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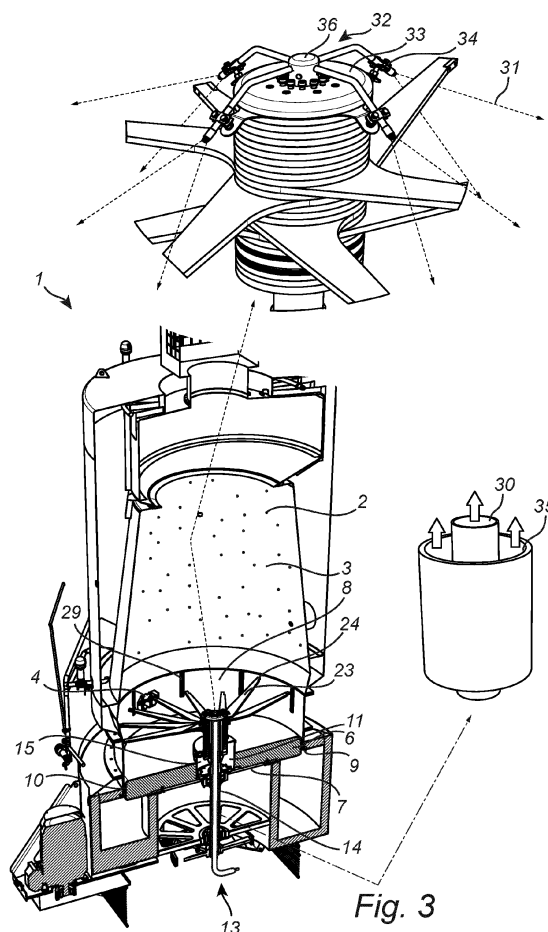
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(54) **A FLASH DRYER FOR DRYING A PRODUCT AND A METHOD FOR DRYING A PRODUCT IN A FLASH DRYER**

(57) The invention relates to a flash dryer (1) for drying a product (2). The flash dryer (1) comprises a chamber (3) having a product inlet (4) and a product outlet (5), a drive unit (13) arranged below the chamber (3) having a drive shaft (14) extending through a hole (15) in a bottom of the chamber (3) into the lower section of the chamber (3), at least one rotatable disintegrator element (23) connected to the drive shaft (14) in the lower section of the chamber (3), an air inlet (12) connected to the lower section of the chamber (3) and adapted to provide air into the chamber (3) to dry the product (2). The flash dryer (1) is characterised by a first conduit (30) extending axially inside the drive shaft (14) into the chamber (3) and adapted to provide a suspension or fluid (31) into the lower section of the chamber (3). The invention also relates to a method for drying a product (2) in a flash dryer (1).



Description

Technical field

[0001] The invention relates to a flash dryer for drying a product and a method for drying a product in a flash dryer or an agitated fluid bed dryer.

Background art

[0002] A flash dryer is used for continuous drying of a filter cake, fibrous materials, paste, sludge or similar materials. The flash dryer uses a rotary disintegrator, mill or impeller rotor for disintegration of the material and provides a change of the structure of the material from the paste or fibrous structure to a more particle shaped structure which is more suitable during the drying. Apertures are provided for supply of hot drying gas and for removal of the spent drying gas and removal of the dried material.

[0003] EP 2 457 049 B1 discloses a method for drying a fluid or wet product and a drying apparatus for carrying out the method. In the method and apparatus for drying a fluid or wet product, a drying chamber, an air inlet, a feed tank, and a product recovery system are provided. During operation, a fluid or wet product is fed from the feed tank into the drying chamber at a predetermined flow rate, and finished dried product is fed into the drying chamber at a flow rate corresponding to controllable settings. The fluid or wet product is mixed with the finished dried product in the drying chamber. The mixture of fluid or wet product and finished dried product is dried in a gas containing finished dried product, and the product is recovered from the gas in the product recovery system.

[0004] When drying a wet product consisting of a blended mix of a semidry/dewatered product and a fluid or suspension it is often difficult to achieve a satisfactory bonding, blending and mixing between the suspension or fluid and the semidry/dewatered product introduced into the drying chamber of the flash dryer, especially with certain substances, such as with certain fluids and solid fractions. In one example, the fluid consists of evaporated viscous stick water from a rendering process and the solid fraction from the same rendering or defatting process.

Summary of the invention

[0005] It is an object of the present invention to provide an improvement of the flash dryers according to prior art. A particular object is to provide an improved flash dryer which allows for a more secure and effective drying process of a wet product.

[0006] According to a first aspect, these and other objects, and/or advantages that will be apparent from the following description of embodiments, are achieved, in full or at least in part, by a flash dryer for drying a product. The flash dryer comprises a chamber having a product inlet and a product outlet, a drive unit arranged below the

chamber having a drive shaft extending through a hole in a bottom of the chamber into the lower section of the chamber, at least one rotatable disintegrator element connected to the drive shaft in the lower section of the chamber, an air inlet connected to the lower section of the chamber and adapted to provide air into the chamber to dry the product. The flash dryer is characterised by a first conduit extending axially inside the drive shaft into the chamber and adapted to provide a suspension or fluid into the lower section of the chamber.

[0007] This is advantageous in that suspension or fluid is introduced in the lower section of the chamber which is the most intense drying zone where most of the dry product is present during the drying process thereof. In other words, the flash dryer described above is configured to direct the suspension or fluid into the chamber to strike the product being dried in the most intense drying zone as ideal as possible.

[0008] The flash dryer may further comprise distributing means connected to the first conduit in the lower section of the chamber.

[0009] The distributing means may be arranged at a top portion of the drive shaft in the lower section of the chamber.

[0010] The distributing means may comprise a plurality of nozzles arranged to distribute the suspension or fluid in the lower section of the chamber.

[0011] The flash dryer may further comprise a second conduit extending through the drive shaft and adapted to provide air, steam or further (or another) suspension or fluid to the lower section of the chamber. In other words, the suspension or fluid from the second conduit may differ from the suspension of fluid from the first conduit.

[0012] The second conduit may extend coaxially with the first conduit through the drive shaft.

[0013] Each one of the plurality of nozzles may be constituted by a spray-injection nozzle which is adapted to provide a mix of suspension or fluid and air, steam or further (or another) suspension or fluid into the lower section of the chamber.

[0014] The flash dryer may further comprise a disc fixedly arranged in the lower section of the chamber below the product inlet, such that a gap is created between an outer edge of the disc and an inner wall of the chamber.

[0015] The flash dryer air inlet may be arranged below the chamber and arranged to provide air into the chamber via the gap.

[0016] The distributing means may be arranged to direct the suspension or fluid towards the gap.

