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(54) **Method and apparatus for separating knots.**

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EP 0 275 967 B1

Description

The present invention relates to a method and apparatus for separating knots. The method and apparatus are in particular suitable in separating knots from high consistency pulp.

In particular, the apparatus for separating knots and other solids from a fiber suspension or a pulp has a screen cylinder rotating in an outer housing, a shaft for rotating the cylinder, one or more blades positioned inside the cylinder and tangential connections for the pulp inlet and reject outlet and a connection for the accept respectively being attached to the outer housing.

Such an apparatus is known from GB-A-2 070 456. The apparatus described shows in particular the arrangement of a first and a second separation chamber, the second chamber being provided for separating the light fraction discharged from the first chamber with the reject. A screen cylinder is also described which is arranged in the first separation chamber and can be rotated. However, a suitable solution for significantly reducing the consumption of energy of the apparatus is not disclosed.

There are several different further kinds of knot separators already known. An apparatus is described in US -A- 3,947,314 which includes an outer casing, an inner screen casing, of cylindrical configuration, a rotating screw conveyor inside the screen casing and an inlet adjacent the lower end of the screen casing, an accept outlet adjacent the lower end of the outer casing and a reject outlet adjacent the upper end of the screen casing.The whole apparatus is preferably slightly inclined in relation to the vertical. The apparatus functions in the way that the pulp including knots or other fairly large pieces of wood is fed to the lower end of the screen casing to be lifted by the screw conveyor. When the screw conveyor lifts the pulp the fine fibers pass through the holes or slots of the perforated casing and are discharged through the accept outlet in the lower end of the outer casing. The coarser material which is not filtered through the holes of the screen casing is carried to the upper end of the screen casing and falls from there to the reject chute.

Another apparatus according to prior art is introduced in SE -A- 316363 in which there is substantially a slightly conically downwards broadening rotating screen cylinder inside the cylindrical casing. Inside the screen cylinder there are stationary pulsation means arranged to ensure that the openings of the screen cylinder remain open. The pulp is tangentially fed to an annular channel situated at the upper end of the outer casing from which channel the pulp flows along the horizontal plate arranged on the outer casing spirally towards the shaft of the screen cylinder. In the middle part of the above mentioned plate there is a hole through which the pulp falls down onto the end cover of the rotating screen cylinder, which has radial ribs giving the pulp its initial rotational motion. From the cover the pulp is dashed due to the centrifugal force to the downwards narrowing space between the screen cylinder and the outer casing. The fines pass through the screen cylinder to the accept side. The material left over between the outer casing and the screen cylinder, the reject, is discharged finally to an annular channel in the lower end of the outer casing, from where the reject is discharged to the tangential outlet.

A third arrangement is described in US -A- 4,441,999 which consists of a cylindrical outer casing and a rotating screen cylinder. Inside the screen cylinder there are one or more stationary non-rotating blades. The pulp is tangentially fed between the screen cylinder and the outer casing, but the opposite to the direction of rotation of the cylinder. The accept is discharged from the inside of the screen cylinder at the end of the cylinder and the reject tangentially, but opposite to the direction of rotation of the cylinder. In accordance with this arrangement, the screen cylinder consists of openings that open to the inside of the cylinder and of connecting pieces which in principle consist of radial arms and parts bent forward to the direction of the pulp flow coming to the cylinder which produce pressure pulses to the pulp to keep the holes of the screen cylinder open. The apparatus in accordance with this publication was found to operate especially well in paper machine short circulation and equivalent where it enabled the dampening of the fluctuation of the pressure inconvenient to further processing.

The latter two devices are characterized in that they reach the consistency range of 4 - 6 %, whereas the device according to the first example functions only in the consistency of up to 1,5 - 2 %. Plugging of the holes on the screen surface limits the operation in all devices. Yet, in stock processing the aim is consistently towards higher consistencies, because it is in every respect more preferable to tend to treat the pulp in different process stages at the same consistency without thickening and dilution. If it is possible to raise the processing consistency, savings can be gained in both device and transportation charges and also considerably in the consumption of energy.

