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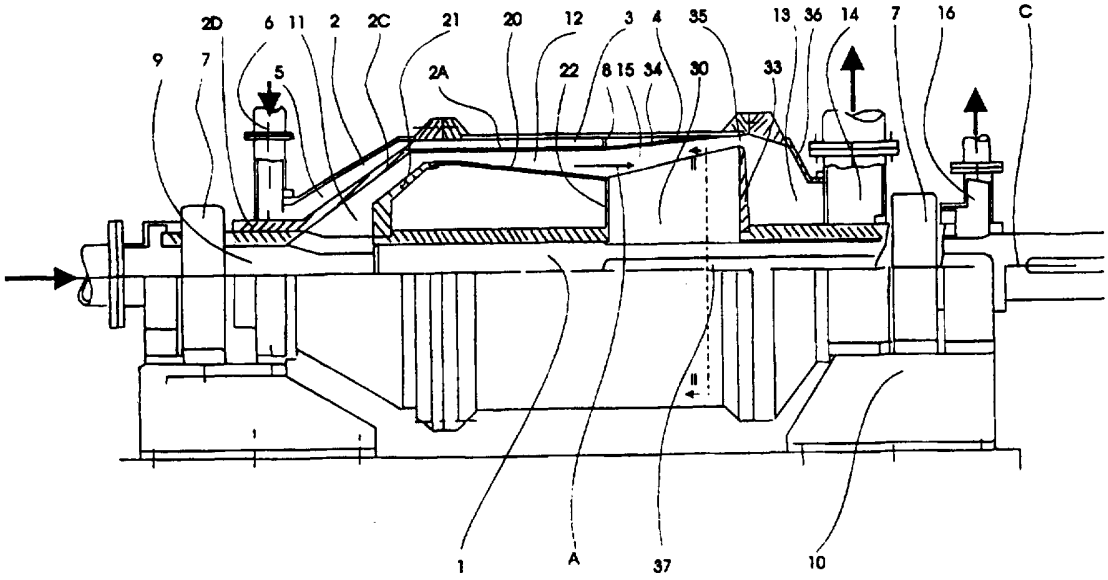

(57) Abstract

The invention relates to an apparatus for treating a fluid containing at least two fractions, which apparatus includes a rotationally symmetrical casing (4) which is firmly connected to a driven, mounted axle (1), with the axle (1), and thereby the casing (4), being caused to rotate around an axis of rotation (C), in addition to which the casing (4) is provided with inlet members (9) for the fluid which is to be treated and with outlet members (14, 16). A number of guiding blades (30) inside the casing (4) are firmly connected to the said axle (1) so that they rotate with it, with the said guiding blades (30) extending from the said axis of rotation (C) out towards the inner walls of the said casing (4).

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Apparatus for treating fibrous suspensions

Technical field

The present invention relates to an apparatus for treating a fluid containing at least two fractions, which apparatus includes a rotationally symmetrical casing which is firmly connected to a driven, mounted axle, with the axle and thereby the casing being caused to rotate around an axis of rotation, in addition to which the casing is provided with inlet members for the fluid which is to be treated and with outlet members.

State of the art

It is well known that fibrous suspensions behave in a very special manner, resulting in special devices being required when, for example, washing the pulp or separating off particles. The known processes and devices which have been developed all suffer in principle from the disadvantage that physical contact takes place between the suspension and some form of screen device in conjunction with the actual liquid penetration phase. This is undesirable, since the contact results in friction and causes disturbances in the onward feeding of the pulp bed. In order to remedy the problems associated with physical contact, a device, as disclosed in WO 93/9321377, has been developed in which the suspension which is to be treated is conveyed into a rotationally symmetrical space whose outer wall is cylindrical and permeable to liquid. A rotationally symmetrical casing is arranged outside this permeable wall so that a gap, which is in the main cylindrical, is formed between them; the whole device is caused to rotate at a relatively high speed of rotation.

