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(54) **Crushing apparatus for treating solid waste**

(57) A crushing apparatus (1) for treating solid waste comprising a container (2) provided with an inlet opening (4) for introducing a mixture of solid waste and of a liquid, crushing means (8; 9) for crushing the solid waste in said mixture, evacuating means (16) for extracting from said container (2) a suspension of particles of solid waste in said liquid characterised in that said evacuating means (16) is associated with filtering means (14) suitable for enabling the passage to said evacuating means (16) of solid particles that do not exceed a preset maximum dimension.

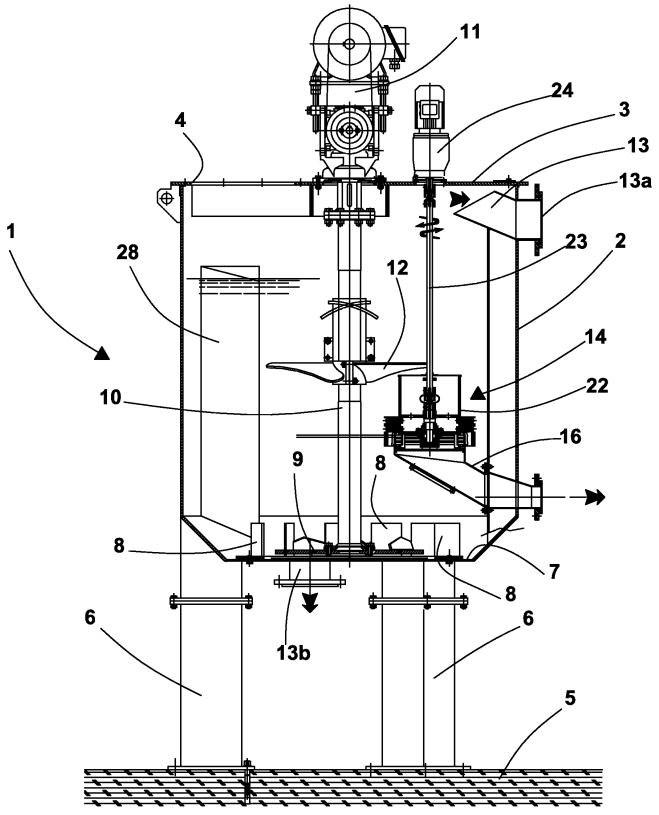

Fig. 1

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Description

[0001] The invention relates to a crushing apparatus for solid waste, usable in a waste treatment plant, in particular solid urban waste, for producing compost and biogas.

[0002] In systems for producing compost and biogas previously selected solid organic waste is mixed with water and ground to obtain a sludge in which the particles in suspension must not exceed a preset maximum dimension. The sludge is then sent to the apparatuses for treatment of the waste.

[0003] Grinding of the waste occurs in a crushing apparatus that is supplied with the solid waste mixed with a preset percentage of water.

[0004] Known crushing apparatuses consist of a container inside which an impeller is arranged, for example a vertical axis impeller that rotates inside a crown of fixed crushing elements, for example shaped as blades or laminas. On the axis of the impeller a stirring element is furthermore mounted to keep the mixture of water and solid waste stirring in order to avoid sedimentation of the solid particles on the bottom of the container. The apparatus is completed by an outlet pipe, possibly connected to a pump, for extracting from the container the suspension of water and solid particles obtained at the end of the grinding treatment.

[0005] Grinding of the waste in the crushing apparatus is prolonged until the waste is reduced to particles suspended in water with a maximum dimension that is not greater than a preset value. The duration of the treatment in the crushing apparatus is fixed so as to substantially have the certainty that in the obtained suspension there are no particles with dimensions greater than the preset value or at least that such particles are present in a negligible percentage.

[0006] Inevitably, in order to be certain to obtain the aforementioned conditions, the duration of the treatment in the crusher must be prolonged for a longer period than would be each time strictly necessary on the basis of the composition of the waste that is supplied to the crusher. This entails a reduction in the performance of the system and a waste of energy.

[0007] At the end of the treatment of the waste in the crusher, the obtained suspension is extracted from the crusher through the outlet pipe and sent to the subsequent treatment apparatuses to obtain compost and biogas.

[0008] The major drawback of known crushing apparatuses is that they do not enable a continuous waste treatment cycle to be achieved because the waste has to remain in the crusher until it is reduced to particles of dimensions that are not greater than the maximum preset dimension. This involves an intermittent flow of waste to the crusher and from the crusher to the subsequent treatment apparatuses, which limits the productive capacity of the waste treatment system in which the crushing apparatus is inserted.