The object of the present invention is to provide an improved method and apparatus for separating knots which reaches the so called low range of the MC-consistency, ie. medium consistency (6 - 8%) and diminishes significantly of the consumption of energy.

This object is solved according to the present

invention with a method for separating knots and other solids from a fiber suspension or a pulp with a rotating screen cylinder, on the outer surface of which the fiber suspension to be treated is introduced tangentially, from the inside of which accept is discharged and from the outer side of which reject is discharged tangentially, and in which the rotating screen cylinder is maintained clean by subjecting it to positive and/or negative pressure pulses from the inside, wherein the tangential introduction of the fiber suspension and the tangential discharge of the reject take place in the direction of rotation of the screen cylinder.

Furthermore, this object is solved in accordance with the present invention by an apparatus characterized in that the tangential connections are arranged such that the directions of the pulp inlet and the reject outlet are the same as the direction of rotation of the screen cylinder and that the screen cylinder is contoured by means of ridges arranged on the outer surface thereof to increase the speed of motion of and the shear forces acting on the pulp.

The rise of the applicable range of consistency is achieved by the correct measuring and formulation of the screen profile, and optimizing the rotational speed of the cylinder with respect to the feeding speed of the pulp. In addition to that it has been possible to diminish the consumption of energy of the knotter itself essentially compared to the apparatus of the US publication 4,441,999. This is mainly due to changing the direction of rotation of the screen cylinder to a direction parallel to the direction of the pulp feed. According to the performed tests the consumption of energy of the knotter of the present invention has been measured to have been at most 0,6 kWh/ mass ton. Furthermore the change of the direction of rotation has diminished the wear of the screen cylinder.

Additionally, one advantage of an apparatus in accordance with the present invention is facilitation of reject outlet compared to the approach in accordance with the US patent 4,441,999, because in the apparatus according to the present invention the reject is discharged in the direction of the rotation of the screen cylinder. This pumping effect together with dilution water led to the reject in the discharge stage significantly facilitates the adjustment of the amount of reject. Thus even with higher consistencies the reject rate can be maintained between 2 to 10 % by using the screen in accordance with the present invention.

Further advantageous features of the present invention are disclosed in the dependent claims.

The method and apparatus according to the present invention are further described with reference to the accompanying drawings, in which

Fig. 1 is a partly sectional side view of the apparatus according to the invention,

Fig. 2 is a partly sectional top view of an apparatus according to Fig. 1,

Fig. 3 is a straightened sectional side view of the screen profile according to a preferred embodiment, and

Fig. 4 is an over view of the screen according to Fig. 3

In Fig. 1 and 2 of the drawings a preferred embodiment of the knotter of the invention is described substantially consisting of a cylindrical outer housing 1, in which there is an inlet connection 2 for the pulp, outlet connection 3 for the accept and outlet connection 4 for the reject, screen cylinder 5, and one or more stationary unrotating blades 6 inside the screen cylinder 5 extending near the surface of the screen cylinder. The screen cylinder 5 is attached by members 12 on the shaft 7 which functions e.g. by belt drive (not introduced). The space 8 between the screen cylinder 5 and the outer housing 1 is annular and sealed at the ends with radial plates 9 and 10 projecting from the outer housing 1 towards the shaft. The above mentioned connections 2 and 4 are tangentially attached to the outer housing 1 of the annular space 8. In addition a feed pipe 11 for dilution water is arranged to the reject connection 4, with which, if necessary, the consistency of the reject is lowered in order to facilitate further screening.

The blades 6 are attached with arms 13 and 14 to a stationary frame 15 which also forms a strut for the shaft 7 through the bearing 16. The blades 6 are positioned in the cylinder 5 so that the blade situated near the reject connection 4 is ± 10 - 45° aside from it. Correspondingly, the other blade is 10 - 45° aside from the input connection 2. Thus the above mentioned blades generate the applicable pulse, positive and/or negative, to the cylinder 5.