As a consequence of the rotation, the pulp suspension in the device according to WO 93/9321377 is subjected to a centrifugal force and is pressed outwards towards the permeable wall and, due to the difference in density, the centrifugal force gives rise

to a stratification of the fibre pulp and the fluid in the suspension which has been fed in. Fluid with which the suspension is to be treated is conveyed into the gap between the permeable wall and the casing and, as a consequence of the pressure, is squeezed through the permeable wall and presses the suspension inwards from the wall so that contact does not take place. The fluid which has been squeezed in also penetrates into the fibre pulp so that an exchange of liquid takes place in the pulp resulting in the fibre pulp being washed. The liquid which is located on the inner side of the fibre pulp, seen in a radial direction from the axis, is then drawn off in such a way that it is conducted away in towards the centre while the pulp is conducted onwards in an essentially axial direction and is removed separately. This process renders it possible to change the liquid content in a fibre suspension in an efficient manner without the pulp bed being subjected to undesirable physical stresses.

Nevertheless, a problem which remains is that of dealing with the withdrawn liquid in an efficient manner without disturbing the pulp bed, and preferably also that of utilizing the kinetic energy in the liquid. NO-B-175 436 describes a device in which the centrifugal force is utilized to separate particles in a liquid and which includes a rotationally symmetrical, cylindrical and rotating casing with stratification being obtained within the said casing. Due to the density and the centrifugal force, the liquid which has been squeezed out of the fibre pulp comes to be located closest to the rotational axis and, according to one embodiment, is taken up by two fins which are directed outwards radially and which are arranged on a rotationally symmetrical body in the form of a double cone which is fixed or which rotates at a lower speed of revolution than does the cylindrical casing, and, according to another embodiment, by fins which are

directed inwards radially and which are arranged in a space within the said double cone body and in close proximity to the rotational axis. This space is connected to the outer space by way of passages. The fins in both the embodiments are intended to conduct the liquid in towards the centre of rotation at the same time as some of the energy possessed by the liquid is returned to the rotational axis on which the double cone body is mounted. In the device according to the abovementioned patent, there still remains the problem that, due to the centrifugal force, the fibre pulp is pushed outwards towards the inner walls of the casing, something which, as outlined above, causes friction and disturbances in the onward feeding of the pulp bed. There is a high risk of the fibre bed building up along the wall of the casing due to the friction and of fibres being drawn along by the fins.

Short description of the invention

The object of the invention is to tackle the abovementioned complex of problems and to offer an improved apparatus of the type specified in the introduction. According to one aspect of the invention, an aim is to improve a device of the type which is described in WO 93/21377 so that efficient separation is achieved without any friction between the pulp suspension and the device, so that the media which have been separated are kept separated and so that at least some of the kinetic energy which is present in the separated media can be returned to the system. According to one aspect of the invention, an aim is also to obtain a device for efficiently separating fractions having different densities. These and other objects are achieved by means of the apparatus according to the invention due to the fact that it includes a number of guiding blades inside the casing which are firmly connected to the said axle so that they rotate with it, and that the said guiding

blades extend out from the said axis of rotation towards the inner walls of the said casing. The guiding blades are preferably curved so that their front side surfaces are directed in the direction of rotation of the apparatus. Additional features and aspects of the invention are evident from the subclaims and from the following description of some preferred embodiments.

Description of the drawings

The apparatus according to the present invention will be described in detail below in association with some preferred embodiments and with reference to the attached drawings in which

Fig. 1 is a cut-away view of the apparatus according to the preferred embodiment of the present invention,

Fig. 2 is a view in the direction of the arrow II, which view shows a cross section of the guiding blades which are included in the apparatus according to a preferred embodiment.

Description of a preferred embodiment

The apparatus according to a preferred embodiment of the invention includes, as can be seen by reference to Fig. 1, an axle 1 which extends along an axis of symmetry and rotation C. The axle 1 is rotatably mounted with the aid of two bearings 7 which are fixed in a stand 10. The axle is driven in a suitable manner (not shown). A device 2, which converges outwards from the axle into a disk-like section 2C, which is essentially Y-shaped in cross section and which merges into a rotationally symmetrical liquid-permeable section 2A, is firmly connected to the axle 1. The device 2 is also provided with an inner base section 2D which, at its inner periphery, is connected to the said axle 1. The liquid-permeable section 2A

exhibits suitable perforations, for example slits or holes.

