth arranged on the rotor and at least one row of teeth arranged on the stator. However, the number of circular rows of teeth realized on the stator and on the rotor may be increased depending on the circumstances. According to a preferred embodiment of the invention the stator and the rotor each comprise a plurality of circular rows of teeth, wherein the teeth of the rows of the stator protrude into the annular cavity between the rows of the rotor and vice versa. Preferably, the stator comprises at least five rows of teeth, preferably at least 7 rows of teeth.

[0016] According to a further preferred embodiment, the teeth of the rotor, in a longitudinal section, have a profile that substantially corresponds to the profile of the annular cavity of the stator, and vice versa. In particular, the cavitation surfaces of teeth of the rotor and of the stator facing each other are parallel to each other and define a gap between them that has a width of 0,3-1,7 mm, preferably 0,4-0,6 mm. Preferably, adjustment means are provided for adjusting the width of the gap.

[0017] According to a preferred embodiment, the teeth of the rotor and of the stator, in a longitudinal section, have a trapezoidal profile. In particular, the angle of inclination of the side faces of the teeth is selected to be 15-20° relative to a plane extending perpendicular to the rotation axis. Preferably, the trapezoidal profile of the teeth of the rotor, tapers in a radially outward direction and the trapezoidal profile of the teeth of the stator, tapers in a radially inward direction.

[0018] With regard to the number of teeth in each circular row of teeth an embodiment is preferred, wherein the rows of the stator have the same number of teeth and the rows of the rotor have the same number of teeth. In particular, all the teeth of the rotor have the same shape and dimension and all the teeth of the stator have the same shape and dimension, so that, in accordance with a preferred embodiment of the invention, the rows of teeth of the stator, in a cross section thereof, are congruent, and the rows of teeth of the rotor, in a cross section thereof, are congruent.

[0019] According to a preferred embodiment of the invention, the ratio of the circumferential extent of each tooth to the circumferential extent of each chamber is 0,6-1,15.

[0020] A further preferred embodiment relates to the number of teeth in a circular row of teeth of the stator in relation to the number of teeth in a circular row of teeth of the rotor. According to a first alternative, the rows of teeth of the rotor have the same number of teeth as the rows of the stator. This construction results in a simultaneous formation of axial channels along the entire circumference of the rotor when the chambers of the rows of the stator and those of the rows of the rotor get axially aligned with each other. Upon further rotation of the rotor by a rotation angle that corresponds to the width of the teeth, all teeth of the rotor will overlap the adjacent chambers of the stator and all teeth of the stator will overlap the adjacent chambers of the rotor simultaneously along the entire circumference.

[0021] Alternatively, the at least two rows of teeth of the rotor each have fewer teeth, in particular one tooth less, than the at least one row of teeth of the stator. In this embodiment an overlapping of the teeth of the rotor with the adjacent chambers of the stator and vice versa at the same time along the entire circumference is excluded. Rather, the overlapping position is assumed gradually along the circumference in the course of the rotation of the rotor. This leads to a stabilization of the hydrodynamic resistance to the rotation of the rotor, thus stabilizing pressure pulsations in outlet pipes of the device and pulsations of current intensity in the circuit of the electromotor drive, wherein the pulsations preferably do not exceed $\pm 5\%$. The technical result is a lowering of the noise level, an improvement of operating conditions and an increase of the service life of the device.

[0022] In particular, the number of teeth in a row of the rotor is a prime number not less than 20.

[0023] As to the flow of the liquid through the device, the following embodiments are advantageous. Preferably, the stator encloses a circular cavity, in which the rotor is arranged in a rotatable manner and which comprises a central inlet arranged coaxially with the rotation axis of the rotor. Thus the feeding of the liquid into the device is performed through a central inlet, that opens into the circular cavity. Inside the circular cavity, the liquid is forced to flow in an outward direction to reach the working region, in which it is subjected to cavitation while being pressed to flow between the teeth of the rotor and the teeth of the stator. The liquid preferably exits the stator in a radial direction and is collected in an annular chamber surrounding the stator.

[0024] In order to impart a centrifugal force to a liquid, a preferred embodiment provides that the rotor comprises impeller blades to direct liquid that enters the cavity through the inlet radially outwardly to the chambers of the rotor and the stator. In this way, the liquid is sucked up by the impeller through the inlet opening and the centrifugal forces direct the liquid from the center of the cavity to the periphery, creating a movement of the liquid in the axial channels that are formed when the teeth of the rotor are aligned with the teeth of the stator.

[0025] According to a further preferred embodiment, the chambers of the stator each have a discharge opening directed radially outwardly. In particular, the discharge opening opens into a radially extending discharge channel, that has a cross section that preferably widens in an outward direction. Due to the widening of the discharge channels, the effect of a diffuser is obtained.

[0026] Under the influence of centrifugal forces the liquid contained in the chambers is removed via the discharge channels, wherein the diffusor effect promotes a pressure decrease, which in turn results in a collapse of cavitation bubbles in the liquid. In particular, the collapsing proceeds from the discharge channels to the walls of the annular chamber surrounding the stator, without contacting the walls. Thus, the working organs and the casing of the device do not experience the destructive force of cavitation.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027] In the following, the invention will be described by reference to an exemplary embodiment schematically illustrated in the drawings.

Fig. 1 is a longitudinal section of a first embodiment of a cavitation device,

Fig. 2 is a partial illustration of the rotor and the stator of the first embodiment in a perspective view, with the rotor in a first position,

Fig. 3 is a perspective cross sectional view of the rotor and the stator with the rotor in a second position,

Fig. 4 is a partial illustration of the stator in an inside perspective view,

Fig. 5 is an outside view of the stator and the rotor,

Fig. 6 is a front view of a second embodiment of the stator and the rotor,

Fig. 7 is a system comprising a cavitation device according to the invention.

