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(54) **A PULPING APPARATUS**

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Description

Field of the invention

[0001] The present invention relates to a pulping apparatus for mixing and mechanically working and processing a mixture of a waste material and a liquid.

Background

[0002] Pulpers are used in the treatment and separation of waste and waste like materials for conversion of the organic fractions into bioenergy. Experiences in industrial plants prove that both household waste and organic waste can be processed as well as organic waste from commercial sources such as restaurants, slaughterhouses, food markets, food processing industries etc.

[0003] Such recycling process traditionally include feeding the waste, which may in some cases initially have been cut or grinded into smaller fractions, into a pulping apparatus in which a rotor mixes the waste with a liquid, usually industrial water. Here, the rotor rotation creates strong flow forces which together with the repeatedly slamming around of the waste material and frictional forces acts to disintegrate the waste, partly dissolve and defibrate the organic part of the waste material forming a slurry or suspension together with non-soluble components of the waste such as plastic elements, bones, glass, stone, batteries, metal parts etc. The mixture is then being guided to a separator wherein the organic pulp substance is withdrawn through a perforated plate or sieve or screen and the non-soluble reject guided aside. The pulp substance is then in some cases concentrated and drained and the liquid reused in the pulping process.

[0004] The mixture of the waste material and the liquid in the pulping apparatus may often constitute a very chemically aggressive environment which combined with the rotation of potentially heavy and solid objects in the waste leads to a high degree of wear on the different parts of the pulping apparatus. Some parts are more subjected to wear than others such as the outermost surface of the rotor screw and the container bottom. Some pulp-ers try to increase the lifetime of the apparatus by manufacturing the container of the pulper in a more wear resistant material, which however also increases the manufacturing costs of the pulping apparatus considerably. Alternatively, some of the parts of the apparatus need to be replaced relatively often due to wear, which however is a cumbersome and work-intensive procedure in repairing the worn parts inside the pulping apparatus and therefore also costly in downtime of the pulper.

[0005] Because of the different nature of the waste material potentially comprising all kinds of material and of different sizes, shapes and textures from large very solid bones to plastic bags, the waste material sometimes gets stuck or entangled in the pulping apparatus - most often around the rotor or between the rotating and the station-

ary parts. If a solid object gets jammed for example between the rotor and the container bottom this may cause the rotor to malfunction or set out which may then require the container to be emptied to be able to remove the stuck object and repair the apparatus. Also, waste material filling up the gap between the rotor and the container bottom is often seen to slow down the rotation of the rotor which potentially may cause the rotor to be unable to be started again after a break in the pulping process. Some types of waste material are more problematic than others. Especially longer and flexible elements such as plastic strips, electrical wires, cables, straps, towlines or the like may cause severe damage and be very difficult to remove if they get entangled around the rotor and or rotor shaft.

[0006] It is known to reduce the risk of waste material getting stuck in the gap between the rotor and the container by filling water into the container from an inlet placed close to the rotor shaft while filling the waste into the container. The water flow then keeps the gap between the rotor and the container free of waste material. This, however, only prevents the waste from getting caught during the filling of the pulper but not during the pulping and mixing process itself.

[0007] Both DE 20 2006 010 608 U and US 5,348,236 describes different types of pulping apparatus where the rotor is surrounded by a stationary wall part thereby to some extent controlling where the pulping material is. FR 1.379.171 discloses an apparatus in accordance with the preamble of claim 1.

Description of the invention

[0008] It is therefore an object of embodiments of the present invention to overcome or at least reduce some or all of the above described disadvantages of the known pulping apparatus by providing a pulping apparatus with minimized risk of entrapment of waste material.

[0009] It is a further object of embodiments of the invention to provide a pulping apparatus with improved wear resistance and longer lifecycle. It is a yet further object of embodiments of the invention to provide a means for increasing the operational reliability of the pulper and which is simple and relatively fast to apply and yet effective.

[0010] A further object of embodiments of the invention is to provide a pulping apparatus where the parts most exposed to wear can be replaced more easily than in traditional pulp-ers. The invention is defined by the combination of features of claim 1. In accordance with the invention this is obtained by a pulping apparatus for mixing and working a mixture of a waste material and a liquid, the apparatus comprising a container and a rotor. The rotor is placed in the container with a rotational axis extending in an axial direction perpendicularly to a container side and the rotor comprising a mounting part which is rotational symmetric around the rotational axis of the rotor and which is placed for rotating with an axial spacing to the container side. The pulping apparatus further com-

prises a protective collar arranged on the container side so as to radially surround the mounting part.

[0011] By the arrangement of the protective collar is advantageously obtained, that the risk of entanglement of the waste material and of the waste material getting caught and stuck between the rotating and stationary parts within the container is considerably reduced or even removed. The performance of the rotor to mix and pulp the waste material is thereby greatly improved and the risk of unintentional braking, malfunctioning, or jamming the rotor correspondingly reduced.

[0012] The pulping apparatus may be used to handle a large variety of waste material of different types, sizes, shapes, density, and texture such as for example but not limited to household waste, waste from slaughterhouses or farms, gardens, restaurants, food markets, or food processing industries. The liquid may be water or another type of liquid optionally with chemical additives.

[0013] The container may attain different shapes such as approximately or partly cylindrical with the rotor arranged to have its rotational axis perpendicular to an end surface of the cylinder. A cylindrical container shape yields an improved mixture flow within the container. Alternatively, the container may be rectangular or of another shape.

[0014] The container side may be a bottom side of the container with the rotor extending approximately vertically inside the container, or may alternatively be a container wall.

[0015] In an embodiment the pulping apparatus comprises more than one rotor, which may be of the same or different types. The rotor may be mounted on a shaft extending through the container side which may preferably be driven by a motor placed outside the container. Alternatively, the container may comprise a sealed off compartment for the motor driving the rotor. The rotor may be arranged to be driven continuously or discontinuously such as in intervals, and at a constant or a varying torque and/or rotational speed for example in dependence on the amount and type of waste material and liquid to be mixed. In an embodiment the rotor is driven at a rotational speed of approximately 250-400 RPM and for a time period of approximately 10-40 minutes for every new portion of waste material to be mixed.

[0016] The mounting part of the rotor may be an integral part of the rotor or a separate part attached to the remaining parts of the rotor. In one embodiment, the mounting part comprises a plate. Additionally or alternatively the mounting part may comprise a conical part. The mounting part may in one embodiment form the connection between the outer part of the rotor and the shaft of the rotor. The outer part of the rotor may in one embodiment comprise a helical screw part and optionally a set of vanes and/or rotor blades. In one embodiment the outer part of the rotor is attached to the mounting part by means of bolts and/or screws. Alternatively or additionally, the outer part of the rotor is welded onto the mounting part. In one embodiment, the rotor is mounted in the con-

tainer by first attaching the mounting part to the rotor shaft and then by attaching the outer part of the rotor to the mounting part.

[0017] The mounting part of the rotor is placed for rotating with an axial spacing to the container side. In other words, the mounting part forms the part of the rotor the closest to or adjacent to the container side. Hereby is formed a spacing or gap between the rotating parts and the stationary container. The spacing has a certain width in the axial direction of the rotor which is large enough to ensure free and unhindered rotation of the rotor yet as small as possible.

[0018] In order to avoid objects from the waste to get stuck between the rotating mounting part of the rotor and the container side, the most obvious modification would probably be to try to reduce the spacing between the rotor and the container side moving the rotor closer to the container side. This however implies major modifications of the mounting of the rotor which are expensive. Also, experiments have shown that such modifications only work to reduce the problem of jamming and entangled waste to a limited extent without solving the problem.

[0019] Rather, the use of a protective collar according to the invention has proven effectively in acting to shield off or reduce the access from within the container to the gap between the mounting part of the rotor and the container side. Also the protective collar acts effectively to shield off an edge of the rotating mounting member. The protective collar preferably encircles the mounting part of the rotor mounting part in all radial directions, or in other words extends alongside an outer circumferential surface or the periphery of the mounting part.

[0020] The protective collar is preferably a circular ring shaped element which preferably may be cut out or otherwise manufactured from a plate. In a preferred embodiment the protective collar is ring shaped with a ring width in the range of 40-200 mm. The protective collar may be manufactured as a single component or from a number of ring segments, which may be easier to handle and attach to the container side. Hereby the protective collar also becomes easier and faster to replace if worn. The protective collar may alternatively have a non-circular outer edge but preferably with a circular central hole, such that it can be arranged to create a spacing to the mounting member of approximately the same size in all radial directions.

[0021] In this way the gap between the rotating rotor part and the stationary container is changed in direction and optionally size without being closed off completely. The protection collar advantageously provides for a protection such that the rotating edges which otherwise potentially may entangle or catch objects become shielded.