A space 3, termed fluid space, encircles the liquid-permeable cylindrical section 2A. The space 3 is delimited outwards by a casing wall 4, which wall essentially exhibits the same shape as the device 2 so that an essentially gap-like channel 5 is formed between the disk-like section 2C of the device and the casing wall 4. The fluid space 3 is delimited in the longitudinal direction by a distancing member 8, for example in the form of an annular wall which is affixed to the casing wall 4, to which wall the permeable section 2A is firmly affixed. The fluid space 3 communicates, via the gap 5, with an inlet 6 for the supply of fluid, for example a washing liquid.

In the preferred embodiment, the inlet device 9 for the medium which is to be treated is a cavity within the axle 1, which cavity opens out, via radial passages, in a first channel system 11 which then merges into a space 12, here termed the displacement space. The first channel system 11 is delimited partly by the inner side of the disk-like section 2C and partly by a disk-shaped wall section 21, which forms a part of a rotationally symmetrical body 20 which is firmly mounted on the axle. The disk-shaped wall section 21 essentially has the same shape as the disk-like section 2C so that the channel system 11 has an essentially gap-like appearance. The body 20 also includes a rotationally symmetrical elongated wall section 20A whose distance from the axis of rotation C decreases in the longitudinal direction as seen in the direction of flow. The wall section 20A is terminated by a wall section 22 which is arranged essentially perpendicular to the axis of rotation C.

The displacement space 12 is delimited by the liquid-permeable section 2A and the elongated wall section 21 of the said rotationally symmetrical body 20.

Due to the fact that the elongated wall section 21 converges towards the axis of rotation C, the displacement space 12 is given a wedge-shaped appearance, as seen in cross section, which increases in the direction of flow.

A number of guiding blades 30, which are firmly connected to the axle 1 and rotate with it, are mounted downstream of the wall surface 22 of the rotationally symmetrical body 20, as seen in the longitudinal direction of the axle 1; in the embodiment shown, there are four of these guiding blades 30, each of which has a front side surface and a rear side surface 31 and 32, respectively. The guiding blades 30 extend along the longitudinal direction of the axle 1 and outwards, perpendicularly to the said longitudinal direction, up into a space 15, here termed separation space, which succeeds the displacement space 12 as seen in the direction of flow A. Next to the wall surface 22, the guiding blades 30 extend outwards to the periphery of the latter, but preferably with their radial extent increasing as seen in the longitudinal direction of the axle so that they have the form of a truncated cone, in a section along the axis of rotation C, whose diameter increases in the direction of flow. In the preferred embodiment, the guiding blades 30 are designed so that they are curved in a section perpendicular to the axle 1, Fig. 2, with the radius of curvature of the guiding blades 30 increasing outwards towards their periphery and thus outwards towards the separation space 15. They can, for example, have a shape which corresponds to the involute curve of a circle. The curvature is such that the front side surface 31 is directed in the direction of rotation R of the apparatus. The guiding blades 30 are terminated at their ends opposite to the rotation body 20 by a disk-shaped supporting member 33 which extends outwards from the axle 1 to the periphery of the guiding blades 30. This supporting member 33 also

delimits the separation space 15 in the axial direction.

The axle is, at the point of attachment of the guiding blades, provided with a number of longitudinal grooves 37 which are arranged in front of the front side surface 31 of the guiding blades 30 for the purpose of conducting away the liquid which has been withdrawn. The axle 1 can also be hollow and be provided with passages at the point of attachment of the guiding blades 30.

Downstream of the distancing member 8, which member is placed on the casing wall 4 approximately in line with the perpendicular wall section 22 of the rotation body, the permeable section 2A merges into an impermeable wall section 34 which converges with the casing wall 4 in line with the disk-shaped supporting member 33. A circular gap 35 for the treated pulp suspension is formed between the disk-shaped supporting member 33 and the casing wall 4. The supporting member 31 forms, together with a closure housing 36, which is firmly connected to the casing wall and seals against the axle 1, a channel 13 for the pulp suspension proceeding towards the outlet device 14. An additional outlet device 16, which is also sealed against the axle 1 in a suitable manner, is arranged for conducting away the liquid which has been withdrawn.