[0017] The flash dryer may further comprise a rotatable shovel arm connected to the drive shaft in the lower section of the chamber below the plurality of disintegrator elements, wherein the shovel arm is adapted to distribute the product in the lower section of the chamber.

[0018] According to a second aspect, the objects are achieved in full, or at least in part, by a method for drying a product in a flash dryer. The method comprises option-

ally, introducing a solid fraction of the product into a chamber of the flash dryer via a product inlet located in a lower section of the chamber, providing a suspension or fluid into a lower section of the chamber from a first conduit extending axially inside a drive shaft into the chamber, rotating at least one rotatable disintegrator elements in the lower section of the chamber, to disintegrate the product, by means of a drive shaft extending through a hole in a bottom of the chamber into the lower section of the chamber, providing air into the chamber from an air inlet connected to the lower section of the chamber to dry the product, and exiting the dried product via a product outlet in an upper section of the chamber. To further clarify, the dry product exiting the product outlet may be constituted by a dried mix of solid fraction and suspension or fluid. It may also be constituted by a dried product which has been introduced into the chamber as a suspension or fluid (with or without steam), dried into a semi-dried product in the lower section of the chamber, and thereafter dried further into a completely dried product which will exit the chamber via the product outlet.

[0019] The method may further comprise the step of directing the suspension or fluid in the lower section of the chamber by means of distributing means connected to the first conduit.

[0020] The method may further comprise the step of providing air, steam or further (or another) suspension or fluid into the lower section of the chamber from a second conduit extending through the drive shaft.

[0021] The method may further comprise the step of directing the air, steam or further (or another) suspension or fluid in the lower section of the chamber by means of distributing means connected to the second conduit.

[0022] It should be noted that the different embodiments of the flash dryer that is described above are exemplifying only. The embodiments may be combined with each other in any suitable way depending on the requirements established for the flash dryer.

[0023] It should be further noted that the different steps of the method described above may be conducted in any suitable order.

[0024] Effects and features of the second aspect of the present invention are largely analogous to those described above in connection with the first aspect the inventive concept. Embodiments mentioned in relation to the first aspect of the present invention are largely compatible with the further aspects of the invention.

[0025] Other objectives, features and advantages of the present invention will appear from the following detailed disclosure, from the attached claims, as well as from the drawings. It is noted that the invention relates to all possible combinations of features.

[0026] Generally, all terms used in the claims are to be interpreted according to their ordinary meaning in the technical field, unless explicitly defined otherwise herein. All references to "a/an/the [element, device, component, means, step, etc.]" are to be interpreted openly as referring to at least one instance of said element, device, com-

ponent, means, step, etc., unless explicitly stated otherwise.

[0027] As used herein, the term "comprising" and variations of that term are not intended to exclude other additives, components, integers or steps.

[0028] As used herein, by the term "suspension" it is primarily meant a mix of solid particles and a fluid, such as starch and water, or protein and water.

[0029] As used herein, the term "flash dryer" also includes a spin flash dryer or agitated fluid bed dryer.

[0030] As used herein, the wording "the most intense drying zone" is meant in the vicinity of the gap created between an outer edge of the disc and an inner wall of the chamber, preferably directly above that gap.

Brief description of the drawings

[0031] The above objects, as well as additional objects, features and advantages of the present invention, will be more fully appreciated by reference to the following illustrative and non-limiting detailed description of preferred embodiments of the present invention, when taken in conjunction with the accompanying drawings, wherein:

Fig. 1 illustrates a perspective view of an exemplary embodiment of a flash dryer according to a first aspect of the invention.

Fig. 2 illustrates a cross-section of the flash dryer in Fig. 1.

Fig. 3 illustrates a cross-section of another exemplary embodiment of the flash dryer according to the first aspect of the invention.

Fig. 4 illustrates a cross-section of another exemplary embodiment of the flash dryer according to the first aspect of the invention.

Fig. 5 illustrates a cross-section of another exemplary embodiment of the flash dryer according to the first aspect of the invention.

Fig. 6 illustrates a cross-section of another exemplary embodiment of the flash dryer according to the first aspect of the invention.

Detailed description of preferred embodiments of the invention

[0032] Fig. 1 and 2 illustrate an exemplary embodiment of a flash dryer 1 for drying a product 2. The flash dryer 1 comprises a chamber 3 having a product inlet 4 and a product outlet 5, a drive unit 13 arranged below the chamber 3 having a drive shaft 14 extending through a hole 15 in a bottom of the chamber 3 into the lower section of the chamber 3, a plurality of rotatable disintegrator elements 23 connected to the drive shaft 14 in the lower section of the chamber 3, an air inlet 12 connected to the lower section of the chamber 3 which is adapted to provide air into the chamber 3 to dry the product 2, and a first conduit 30 extending axially inside the drive shaft 14 into the chamber 3 which is adapted to provide a sus-

pension or fluid 31 into the lower section of the chamber 3. The first conduit 30 extends from below the chamber 3, axially through the drive shaft 14, and into the chamber 3 in its lower section. An inlet connection to the first conduit 30 is arranged at one end of the same below the chamber 3.

[0033] It is a solid fraction of the product 2 that enters into the chamber 3 via the product inlet 4. When the solid fraction of the product 2 is semi-dried, it is located in the most intense drying zone of the chamber 3 in the initial stage of the drying cycle above the gap 9 in the lower section of the chamber 3, where suspension or fluid is directed towards the same. This way, the suspension or fluid 31 can attach to or bond with the semi-dried product in the initial stage of the drying cycle, which in turn will carry the suspension or fluid 31, while drying and evaporating, from the lower section of the chamber 3 to an upper section thereof. Finally, the dried mix of the solid fraction and the suspension or fluid 31 will exit through the product outlet 5.

[0034] Distributing means 32 are connected to the first conduit 30 at the other end thereof in the lower section of the chamber 3. More specifically, the distributing means 32 is arranged at a top portion 33 of the drive shaft 14 in the lower section of the chamber 3. In this specific embodiment, the distributing means 32 comprises a distributing chamber 36 to which a plurality of nozzles 34 are connected at a predetermined distance from each other and arranged to evenly distribute the suspension or fluid 31 in the lower section of the chamber 3. The nozzles 34 are provided onto the outer end of each conduit which are directed towards the product 2 located in the most intense drying zone in the chamber 3, which is located in the lower section thereof. Naturally, the amount, size and shape of the nozzles 34 can be varied in any suitable way. It is, however, important that they are shaped to direct the suspension or fluid 31 provided therethrough towards the location in the chamber where most of the dry product 2 is positioned. This is to make sure that the suspension or fluid 31 can attach to or bond with the semi-dried product 2, which in turn will carry the suspension or fluid 31, while drying and evaporating the same, from the lower section of the chamber 3 to an upper section thereof, and finally out through the product outlet 5 together with the dry product 2. The flash dryer 1 comprises a disc 6 arranged in the lower section of the chamber 3 below the product inlet 4, such that a gap 9 is created between an outer edge 10 of the disc 6 and an inner wall 8 of the chamber 3. The disc can be rotatably or fixedly arranged in the lower section of the chamber 3. The air inlet 12 is arranged below the chamber 3 and arranged to provide air into the chamber 3 via the gap 9. In one preferred embodiment, the distributing means 32 is arranged to direct the suspension or fluid 31 towards the gap 9 or just above the gap 9 where the majority of the dry product in the chamber 3 is located during the drying process. Note, however, that the flash dryer 1 can be used with no disc 6 present in the chamber 3.