[0022] Also, because of the placing of the protective collar according to the invention, the gap between rotating and stationary parts in the apparatus is angled or bent which prevents or at least impede the intrusion of waste material into the spacing between the mounting part and the container side.

[0023] The arrangement of the protective collar according to the invention is furthermore advantageous in providing a simple solution to the problem and in being very easy and simple to mount at a low cost and with only little downtime of the pulping apparatus needed for the placing of the protective collar. Furthermore the protective collar can be retrofitted to an existing pulping apparatus.

[0024] The protective collar according to the invention is furthermore advantageous in acting as a wear member which is exposed to the frictional forces of the mixture flow rather than the container side. In this way the protective collar protects the container side and can simply be replaced and repaired or renewed relatively fast if needed. This is very advantageous compared to the more expensive alternatives of exchanging or repairing the entire container side when worn, or having to manufacture the container in a wear resistant material.

[0025] According to an embodiment of the invention, the protective collar is arranged with a radial spacing to the mounting part which is approximately of the same size or smaller than the axial spacing between the mounting part and the container side. Hereby the size of the gap between the rotating and the stationary parts of the apparatus is reduced without being closed off completely. The radial spacing between the mounting part and the protective collar is easily controlled or changed, for example if the type of waste is changed, by the setting of the inner diameter of the protective collar.

[0026] In an embodiment of the invention the protective collar is arranged with a radial spacing to the mounting part in the range of 1-15 mm, such as in the range of 3-8 mm, or between 4-5 mm. These ranges have proven advantageous for different types of waste material.

[0027] In an embodiment of the invention the axial spacing between the mounting part and the container side is in the range of 10-40 mm, such as in the range of 15-25 mm.

[0028] According to a further embodiment of the invention, the protective collar is arranged such as to extend axially a distance from the container side, the distance being larger than the axial spacing between the mounting part and the container side. In an embodiment, the protective collar has an axial thickness (i.e. a thickness in the axial direction) which is larger than the axial spacing between the mounting part and the container side. In this way the protective collar extends up along the outer circumferential side of the mounting part. Hereby the radially outermost edge of mounting member towards the container side becomes shielded off effectively even if the rotor does not comprise any rotor plate, and thereby preventing or at least making it very difficult for a piece of waste material to get caught by the edge.

[0029] In a further embodiment, the protective collar is arranged such as to extend axially a distance from the container side, the distance being approximately equal to the sum of the axial spacing between the mounting part and the container side and the radially outermost

thickness in the axial direction of the mounting part. Hereby, a flow in a radial direction towards the container walls will pass over the surface of the mounting member of the rotor and over an upper surface of the protective collar in an approximately uninterrupted flow without any significant difference in level. This reduces the risk significantly of some piece of waste getting caught in the gap between the rotating mounting member and the stationary protective collar. Further, by the upper surfaces of the mounting member and protective collar being approximately in level reduces the wear on any the protective collar by the mixture flow. According to the invention, the rotor further comprises a rotor plate placed on top of the mounting part such as to rotate over the protective collar. Experiments have shown that such rotor plate rotating with the rotor over the protective collar advantageously acts to even further reduce the risk of entanglement or entrapment of the waste material between the rotating parts and the stationary parts of the pulping apparatus. The performance of the rotor to mix and pulp the waste material is thereby further improved and the risk of unintentional braking, malfunctioning, or jamming the rotor correspondingly reduced. Because of the arrangement of the rotor plate relative to the protective collar, the gap or spacing between the rotating parts and the stationary parts opens up or ends in an opening in a radial direction. Experiments have shown that such placing of the opening is advantageous which is believed to be because the opening thereby is being shielded from the general flow and motion of the waste inside the container during pulping whereby less waste material passes by and can get stuck in the opening.

[0030] By the construction described in the above, the rotor plate and the protective collar are arranged relative to each other such that the spacing between rotor and the stationary parts of the container forms a labyrinth seal with at least one bend. I.e., the placing of the rotor plate such as to rotate over the protective collar advantageously provides for a bending or kinking of the path or gap between the rotating parts and the stationary parts of the pulping apparatus, i.e. between the mounting part and the rotor plate of the rotor on the one side and the container side and the protective collar of the container on the other side. In other words, if seen in a cross sectional view, by the placing of the rotor plate to rotate over the protective collar, the spacing between the rotating parts and the stationary parts extends first alongside the container side in a radial direction, then between the mounting part and the protective collar in a mainly axial direction and then again in a mainly radial direction between the rotor plate and the protective collar. These bends or kinks act to hinder the waste material in filling up the spacing and in particular in impeding or even hindering the access to the rotor shaft. In this way the problem of especially long and flexible objects such as wires, cables or strips entangling the rotor shaft is reduced or even removed. Also, even if the outermost part of the spacing up to the first bend should become filled with waste material, then

this would only cause the rotor to be slowed down insignificantly compared to conventional designs without the rotor plate and the protective collar.

[0031] These bends in the spacing between the rotating and stationary parts may be sharp, or approximately of 90 degrees or more soft or gradual depending on the shape of corners of the different parts.

[0032] A further advantage of the rotor plate is that it can be attached to the rotor such as to protect the rotor from wear. Instead the rotor plate may be subjected to the most wear but may relatively easily be replaced as needed. The rotor plate may further be replaced without having to take the entire rotor out of the container which often is a very difficult and time consuming operation.

[0033] In an embodiment, the rotor plate is attached to the mounting part by means of attachment members such as bolts or screws. Hereby the rotor plate becomes easily replaceable.

[0034] The rotor plate may rotate over the entire protective collar or over at least a part of the protective collar.

[0035] The rotor plate may be placed with a distance to the protective collar in the range of 0.5-10 mm such as in the range of 1-4 mm. Such distance allows for some rotational slack or unevenness during rotation while on the same time being sufficiently small for preventing most types of waste material to enter the gap.

[0036] In a further embodiment of the invention, the diameter of the rotor plate is approximately the same or larger than the outer diameter of the protective collar. Hereby the rotor plate acts to shield the opening to the spacing between the rotating and stationary parts thereby reducing the amount of waste passing by the opening during pulping. According to the invention the rotor plate further comprises a ring member placed to radially surround the protective collar. Hereby is formed a further bend or turn in the spacing between the rotating and the stationary parts of the pulping apparatus providing a sealing effect.

[0037] The ring member may have an approximately rectangular cross-section. The ring member may form an integral part of the rotor plate or may be attached to the rotor plate by fastening members such as bolts or screws. The ring member may be of the same or a different material than the rotor plate such as e.g. of a wear resistant material such as a wear resistant steel as for example the steel types manufactured in the names of Hardox®, Abrazo®, or Brinar®.

[0038] The rotor plate may further comprise additional ring shaped members such as to obtain the desired shape and size of the spacing between the rotor plate and the protective collar.

[0039] In an embodiment the ring member is placed such as to form a gap down to the container side of a width in the range of 0.5-10 mm such as in the range of 1-4 mm. Such distance allows for some rotational slack or unevenness during rotation while on the same time being sufficiently small for preventing most types of waste material to enter the gap.

[0040] In an embodiment the ring member has a width in the radial direction in the range of 4-20 mm such as in the range of 8-15 mm such as approximately 10 mm. The outermost portion of the spacing between the ring member and the container side may be the portion with the greatest risk of being filled with waste material which may then act to slow down the motion of the rotor and possibly even prevent the rotor from starting from stand-stills. However, by the aforementioned dimensions of the width of the ring member, the size of this outermost portion of the spacing is reduced whereby the risk of such breaking of the rotor is reduced considerably.

[0041] In an embodiment, the protective collar forms an integrated part of the container side. Hereby the need to post assemble the protective collar to the container side is obviated. Alternatively, the protective collar is arranged on the container side by means of attachment members such as bolts or screws. This allows for the replacement and renewal of the protective collar if worn or broken. Also, this allows for changing the size of the protective collar and of the size of the radial spacing to the mounting member which may be advantageous for example is the pulping apparatus is to be used to a different type of waste material.

[0042] The protective collar may advantageously be made of wear resistant material such as a wear resistant steel as for example the steel types manufactured in the names of Hardox®, Abrazo®, or Brinar®. In this way the protective collar more effectively acts also as a wear member reducing the wear of the container. When worn the protective collar can simply be replaced as needed at a very low cost compared to the alternatives of having to repair or replace the container side or alternatively manufacturing the entire container side of a wear resistant material.