The apparatus functions as follows. The medium which is to be treated, for example a pulp suspension which has passed through a bleaching stage, is fed, via the inlet opening 9, into the cavity of the axle 1. A driving device (not shown) rotates the axle 1 and the parts 2, 4, 8, 20-22 and 30, 33 and 34 which are connected to it at a relatively high speed of rotation. The speed of rotation is maintained at a high level in order to bring about a relatively rapid stratification between the fibres and the liquid in the suspension as a consequence of the centrifugal force. The suspension

flows through the passages in the axle 1 and out into the first channel system 11. In this channel system, the suspension is subjected to a rapid increase in speed as a consequence of the rotation and, at the outer part of the said system, turns off in an axial direction and out into the displacement space 12 and then proceeds along the inner surface of the cylindrical, permeable section 2A of the section 2, which rotates together with the axle 1. In connection with this, the suspension becomes stratified such that the heavier fibres come to lie in an outer layer and the lighter liquid in an inner layer.

In order to avoid physical contact between the fibre layer and the inner surface of the permeable section 2A, a liquid having a static pressure is supplied to the fluid space 3 via the inlet opening 6 and the second channel system 5. The static pressure of this liquid balances the pressure with which the fibre layer, due to the centrifugal force, acts in the direction towards the inner wall 2A. Thus, it is possible, by supplying liquid and pressing a liquid layer in through the liquid-permeable section 2A, to lift up the annular suspension cake which has been formed and prevent physical contact between the casing and the fibres. In conjunction with this, the liquid is also pressed through the fibre bed, thereby resulting in the latter being washed.

Since pulp suspension is being supplied continuously, the layer moves gradually towards the right hand side of the figure. When the layer with the pulp on the outside and the washed-out liquid on the inside has moved from the displacement space 12 to the separation space 15, the liquid located on the inside is taken up by the outer edges of the guiding blades 30 and conducted away from the treated pulp suspension along the front side surface 31. Due to the fact that, in the embodiment illustrated in Fig. 2, the guiding

blades 30 are designed with a curvature in which the radius of curvature increases outwards towards the periphery, the speed of the liquid increases continuously as it moves along the front side surface 31 in towards the axle, thereby facilitating its removal. At the same time, again as a result of the design of the guiding blades, the radially-directed kinetic energy possessed by the drawn-off liquid comes to act on the guiding blades 30 and, in this way, gives back a certain portion of this energy. The drawn-off liquid is then conducted from the guiding blades 30 via the third channel system 37 to the outlet device 16. As a result of the above-described method of withdrawal, the air, which is always present to a certain degree and which, in processes for treating suspensions, often represents a problem which has to be solved using special deaeration devices, accompanies the drawn-off liquid and does not, therefore, present any problem.

The pulp layer in the separation space 15 moves outwards towards the periphery at the same time as it moves forwards owing to the fact that it has passed the permeable layer 2A and the pressure, acting from the outside through this layer, from the liquid in the fluid space 3 is decreasing. The pulp layer then passes out from the separation space 15, into the gap 35 between the disk-shaped supporting member 31 and the casing wall 4, and then into the fourth channel system 13 which conducts the suspension outwards towards the outlet device 14. As a variant within the scope of the invention, the space 13 can also be provided with guiding blades 30 so that the kinetic energy possessed by the departing suspension can also be recovered.

As will be understood from the description, it is important to regulate the inlet pressures, the speed of rotation and the outlet pressures in order to achieve efficient separation of pulp and liquid in the device. Thus, the pressure on the liquid in the fluid

space must be sufficiently high to lift the fibre layer from the permeable section but not so great that the fibre layer is pressed inwards in the region of the guiding blades.

The guiding blades 30 can be curved as has been described above and also twisted so that the angle between the axis of rotation C and the front side surfaces 31 of the guiding blades increases from their point of attachment out towards the periphery and so that the front surface 31 is directed towards the axial direction of flow A. When the guiding blades 30 are designed as doubly curved surfaces it is also possible to recover some of the axially directed kinetic energy which is imparted to the drawn-off liquid due to the inlet pressures on the pulp suspension and the fluid which is supplied. This can, naturally, also be applied to the guiding blades which are located in the space 13 for the departing pulp suspension.