[0035] When the flash dryer 1 according to this embodiment is used, the product 2 to be disintegrated and dried is fed into the chamber 3 via the product inlet 4 by means of a product conveyer. The product 2 entering the chamber 3 is disintegrated by means of the rotating disintegrator elements 23 when falling towards the disc 6 (if present) in the bottom 7 of the chamber 3 by means of gravity.

[0036] Air from the air inlet 12 flowing into the chamber 3 will lift the product 2 up from the lower section of the chamber 3 towards the upper section thereof.

[0037] The suspension or fluid 31 will be delivered by means of the distribution means 32 towards the location in the chamber where most of the dry product 2 is positioned. This is to make sure that the suspension or fluid 31 can attach to or bond with the semi-dried product 2, which in turn will carry the suspension or fluid 31, while drying and evaporating the same, from the lower section of the chamber 3 to an upper section thereof, and finally out through the product outlet 5 together with the dry product 2.

[0038] In Fig. 3, another exemplary embodiment of the flash dryer 1 is illustrated. Here, the flash dryer 1 comprises a second conduit 35 extending through the drive shaft 14 which is adapted to provide air, steam or further (or another) suspension or fluid to the lower section of the chamber 3. The second conduit 35 extends coaxially with the first conduit 30 through the drive shaft 14. However, other possibilities are also possible, in which the first conduit 30 extends in parallel with the second conduit 35.

[0039] In this embodiment, the first conduit 30 is a suspension or fluid conduit and the second conduit 35 is a steam conduit, air conduit or suspension or fluid conduit.

[0040] The nozzles 34 of the distributing means can be usual nozzles which merely distributes suspension or fluid. However, in some embodiments, the nozzles 34 comprise spray-injection nozzles which are adapted to provide a mix of suspension or fluid 31 from the first conduit 30 and air, steam or further (or another) suspension or fluid from the second conduit 35 into the lower section of the chamber 3.

[0041] Accordingly, the flash dryer 1 can be used for so called spray-cooking of suspension or fluid 31 where fluid or suspension 31 (such as starch suspension, protein suspension or protein containing fluid, blood) would be supplied from the first conduit 30 and steam from the second conduit 35. The fluid or suspension 31 and the steam are thereafter mixed together in the nozzle 34 causing an instant heat treatment of the fluid (cooking of starch, coagulation of protein), and are supplied from there into the chamber 3 to be dried and simultaneously mixed, bonded to and dried with the semi-dried product present therein.

[0042] To further clarify, the dry product exiting the product outlet may be constituted by a dried mix of solid fraction and suspension or fluid. It may also be constituted by a dried product which has been introduced into the

chamber as a suspension (with or without steam), dried into a semi-dried product in the lower section of the chamber, and thereafter dried further into a completely dried product which will exit the chamber via the product outlet.

[0043] Fig. 4 to 6 illustrate another exemplary embodiment of the flash dryer 1. The flash dryer 1 comprises a chamber 3 having a product inlet 4 and a product outlet 5. The product inlet 4 is located in a lower section of the chamber 3 and the product outlet 5 is located in an upper section of the chamber 3.

[0044] A domed shaped disc 6 is fixedly arranged in a bottom 7 of the chamber 3 below the product inlet 4. The disc 6 has a diameter that is slightly smaller than an inner diameter of an inner wall 8 in the lower section of the chamber 3, such that a gap 9 is created between an outer edge 10 of the disc 6 and the inner wall 8 of the chamber 3. As the disc 6 is has a domed shape, a thickness of the disc 6 is decreasing radially from a mid-section 11 of the disc 6 towards the outer edge 10 of the disc 6. The outer edge 10 of the disc 6 is preferably at least partly rounded for manufacturing purposes and structural strength. The rounded shape of the outer edge 10 of the disc 6 makes it possible to avoid welded corner joints which highly contributes to an increase structural strength of the disc 6. The radius of the rounded outer edge is preferably 50 mm or more. Naturally, the exact size and shape of the disc 6 may be varied. The disc 6 can have a domed shape or for example straight upper surfaces where the thickness of the disc 6 is decreasing radially from a mid-section 11 of the disc 6 towards the outer edge 10 of the disc 6. In this specific embodiment, the disc 5 has a domed shape with a diameter of approximately 3200 mm, maximum height - at the mid-section 11 - of approximately 600 mm, and a minimum height - at the outer edge 10 - of approximately 300 mm.

[0045] A primary air inlet 12 is arranged below the chamber 3 and arranged to provide air into the chamber 3 via the gap 9. The disc 6 comprises protrusions 25 along its outer periphery. The protrusions 25 are illustrated in Fig. 3 and are formed to direct air from the primary air inlet 12 to enter the chamber 3 via the gap 9 in a substantially vertical direction.

[0046] The flash dryer 1 further comprises a drive unit 13 arranged below the chamber 3 which has a drive shaft 14 extending through a hole 15 in the mid-section 11 of the disc 6 into the lower section of the chamber 3.

[0047] A rotatable shovel arm 16 is connected to the drive shaft 14 directly above the disc 6 in the lower section of the chamber 3. The shovel arm 16 rotates above the disc 6 and is used to push the product 2 towards the gap 9 and the air flowing into the chamber 3 therefrom. In a bottom section 17 of the shovel arm 16 is provided a plurality of recesses allowing parts of product 2 located on the disc to escape therethrough. The recesses is used minimize the torque of the shovel arm 16 when distributing the product 2 present on the disc 6. More specifically, the shovel arm 16 comprises a first portion which is flat and extends horizontally from the drive shaft 14 towards

the inner wall 8 of the chamber 3, a second portion, comprising the recesses, which also is flat and extends perpendicular from the first portion vertically in a downward direction towards the disc 6, and a wing portion attached to the first portion at an outer edge thereof. The second portion is preferably shaped to correspond with the shape of the domed shaped of the disc 6 thereby nearly engaging with the disc 6. The wing portion is vertically aligned with the product outlet 5 such that the product 2 fed into the chamber 3 can be cut into pieces by means of the wing portion.