DETAILED DESCRIPTION

[0028] Aspects of the present invention are disclosed in the following description and related figures directed to specific embodiments of the invention. Those skilled in the art will recognize that alternate embodiments may be devised without departing from the spirit or the scope of the claims. Additionally, well-known elements of exemplary embodiments of the invention will not be described in detail or will be omitted so as not to obscure the relevant details of the invention.

[0029] It should be understood that the described embodiments are not necessarily to be construed as preferred or advantageous over other embodiments. Moreover, the terms "embodiments of the invention", "embodiments" or "invention" do not require that all embodiments of the invention include the discussed feature, advantage or mode of operation.

[0030] In Fig. 1 a cavitation device 1 of the invention is illustrated comprising a substantially cylindrical housing 2 having a flange connection 3 for connecting a feeding pipe for feeding liquid to the inside of the device. The housing 2 comprises an inlet opening 4 that opens centrally into the cavity of the housing and is aligned with the rotation axis 5 of the device 1.

[0031] A stator arranged inside the housing 2 is denoted by 6 and defines a cylindrical cavity, in which a rotor 7 is arranged in a rotatable manner. The rotation axis of the rotor 7 is denoted by 5. The rotor 7 is supported on a shaft 8, which is arranged to rotate within a bearing 9. A sealing member is denoted by 10. The rotor carries a plurality of impeller blades 11, in order to direct fluid that enters the cavity through the inlet 4 radially outwardly towards the periphery of the rotor 7 and to the stator 6. As will be explained with reference to Figs. 2 to 4 the fluid is subjected to cavitation by cavitation elements of the rotor 7 and the stator 6, exits the stator 6 in a radial direction and is collected in an annular chamber 12 that surrounds the stator 6. The housing 2 comprises a tangential outlet opening 13, which serves to discharge the treated fluid.

[0032] As can be seen in Fig. 2 the impeller blades 11 of the rotor 7 are curved and extend to the peripheral region or the rotor 7. On its periphery, the rotor 7 comprises a plurality of teeth 15 that are arranged at equal circumferential distances from each other, so that a chamber 16 is formed between each two subsequent teeth 15 in a row. The teeth 15 are arranged along the entire circumference of the rotor 7. Further, the teeth 15 are arranged in eight parallel, circular rows 14 of teeth. The rows 14 of teeth 15 are arranged concentrically and at the same radial distance from the rotation axis 5. An annular cavity is formed between each two adjacent rows 14.

[0033] As best seen in Fig. 4, the stator 6 comprises a plurality of circular rows 17 of radially inwardly protruding teeth 18, wherein the teeth 18 of each row 17 are arranged at an equal circumferential distance to each other so that a chamber 19 is formed between each two subsequent teeth 18 in a row 17. The teeth 18 of the stator 6 are arranged to protrude into the annular cavity between two neighboring rows 14 of the rotor 7. The teeth 15 of the rotor 7 and the teeth 18 of the stator 6, in a longitudinal section as shown in Fig. 1, have a trapezoidal profile. The trapezoidal profile of the teeth 15 of the rotor 7 tapers in a radially outward direction and the trapezoidal profile of the teeth 18 of the stator 6 tapers in a radially inward direction. Specifically, the profiles of the teeth 15 correspond to the profile of the annular cavity formed between two adjacent rows 19 of the teeth 18 and the profiles of the teeth 18 correspond to the profile of the annular cavity formed between two adjacent rows 14 of the teeth 15. However, the corresponding surfaces of the teeth and the annular cavity do not glide on each other, but the surfaces facing each other define a gap between them that allows fluid to flow therethrough.

[0034] In a first rotational position of the rotor 7 as shown in Fig. 2, the teeth 15 of the rotor 7 and the teeth 18 of the stator 6 overlap each other, so that the respective chambers 16 and 19 are aligned in an axial direction thereby forming channels extending parallel to the rotation axis 5 of the rotor 7. Upon further rotation of the rotor 6, the chambers 16 of the rows 14 get gradually closed on their sides by the teeth 18 of the stator 6 and the chambers 19 of the rows 17 get gradually closed on their sides by the teeth 15 of the rotor 7. Fig. 3 illustrates the beginning closing procedure, wherein the teeth 15 of the rotor 7 have left their position, in which they are axially aligned with the teeth 18 of the stator 6, and slightly project into the chambers 16,19.

[0035] The chambers 19 of the stator 6 each have a discharge opening 20 directed radially outwardly. The discharge opening 20 is configured as a slit and has a circumferential extent that corresponds to the circumferential distance between two teeth 18 in a row 17. The discharge openings 20 each open into a discharge channel 21, that has a cross section that widens in an outward direction. Specifically, the discharge channels 21 are defined between circumferential ribs 22 of the stator 6, wherein the ribs 21 taper in a radially outward direction.

[0036] In the embodiment shown in Fig. 1 to 5 the rows 14 of the rotor 7 and the rows 17 of the stator 6 have an equal number of teeth 15,18. In contrast, in the embodiment shown in Fig 6, the rows 14 of the rotor 7 have one tooth 15 less than the rows 17 of the stator 6. Therefore, as illustrated in Fig. 6, the teeth 15 of the rotor 7 and the teeth 18 of the stator 6 do not overlap each other to the same extent.

[0037] The cavitation device 1 of the invention may be used in a system illustrated in Fig. 7. The system comprises a supporting frame 23, which carries a pump 24, a mixing tank 25, a power cabinet 26, a control console equipped with a touch screen 27 and an electric engine

28. All components of the device are connected by a system of pipes 29. The pipes 29 are equipped with temperature measuring devices 30, pressure measuring devices 31, a flow meter 32, a protective screen 33 for the operator and other devices necessary for the measuring and defining the technical working parameters of the cavitational pump.