It is to be understood that the invention is not limited to that which has been described above and shown on the drawings, and can be modified within the scope of the subsequent patent claims. In addition, the channel system 11, which conducts the medium to be treated out towards the periphery of the apparatus, can be arranged with radially directed members which form channels for setting the medium in rotation more rapidly. It will also be realized that the invention is not limited to water and that other fluids can be used, and that the medium which is to be treated does not have to be fibres and can be some other medium provided that a density difference exists between the different fractions.

PATENT CLAIMS

1. Apparatus for treating a fluid containing at least two fractions, which apparatus includes a rotationally symmetrical casing (4) which is firmly connected to a driven, mounted axle (1), with the axle (1), and thereby the casing (4), being caused to rotate around an axis of rotation (C), in addition to which the casing (4) is provided with inlet members (9) for the fluid which is to be treated and with outlet members (14, 16), c h a r a c t e r i z e d i n that it includes a number of guiding blades (30) inside the casing (4) which are firmly connected to the said axle (1) so that they rotate with it, and in that the said guiding blades (30) extend from the said axle of rotation out towards the inner walls of the casing (4).

2. Apparatus according to Claim 1, c h a r a c t e r i z e d i n that the side surfaces (31, 32) of the said guiding blades (30) are parallel to the said axis of rotation (C) and exhibit a curved shape in a plane perpendicular to the said axis of rotation (C), and in that the said guiding blades (30) are curved so that the front side surface (31) of the said guiding blades (30) is directed in the direction of rotation (R) of the apparatus.

3. Apparatus according to Claim 2, c h a r a c t e r i z e d i n that the side surfaces (31, 32) of the said guiding blades (30) exhibit a curved shape in a plane along the said axis of rotation (C), and in that the said guiding blades (30) are curved so that the angle between the said axis of rotation (C) and the front side surface (31) increases from the point of attachment of the guiding blades (30) out towards their periphery, so that the front side

surface (31) is directed towards the axial direction of flow (A).

4. Device according to either of Claims 2 or 3, c h a r a c t e r i z e d i n that the said guiding blades (30) are curved in such a way that the radius of curvature increases from the point of attachment outwards towards the periphery.

5. Device according to any one of the preceding claims, c h a r a c t e r i z e d i n that the guiding blades (30) are affixed to a member (1) which, from the point of attachment of the guiding blades, is arranged with draining members (37).

6. Device according to Claim 5, c h a r a c t e r i z e d i n that the draining member (37) is a number of longitudinal grooves which commence in front of the front side surface (31) of the guiding blades (30), as seen in the direction of rotation (R).

7. Device according to any one of the preceding claims, c h a r a c t e r i z e d b y a rotatably arranged axle (1), a rotationally symmetrical casing (2A) which is at least in part liquid-permeable and which is fixedly arranged on the axle (1) so that it rotates with it, an inlet member (9) for the medium which is to be treated, and a first channel system (11) which communicates with the inlet member (9) and which opens out in a rotationally symmetrical displacement space (12) inside the said casing (2A), a fluid space (3) which encircles the outer periphery of the said casing (2A), a second channel system (5) which is connected to an inlet (6) for a fluid and which leads to the said fluid space (3), a separation space (15) which, in the direction of flow, succeeds the said displacement space (12) and in which the said guiding

blades (30) are arranged, a third channel system (37) which, from the point of attachment of the guiding blades (30), connects the separation space (15) to an outlet member (16) for withdrawing the fluid which has been separated off, and a fourth channel system (13) which, from the peripheral part of the separation space (15), is connected to an outlet (14) for the medium which has been treated.

8. Device according to Claim 7, c h a r a c t e r i z e d i n that the said fourth channel system (13) is arranged with the said guiding blades (30).

9. Device according to Claim 7, c h a r a c t e r i z e d i n that the said displacement space (12) has a wedge-shaped design as seen in a section along the axis of rotation (C), which displacement space (12) increases in the axial direction of flow (A).