[0048] A plurality of rotatable disintegrator elements 23 is connected to the drive shaft 14 directly above the shovel arm 16 in the lower section of the chamber 3. The disintegrator elements 23 are vertically aligned with the location of the product inlet 4. Each one of the disintegrator elements 23 comprises a grinding edge 24 which is used to grind and/or disintegrate the product 2 towards the inner wall 8 of the chamber 3. The grinding edge 24 is replaceable and can be turn over in any suitable position. The shape, extent and number of disintegrator elements 23 may naturally be varied in any suitable way. They can be mounted in different angles in relation to each other, they can be displaced at a specific distance from each other, and they can be mounted in a cross or to overlap. By the different mounting possibilities of the disintegrator elements 23 to the drive shaft 14 any desired type of disintegration and/or grinding results can be achieved. In this specific embodiment, the disintegrator elements 23 extends more or less from the drive shaft 14 towards the inner wall 8 of the chamber 3 in a tapering manner with the grinding edge 24 provided on the outermost edge thereof.

[0049] A secondary air inlet 26 is arranged in the lower section of the chamber 3 above the disintegrator elements 23. The secondary air inlet 26 comprises an outer air inlet 27 and a plurality of inner air inlets 28 providing air into the chamber 3. The inner air inlets 28 are arranged along the entire periphery of the chamber 3 in a substantially tangential direction to create circular flow along the inner wall 8 of the chamber 3.

[0050] The lower section of the chamber 3 comprises protrusions 29 arranged at a distance from each other along the entire periphery of the inner wall 8 of the chamber 3. Each one of the protrusions 29 comprises an exchangeable cutting edge. The protrusions 29 are vertically aligned with the disintegrator element 23 such that the product 2 can be grinded and/or disintegrated between the grinding edges 24 of the disintegrator elements 23 and the cutting edges of the protrusions 29. The exchangeable cutting edge of the protrusion 29 can be placed in different positions in order to adjust the distance between themselves and the grinding edges 24 of the disintegrator elements 23.

[0051] The flash dryer 1 comprises a first conduit 30 extending axially inside the drive shaft 14 into the chamber 3 which is adapted to provide a suspension or fluid 31 into the lower section of the chamber 3. The first con-

duit 30 extends from below the chamber 3, through the drive shaft 14 and into the chamber 3 in its lower section.

[0052] Distributing means 32 are connected to the first conduit 30 in the lower section of the chamber 3. More specifically, the distributing means 32 is arranged at a top portion 33 of the drive shaft 14 in the lower section of the chamber 3. In this specific embodiment, the distributing means 32 comprises a chamber 36 to which a plurality of nozzles 34 are connected at a predetermined distance from each other and arranged to evenly distribute the suspension or fluid 31 in the lower section of the chamber 3. The nozzles 34 provided onto the outer end of each conduit which are directed towards the product 2 located in the most intense drying zone in the chamber 3, which is located in the lower section thereof. Naturally, as shown in Fig. 4 to 6, the amount, size and shape of the distributing means 32 and the nozzles 34 can be varied in any suitable way. It is, however, important that they are shaped to direct the suspension or fluid 31 provided therethrough towards the location in the chamber where most of the semi-dried product 2 is positioned. This is to make sure that the suspension or fluid 31 can attach to or bond with the semi-dried product 2 in its initial drying stage, which in turn will carry the suspension or fluid 31, while drying and evaporating the same, from the lower section of the chamber 3 to an upper section thereof, and finally out through the product outlet 5 together with the dry product 2.

[0053] Naturally, as shown in Fig. 4, also this embodiment can be equipped with a second conduit 35 arranged either coaxially or parallel with the first conduit 30, which second conduit 35 is adapted to provide air, steam or further (or another) suspension or fluid to the lower section of the chamber 3.

[0054] It is important to understand that the different method steps may be conducted in any suitable order and that the detailed description of the method presented above is of exemplary nature only.

[0055] The skilled person realizes that a number of modifications of the embodiments described herein are possible without departing from the scope of the invention, which is defined in the appended claims.

[0056] For instance, the flash dryer 1 can be equipped with a CIP-system comprising pop-in-pop-out (PIPO) nozzles which are activated by means of pressure in order to clean the inner surfaces of the flash dryer 1 that are in contact with the product 2 inside the chamber 3.

[0057] The disc 6 can be filled with an insulating material, preferably a non-inflammable, such as vermiculite, in order to increase the isolating properties of the disc 6 and limit the heat transfer in a downward direction of the flash dryer 1.

[0058] The disc 6 can be placed in the bottom 7 of the chamber 8 or in fact constitute the bottom 7 of the chamber 3.

[0059] The distributing means 32 can be varied in any suitable way. It can for example contain the chamber 36 only with holes provided therein and thus without any

nozzles or conduits (see Fig. 6). Another example, is nozzles connected directly to the holes described above.

[0060] The distributing means 32 can include one or several conduits only or one or several conduits with a nozzle connected thereto.

Claims

1. A flash dryer (1) for drying a product (2), comprising:
 - a chamber (3) having a product inlet (4) and a product outlet (5),
 - a drive unit (13) arranged below the chamber (3) having a drive shaft (14) extending through a hole (15) in a bottom of the chamber (3) into the lower section of the chamber (3),
 - at least one rotatable disintegrator element (23) connected to the drive shaft (14) in the lower section of the chamber (3),
 - an air inlet (12) connected to the lower section of the chamber (3) and adapted to provide air into the chamber (3) to dry the product (2),
 - characterised by**
 - a first conduit (30) extending axially inside the drive shaft (14) into the chamber (3) and adapted to provide a suspension or fluid (31) into the lower section of the chamber (3).
2. The flash dryer (1) according to claim 1, further comprising distributing means (32) connected to the first conduit (30) in the lower section of the chamber (3).
3. The flash dryer (1) according to claim 2, wherein the distributing means (32) is arranged at a top portion (33) of the drive shaft (14) in the lower section of the chamber (3).
4. The flash dryer (1) according to claim 2 or 3, wherein the distributing means (32) comprises a plurality of nozzles (34) arranged to distribute the suspension or fluid (31) in the lower section of the chamber (3).
5. The flash dryer (1) according to anyone of the preceding claims, further comprising a second conduit (35) extending through the drive shaft (14) and adapted to provide air, steam or further (or another) suspension or fluid to the lower section of the chamber (3).
6. The flash dryer (1) according to claim 5, wherein the second conduit (35) extends coaxially with the first conduit (30) through the drive shaft (14).
7. The flash dryer (1) according to claim 5 or 6 when dependent on claim 4, wherein each one of the plurality of nozzles (34) is constituted by a spray-injection nozzle which is adapted to provide a mix of sus-

pension or fluid (31) and air, steam or further (or another) suspension or fluid into the lower section of the chamber (3).