[0038] The functioning of the device can be split into three cyclically changing phases, whereby in the mechanical functioning of device, phase (I) is conjugated with phase (III).

First phase (I)

[0039] The teeth 15 of the rotor 7 and the teeth 18 of the stator 6 are completely aligned in an axial direction (as shown in Fig. 2). In this position of the rotor 7 relative to the stator 6 axial channels are formed by the alignment of the chambers 16 and 19, through which the liquid moves. Further, in this position a gap is present between the surfaces of the teeth 15 and the teeth 18 facing each other. In this gap there is a sudden drop in pressure and caverns are formed.

[0040] During the movement of the liquid or gas-like environment, the pressure in the environment drops. Thereby, the higher the movement speed of the environment, the lower the pressure. Thus, when the liquid flows through the local narrowing (gaps), according to the continuity equation of flows, there is an increase in speed with a simultaneous decrease in pressure in this spot. At this point, absolute pressure reaches a value equal to the pressure of saturated gases of the liquid at a given temperature; or it reaches a value equal to the pressure at which dissolved gases are released from the liquid. In this case, intensive steam formation (boiling) and release of gases is observed. The beginning of the cavitational processes takes place, with the formation of caverns.

[0041] Characteristic of this phase is flow, accompanied by intensive mixing of liquid with pulsation of speeds and pressure in the narrow gaps. Along with the main longitudinal movement of liquid, a transversal movement and spinning motions of separate volumes of liquid are observed.

Second phase (II)

[0042] The teeth 15 and the teeth 18 leave their axially aligned position, whereby the chambers 16,19 begin to get closed on their sides by the adjoining teeth, thereby slowing down the movement of the liquid. Inside the closing chambers 16,19 there is a sudden spike in pressure (direct hydraulic shock). In the process of hydrodynamic cavitation there is a formation of fields of cavitational bubbles and cumulative micro streams with a diameter of 5-200 micrometers, moving at speeds of 50-1500 m/s. When the liquid moves in the chambers 16,19 the movement speed decreases, the pressure increases and the cavitational bubbles implode. The pressure in the area of implosion of cavitational bubbles can reach $1,5x10^3$ MPa.

[0043] Liquid flow moves along the discharge channels 21 for the outlet of treated liquid. The treated liquid is transferred from the discharge channels 21 into the annular cavity 12 and to the outlet opening 13 of the device.

Third phase (III)

[0044] Under certain circumstances, when the liquid moves along the closed chambers 16,19 a phenomenon, associated with a change in the aggregate condition of the liquid occurs, i.e. the transformation of the liquid into steam with the release of gases which were dissolved in the liquid. Teeth rows 14 of the rotor 7 additionally provide flow of liquid to the discharge channels 21 due to centrifugal forces. At low rotation speed of the rotor 7 and at low pressure, no visible change in the liquid movement in the discharge channels 21 is observed. When increasing the movement speed of the liquid in the discharge channels 21 a second zone of cavitation formation arises, with the formation of gas filled bubbles. A second area of local boiling is formed. i.e. the formation of steam with the release of gas which is dissolved in the water. The subsequent condensation and the implosion of caverns are accompanied by a hydraulic shock.

[0045] The speed at which the liquid moves in the device can be altered by the rotation frequency of the rotor; pressure in the system can be altered, for example, by a stop valve which is placed at the inlet 4. In this way a controlled cavitational process is provided that safeguards the working organs from tear and wear. The productivity of the device is directly dependent on altering these parameters and the parameters of the processed liquid.

[0046] When treating liquid containing organic inclusions, in the axial channels, which form when the chambers 16,19 are axially aligned, mechanical grinding, cross slicing, mixing, and shredding occurs. This occurs due to the chopping movement of the rotor teeth between the stator teeth, working on the principle of guillotine scissors.

[0047] The foregoing description and accompanying figures illustrate the principles, preferred embodiments and modes of operation of the invention. However, the invention should not be construed as being limited to the particular embodiments discussed above. Additional variations of the embodiments discussed above will be appreciated by those skilled in the art.

[0048] Therefore, the above-described embodiments should be regarded as illustrative rather than restrictive. Accordingly, it should be appreciated that variations to those embodiments can be made by those skilled in the art without departing from the scope of the invention as defined by the following claims.

Claims

1. Cavitation device comprising a rotor arranged to rotate about a rotation axis and a stator, the rotor and the stator each comprising teeth arranged along a circle, the teeth of the rotor and the teeth of the stator having cavitation surfaces facing each other and defining a gap between them in order to induce cavitation in a liquid flowing therethrough, wherein the rotor comprises at least two circular rows of radially outwardly protruding teeth, the at least two circular rows of the rotor being arranged concentrically having the same radius and arranged at an axial distance from each other so that an annular cavity is formed between each two adjacent rows, wherein the stator comprises at least one circular row of radially inwardly protruding teeth, wherein the teeth of each row are arranged at a circumferential distance to each other so that a chamber is formed between each two subsequent teeth in a row, wherein the teeth of the stator are arranged to protrude into the annular cavity between the at least two rows of the rotor, so that the chambers of the at least two rows of the rotor and the chambers of the at least one stator, when axially aligned with each other, form channels extending parallel to the rotation axis of the rotor.

2. Device according to claim 2, wherein the stator and the rotor each comprise a plurality of circular rows of teeth, wherein the teeth of the rows of the stator protrude into the annular cavity between the rows of the rotor and vice versa.

3. Device according to claim 1 or 2, wherein the teeth of the rotor, in a longitudinal section, have a profile that substantially corresponds to the profile of the annular cavity of the stator, and vice versa.

4. Device according to claim 1, 2 or 3, wherein the cavitation surfaces of teeth of the rotor and of the stator facing each other are parallel to each other and define a gap between them that has a width of 0,3-1,7 mm, preferably 0,4-0,6 mm.