In Fig. 3 and 4 there is described an opened screen in accordance with one preferred embodiment. The contoured plate 20 consists of openings 21 and of lands 22 between them. The plate 20 is plain on the inner surface 23, excluding the openings. The outer surface of the plate 20 consists of front surfaces 25 rising at a certain angle from the plane 24 of the plate 20, of the surfaces 26 substantially parallel to the plane 24 of the plate 20, of the end surfaces 27 substantially upright to the plane 24 of the plate 20, and of parts 28 of the plane 24 between the openings 21. On the other hand, the screen plate can be considered to consist of a plate which has ridges 29 which consist of the above mentioned parts 25, 26 and 27, and of the plane like parts 28 between them, in which the openings 21 are machined.

As shown in Fig. 4, the openings 21 are preferably holes (or slots), the diameter of which can

range, depending on the application, at least between 5 - 15 mm. It also appears in Fig. 4 that the ridges 29 can be slightly declined from the axial direction of the plate. From the declination angle of the ridges, the direction of the declination in respect to the direction of rotation, the speed of rotation and the ascending angle of the part 25 of the ridges, the circulation time of the pulp in the knotter can be optimized in relation to the result of the separation. The circumferential speed of the cylinder used in the performed tests has been 4 - 10 m/s and for the feed of the pulp 2 m/s in the performed experiments. In that case the speed difference between the cylinder and the pulp is 2 - 8 m/s. The gradient plane 25 of the ridges 29 of the screen plate 20 receives the pulp coming into the cylinder, tending to accelerate its speed. The direction of the ridges 29 has the effect that if the ridges 29 on the screen cylinder 5 are backwards inclined, they tend to raise the pulp upwards in the cylinder, thereby the circulation time of the pulp in the knotter becomes longer, the separation takes place more accurately and the amount of reject diminishes while the amount of accept grows.

If the ridges are forwards inclined the circulation time becomes shorter and the separation is not so accurate. In addition to the above mentioned factors the height of the screen cylinder also effects the speed, inclination angles, etc. used.

The method and apparatus in accordance with the present invention function in the following way. The pulp is tangentially fed under pressure into the space between the rotating screen cylinder and the outer housing of the knotter and in the same direction as the rotating motion of the screen. The ridges of the screen cylinder subject the infed pulp to circumferential forces for increasing its speed of motion and, due to the shape of the ridges, also shear forces for opening the bonds between the pulp particles, i.e. the fibres. The ridges cause a low pressure zone at the outlet end in front of the surface 27 that attracts the loose fibres through openings 21 with the help of the pressure difference between the inlet connections 2 and the accept connections 3. The heavier particles carried by the pulp sling towards the surface of the housing 1 when hitting the ridges, whereby they are also subjected to the centrifugal force. In that case the lighter particles of the pulp are enriched near the surface of the screen cylinder and are separated from the pulp in the above mentioned way. Due to the contours of the surface of the cylinder, a slight fluidization takes place near the surface of the screen cylinder, helping the separation and on the other hand also diminishing the consumption of energy of the separation and the wear of the screen cylinder. The heavy particles separated onto the surface of the outer housing of the knotter circulate down the housing surface along the spiral path and are tangentially discharged from the knotter through the connection 4. The discharge is activated more by feeding, if necessary, dilution water to the reject from the pipe 11.

As already mentioned above, the apparatus in accordance with the invention described above has made it possible to diminish the consumption of energy in respect to the prior art by more than 30 % and at the same time it has been possible to increase the consistency of the pulp up to the lower range of the MC-consistency. As a by product a less wearing screen cylinder and an apparatus better adjustable in its function and in its end products has also been brought about. For example, by merely changing the rotational speed of the cylinder, it is possible to adjust the apparatus applicable to most different consistencies and different kinds of pulps. When this method is added by a possibility to produce screen cylinders having varying inclination angles of ridges or openings of variable sizes, one is able to talk about an ultimately optimized knotter.