[0009] The present invention aims to provide a crushing apparatus of solid waste that enables a continuous inlet and outlet flow of waste to be obtained, to be sent to successive treatment apparatuses.

[0010] According to the present invention a crushing apparatus is provided for treating solid waste comprising a container provided with introducing means for introduce a mixture of solid waste and of a liquid, crushing means for crushing the solid waste in said mixture, evacuating means for extracting from said container a suspension of particles of solid waste in said liquid characterised in that said evacuating means is associated with filtering means suitable for enabling the passage to said evacuating means of solid particles that do not exceed a preset maximum dimension.

[0011] Owing to the invention it is possible to take with continuity from the crushing apparatus a flow of treated waste, without having to wait for all the particles in suspension in the mixture in the crusher to be reduced to the desired dimensions. In fact, the presence of the filtering means makes sure that only the particles that have already reached the desired dimensions may be present in the flow of mixture that leaves the crusher.

[0012] It is therefore possible to treat the waste in a continuous cycle, without interruption, with significant increase in the productivity of the entire waste treatment system and with considerable energy saving inasmuch as the time the waste remains in the crushing apparatus is minimised.

[0013] Further, the presence of the filter ensures that in the mixture leaving the crusher there cannot be any solid particle of dimensions greater than the preset ones, which is a guarantee for obtaining maximum efficiency in the treatment to which the waste will be subjected downstream of the crusher.

[0014] An embodiment of the invention will now be disclosed with reference to the enclosed drawings, in which:

Figure 1 is an elevation sectioned view of an apparatus according to the invention;

Figure 2 is a view from above of the impeller and of the filtering means of the apparatus in Figure 1;

Figure 3 is a view from above of the apparatus in Figure 1.

Figure 4 is an enlarged axial section of the filtering means;

Figure 5 is a partially sectioned view from above of the filtering means.

[0015] Figure 1 illustrates an apparatus 1 according to the invention, comprising a container 2 intended to receive the solid waste to be crushed, mixed with a liquid, preferably water, in preset proportions. The container 2 is provided with a closing lid 3, in which an opening 4 is made for the introduction of the solid waste and a second opening 4a for the introduction of water. The container 2 can be fixed to a supporting plane 5, for example to the ground directly, or by means of supporting elements 6.

On the bottom 7 of the container 2 a plurality of blades 8, or laminas is fixed, that are arranged in a circular crown-shaped configuration. The blades or laminas 8 are intended to crush the solid waste introduced into the container, to reduce it into particles of dimensions that are not greater than a preset value. Within the circular crown configuration of the blades or laminas 8 there is arranged an impeller 9 fixed to a first substantially vertical shaft 10 rotated by a gearmotor 11 fixed to the lid 3 of the container 2. When the impeller 9 is rotated, the suspension of water and solid waste present inside the container 2 is in turn rotated and the particles of solid waste contained therein are projected against the blades 8, or laminas by the effect of the centrifugal force, and by knocking against them at high speed, are crushed so that the dimension thereof is reduced progressively.

[0016] On the shaft 10 of the impeller 9 at a certain distance from the bottom 7 of the container 2 there is fixed a stirring element 12 that is used to keep the fraction of mixture stirring that is present in the upper part of the container, to prevent the solid particles contained therein from being able to descend to the bottom 7 of the container increasing the density of solid particles in that zone, which would make the action of crushing of said particles less effective.

[0017] Within the container 2 there is arranged a spillway pipe 13, the function of which is to set a maximum level of the mixture in the container, discharging through a discharging opening 13a a possible excess of mixture.

[0018] Within the container 2 antirotation deflecting elements 28 are further provided, for example in the form of bend panels, that prevent compact rotating movement of the entire mixture of water and solid waste from commencing, which would produce thickening of the solid particles towards the walls of the container 2, moving them away from the impeller 9, with a consequently strong reduction in the efficacy of crushing.

[0019] On the bottom of the container 2 there is further provided a discharge opening 13b, provided with an opening and closing mechanism (not shown). The opening 13b is used to periodically discharge materials that are not treatable such as, for example, metal or glass that accumulate on the bottom of the container 2.

[0020] In the container 2 there is further arranged a filtering element 14, through which the mixture is passed before being extracted from the container 2. The filtering element 14, which will be disclosed in detail below, is intended to block the passage of particles that have a dimension that is greater than a maximum set dimension, so that the mixture extracted from the container 2 contains only particles of dimensions that are less than the set maximum dimension.