[0043] In an embodiment of the invention, the pulping apparatus further comprises a replaceable or exchangeable wear plate attached to the container side. The protective collar may form an integrated part of the replaceable wear plate or may alternatively be installed on top of the replaceable wear plate. Hereby is obtained an improved wear protection of the container side. Also, the replaceable wear plate may simply be replaced if or when worn, which can be performed at a relatively low cost and with a relatively short down time for the pulping apparatus.

[0044] In an embodiment of the invention, the rotor further comprises a number of vanes placed adjacent to the mounting part and wherein the vanes extend radially such as to pass over the protective collar when the rotor rotates. Hereby is obtained an improved mixture flow where the vanes aid in creating an axial flow within the container.

[0045] The container may further comprise a fluid inlet for at least a part of the liquid to be mixed with the waste material, the inlet being placed in the container side so that the liquid flows into the container via at least a part of the spacing between the mounting part and the con-

tainer side. The fluid flow may in this way advantageously aid in keeping the spacing between the rotating mounting part and the stationary container side free from waste material.

[0046] In an embodiment, the container further comprises an additional fluid inlet placed in the container side next to the protective collar for flushing at least a part of the spacing between the protective collar and the rotor. By such placing on the interior side of protective collar is obtained that the outermost spacing between the rotating and stationary parts of the apparatus may be sprayed or flushed with for example water at intervals or when needed to thereby clean out any smaller particles of waste material which may potentially in time fill up the spacing such as sand or smaller glass pieces etc.

[0047] According to a further embodiment of the invention, the container further comprises a primary inlet for the waste material, where the primary inlet is placed in an upper part of the container. The liquid may also be filled into the container via the primary inlet or via both the primary inlet and a fluid inlet in the bottom of the container.

[0048] The pulping apparatus may further comprise a controller adapted to control the opening of the above mentioned fluid inlet in dependence of the opening of the primary inlet, such that the fluid inlet is being opened for the liquid to flow into the container whenever the primary inlet for the waste material is opened. Hereby is obtained that waste material is prevented from entering the spacing between the mounting member of the rotor and the container side at least during filling of the container.

Brief description of the drawings

[0049] In the following different embodiments of the invention will be described with reference to the drawings, wherein:

Fig. 1 shows a pulping apparatus for the degeneration of waste material

Figs. 2 and 3 show in greater detail the rotor mounted on a container wall in a perspective and a cross sectional view, respectively,

Fig. 4 shows a part of the rotor close to the container wall in a cross sectional view and according to prior art,

Figs. 5-6 illustrate the arrangement of a protective collar close to the rotor in cross sectional views

Fig. 7 illustrates a further embodiment of a pulping apparatus with a protective collar and a rotor comprising a rotor plate,

Figs. 8 and 9 show in greater detail embodiments of a pulping apparatus as outlined in figure 7 without

and with an replaceable wear plate,

Figs. 10 and 11 illustrate the working principle of an embodiment of the pulping apparatus of figures 7-9, and

Figs. 12 and 13 show sketches of two alternative embodiments of the arrangement of a protective collar and a rotor plate, figure 12 being not in accordance with the invention.

Detailed description of the drawings

[0050] Figure 1 shows in a cross sectional view a pulping apparatus 100 and a motor driving the rotor 101 in the pulping apparatus. The lower part of the pulping apparatus is shown in greater detail in figures 2 and 3 in a perspective and cross sectional view, respectively. During use, the waste material and liquid is filled into the container 102 from a primary inlet or opening 110 in the upper part of the container. As the desired amount of waste material and liquid is supplied, the rotor 101 is started and the pulping, mixing and working of the mixture is performed for a period of time usually in the range of 10-40 minutes depending on the amount and content of waste material. The rotor 101 is driven by a motor 103 and is rotably mounted to the container bottom 106 with the rotation axis 111 extending approximately vertically. Alternatively, the rotor may in some pulping apparatus be mounted on a container wall with the rotation axis perpendicularly to the wall surface. When pulped, the waste mixture is emptied from the pulping apparatus via an outlet (not shown) in the lowermost part of the container and is directed to a separator for the separation of the mixture into the more or less dissolved organic pulp substance and the non-dissolved reject.

[0051] The rotor 101 of the pulping apparatus 100 comprises a helical screw part 105 creating primarily an axial flow in the container as outlined by the arrow 104. As shown in the figure 1, the rotor may optionally comprise a number of vanes 107 extending radially from the rotation axis and placed near the bottom of the container. The vanes act to increase the outward flow of the mixture in a direction from the rotor shaft towards the container walls along the bottom of the container. The vanes may in one embodiment comprise a number of wear plates 112. The wear plates are manufactured of a more wear resistant material and can readily be replaced if needed. The rotor 101 further comprises a mounting part 108 in the region the closest to the container side 106. In an embodiment the mounting part 108 constitutes a separate mounting plate attached to the helical screw part 105 of the rotor on one side and to the rotor shaft 109 on the other side. The mounting part is rotational symmetric around the rotational axis.

[0052] The figures 4-6 which show an enlargement of the region 'E' as marked in the figure 3 for different configurations of a pulping apparatus. Figure 4 illustrate in

a cross sectional view the arrangement of the rotor relative to the container side according to a conventional pulping apparatus, whereas figures 5 and 6 show the same view but of two different embodiments of pulping apparatus according to the invention.

[0053] As can be seen best in figures 4-6, the rotating rotor mounting part 108 is arranged with an axial spacing 400 to the stationary container side 106. A liquid inlet 401 is arranged in the container side 106 beneath the rotor 101 from which a part of or all the liquid to be mixed with the waste material can flow into the container as illustrated by the arrows 404. Hereby the liquid flow can aid in keeping the gap 400 clear of waste material during filling and preventing waste material from getting stuck between the rotor and the container side. However, as soon as the filling of the container is completed and the mixing and pulping initiated, the waste material in conventional pulping apparatus as in figure 4 is seen to get caught by the radially outermost edges 405 of the rotor mounting part 108 and get stuck in the spacing between the rotating part of the rotor and the stationary container side thereby potentially jamming the rotation of the rotor.

[0054] This is solved by embodiments of the invention by the placing of a protective collar 500 arranged on the container bottom plate 106 as can be seen in figures 2, 3, 5, and 6. The protective collar is arranged to radially surround the rotating mounting part 108. In this way the protective collar 500 acts to shield off the spacing 400 between the rotating mounting part and the stationary container bottom 106, while on the same time leaving a radial spacing 501 open both to avoid friction between the moving and stationary parts and to allow for a liquid flow into the container from the liquid inlet 401. In the embodiments of figure 5 and 6, and as can also be seen in figure 2, the protective collar 500 is ring-shaped. The protective collar can in one embodiment be cut out from a plate. The protective collar is bolted to the container bottom by a number of bolts 502. The bolts are preferably inserted from the outside of the container so that the bolt heads are not subjected to the aggressive environment and wear within the container.

[0055] The protective collar may be arranged so as to extend a distance in the axial direction from the container side which distance is larger than the axial spacing between the mounting part and the container side. In other words, the protective collar (optionally together with the exchangeable wear plate 505) has a thickness corresponding to or larger than the gap between the mounting part and the container side.

[0056] In the embodiments shown in figures 5 and 6, the protective collar extends axially from the container side and up to approximately the same height as the mounting part 108. In this way the waste mixture within the container during the pulping process primarily passes radially from the rotor mounting part over the radial gap 501 towards the container walls without encountering any sharp edges and with a reduced risk of getting caught or somehow entangled. Also, the same height of the rotor

mounting part and the protective collar reduces the wear on these parts.

[0057] The protective collar is preferably manufactured from a wear resistant material such as wear resistant steel as for example Hardox®, Abrazo®, or Brinar® and thereby also acts to reduce the wear and increase the lifetime of the container significantly. The protective collar can easily be renewed if worn.

[0058] In the embodiments shown in figures 2, 3, 5, and 6, as well as in the embodiments of figures 8-9 and 12-13, the pulping apparatus further comprises an exchangeable wear plate 505 attached to the container bottom 106. The wear plate preferably covers the majority of the bottom area between the rotor and the container walls where the wear is worst. Alternatively, the protective collar and the wear plate can be made as one component. The wear plate can be placed to cover the portion of the container the bottom surrounding the mounting plate as illustrated in e.g. figure 5. Alternatively, the wear plate can be placed such as to pass under the outermost part of the mounting plate such as illustrated in figure 8 or 12-13.

[0059] In the embodiment of figure 6 the rotor 101 of the pulping apparatus comprises a number of vanes 107 placed adjacent to the mounting part 108 and extending radially. The vanes 107 in this embodiment extend radially beyond the radius of the mounting part 108 and pass over the protective collar 500 when the rotor rotates.