8. The flash dryer (1) according to anyone of the preceding claims, further comprising a disc (6) fixedly arranged in the lower section of the chamber (3) below the product inlet (4), such that a gap (9) is created between an outer edge (10) of the disc (6) and an inner wall (8) of the chamber (3). 5
9. The flash dryer (1) according to claim 8, wherein the air inlet (12) is arranged below the chamber (3) and arranged to provide air into the chamber (3) via the gap (9). 10
10. The flash dryer (1) according to claim 8 or 9 when dependent on claim 2, wherein the distributing means (32) is arranged to direct the suspension or fluid (31) towards the most intense drying zone above the gap (9). 15
11. The flash dryer (1) according to anyone of the preceding claims, further comprising a rotatable shovel arm (16) connected to the drive shaft (14) in the lower section of the chamber (3) below the plurality of disintegrator elements (23), wherein the shovel arm (16) is adapted to distribute the product (2) in the lower section of the chamber (3). 20
12. A method for drying a product (2) in a flash dryer (1), comprising:
optionally, introducing a solid fraction of the product into a chamber (3) of the flash dryer (1) via a product inlet (4) located in a lower section of the chamber (3), 25
providing a suspension or fluid into a lower section of the chamber (3) from a first conduit (30) extending axially inside a drive shaft (14) into the chamber (3), 30
rotating at least one rotatable disintegrator element (23) in the lower section of the chamber (3), to disintegrate the product, by means of a drive shaft (14) extending through a hole (15) in a bottom of the chamber (3) into the lower section of the chamber (3), 35
providing air into the chamber (3) from an air inlet (12) connected to the lower section of the chamber (3) to dry the product, and 40
exiting the dried product (2) via a product outlet (5) in an upper section of the chamber (3). 45
13. The method according to claim 12, further comprising the step of directing the suspension or fluid (31) in the lower section of the chamber (3) by means of distributing means (32) connected to the first conduit (30). 50

14. The method according to claim 12 or 13, further comprising the step of providing air, steam or further (or another) suspension or fluid into the lower section of the chamber (3) from a second conduit (35) extending through the drive shaft (14). 5

15. The method according to claim 14, further comprising the step of directing the air, steam or further (or another) suspension or fluid in the lower section of the chamber (3) by means of distributing means (28) connected to the second conduit (35). 10