5. Device according to claim 4, wherein adjustment means are provided for adjusting the width of the gap.

6. Device according to any one of claims 1 to 5, wherein the teeth of the rotor and of the stator, in a longitudinal section, have a trapezoidal or rectangular profile.

7. Device according to any one of claims 1 to 6, wherein the rows of the stator have the same number of teeth and the rows of the rotor have the same number of teeth.

8. Device according to any one of claims 1 to 7, wherein the rows of teeth of the stator, in a cross section thereof, are congruent, and the rows of teeth of the rotor, in a cross section thereof, are congruent.

9. Device according to any one of claims 1 to 8, wherein the rows of teeth of the rotor have the same number of teeth as the rows of the stator.

10. Device according to any one of claims 1 to 9, wherein the at least two rows of teeth of the rotor each have fewer teeth, in particular one tooth less, than the at least one row of teeth of the stator.

11. Device according to any one of claims 1 to 10, wherein the chambers of the stator each have a discharge opening directed radially outwardly.

12. Device according to claim 11, wherein the discharge opening opens into a discharge channel, that has a cross section that preferably widens in an outward direction.

13. Device according to any one of claims 1 to 12, wherein the ratio of the circumferential extent of each tooth to the circumferential extent of each chamber is 0,6-1,15.

14. Device according to any one of claims 1 to 13, wherein the stator encloses a circular cavity, in which the rotor is arranged in a rotatable manner and which comprises a central inlet arranged coaxially with the rotation axis of the rotor.

15. Device according to any one of claims 1 to 14, wherein the rotor comprises impeller blades to direct fluid that enters the cavity through the inlet radially outwardly to the chambers of the rotor and the stator.