[0060] The figures 8-9 and 12-13 show an enlargement of the region 'B' as marked in the figure 7 for different configurations of a pulping apparatus. These figures illustrate in cross sectional views the arrangement of the rotor relative to the container side according to different embodiments of pulping apparatus according to the invention. In addition to the elements described in relation to the previous figures, the rotor 101 of the pulping apparatus here also comprise a rotor plate 800. The rotor plate 800 is placed on top of the mounting plate 108 and extends radially such as to pass over at least a part of the protective collar 500 during rotation.

[0061] In the embodiment according to the invention shown in figure 8, the rotor plate 800 further comprises a ring member 801 placed to radially surround the protective collar 500. In this way is formed a labyrinth sealing between the rotating parts and the stationary parts, - the rotating parts being the mounting part 108 and the rotor plate 800, and of the stationary parts being the container side 106 (and optionally a wear plate 500) and the protective collar 500. The spacing 805 between the rotating and the stationary parts hereby comprises a number of bends which hinder and impede the waste material in working its way into the gap.

[0062] In the embodiment sketched in figure 8, the rotor plate 800 comprises an additional ring member 802. The thickness of the two ring members 801, 802 are dimensioned to obtain a spacing or gap width as desired. Successful experiments have been conducted with a gap width of around 1-4 mm and with a width of the ring mem-

ber 801 of approximately 10 mm.

[0063] Figure 9 show an embodiment of a pulping apparatus similar to the embodiment of figure 8 and with a number of vanes 107 in this case extending out to the outermost diameter of the mounting plate 108. When the vanes do not extends beyond the rotating parts, the waste cannot be caught under any of the vanes. The rotor plate 800 is hereby also advantageous in increasing the diameter of the rotating parts, whereby larger vanes 107 can be used which creates a more powerful circulation and flow inside the container during pulping.

[0064] Figures 10 and 11 illustrate the working principle of the sealing created by the use of the rotor plate 800 and the protective collar 500. As the rotor plate 800 rotates over the protective collar 500, the spacing 805 between the rotating and stationary parts ends in an opening 1000 in a radial direction. The opening 1000 thereby is away from the primary direction of the flow of the waste material inside the container during pulping. The arrow 104 illustrates the flow in the region near to the bottom of the container. Thereby less waste material passes by the opening 1000 with a reduced risk of being caught or falling into the opening.

[0065] Also, the bends in the spacing 805 between the rotating and stationary parts have shown to considerably decrease the problems of waste material getting trapped. Experiments indicate that to the extent that some waste material works its way into the spacing 805, the waste material (indicated by 1100 in figure 11) is for the largest part stopped by the bends in the spacing. Only some smaller particles like sand or pieces of glass seem to be able to pass the bends.

[0066] Even if the outermost portion of the spacing 805 becomes filled with waste material over time, this portion can be kept relatively small and small enough not to impede the rotation of the rotor by the dimensioning of the components forming the labyrinth sealing. In the embodiment of figures 8-11 and 13 this is obtained by the use of a ring member of sufficiently small radial width. Successful experiments have been conducted with a ring member of a width of approximately 10 mm.

[0067] Figures 12 and 13 show sketches of two alternative embodiments of the arrangement of a protective collar 500 and a rotor plate 800,

[0068] figure 12 being not in accordance with the invention. In figure 12, the rotor plate does not comprise any ring member to surround the protective collar 500. However, the arrangement of the rotor plate 800 and the protective collar 500 relative to the mounting plate 108 still forms a labyrinth sealing with bends preventing the waste material to be entrapped.

[0069] The embodiment of figure 13 corresponds to the embodiment of figures 8 and 9 only with a ring member 801 attached directly to the rotor plate 800 with no additional ring member. The rotor plate and ring member(s) are preferably manufactured from a wear resistant material such as wear resistant steel as for example Hardox®, Abrazo®, or Brinar® and thereby also acts to re-

duce the wear and increase the lifetime of the rotor significantly. The rotor plate can easily be replaced if worn.

5 Claims

1. A pulping apparatus (100) for mixing and working a mixture of a waste material and a liquid, the apparatus comprising a container (102) and a rotor (101), wherein the rotor is placed with a rotational axis (111) extending in an axial direction perpendicularly to a container side (106), the rotor comprising a mounting part (108) which is rotational symmetric around the rotational axis (111) of the rotor and which is placed for rotating with an axial spacing (400) to the container side (106), the pulping apparatus further comprising a protective collar (500) arranged on the container side (106) so as to radially surround the mounting part (108) and a rotor plate (800) placed on top of the mounting part (108) so as to rotate over the protective collar (500), **characterized in that** the rotor plate (800) comprises a ring member (801) placed to radially surround the protective collar (500).
2. A pulping apparatus according to claim 1, wherein the protective collar (500) is arranged with a radial spacing (501) to the mounting part (108) which is approximately of the same size or smaller than the axial spacing (400) between the mounting part (108) and the container side (103).
3. A pulping apparatus according to claim 1 wherein the diameter of the rotor plate (800) is approximately the same or larger than the outer diameter of the protective collar (500).
4. A pulping apparatus according to claim 1 wherein the rotor plate (800) is attached to the mounting part (108) by means of attachment members such as bolts or screws.
5. A pulping apparatus according claim 1 wherein the protective collar (500) is arranged such as to extend axially a distance from the container side (106), the distance being larger than the axial spacing (400) between the mounting part (108) and the container side (106).
6. A pulping apparatus according to claim 1 wherein the protective collar (500) has an axial thickness larger than the axial spacing (400) between the mounting part (108) and the container side (106).
7. A pulping apparatus according to claim 1 wherein the protective collar (500) is arranged such as to extend axially a distance from the container side (106), the distance being approximately equal to the sum of the axial spacing (400) between the mounting part

(108) and the container side (106) and the radially outermost thickness in the axial direction of the mounting part (108).

8. A pulping apparatus according to claim 1 wherein the protective collar (500) forms an integrated part of the container side (106). 5
9. A pulping apparatus according to claim 1 wherein the apparatus further comprises an exchangeable wear plate (505) attached to the container side (106). 10
10. A pulping apparatus according to claim 9 wherein the protective collar (500) forms an integrated part of the exchangeable wear plate (505). 15
11. A pulping apparatus according to claim 9 wherein the protective collar (500) is installed on top of the exchangeable wear plate (505). 20
12. A pulping apparatus according to claim 1 wherein the rotor (101) further comprises a number of vanes (107) placed adjacent to the mounting part (108) and wherein the vanes (107) extend radially such as to pass over the protective collar (500) when the rotor rotates. 25
13. A pulping apparatus according to claim 1 wherein the container (102) further comprises a fluid inlet (401) for at least a part of the liquid to be mixed with the waste material, the inlet being placed in the container side (106) so that the liquid flows into the container via at least a part of the spacing (400) between the mounting part (108) and the container side (106). 30
14. A pulping apparatus according to claim 1 wherein the container (102) further comprises an additional fluid inlet (401) in the container side (106) next to the protective collar (500) for flushing at least a part of the spacing between the protective collar and the rotor. 35
15. A pulping apparatus according to claim 13 or 14, wherein the container (102) comprises a primary inlet (110) for the waste material, which primary inlet is placed in an upper part of the container, and wherein the pulping apparatus comprises a controller adapted to control the opening of the fluid inlet (401) in dependence of the opening of the primary inlet (110), such that the fluid inlet (401) is being opened for the liquid to flow into the container whenever the primary inlet (110) for the waste material is opened. 40

Patentansprüche

1. Stofflösevorrichtung (100) zum Mischen und Bear-

beiten eines Gemischs aus einem Abfallmaterial und einer Flüssigkeit, die Vorrichtung umfassend einen Behälter (102) und einen Rotor (101), wobei der Rotor mit einer Drehachse (111) platziert ist, die sich in einer axialen Richtung senkrecht zu einer Behälterseite (106) erstreckt, der Rotor umfassend ein Anbauteil (108), das dreh-symmetrisch um die Drehachse (111) des Rotors ist und das zum Drehen mit einem axialen Abstand (400) zu der Behälterseite (106) platziert ist, die Stofflösevorrichtung ferner umfassend einen Schutzkragen (500), der auf der Behälterseite (106) angeordnet ist, um das Anbauteil (108) radial zu umgeben, und eine Rotorplatte (800), die auf dem Anbauteil (108) platziert ist, um sich über dem Schutzkragen (500) zu drehen, **dadurch gekennzeichnet, dass** die Rotorplatte (800) ein Ringelement (801) umfasst, das platziert ist, um den Schutzkragen (500) radial zu umgeben.