[0021] Advantageously, the filtering element 14 is arranged underneath the stirring element 12 in such a way that the action of the latter on the mixture of liquid and solid particles, together with the static pressure due to the mixture head, promotes the passage of the mixture through the filtering element 14.

[0022] The filtering element 14 (Fig. 4) comprises a lower flange 15, fixed to an evacuation conduit 16 through which the mixture of water and solid particles in suspension is extracted from the container 2 and an upper flange 17 connected to the lower flange 15 through a plurality of spacing elements 18, for example four, distributed with a substantially constant angular pitch and fixed to both the flanges 15 and 17, for example through welding. Between the lower flange 15 and the upper flange 17 there is interposed a plurality of annular elements 19, fixed to the spacing elements 18 and to a central hub 20 that protrudes from the lower side of the upper flange 17. The annular elements 19 are arranged in such a way that the distance existing between each annular element 19 and the adjacent elements, and between the annular elements 19 and the upper 17 and lower 15 flanges is not greater than the maximum preset dimension for the solid particles in suspension present in the mixture that is extracted from the container 2. Between the flanges 15 and 17 and the annular elements 19 passages 21 are thus defined of calibrated dimensions that are not greater than the maximum dimensions preset for the solid particles in suspension. In this way, when the mixture of water and solid particles passes through the passages 21 to then enter the evacuation conduit 16, the solid particles of dimensions greater than the maximum preset dimension are blocked. Therefore, the mixture that enters the evacuation conduit 16 contains only solid particles of dimensions not greater than the maximum preset dimension, whereas the particles of dimensions greater than said maximum preset dimension remain within the container 2.

[0023] The filtering element 14 is provided with an anti-occlusion device, to prevent the solid particles that do not get past the passages 21 from occluding them, clogging the filter 14. The anti-occlusion device comprises a body 22, for example cylindrical, supported on a second shaft 23, which is also substantially vertical, rotated in a reciprocating manner by a second gearmotor 24, which is also fixed to the lid 3 of the container 2.

[0024] The second shaft 23 is rotatingly coupled to the hub 20 that acts as a centring element and guide for the lower end of the second shaft 23.

[0025] To the lower part of the body 22 of the anti-occlusion device removing elements 25 are fitted, the function of which is to remove possible occlusions from the passages 21 between the annular elements 19 of the filtering element 14. Each removing element 25 comprises a supporting element 26 to which a plurality of lamina elements 27 is fixed having dimensions such as to be inserted into the aforementioned passages 21.

[0026] When the body 22 is rotated, with reciprocating movement, by the gearmotor 24, the lamina elements 27 slide in the passages 21 parallel to the edge of the rings 19, removing possible occlusions that form in said passages 21. The reciprocating rotation ensures more effective removal of the occlusions, preventing them accumulating along the path of the lamina elements 27.

[0027] The supporting elements 26 may, for example, be "V"-shaped with a lamina element 27 fixed to the end of each arm of the "V". Advantageously, two supporting elements 26 can be provided in diametrically opposite positions, each of which carries two lamina elements 27.

[0028] Advantageously, the lamina elements 27 can have a triangular shape and can be connected to the respective supporting element 26 at one of the vertices of the triangle. The connection of the lamina elements 27 to the supporting element 26 is made in such a way as to enable the lamina elements 27 to have limited rotation on a plane parallel to the rings 19, in order to enable the lamina elements 27 to adapt to variable operating conditions and to offset inevitable constructional tolerances of the filtering element.

[0029] In the practical embodiment, the materials, the dimensions and the constructional details may be different from those indicated but be technically equivalent thereto without thereby departing from the ambit of protection of the present invention.

Claims

1. Crushing apparatus (1) for treating solid waste comprising a container (2) provided with an inlet opening (4) for introducing a mixture of solid waste and of a liquid, crushing means (8; 9) for crushing the solid waste in said mixture, evacuating means (16) for extracting from said container (2) a suspension of particles of solid waste in said liquid **characterised in that** said evacuating means (16) is associated with filtering means (14) suitable for enabling the passage to said evacuating means (16) of solid particles that do not exceed a preset maximum dimension.

2. Apparatus (1) according to claim 1, wherein said filtering means (14) defines a plurality of passages (21) for said mixture having dimensions that are not greater than said maximum preset maximum dimension.

3. Apparatus (1) according to claim 2, wherein said passages (21) are defined between a plurality of annular elements (19) that are parallel to one another.

