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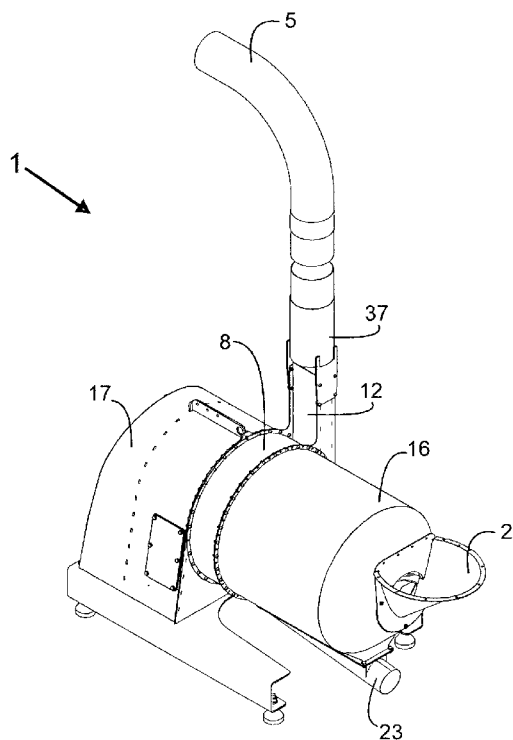


FIG. 1

(57) Abstract: The present invention relates to a centrifugal machine (1) for drying granular solid materials, comprising a hopper (2), a centrifuging mechanism (3), associated to the hopper (2), provided with a rotary helical device (6) enabling the transport of the granular solid materials. Said centrifuging mechanism (3) is also provided with a perforated rotary piece (7), surrounding the rotary helical device (6) configured to remove, by centrifugal force, free liquids adhered to the surface of the granular solid materials. Additionally, the machine (1) comprises a solid outlet duct (5) and a solid collecting chamber (8), arranged between the centrifuging mechanism (3) and the solid outlet duct (5), capable of receiving the centrifuging granular solid materials from the rotary piece (7). The solid collecting chamber (8) is provided with a solid conducting rotor (9), which comprises radial blades (10) configured to push the granular solid materials and impart an increase in tangential velocity to them. The rotary helical device (6) and the rotary piece (7) are configured to allow adjustments of angular velocity.

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A CENTRIFUGAL MACHINE FOR DRYING GRANULAR SOLID MATERIALS

Technical field of the invention

The present invention relates to a centrifugal machine for solid materials with granular characteristics, which aggregates the function of carrying them in a reliable, safe and effective manner. Particularly, the present invention relates to a compact centrifugal machine of continuous flow, capable of removing liquids from granular solid materials, as well as of carrying the previously centrifuged materials in directions, distances and heights configured according to the demand for application, further preventing damages thereof, without impairing the efficacy of the centrifuging process.

Description of the Prior Art

Coffee beans are the type of granular solid material consisting of one of the main products of the world agribusiness. For this reason, one constantly looks for technique and solutions capable of reducing production costs and that, in addition, provides a final product of high quality and which meets the requirements for export.

In this regard, one of the main factors that influence the quality of coffee is the way of handling/treating it in the processing that follows harvest, chiefly at the drying step, which consists in evaporating the moisture present on the exposed surface of the coffee beans. It should be noted that coffee growing has post-harvest steps that cause the coffee beans to pass through a moist route initially.

Thus, drying is a quite important step in the process of treating coffee beans, in order to obtain a final product of high quality, since the ripe coffee beans are highly perishable due to the conditions of high moisture at harvest time. If the coffee beans are kept under conditions of high moisture for a given period of time, fungi begin to develop on the surface of the beans, which, coupled to the increase in respiration rate and temperature rise, will lead to fermentation. So, important characteristics of coffee such as aroma and taste deteriorate, that is, the quality of the final product is significantly affected.

Usually, the drying of coffee beans is carried out manually, in house yards, such as trodden-earth, cement or asphalt floor. However, this method is susceptible to weather variations, which may impair its efficacy, since at low temperatures and/or on a high level of moisture the drying time increases, causing damages to the coffee-growers. Besides, the drying on trodden-earth yards usually requires a relatively long time for carrying out the process and further requires large areas for building them. Additionally, it is also necessary to hire labor for conducting the drying process. Such factors contribute decisively to enriching the final product.

On the other hand, there are already a few techniques used for reducing the time it takes to remove water from the surface of the coffee beans, through automated machines such as mechanical dryers or similar equipment.

For instance, Brazilian patent application PI 0201900-0 describes a machine intended for removing excess water from the surface of the coffee beans by the principle of evaporation, by means of a forced hot-air stream capable of passing through the layer of grains that float on a perforated surface.