2. Stofflösevorrichtung nach Anspruch 1, wobei der Schutzkragen (500) mit einem radialen Abstand (501) zu dem Anbauteil (108) angeordnet ist, der ungefähr genauso groß wie oder kleiner als der axiale Abstand (400) zwischen dem Anbauteil (108) und der Behälterseite (106) ist.
3. Stofflösevorrichtung nach Anspruch 1, wobei der Durchmesser der Rotorplatte (800) derselbe wie oder größer als der Außendurchmesser des Schutzkragens (500) ist.
4. Stofflösevorrichtung nach Anspruch 1, wobei die Rotorplatte (800) mittels Anbringungs-vorrichtungen wie beispielsweise Bolzen oder Schrauben an dem Anbauteil (108) angebracht ist.
5. Stofflösevorrichtung nach Anspruch 1, wobei der Schutzkragen (500) derart angeordnet ist, dass er sich axial um einen Abstand von der Behälterseite (106) erstreckt, wobei der Abstand größer als der axiale Abstand (400) zwischen dem Anbauteil (108) und der Behälterseite (106) ist.
6. Stofflösevorrichtung nach Anspruch 1, wobei der Schutzkragen (500) eine axiale Dicke aufweist, die größer als der axiale Abstand (400) zwischen dem Anbauteil (108) und der Behälterseite (106) ist.
7. Stofflösevorrichtung nach Anspruch 1, wobei der Schutzkragen (500) derart angeordnet ist, dass er sich axial um einen Abstand von der Behälterseite (106) erstreckt, wobei der Abstand ungefähr gleich der Summe des axialen Abstands (400) zwischen dem Anbauteil (108) und der Behälterseite (106) und der radial äußersten Dicke in der axialen Richtung des Anbauteils (108) ist.

8. Stofflösevorrichtung nach Anspruch 1, wobei der Schutzkragen (500) einen integrierten Teil der Behälterseite (106) bildet.
9. Stofflösevorrichtung nach Anspruch 1, wobei die Vorrichtung ferner eine austauschbare Schleißplatte (505) umfasst, die an der Behälterseite (106) angebracht ist. 5
10. Stofflösevorrichtung nach Anspruch 9, wobei der Schutzkragen (500) einen integrierten Teil der austauschbaren Schleißplatte (505) bildet. 10
11. Stofflösevorrichtung nach Anspruch 9, wobei der Schutzkragen (500) auf der austauschbaren Schleißplatte (505) angebaut ist. 15
12. Stofflösevorrichtung nach Anspruch 1, wobei der Rotor (101) ferner eine Anzahl von Schaufeln (107) umfasst, die angrenzend an das Anbauteil (108) platziert sind, und wobei sich die Schaufeln (107) derart radial erstrecken, dass sie über den Schutzkragen (500) gehen, wenn sich der Rotor dreht. 20
13. Stofflösevorrichtung nach Anspruch 1, wobei der Behälter (102) ferner einen Fluideinlass (401) für zumindest einen Teil der mit dem Abfallmaterial zu mischenden Flüssigkeit umfasst, wobei der Einlass in der Behälterseite (106) platziert ist, so dass die Flüssigkeit über mindestens einen Teil des Abstands (400) zwischen dem Anbauteil (108) und der Behälterseite (106) in den Behälter fließt. 25 30
14. Stofflösevorrichtung nach Anspruch 1, wobei der Behälter (102) ferner einen zusätzlichen Fluideinlass (401) in der Behälterseite (106) neben dem Schutzkragen (500) zum Spülen zumindest eines Teils des Abstands zwischen dem Schutzkragen und dem Rotor umfasst. 35 40
15. Stofflösevorrichtung nach Anspruch 13 oder 14, wobei der Behälter (102) einen Haupteinlass (110) für das Abfallmaterial umfasst, der in einem oberen Teil des Behälters platziert ist, und wobei die Stofflösevorrichtung eine Steuerung umfasst, die angepasst ist, die Öffnung des Fluideinlasses (401) in Abhängigkeit von der Öffnung des Haupteinlasses (110) derart zu steuern, dass der Fluideinlass (401) geöffnet wird, damit die Flüssigkeit immer dann in den Behälter fließt, wenn der Haupteinlass (110) für das Abfallmaterial geöffnet ist. 45 50

Revendications

1. Appareil de pulpage (100) destiné à brasser et à travailler un mélange de déchets et de liquide, l'appareil comprenant un récipient (102) et un rotor (101), dans

lequel le rotor est placé avec un axe de rotation (111) s'étendant dans une direction axiale perpendiculairement à un côté de récipient (106), le rotor comprenant une partie de montage (108) symétrique en rotation autour de l'axe de rotation (111) du rotor et disposée de manière à tourner avec un espacement axial (400) par rapport au côté de récipient (106), l'appareil de pulpage comprenant en outre une collerette de protection (500) disposée sur le côté de récipient (106) de manière à entourer radialement la partie de montage (108), et une plaque de rotor (800) placée au-dessus de la partie de montage (108) de manière à tourner au-dessus de la collerette de protection (500), **caractérisé en ce que** la plaque de rotor (800) comprend un élément annulaire (801) disposé de manière à entourer radialement la collerette de protection (500).

2. Appareil de pulpage selon la revendication 1, dans lequel la collerette de protection (500) est disposée avec un espacement radial (501) par rapport à la partie de montage (108), lequel est approximativement égal ou inférieur à l'espacement axial (400) entre la partie de montage (108) et le côté de récipient (106).
3. Appareil de pulpage selon la revendication 1, dans lequel le diamètre de la plaque de rotor (800) est approximativement supérieur ou égal au diamètre extérieur de la collerette de protection (500).
4. Appareil de pulpage selon la revendication 1, dans lequel la plaque de rotor (800) est fixée à la partie de montage (108) à l'aide d'éléments de fixation tels que des boulons ou des vis.
5. Appareil de pulpage selon la revendication 1, dans lequel la collerette de protection (500) est disposée de manière à s'étendre axialement sur une distance par rapport au côté de récipient (106), la distance étant supérieure à l'espacement axial (400) entre la partie de montage (108) et le côté de récipient (106).
6. Appareil de pulpage selon la revendication 1, dans lequel la collerette de protection (500) présente une épaisseur axiale supérieure à l'espacement axial (400) entre la partie de montage (108) et le côté de récipient (106).
7. Appareil de pulpage selon la revendication 1, dans lequel la collerette de protection (500) est disposée de manière à s'étendre axialement sur une distance par rapport au côté de récipient (106), la distance étant approximativement égale à la somme de l'espacement axial (400) entre la partie de montage (108) et le côté de récipient (106) et l'épaisseur radialement le plus à l'extérieur dans la direction axiale de la partie de montage (108).