4. Apparatus (1) according to claim 3, wherein said filtering means comprises a lower flange (15) and an upper flange (17) connected by spacing elements (18), said annular elements (19) being supported by said spacing elements and by a hub (20) associated with said upper flange (17).

5. Apparatus (1) according to claim 4, wherein said lower flange (15) is connected to said evacuating means (16).

6. Apparatus (1) according to any one of claims 3 to 5, wherein said filtering means (14) comprises anti-occlusion means suitable for removing possible occlusions from said passages (21).

7. Apparatus (1) according to claim 6, wherein said anti-occlusion means comprises removing elements (25) suitable for inserting themselves in said passages (21) to remove possible occlusions.

8. Apparatus (1) according to claim 7, wherein said anti-occlusion means comprises a body (22), driven to rotate with alternating motion, to which said removing elements (25) are connected.

9. Apparatus (1) according to claim 7, or 8, wherein said removing elements comprise lamina means (27) having dimensions such as to be inserted into said passages (21).

10. Apparatus (1) according to claim 9, wherein said lamina means (27) is supported by supporting elements (26) fixed to said body (22).

11. Apparatus (1) according to claim 10, wherein said supporting elements (26) are "V"-shaped, said lamina elements (27) being connected to the ends of the arms of said "V".

12. Apparatus (1) according to claim 11, wherein said lamina elements (27) have a triangular shape and are connected to said supporting elements (26) near one of the vertices of said triangular shape.

13. Apparatus (1) according to claim 12, wherein said lamina elements (27) are connected to said supporting elements (26) so as to be able to rotate by a limited angle on a plane substantially parallel to said annular elements (19).

14. Apparatus (1) according to any one of claims 10 to 13, wherein said supporting elements (26) are arranged in diametrically opposite positions with respect to said annular elements (19).

15. Apparatus (1) according to any preceding claim, wherein said crushing means (8; 9) comprises a plurality of blades (8), or laminas, arranged in a circular crown-shaped configuration on a bottom (7) of said container (2) and an impeller (9) arranged in a concentric position inside said circular crown-shaped configuration.

16. Apparatus (1) according to claim 15, wherein said impeller is supported on a substantially vertical shaft (10) rotated by a gearmotor (11).

17. Apparatus (1) according to claim 16, wherein a stirring element (12) is fixed to said shaft (10).

18. Apparatus (1) according to any one of claims 8 to 17, wherein said body (22) is connected to a second shaft (23) rotated alternately by a second gearmotor (24).

19. Apparatus (1) according to any preceding claim, wherein inside said body (2) a spillway pipe (13), connected to an outlet pipe (13a) is provided.

20. Apparatus (1) according to any preceding claim, wherein inside said container (2) deviating elements (28) are provided.