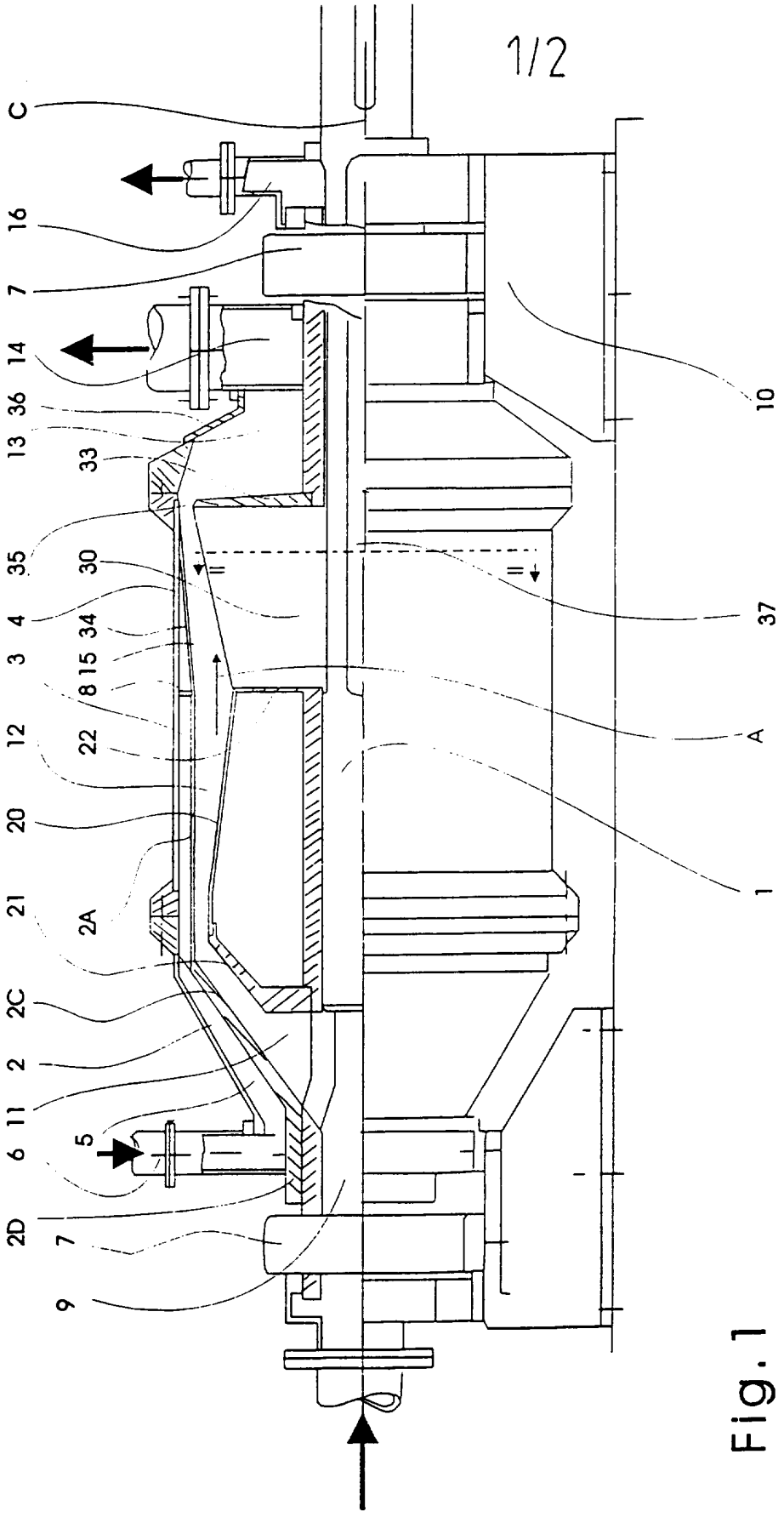
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Fig. 1