8. Appareil de pulpage selon la revendication 1, dans lequel la collerette de protection (500) forme une partie intégrante du côté de récipient (106).
9. Appareil de pulpage selon la revendication 1, dans lequel l'appareil comprend en outre une plaque d'usure remplaçable (505) fixée au côté de récipient (106). 5
10. Appareil de pulpage selon la revendication 9, dans lequel la collerette de protection (500) forme une partie intégrante de la plaque d'usure remplaçable (505). 10
11. Appareil de pulpage selon la revendication 9, dans lequel la collerette de protection (500) est installée au-dessus de la plaque d'usure remplaçable (505). 15
12. Appareil de pulpage selon la revendication 1, dans lequel le rotor (101) comprend en outre un certain nombre de pales (107) adjacentes à la partie de montage (108), et dans lequel les pales (107) s'étendent radialement de manière à passer au-dessus de la collerette de protection (500) lorsque le rotor tourne. 20
25
13. Appareil de pulpage selon la revendication 1, dans lequel le récipient (102) comprend en outre une entrée de fluide (401) pour une partie au moins du liquide à brasser avec les déchets, l'entrée étant placée dans le côté de récipient (106) de telle façon que le liquide s'écoule dans le récipient par le biais d'une partie au moins de l'espacement (400) entre la partie de montage (108) et le côté de récipient (106). 30
14. Appareil de pulpage selon la revendication 1, dans lequel le récipient (102) comprend en outre une entrée de fluide supplémentaire (401) dans le côté de récipient (106) à côté de la collerette de protection (500) pour rincer au moins une partie de l'espacement entre la collerette de protection et le rotor. 35
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15. Appareil de pulpage selon la revendication 13 ou 14, dans lequel le récipient (102) comprend une entrée primaire (110) pour les déchets, ladite entrée primaire étant placée dans une partie supérieure du récipient, et dans lequel l'appareil de pulpage comprend une commande adaptée pour commander l'ouverture de l'entrée de fluide (401) en fonction de l'ouverture de l'entrée primaire (110), de manière à ce que l'entrée de fluide (401) soit ouverte pour laisser le liquide s'écouler dans le récipient à chaque fois que l'entrée primaire (110) destinée aux déchets est ouverte. 45
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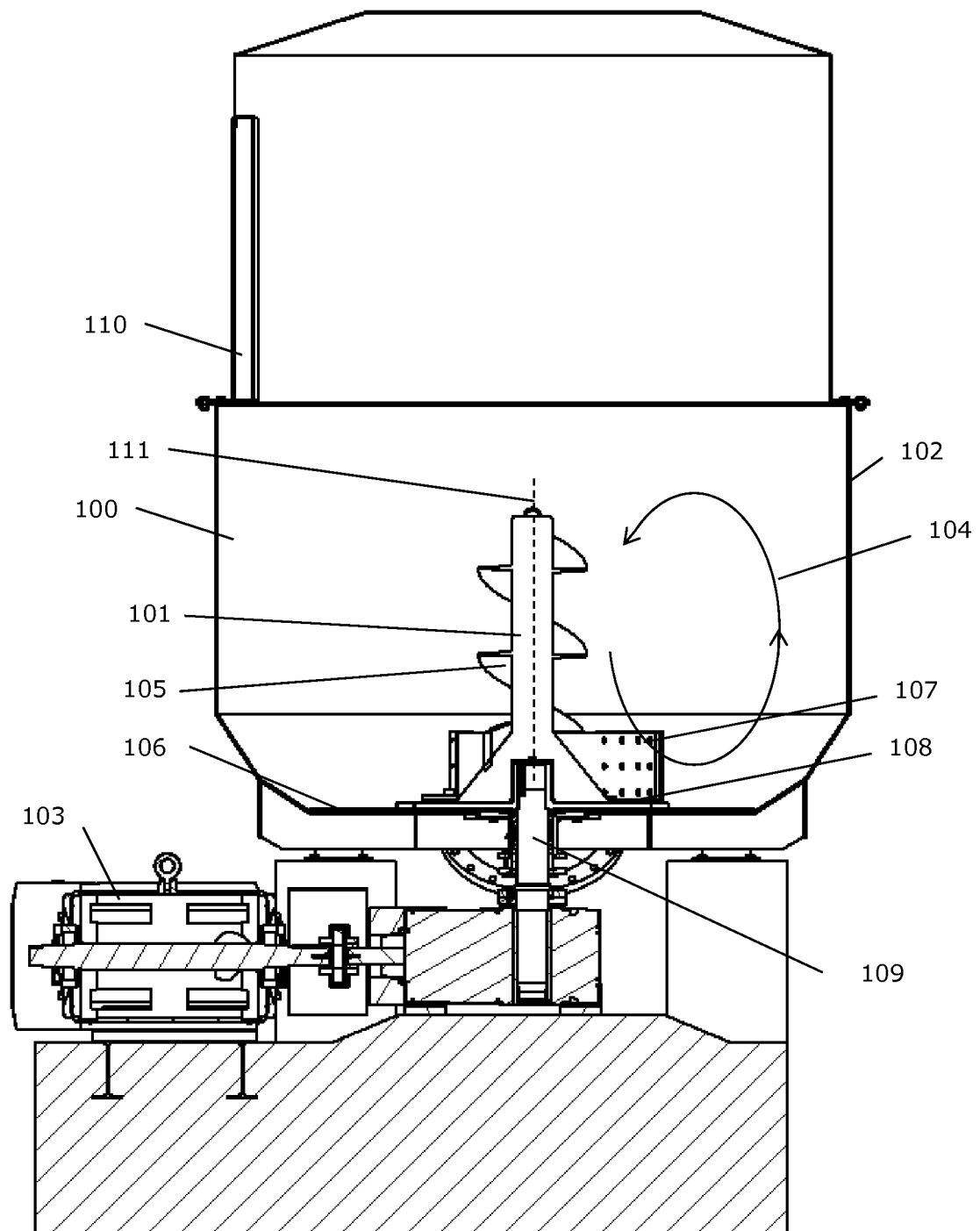