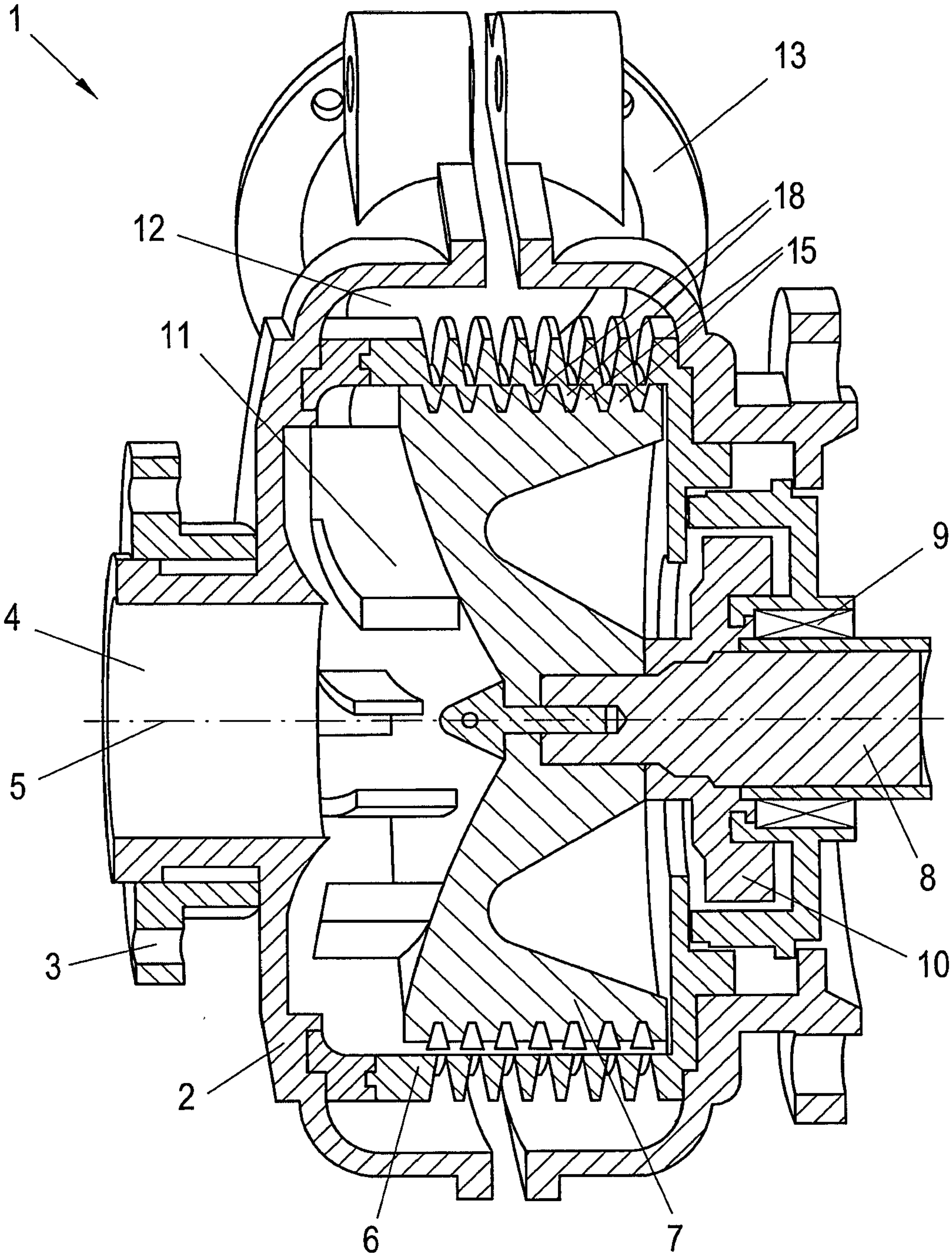

Fig. 1

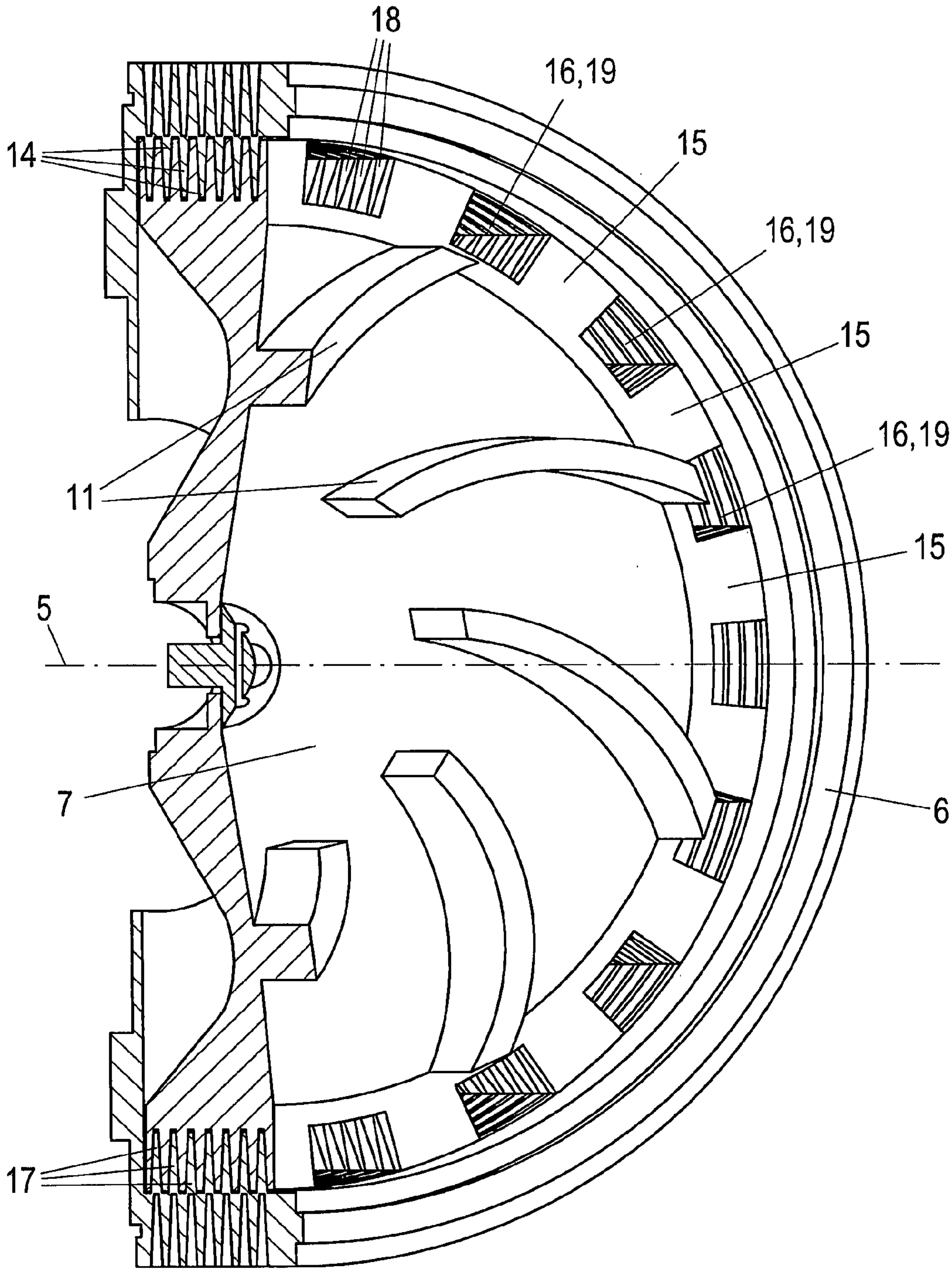

Fig. 2

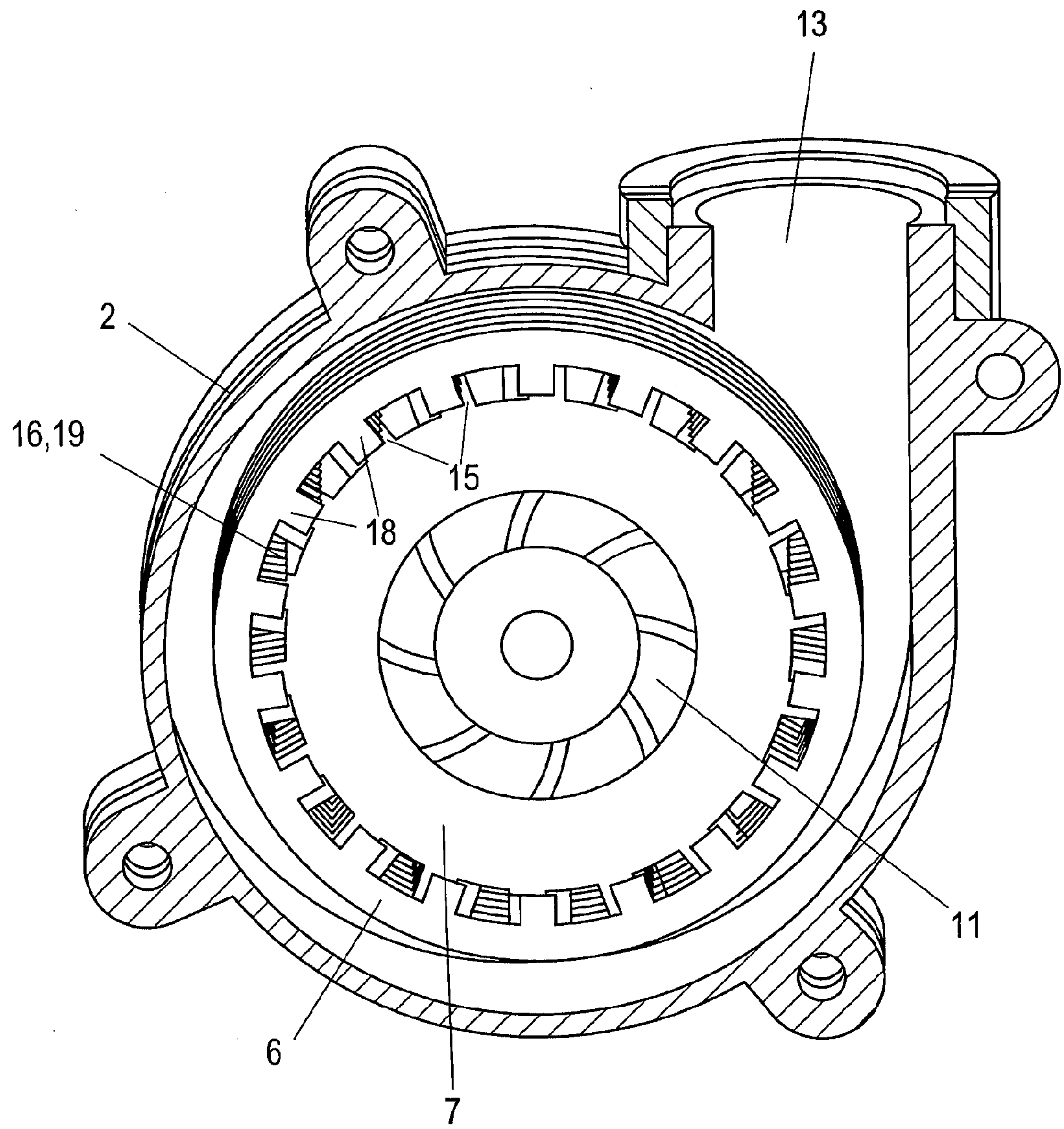

Fig. 3

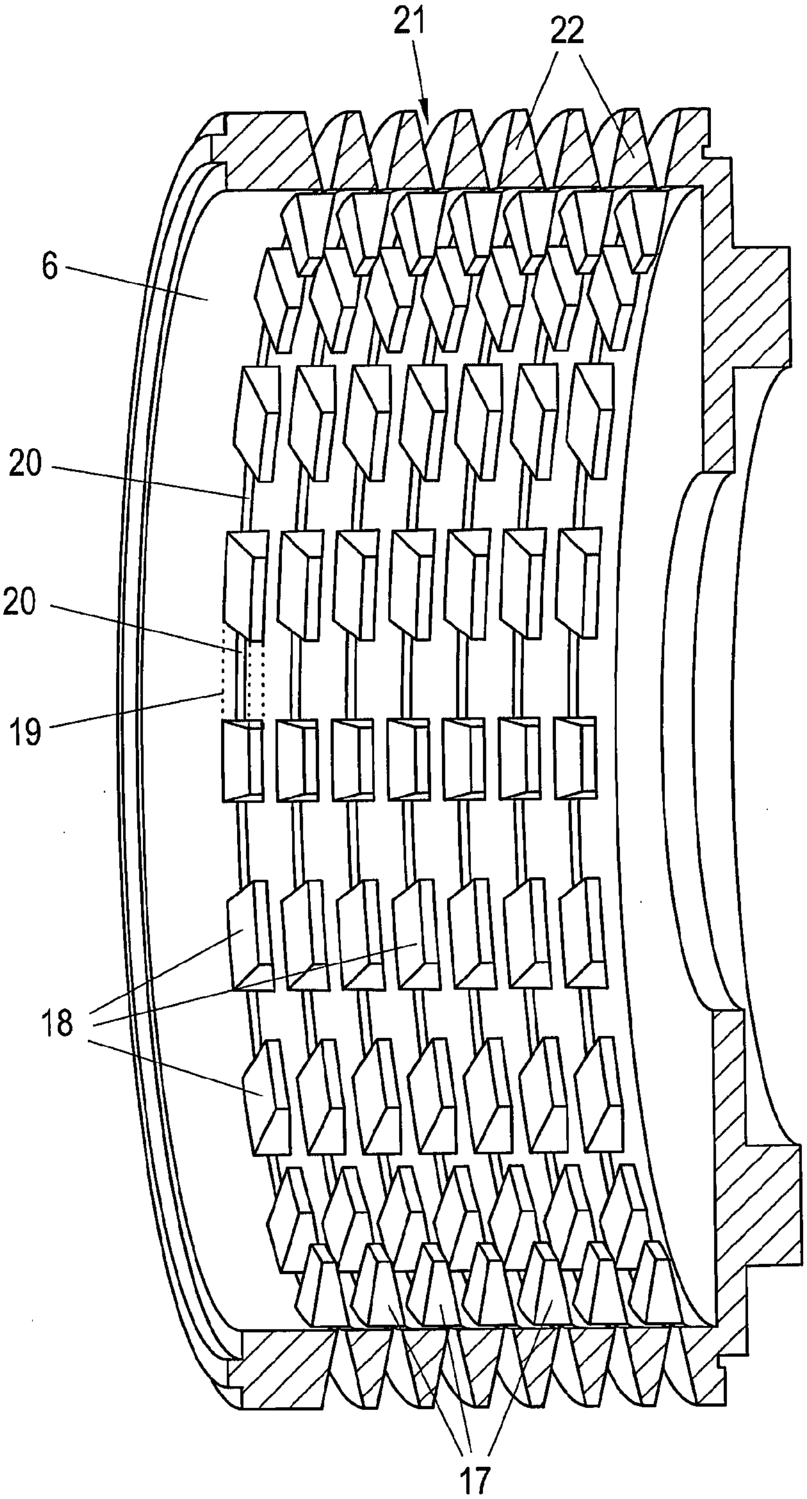

Fig. 4

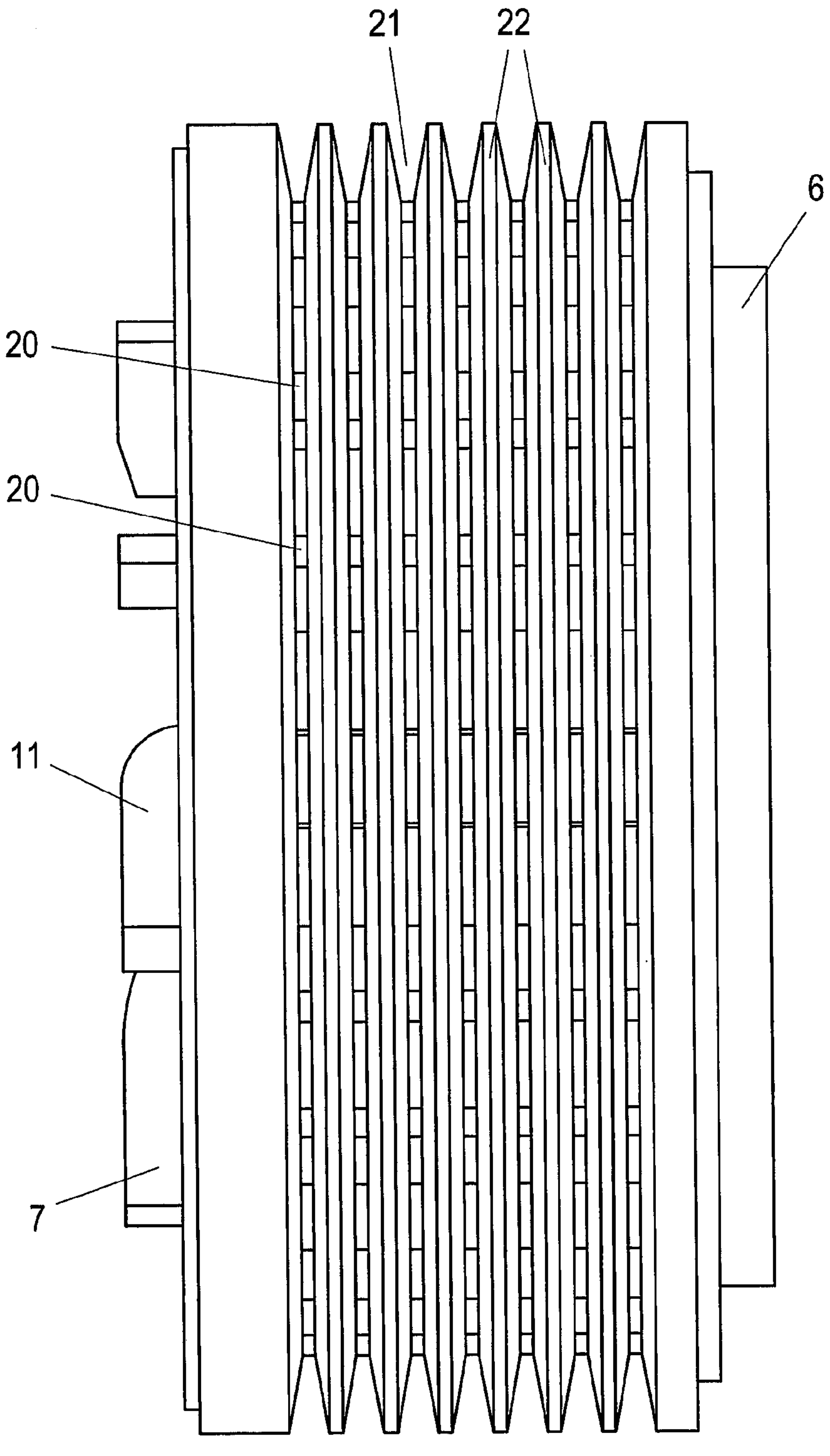

Fig. 5

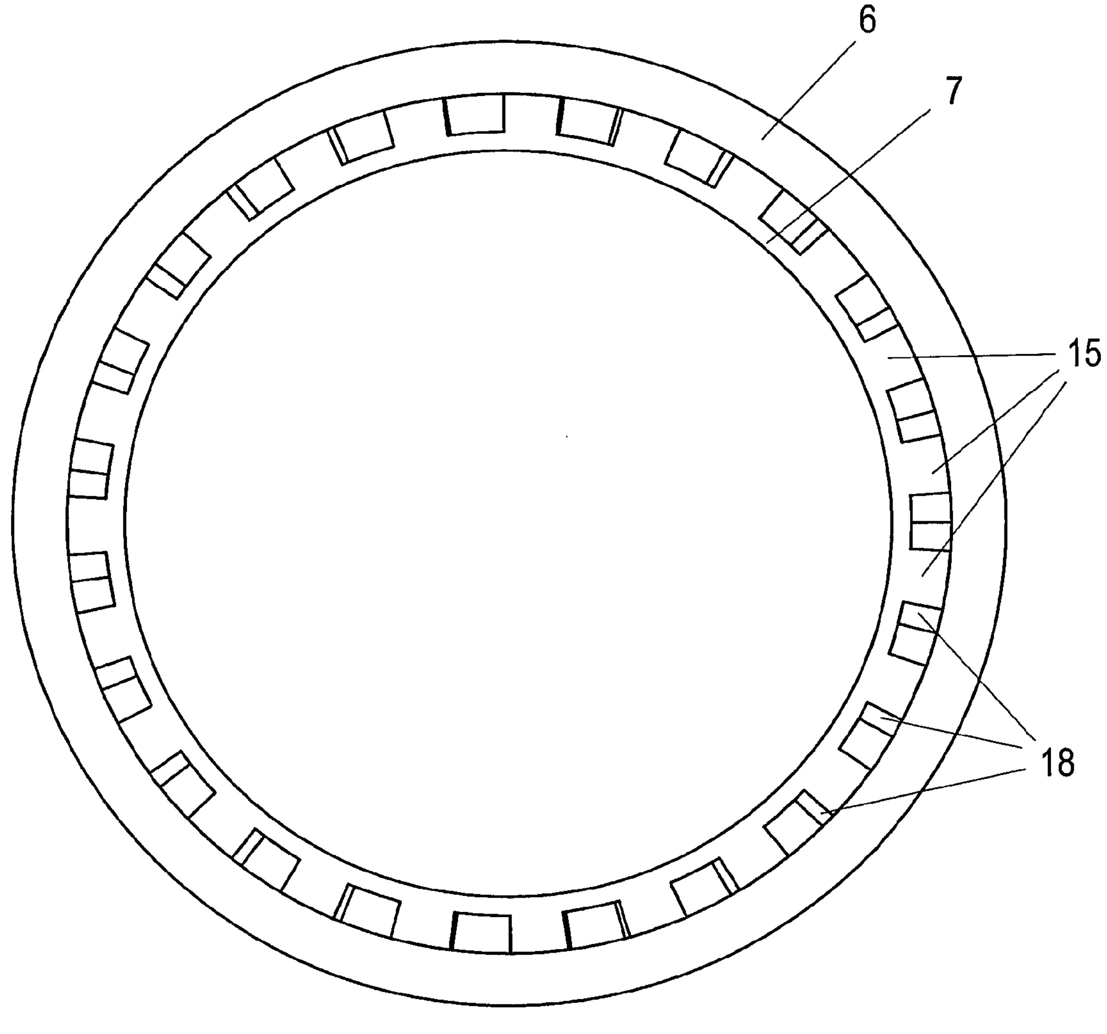