It should be borne in mind that in the above only one preferred embodiment of the apparatus in accordance with the present invention has been described. A knotter according to the present invention may in reality differ a lot from the form shown above and yet not differ from the inventive idea which is more closely described in the accompanying claims. It is namely quite possible that, in some cases, it is necessary to use ridges with two or more inclination angles or that the speeds of the pulp suspension and the cylinder differ a lot from the example shown above, substantial is, however, only the difference of the speeds which according to the claims is 2-8 m/s.

The reference numerals introduced in the claims are solely provided for reasons of clarity and do not limit the scope of the claims.

Claims

1. A method for separating knots and other solids from a fiber suspension or a pulp with a rotating screen cylinder, on the outer surface of which the fiber suspension to be treated is introduced tangentially, from the inside of which accept is discharged and from the outer side of which reject is discharged tangentially, and in which the rotating screen cylinder is maintained clean by subjecting it to positive and/or negative pressure pulses from the inside,

   characterized in that

   the tangential introduction of the fiber suspension and the tangential discharge of the reject take place in the direction of rotation of

the screen cylinder.

2. The method according to claim 1, characterized in that the discharge of the reject is facilitated by spraying water into the reject outlet duct with which the consistency of the reject is diluted at the same time.

3. An apparatus for separating knots and other solids from a fiber suspension or a pulp, the apparatus having a screen cylinder (5) rotating in an outer housing (1), a shaft (7) for rotating said cylinder, one or more blades (6) positioned inside the cylinder (5) and tangential connections (2, 4) for the pulp inlet and reject outlet and a connection (3) for the accept respectively being attached to the outer housing (1), characterized in that the tangential connections (2, 4) are arranged such that the directions of the pulp inlet and the reject outlet are the same as the direction of rotation of the screen cylinder and that the screen cylinder (5) is contoured by means of ridges (29) arranged on the outer surface (24) thereof to increase the speed of motion of and the shear forces acting on the pulp.

4. The apparatus according to claim 3, characterized in that the ridges (29) consist of front surfaces (25) rising declined from the outer surface (24) of the cylinder (5) and of the end surfaces (27) substantially upright to the outer surface (24) of the cylinder (5).

5. The apparatus according to claim 3 or 4, **characterized** in that the ridges are declined in respect to the shaft (7) of the cylinder (5).

6. The apparatus according to claim 5, **characterized** in that the declination angle of the ridges is between -45° - +45°.

7. The apparatus according to claim 3, **characterized** in that the openings on the cylinder are either holes or slots.

8. The apparatus according to claim 3, **characterized** in that the difference between the circumferential speed of the cylinder and the feeding speed of the fibre suspension is 2 - 8 m/s.

9. The apparatus according to claim 3, **characterized** in that one of the blades (6) generating a positive or negative pressure pulse is situated ±10 - 45° aside from the reject connection (4).

10. The apparatus according to claim 3, **characterized** in that one of the blades (6) generating a positive or negative pressure pulse is situated ±10 - 45° aside from the pulp inlet connection (2).

11. The apparatus according to claim 3, characterized in that the connection (3) for the accept is tangential.

Revendications

1. Procédé pour la séparation des noeuds et autres matières solides d'une suspension de fibres, ou de pâte à papier brute, à l'aide d'un cylindre épurateur rotatif sur la surface extérieure duquel on introduit tangentiellement la suspension de fibres à traiter, à partir de la partie interne duquel la portion acceptée est déchargée et à partir du côté extérieur duquel la portion rejetée est évacuée, et selon lequel le cylindre épurateur rotatif est maintenu propre en le soumettant à des impulsions de pression positives et/ou négatives depuis l'intérieur, caractérisé en ce que l'introduction tangentielle de la suspension de fibres, et l'évacuation tangentielle de la portion rejetée sont effectuées dans le sens de la rotation du cylindre épurateur.

2. Procédé selon la revendication 1 caractérisée en ce que l'évacuation de la portion rejetée est facilitée en pulvérisant de l'eau dans la conduite de sortie de la portion rejetée grâce à laquelle on dilue en même temps la consistance de la portion rejetée.