Another known automated solution for drying coffee beans is centrifugation, which consists of a technique based on the application of a centripetal force that is greater than gravity and can be increased by raising the rotation velocity. Centrifugation is a technique often used in the industries for separating solid from liquid, liquid from gaseous or still for separating two types of liquids.

For instance, Brazilian patent application PI 0304448-3 relates to a centrifuge capable of removing surface water and/or coffee-been wash water. Such a centrifuge comprises a drum with the shape of a horizontal truncated cone, constituted by a perforated metal plate, the rotation of which is controlled. This centrifuge has the limitation that it is not possible to control exactly the residence time of the product und centrifugation effect. Besides, the effectiveness of its functioning depends directly on the beans having good rolling characteristics, since they should roll inside the cone trunk until

they reach the outlet without the aid of any specific device. Since the coffee beans not always have good rolling characteristic, there is a non-negligible chance of clogging the centrifugal machine, which restricts the use thereof to a limited range of granular materials, namely: those that have a rounded shape and greater rigidity.

Patent application PI 0502946-5 describes a centrifugal machine for coffee beans, provided with a vertical axle having a lower portion with an inlet for the coffee beans, which in turn are carried to an upper portion of the vertical axle by means of two endless screws that rotate in clockwise and counterclockwise direction. In addition, the centrifuge has a cylindrical sieve capable of permitting the liquid phase of the centrifuged material to come out, which involves the endless screws. Additionally, the centrifuge further comprises a cylinder that involves the cylindrical sieve to lead the liquid out of the machine. It should be noted that the rising flow of coffee beans in this machine is forced by the action of the endless screws from the bottom of the machine to its top, which generates an excess pressure on the coffee beans, resulting in a significant percentage of damaged grains. For this reason, it is recommended in the specification of this application that moderate rotation be adopted in order to balance the benefit of removing surface water with a lower percentage of damaged beans, which naturally impairs the efficacy of the machine.

Therefore, the presently known centrifugal machines are not capable of meeting satisfactorily all the requirements of coffee growing, so as to enable the replacement of manual methods that are still often used at present. In other words, there is a demand for technologies that are capable of optimizing the process of drying coffee beans, in order to increase the production scale, while maintaining the quality of the product, coupled with a relatively low cost.

Objectives of the Invention

The objectives of the present invention consist in providing an automated machine, capable of providing drying of the surface of granular solid materials (for example, coffee beans), in an automated and optimized manner,

in order to provide higher output, effectiveness and rapid processing, compatible with a great production scale demand.

Besides, the objectives of the invention further consist in providing an automated machine, capable of providing drying of surface of granular solid materials (for example coffee beans), having a compact constructive arrangement, exhibiting easy and simple installation and integration with the other equipment/machines/devices involved in the process of treating and handling these granulated solid materials.

Additionally, the objectives of the present invention consist in providing a machine capable of removing surface liquids from granular solid materials (for example, coffee beans), as well as carrying such materials previously centrifuged in multiple directions, distances and heights configurable according to the demand for application.

Further, the objectives of the present invention consist in providing a machine capable of removing liquids from the surface of granular solid materials, as well as carrying such previously centrifuged materials so as to prevent or minimize damage to them, thus eliminating or minimizing waste without impairing the output, efficacy and processing speed.

Brief Description of the Invention

A first way to achieve one or more of the objectives of the present invention is through a centrifugal machine for granulate solid materials, which comprises at least one hopper capable of enabling the entry of the granular solid materials. Besides, the centrifugal machine also comprises at least one centrifuging mechanism associated to the hopper, provided with at least one rotary helical device capable of enabling the transport of the granular solid materials. Such a centrifuging mechanism is further provided with a perforated rotary piece, which involves the rotary helical device externally. Said rotary piece is configured to remove by centrifugal force free liquids adhered to the surface of the granular solid materials. Additionally, the centrifugal machine comprises at least one outlet duct for solids, associated to the centrifuging mechanism, capable of enabling the centrifuged granular solid materials to come out. Further, the centrifugal machine comprises at least

one solid collecting chamber, arranged between the centrifuging mechanism and the outlet duct for solids, capable of receiving the centrifuged granular solid materials from the rotary piece. Said solid collecting chamber is provided with a solid conducting rotor, which comprises radial blades configured to pull the granular solid materials and impart a tangential increase in velocity to them.

A second way of achieving one or more of the objectives of the present invention is through a centrifugal machine for granulate solid materials, which comprises at least one hopper capable of enabling the entry of the granular solid materials. Besides, the centrifugal machine also comprises at least one centrifuging mechanism associated to the hopper, provided with at least one rotary helical device capable of enabling the transport of the granular solid materials. Such a centrifuging mechanism is further provided with a perforated rotary piece, which involves the rotary helical device externally. Said rotary piece is configured to remove by centrifugal force free liquids adhered to the surface of the granular solid materials. Additionally, the centrifugal machine comprises at least one outlet duct for solids, associated to the centrifuging mechanism, capable of enabling the centrifuged granular solid materials to come out. Further, the centrifugal machine comprises at least one driving mechanism, associated to the centrifuging mechanism, capable of enabling rotation of the rotary helical device and of the rotary piece around their central axis. Additionally, the centrifugal machine comprises at least one main chassis capable of housing the driving mechanism. Besides, the centrifugal machine comprises a set of bearings arranged inside the main chassis, capable of enabling support of the centrifuging mechanism.