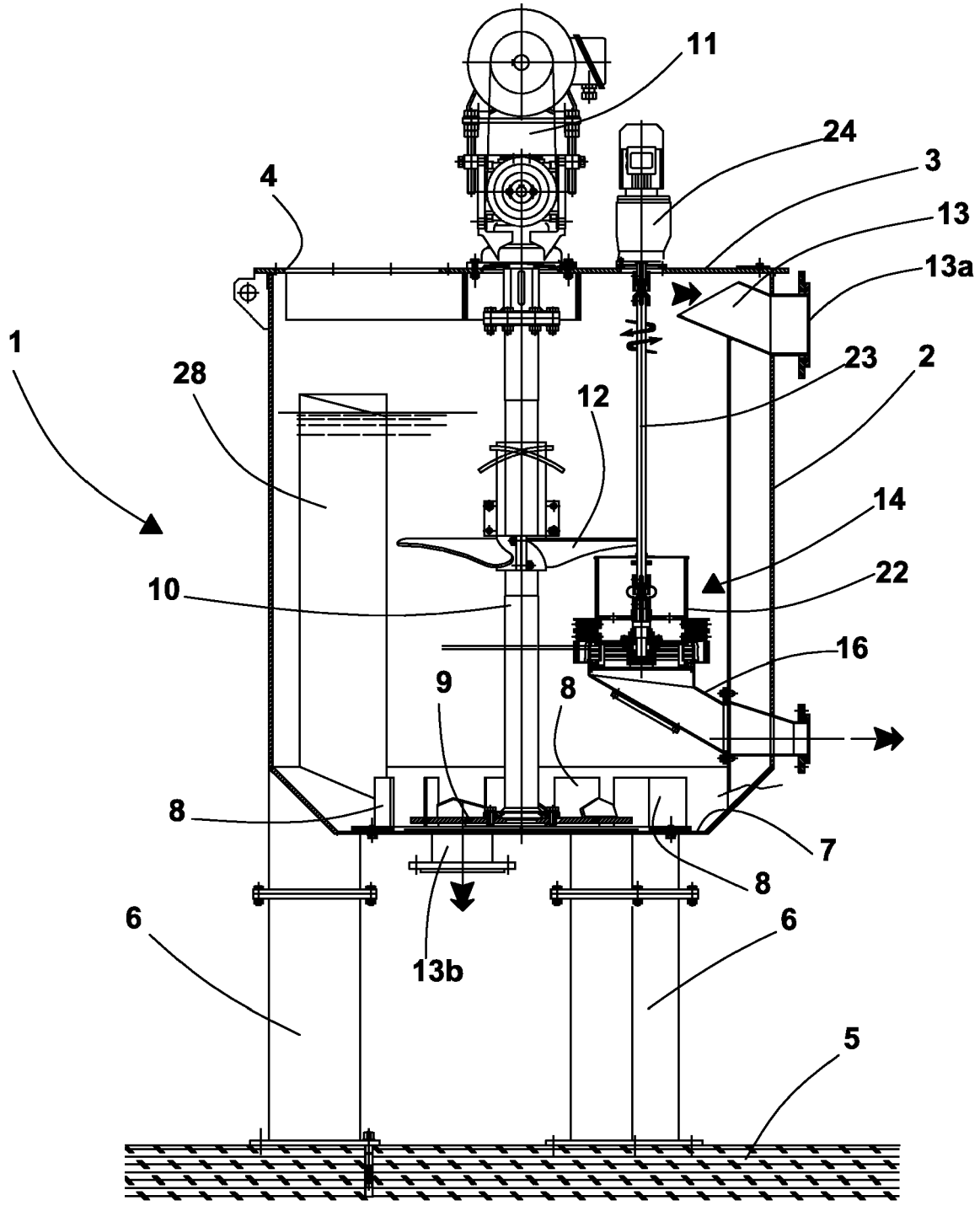

Fig. 1

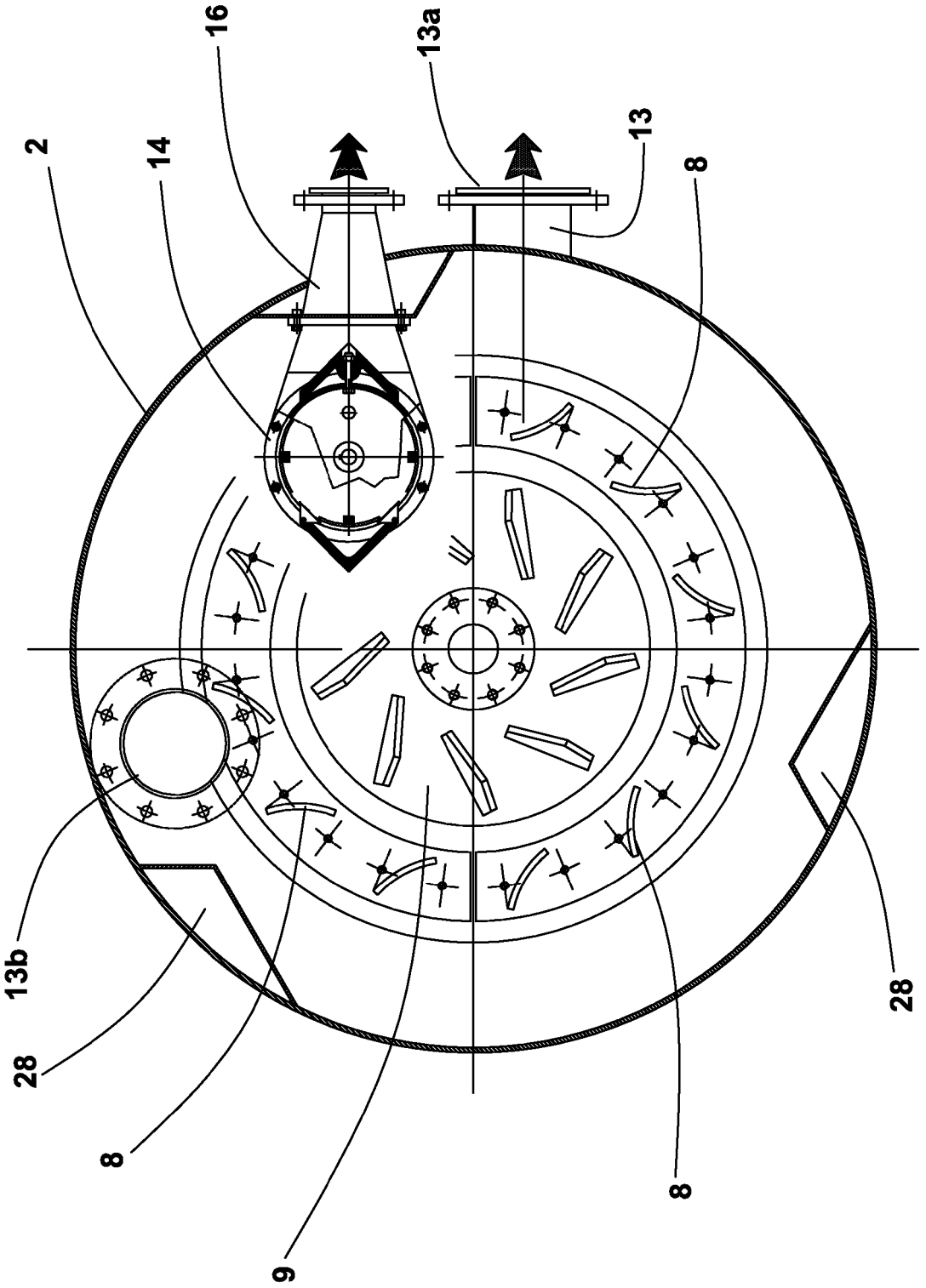

Fig. 2

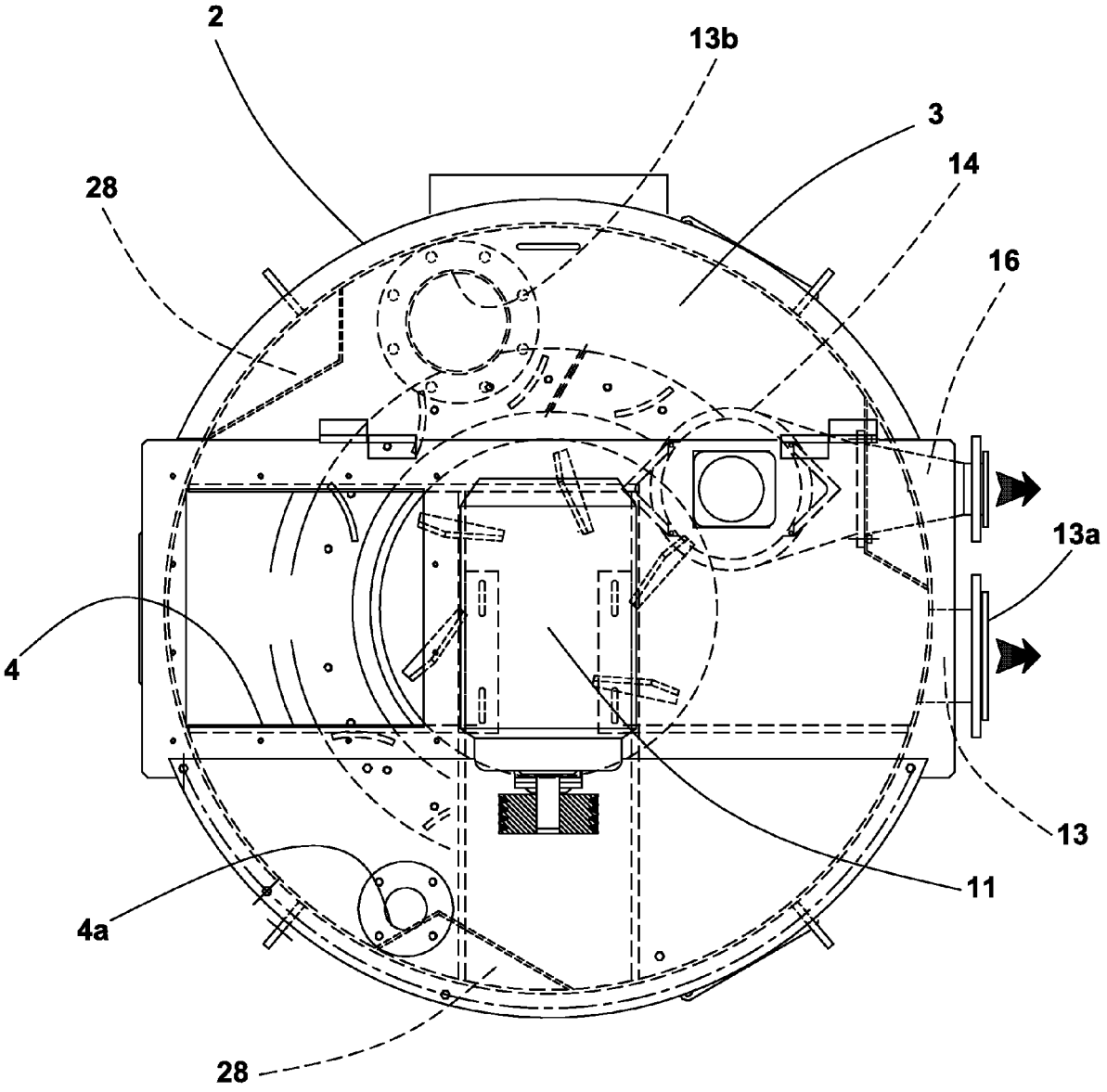