Fig. 6

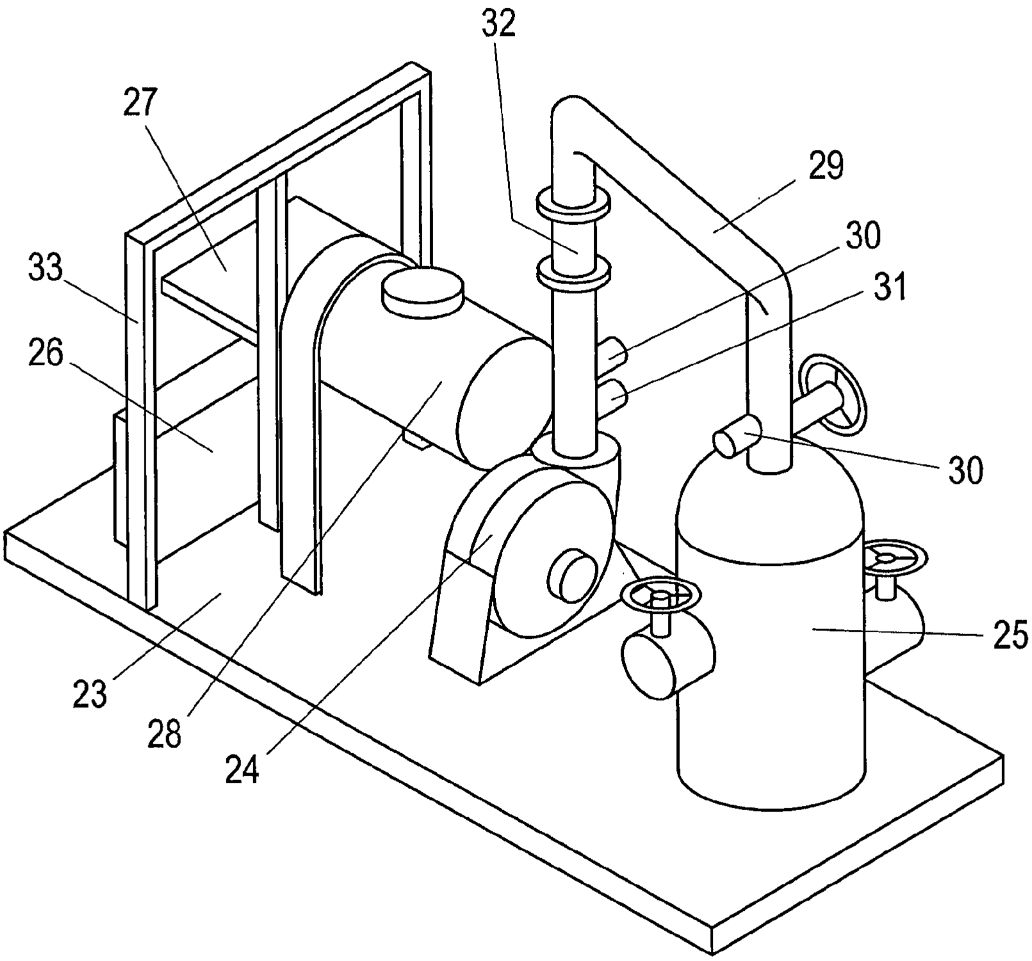

Fig. 7

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EUROPEAN SEARCH REPORT

Application Number
EP 15 00 0878

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X A	US 1 487 208 A (COOKE GORDON C ET AL) 18 March 1924 (1924-03-18) * page 1, line 46 - line 53 * * page 2, line 5 - line 23 * * figures 1,2 *	1-3,6-9, 13,14 4,5, 10-12,15	INV. B01F7/00
X A	US 4 330 215 A (GALE GEORGE M) 18 May 1982 (1982-05-18) * column 3, line 45 - line 61 * * column 4, line 31 - line 39 * * figures 1,2 *	1-3,6-9, 13,14 4,5, 10-12,15	
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1

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	21 September 2015	Real Cabrera, Rafael

CATEGORY OF CITED DOCUMENTS

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