Fig. 1

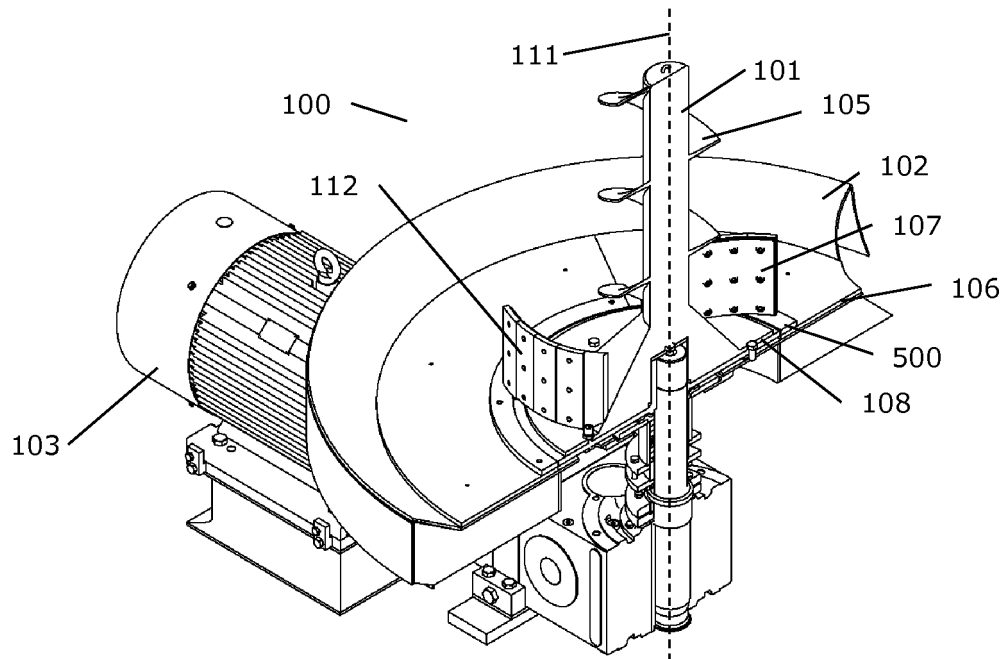


Fig. 2

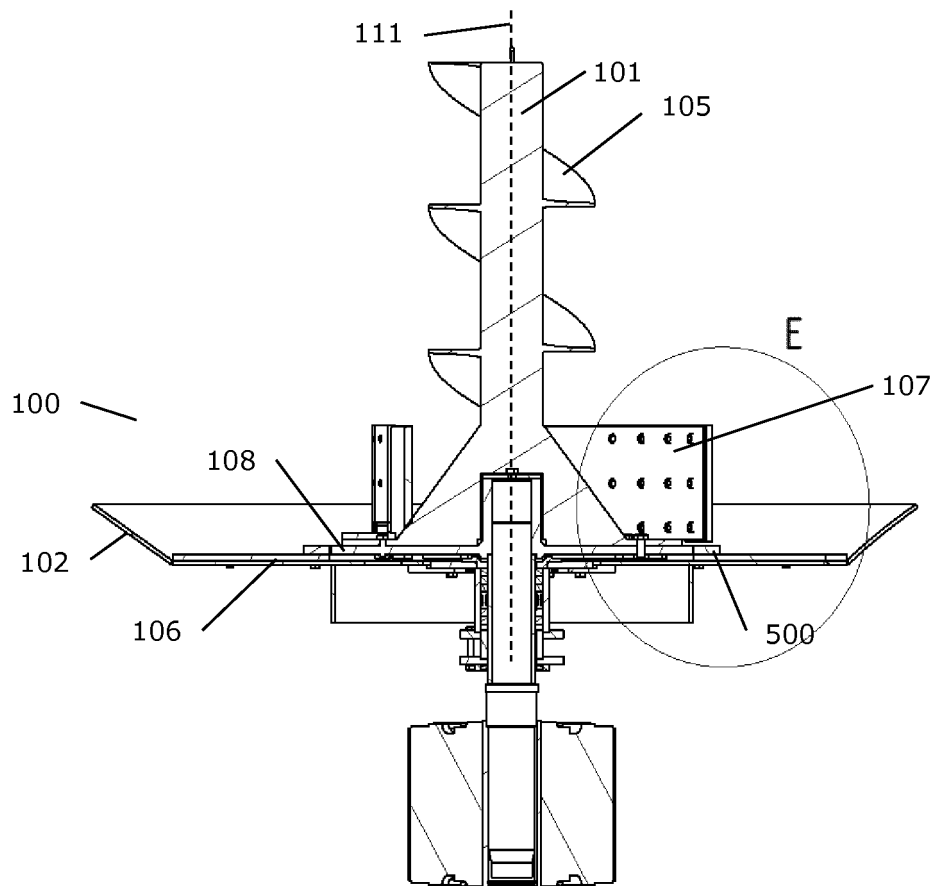
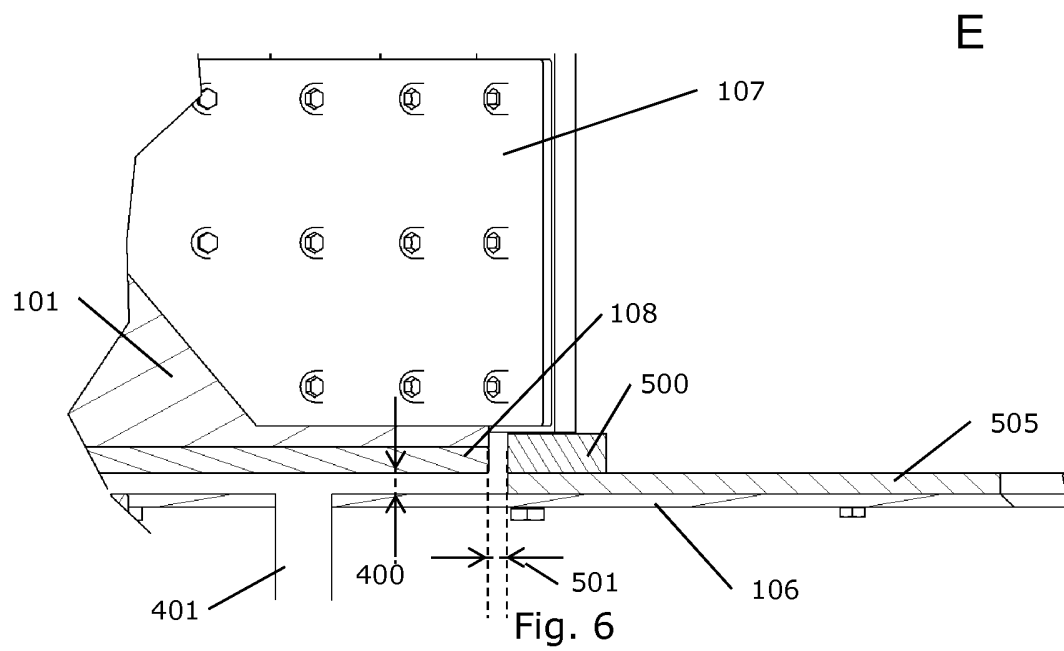
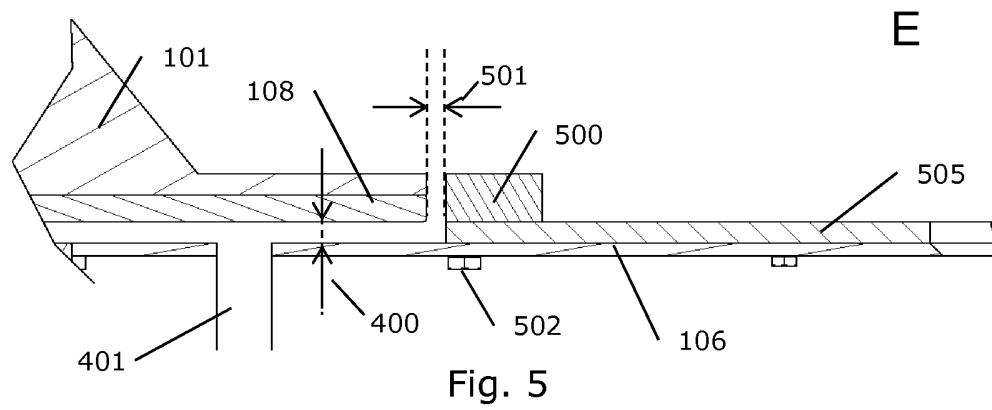
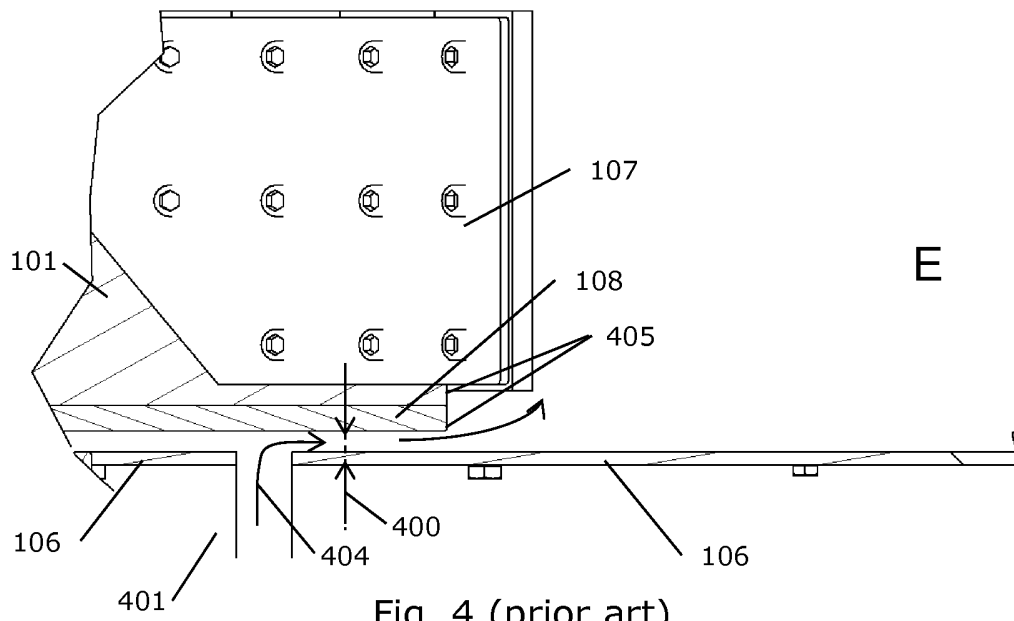