3. Dispositif pour séparer des noeuds et autres matières solides d'une suspension de fibres, ou de pâte à papier brute comportant un cylindre perforé (5) tournant dans un logement extérieur (1), un arbre (7) pour la rotation dudit cylindre, une ou plusieurs pales positionnées à l'intérieur du cylindre (5) et des connexions tangentielles (2, 4) fixées à l'enveloppe extérieure (1) pour l'admission de la pâte brute et pour l'évacuation de la portion rejetée et une connexion (3) pour la portion acceptée, respectivement, caractérisé en ce que les connexions tangentielles (2, 4) sont disposées de manière que les directions de l'admission de la pâte brute et l'évacuation de la portion rejetée soient les mêmes que le sens de la rotation du cylindre et que la configuration du cylindre (5) est réalisée à l'aide de nervures (29) disposées sur la surface extérieure (24) de ce cylindre pour augmenter la vitesse de déplacement et les forces de cisaillement agissant sur la

pâte.

4. Dispositif selon la revendication 3, caractérisé en ce que les nervures (29) comprennent des surfaces frontales (25) relevées et écartées de la surface extérieure (24) du cylindre (5) et des surfaces d'extrêmité (27) qui sont sensiblement perpendiculaires à la surface extérieure (24) du cylindre (5).

5. Dispositif selon la revendication 3 ou 4, caractérisé en ce que les nervures sont inclinées par rapport à l'arbre (7) du cylindre (5).

6. Dispositif selon la revendication 5, caractérisé en ce que l'angle d'inclinaison des nervures est compris entre - 45° et + 45°.

7. Dispositif selon la revendication 3, caractérisé en ce que les ouvertures sur le cylindre sont soit des trous, soit des fentes.

8. Dispositif selon la revendication 3, caractérisé en ce que la différence entre la vitesse circonférentielle du cylindre et la vitesse d'alimentation de la suspension de fibres est de 2 à 8 m/s.

9. Dispositif selon la revendication 3, caractérisé en ce que l'une des pales (6) engendrant une impulsion de pression positive ou négative est située à + ou - 10 - 45° à l'écart de la connexion (4) pour la portion de rejet.

10. Dispositif selon la revendication 3, caractérisé en ce que l'une des pales (6) engendrant une impulsion de pression positive ou négative est située à + ou - 10 - 45° à l'écart de la connexion (12) d'amenée de la pâte brute.

11. Dispositif selon la revendication 3, caractérisé en ce que la connexion (3) pour la portion acceptée est tangentielle.

Patentansprüche

1. Verfahren zur Abscheidung von Ästen und anderen Feststoffen aus einer Fasersuspension oder einer Pulpe mit einem umlaufenden Siebzylinder, auf dessen Außenfläche die zu behandelnde Fasersuspension tangential aufgetragen wird, von dessen Innenseite Gutstoff ausgetragen und von dessen Außenseite Spuckstoff tangential ausgetragen wird, und bei dem das umlaufende Siebzylinder sauber gehalten wird, indem es positiven und/oder negativen Druckimpulsen vor der Innenseite her ausgesetzt wird,

dadurch gekennzeichnet, daß die tangentiale Aufgabe der Fasersuspension und die tangentiale Austragung des Spuckstoffs in der Umlaufrichtung des Siebzylinders stattfinden.

2. Verfahren gemäß Anspruch 1, dadurch gekennzeichnet, daß die Austragung von Spuckstoff erleichtert wird, indem Wasser in den Spuckstoffaustrittskanal eingespritzt wird, wodurch die Konsistenz des Spuckstoffs gleichzeitig verdünnt wird.