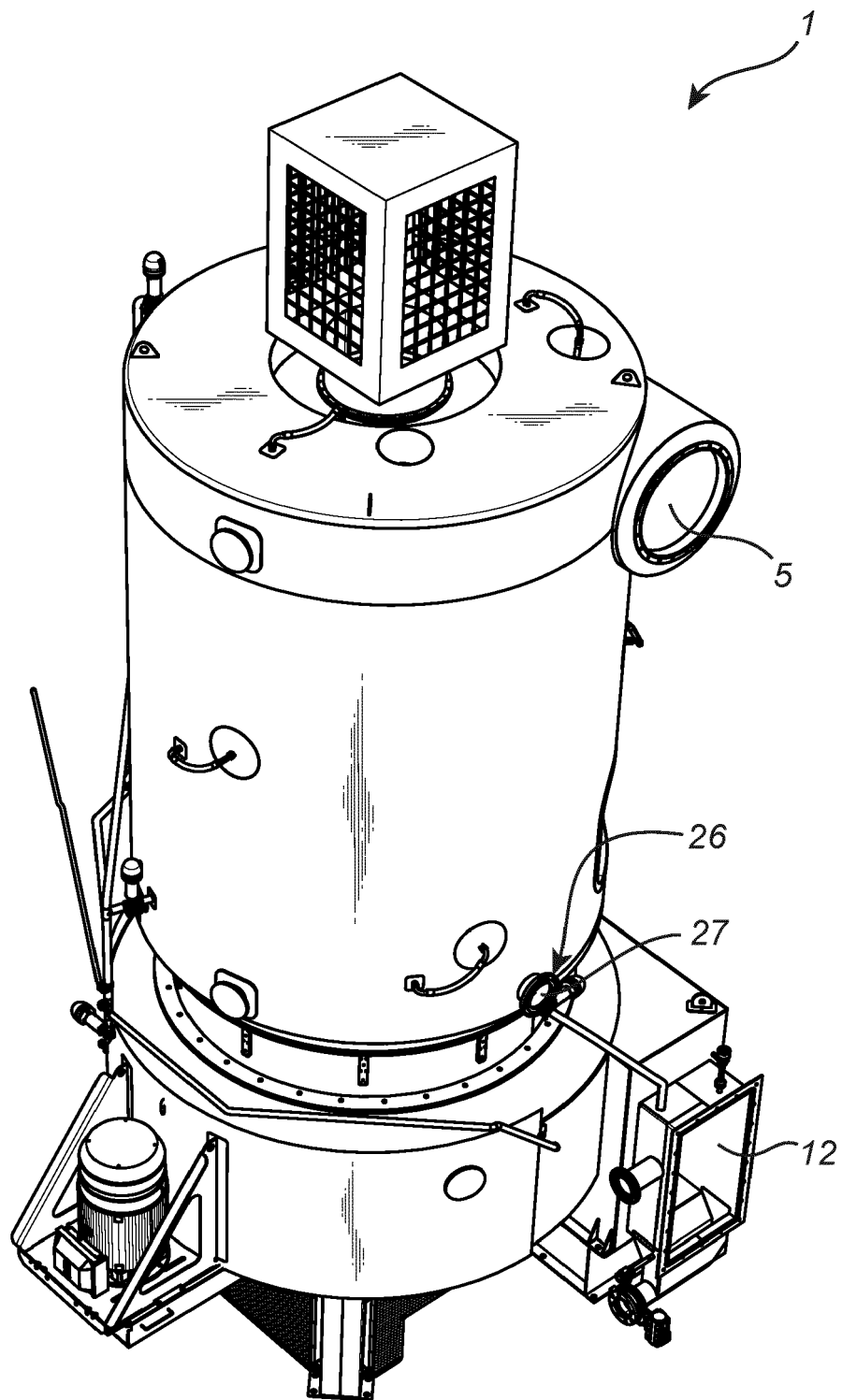


Fig. 1

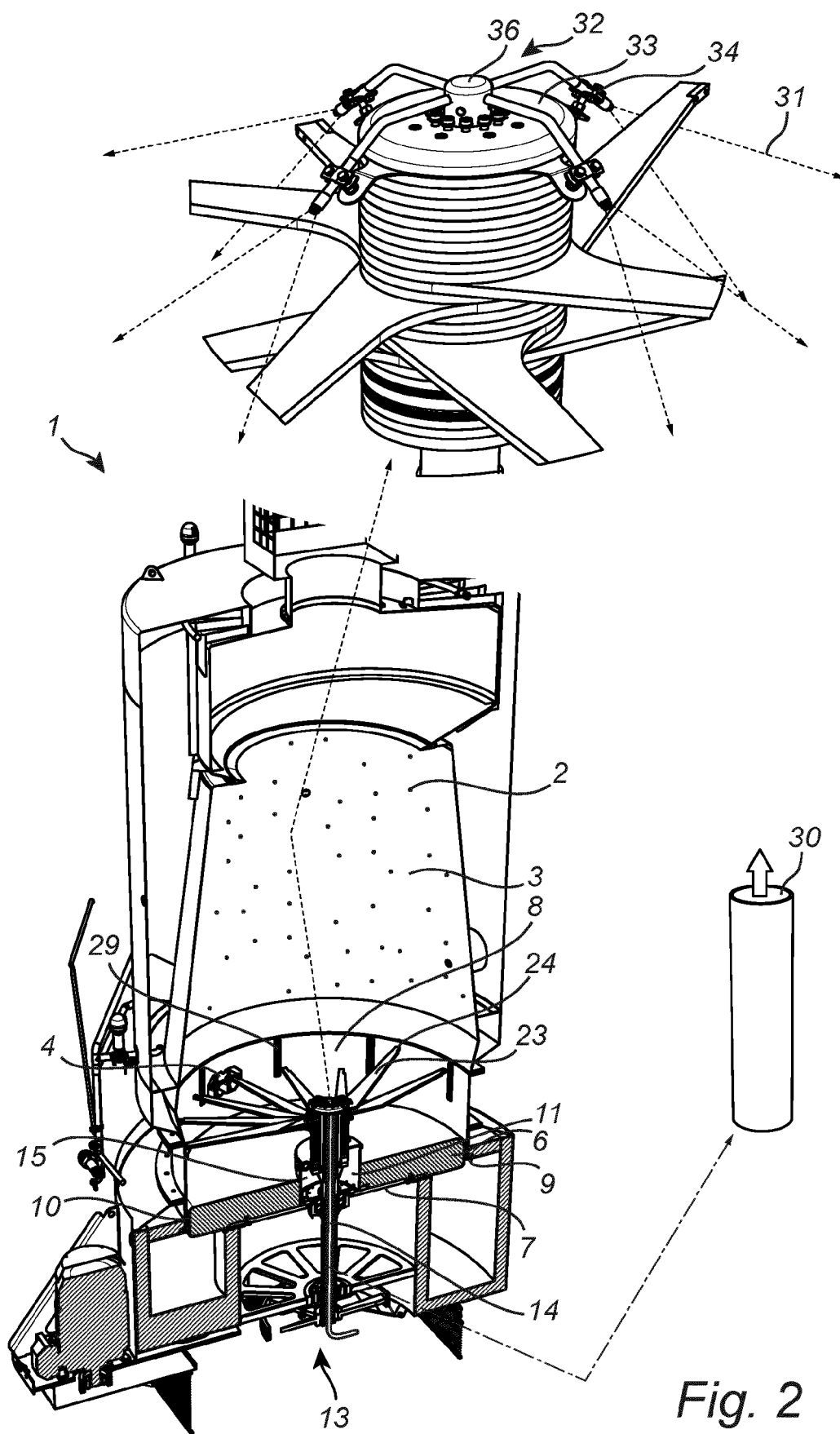


Fig. 2

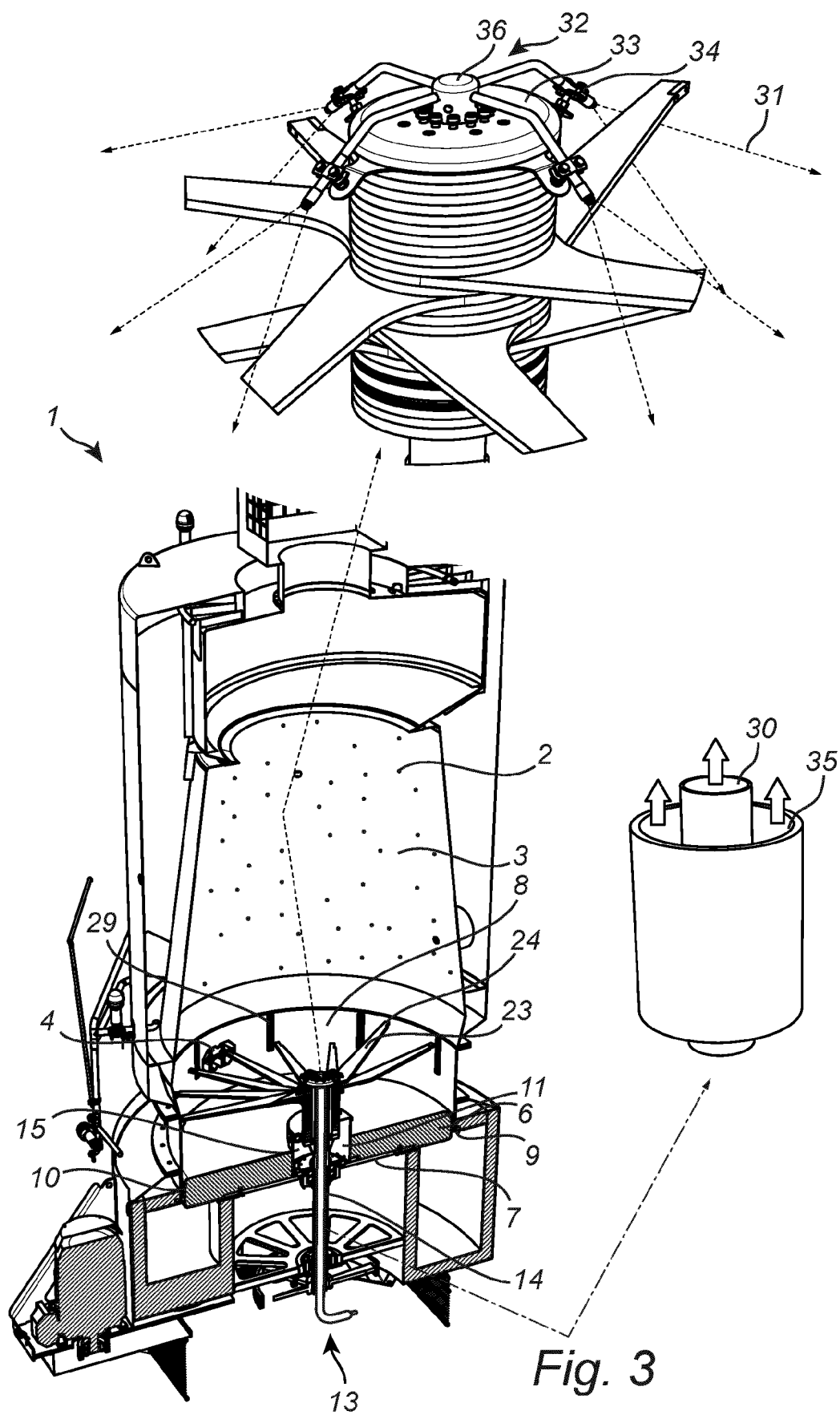


Fig. 3

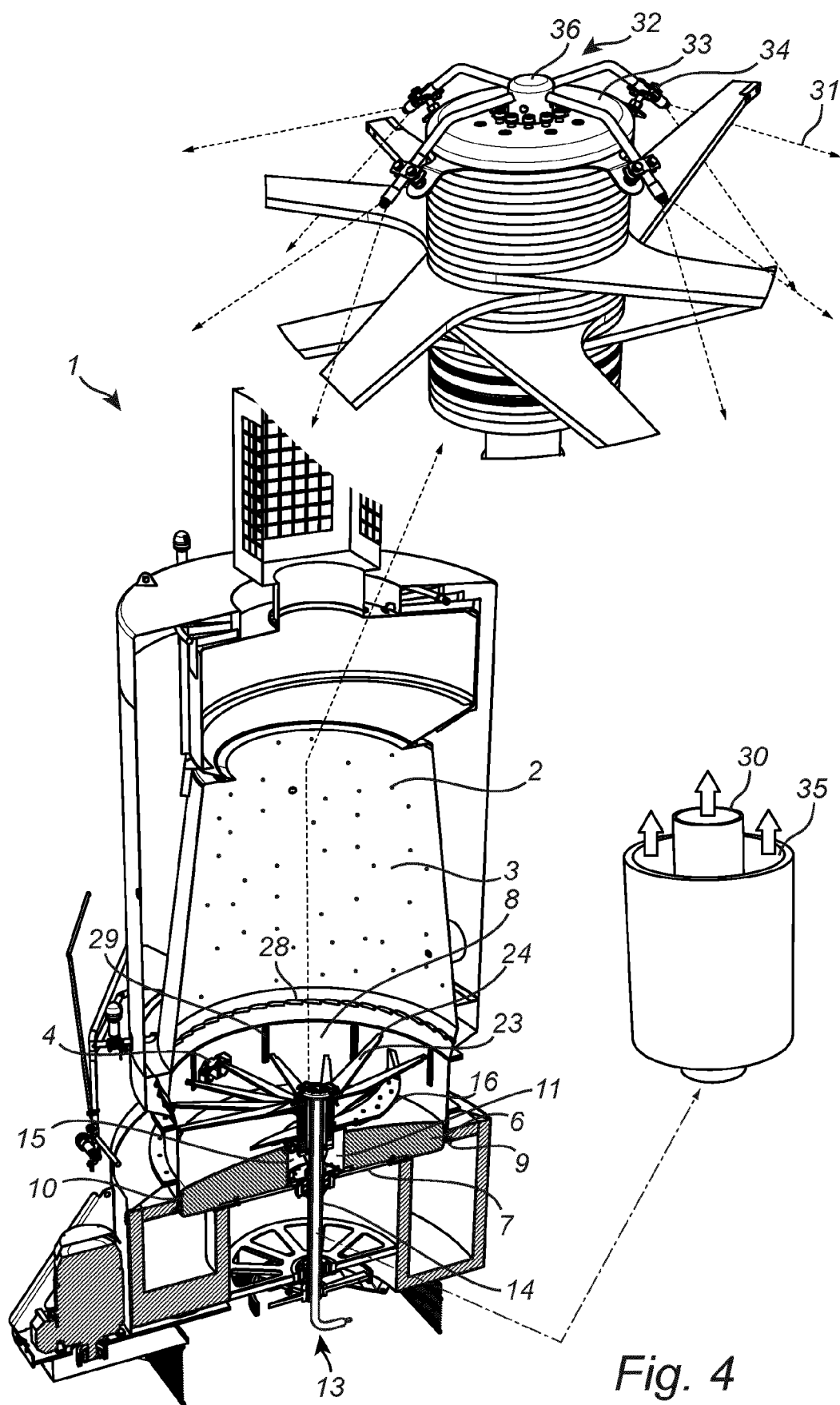


Fig. 4

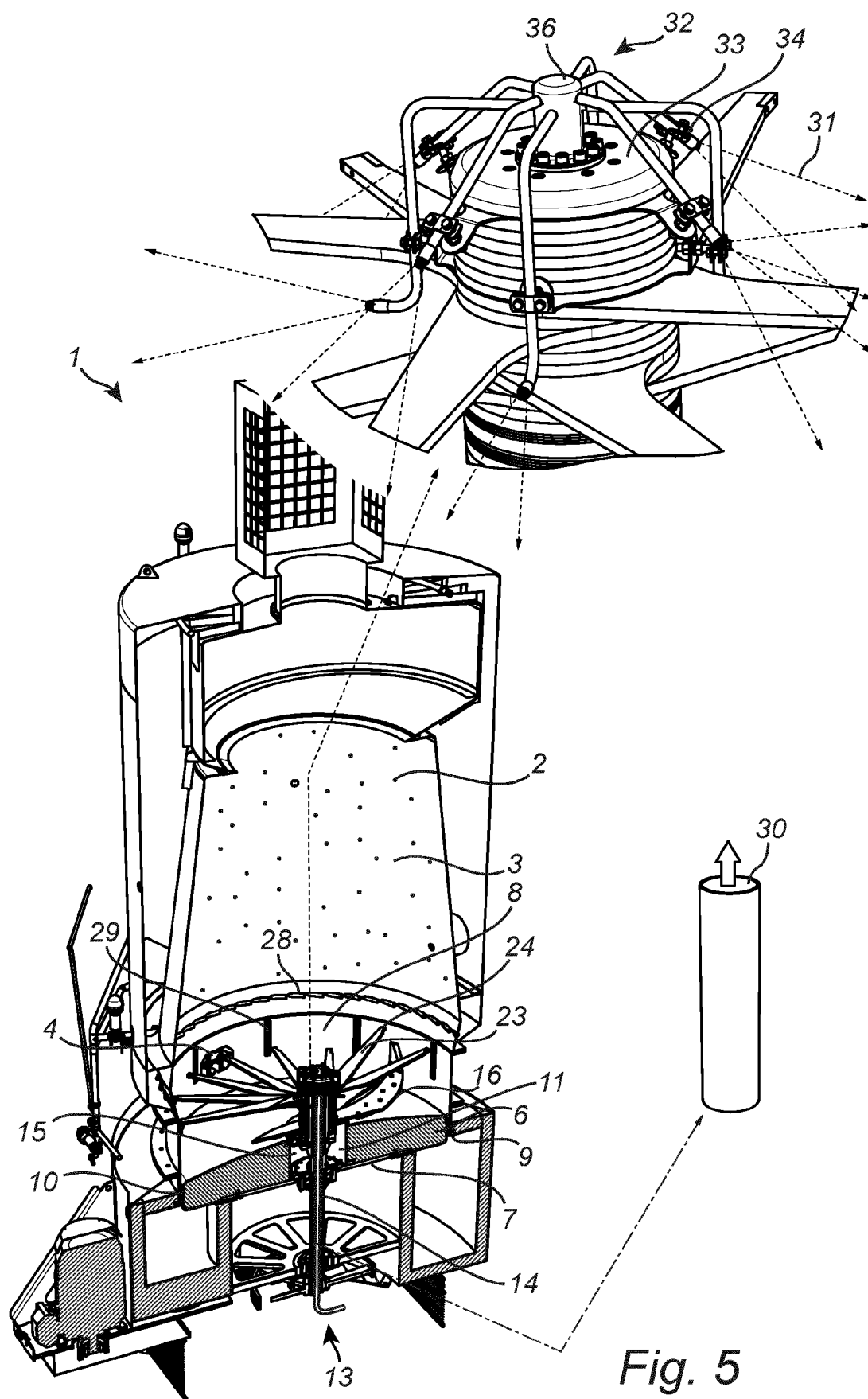


Fig. 5

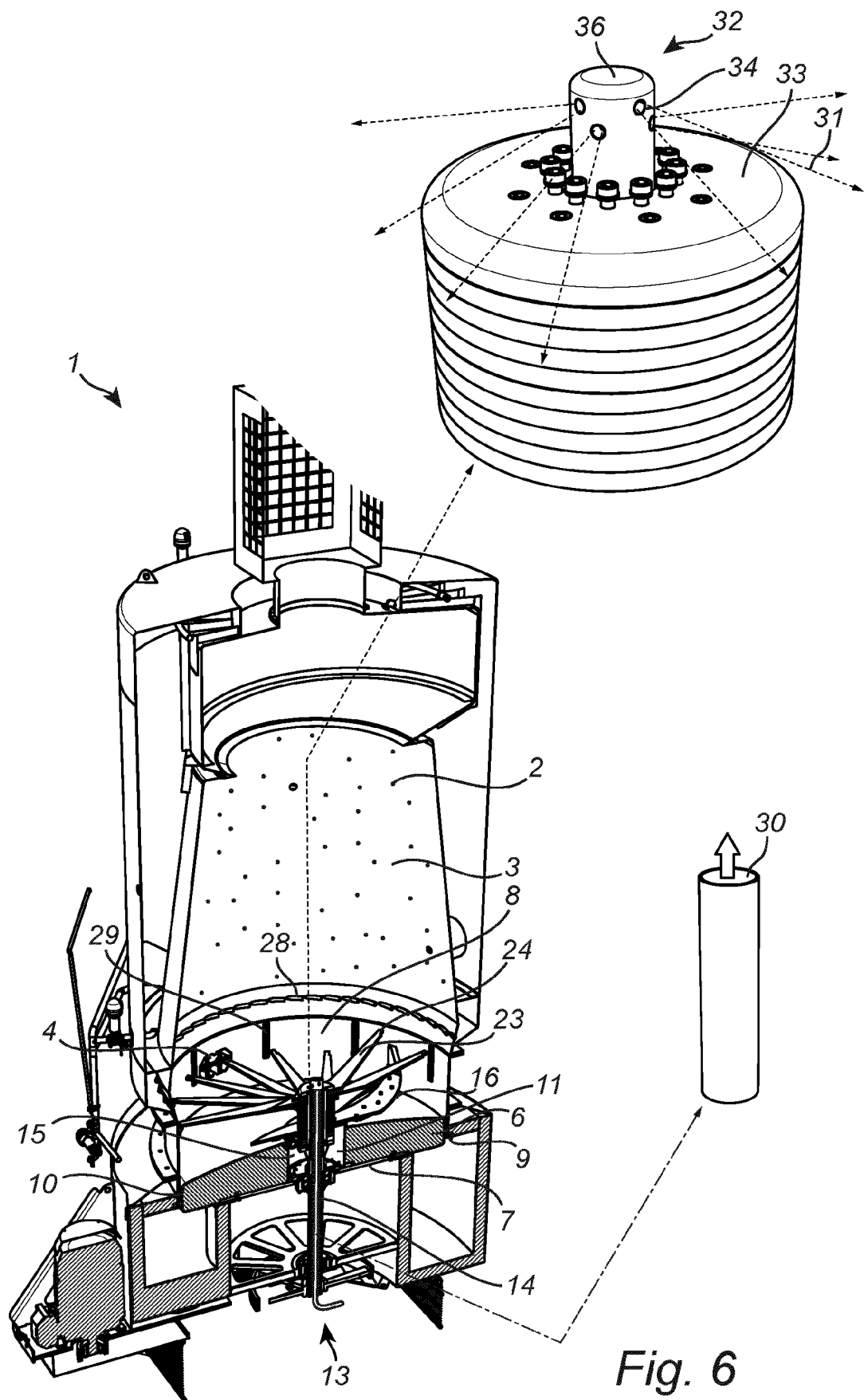


Fig. 6



EUROPEAN SEARCH REPORT

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 4 February 2022	Examiner Villar Fernández, R
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			



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CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing claims for which payment was due.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☒ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

1-7, 12-15

☐ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

☐ The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).

**LACK OF UNITY OF INVENTION
SHEET B**

Application Number

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The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 2-4, 13 (completely); 1, 12 (partially)

Flash dryer comprising fluid distribution means

2. claims: 5-7, 14, 15 (completely); 1, 12 (partially)

Flash dryer comprising two fluid conduits

3. claims: 8-10 (completely); 1, 12 (partially)

Flash dryer comprising a disc defining a gap with the chamber wall

4. claims: 11 (completely); 1, 12 (partially)

Flash dryer comprising a shovel arm

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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