Fig. 3



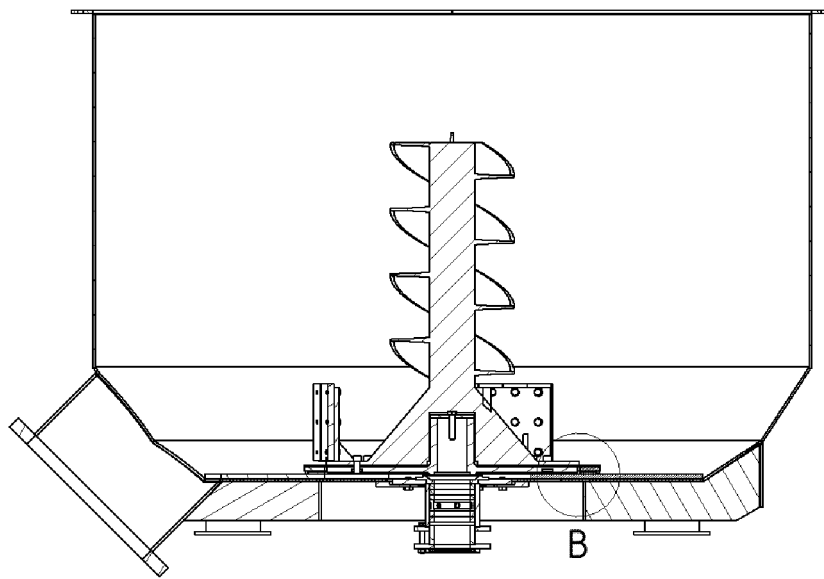


Fig. 7

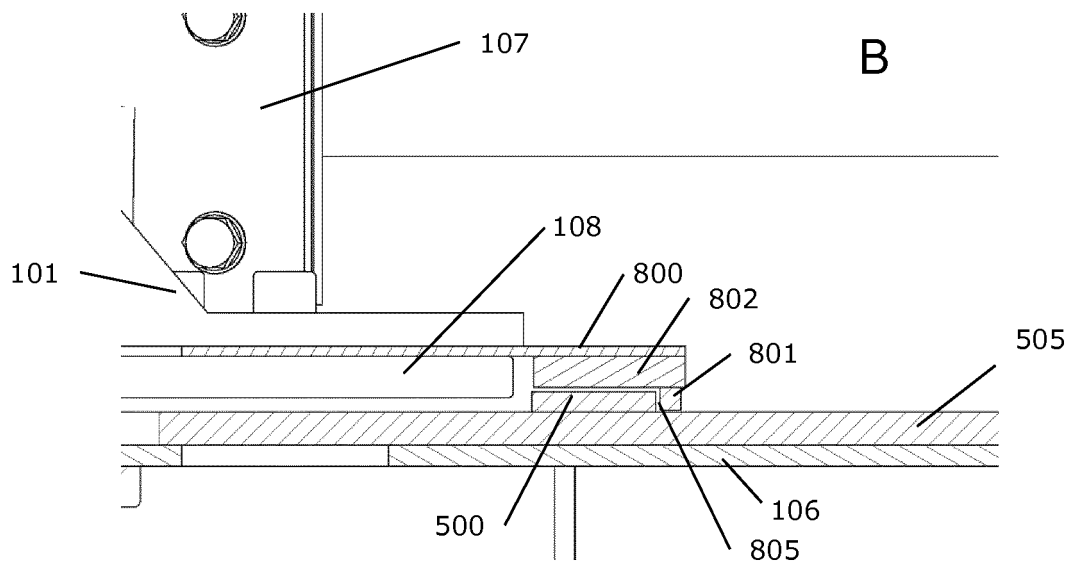
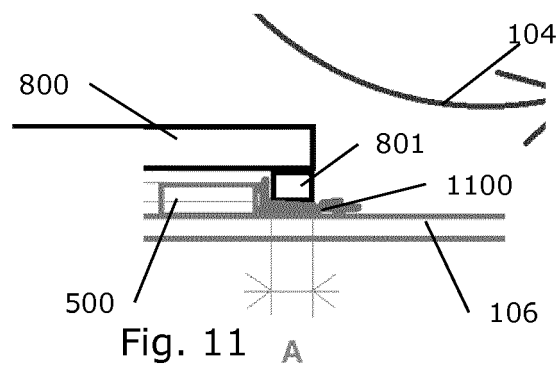
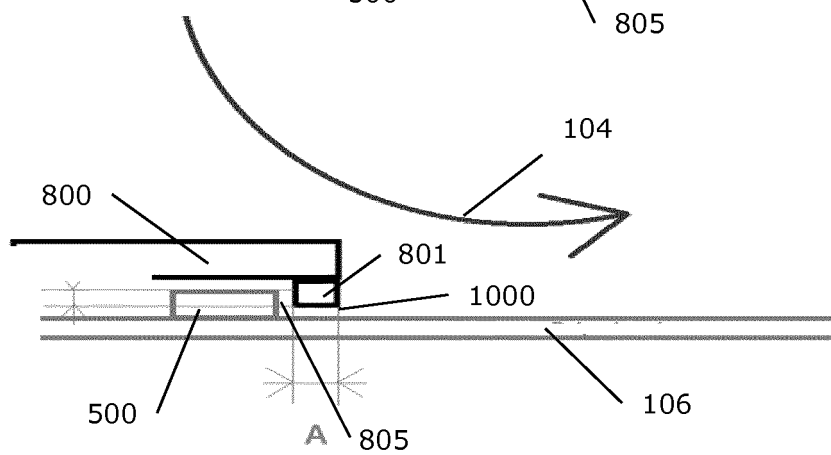
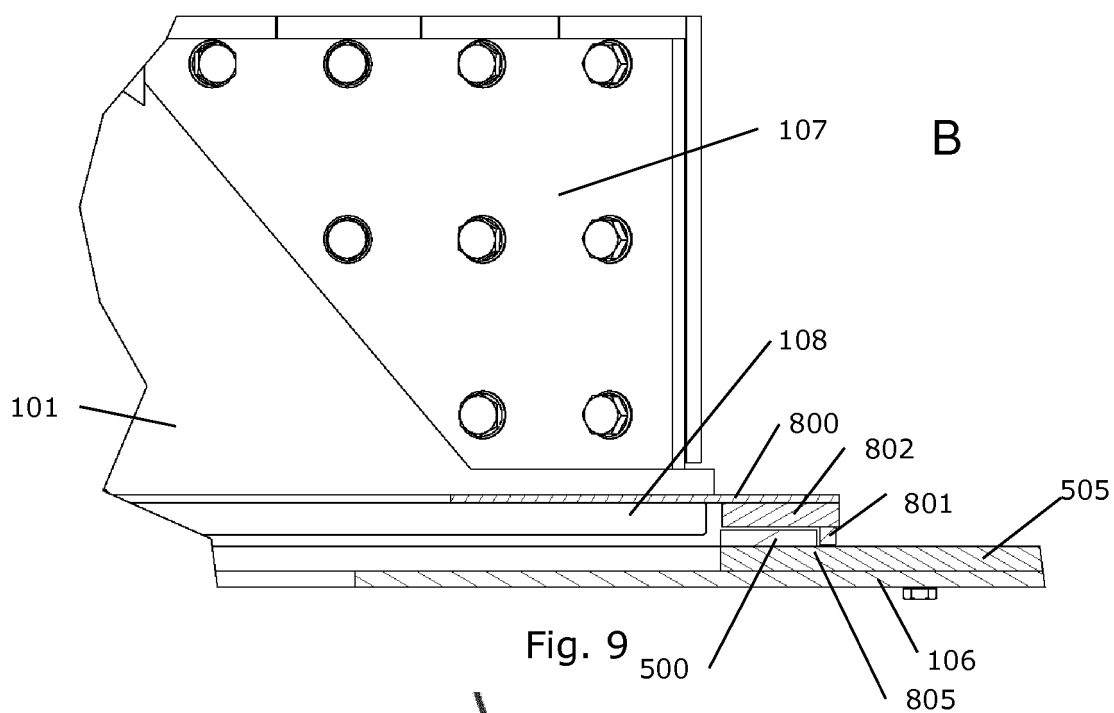


Fig. 8



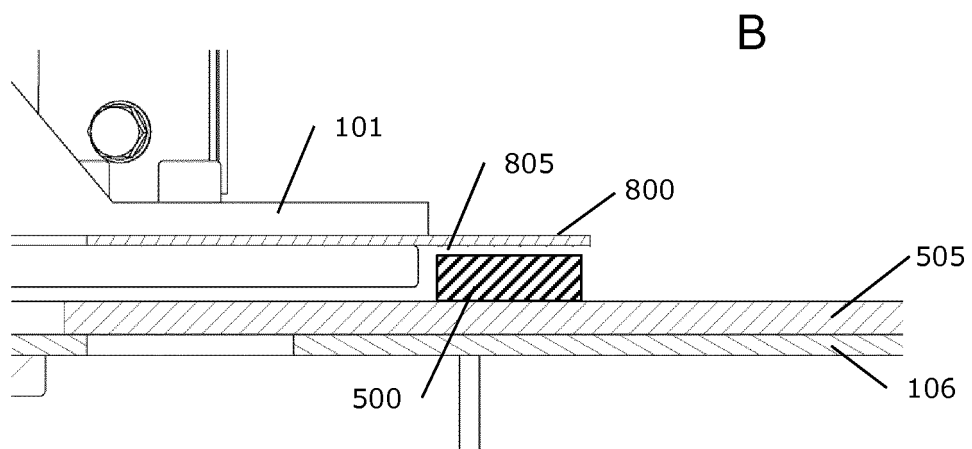


Fig. 12

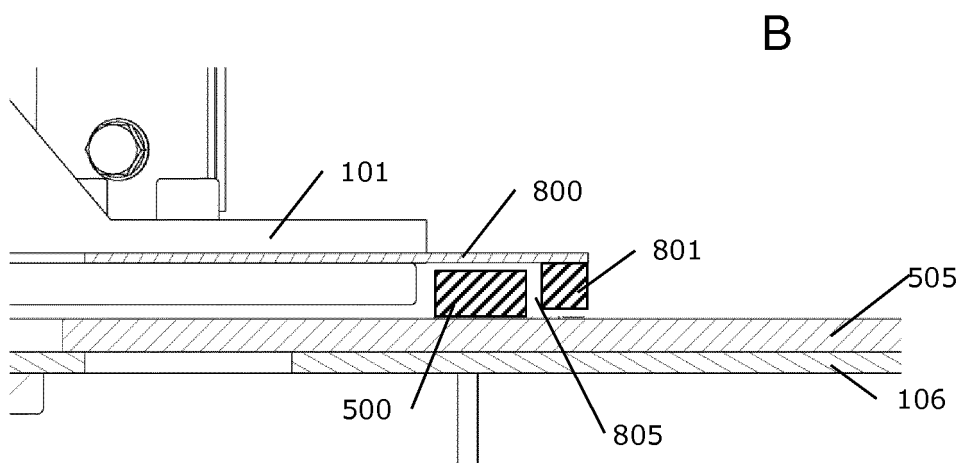


Fig. 13

REFERENCES CITED IN THE DESCRIPTION

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