3. Vorrichtung zur Abscheidung von Ästen und anderen Feststoffen aus einer Fasersuspension in einer Pulpe, bestehend aus einem Siebzylinder (5) das in einem Außengehäuse (1) rotiert, einer Welle (7) fürs Drehen des genannten Zylinders, einer oder mehreren innerhalb des Zylinders (5) positionierten Schaufeln (6) und tangentialen Stutzen (2, 4) für den Pulpeneintritt und Spuckstoffaustritt und einem Stutzen (3) für den Gutstoff, die jeweils am Außengehäuse (1) befestigt sind, dadurch gekennzeichnet, daß die tangentialen Stutzen (2, 4) derart angeordnet sind, daß die Richtungen des Pulpeneintritts und Spuckstoffaustritts die gleichen sind wie die Umlaufrichtung des Siebzylinders und daß das Siebzylinder (5) durch auf dessen Oberfläche (24) angeordnete Kämme (29) konturiert ist, um die Geschwindigkeit der Bewegung der Pulpe und die Scherkräfte zu erhöhen, die auf die Pulpe einwirken.

4. Vorrichtung gemäß Anspruch 3, dadurch gekennzeichnet, daß die Kämme (29) aus Frontflächen (25), die sich geneigt von der Außenfläche (24) des Zylinders (5) ansteigen und aus zur Außenfläche (24) des Zylinders (5) im wesentlichen senkrechten Endflächen (27) bestehen.

5. Vorrichtung gemäß Anspruch 3 oder 4, dadurch gekennzeichnet, daß die Kämme gegenüber der Welle (7) des Zylinders (5) geneigt sind.

6. Vorrichtung gemäß Anspruch 5, dadurch gekennzeichnet, daß der Neigungswinkel der Kämme zwischen -45° und +45° liegt.

7. Vorrichtung gemäß Anspruch 3, dadurch gekennzeichnet, daß die Öffnungen am Zylinder entweder Löcher oder Schlitze sind.

8. Vorrichtung gemäß Anspruch 3, dadurch gekennzeichnet, daß die Differenz zwischen der Umfangsgeschwindigkeit des Zylinders und der Eingabegeschwindigkeit von Fasersuspen-

sion 2 bis 8 m/s beträgt.

9. Vorrichtung gemäß Anspruch 3, dadurch gekennzeichnet, daß eine der einen positiven oder negativen Impuls erzeugenden Schaufeln (6) gegenüber dem Spuckstoffstutzen (4) ±10 - 45° seitlich versetzt positioniert ist.

10. Vorrichtung gemäß Anspruch 3, dadurch gekennzeichnet, daß eine der einen positiven oder negativen Impuls erzeugenden Schaufeln (6) gegenüber dem Pulpeneintrittsstutzen (2) ±10 - 45° seitlich versetzt positioniert ist.