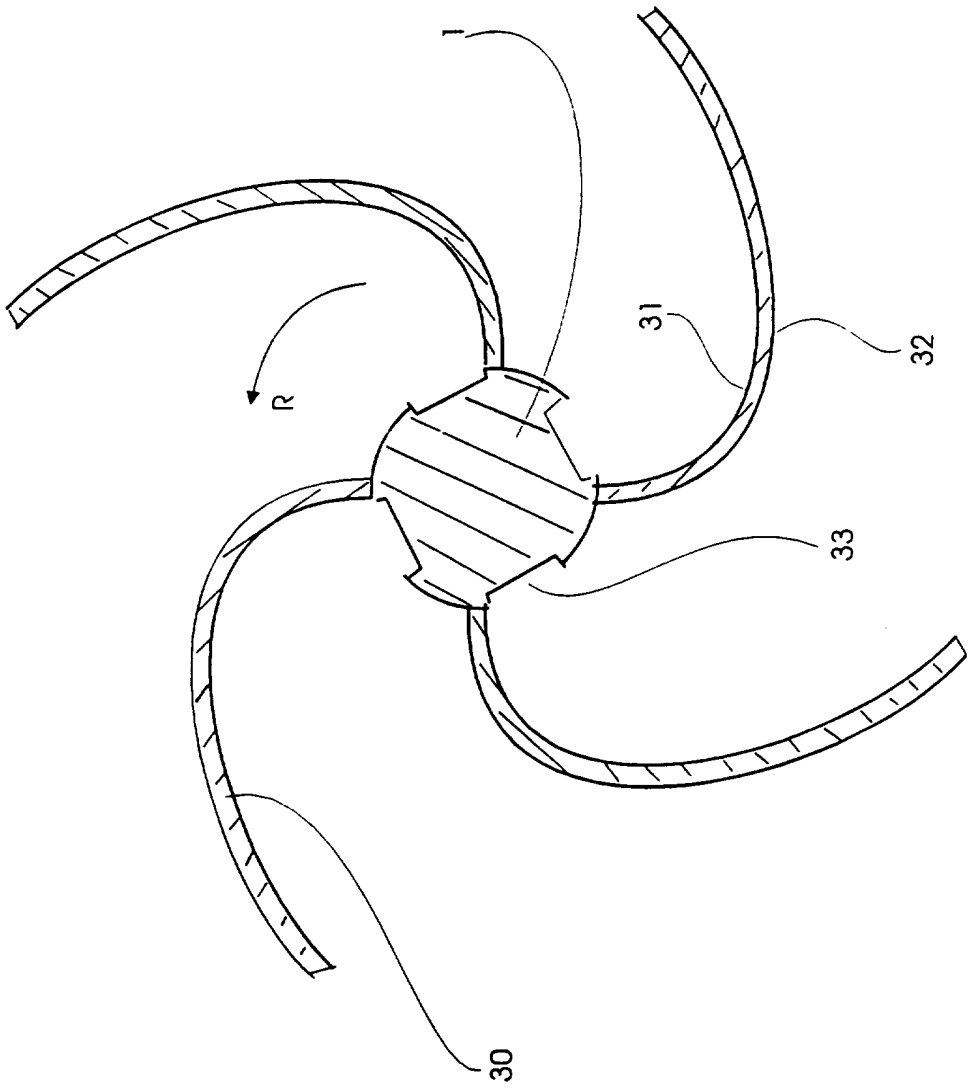

Fig. 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 95/01087

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: B04B 1/00, D21D 5/20
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: B04B, D21D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 143647 C (C.M. TAMASCHKE), 22 August 1903 (22.08.03) --	1
A	NO 175436 B (E.ET M. LAMORT), 4 July 1994 (04.07.94) --	1
A	WO 9321377 A1 (KAMYR AB), 28 October 1993 (28.10.93) --	1
A	DE 211444 C (HEINRICH TOELLE), 27 October 1908 (27.10.08) -- --------	1

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Date of the actual completion of the international search	Date of mailing of the international search report
17 January 1996	05.02.1996
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Johan von Döbeln Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

11/12/95

International application No.
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE-C- 143647	22/08/03	NONE	
NO-B- 175436	04/07/94	CA-A- 1331956	13/09/94
		DE-U- 6890220	27/08/92
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