Fig. 3

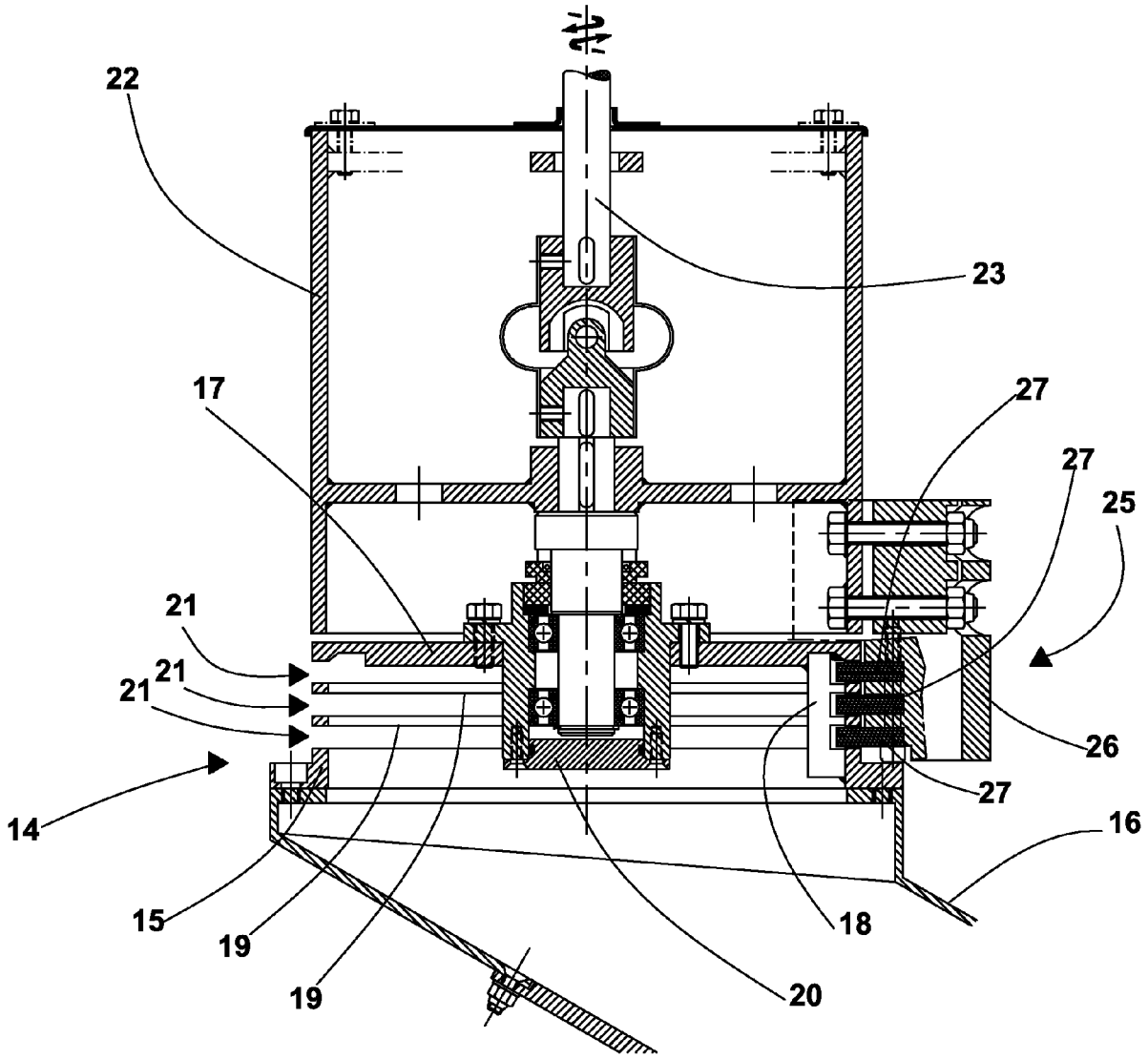

Fig. 4

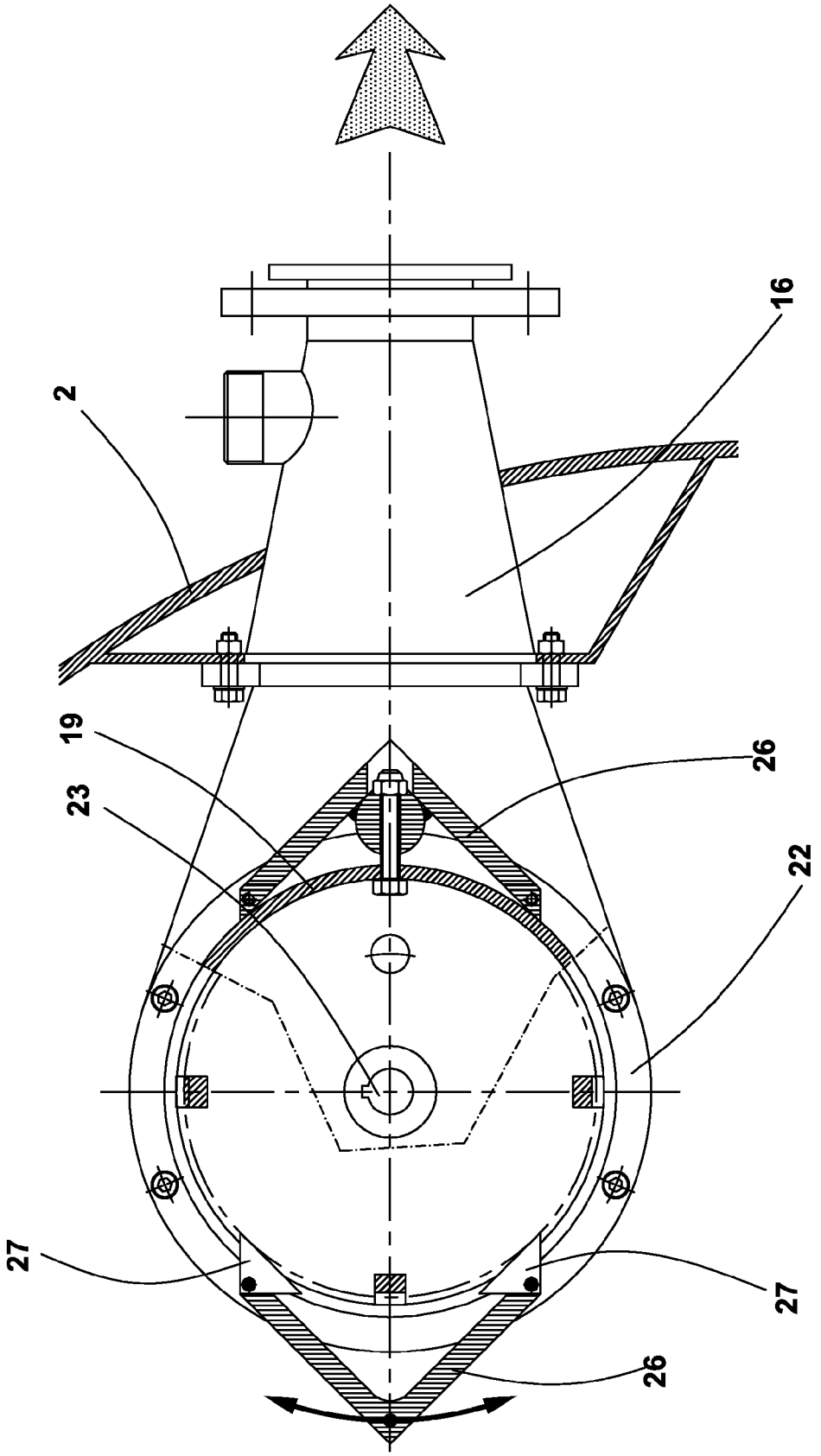

Fig. 5

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EUROPEAN SEARCH REPORT

Application Number
EP 06 11 7016

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	16 October 2006	Kopacz, Ireneusz

CATEGORY OF CITED DOCUMENTS

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