11. Vorrichtung gemäß Anspruch 3, dadurch gekennzeichnet, daß der Stutzen für Gutstoff tangential ist.

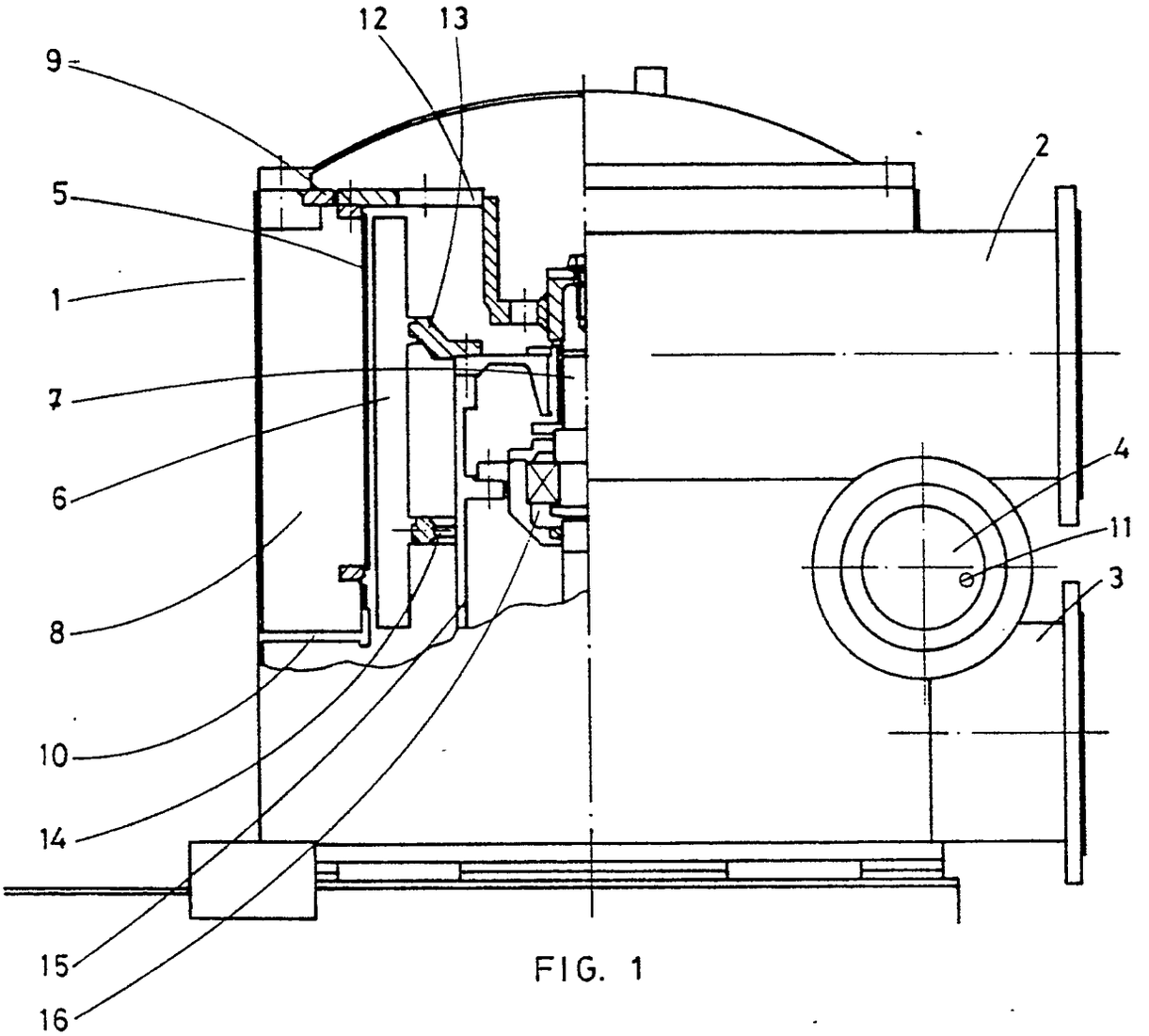

FIG. 1

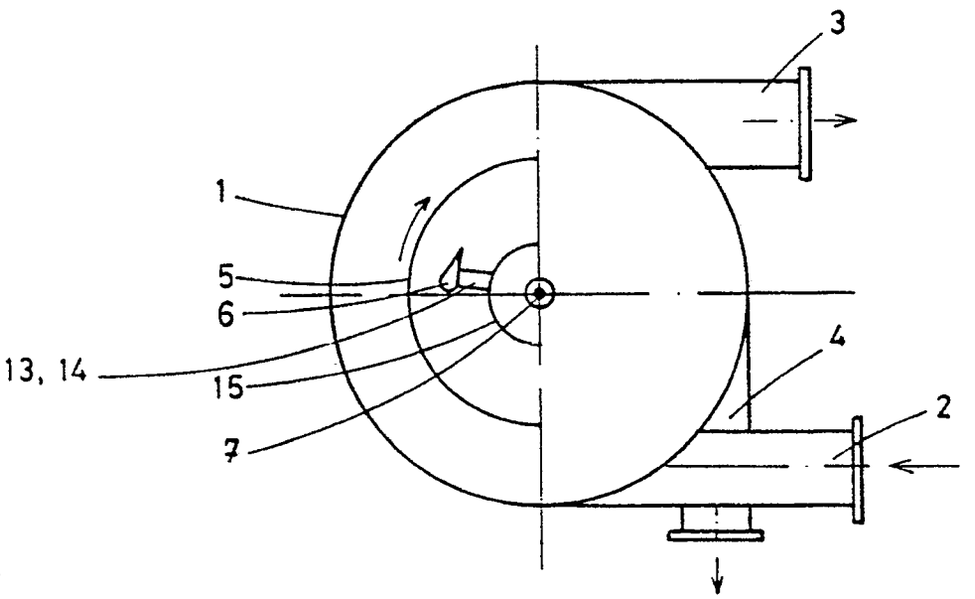

FIG. 2

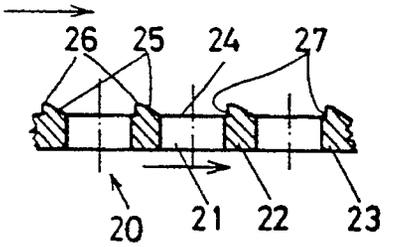

FIG. 3 (A-A)

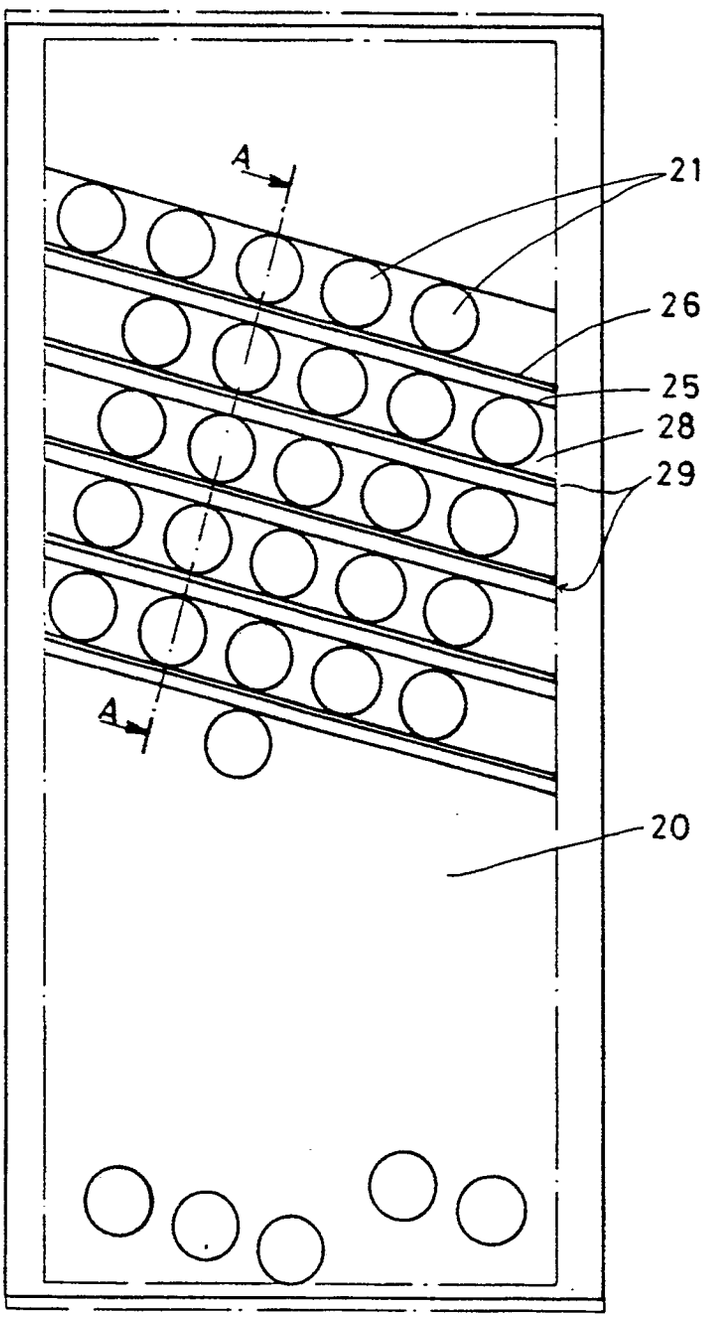

FIG. 4