A third way of achieving objectives of the present invention is through a centrifugal machine for granulate solid materials, which comprises at least one hopper capable of enabling the entry of the granular solid materials. Besides, the centrifugal machine also comprises at least one centrifuging mechanism associated to the hopper, provided with at least one rotary helical device capable of enabling the transport of the granular solid materials. Such a centrifuging mechanism is further provided with a perforated

rotary piece, which involves the rotary helical device externally. Said rotary piece is configured to remove by centrifugal force free liquids adhered to the surface of the granular solid materials. Additionally, the centrifugal machine comprises at least one outlet duct for solids, associated to the centrifuging mechanism, capable of enabling the centrifuged granular solid materials to come out. Further, the centrifugal machine comprises at least one driving mechanism, associated to the centrifuging mechanism, capable of enabling rotation of the rotary helical device and of the rotary piece. Said rotary helical device is associated to the driving mechanism by means of a first central axle comprised by the centrifugal machine. Said rotary piece is associated to the driving mechanism by means of a second central axle, also comprised by the centrifugal machine, arranged internally and concentrically with the first central axle. The first central axle and the second central axle are turnable by the driving mechanism independently of each other, the driving mechanism being configured to provide a specific angular velocity adjustment for the rotary helical device around its central axis through the first central axis; and further configured to provide specific angular velocity adjustment for the rotary piece around its central axis through the second central axle.

Brief Description of the Drawings

The present invention will now be described in greater detail with reference to the attached drawings, in which:

- Figure 1 represents a perspective view of a centrifugal machine for granular solid materials according to a preferred embodiment of the present invention;
- Figure 2 represents an exploded view of the machine illustrated in figure 1;
- Figure 3 represents a perspective view of a solid conducting rotor of the machine illustrated in Figure 1;
- Figure 4 represents a perspective view of an internal portion of a main chassis of the machine illustrated in Figure 1, pointing out a fixation panel;
- Figure 5 represents a perspective view of a sub-assembly of a

transmission mechanism of the machine illustrated in Figure 1;

- Figure 6 represents an exploded view of the sub-assembly illustrated in Figure 5;

- Figure 7 represents a side view of an assembled sub-assembly of the machine illustrated in Figure 1, which comprises the centrifugation mechanism, a support and a portion of the transmission mechanism;

- Figure 8 represents an exploded view of the sub-assembly illustrated in Figure 7;

- Figure 9 represents a perspective front view of the centrifugation mechanism of the machine illustrated in figure 1;

- Figure 10 represents a side view of the centrifugation mechanism of the machine illustrated in figure 1;

- Figure 11 represents a perspective back view of the centrifugation mechanism of the machine illustrated in Figure 1;

- Figure 12 represents a perspective front view of the centrifugation mechanism of the machine illustrated in Figure 1, according to a partial section G-G in Figure 10;

- Figure 13 represents a side view of the centrifugation mechanism of the machine illustrated in Figure 1, according to the partial section G-G in Figure 10;

- Figure 14 represents a perspective back view of the centrifugation mechanism of the machine illustrated in Figure 1, according to the partial section G-G in Figure 10;

- Figure 15 represents an exploded view of the configuration mechanism of the machine illustrated in Figure 1 in sub-assemblies;

- Figure 16 represents an exploded view of the centrifugation mechanism of the machine illustrated in Figure 1 in parts and pieces;

- Figure 17 represents a side view of the set of helical devices of the centrifugation mechanism of the machine illustrated in Figure 1;

- Figure 18 represents a perspective back view of the set of helical devices of the centrifugation mechanism of the machine illustrated in Figure 1, according to the partial section M-M in Figure 17;

- Figure 19 represents a side view of the set of helical devices of the centrifugation mechanism of the machine illustrated in Figure 1, according to the partial section M-M in Figure 17;
- Figure 20 represents a perspective front view of the set of helical devices of the centrifugation mechanism of the machine illustrated in Figure 1, according to the partial section M-M in Figure 17;
- Figure 21 represents a side view of a mounted sub-assembly of the machine illustrated in Figure 1, which comprises a rotary conical chamber and a rotary cylinder;
- Figure 22 represents a perspective back view of the mounted sub-assembly of the machine illustrated in Figure 1, which comprises the rotary conical chamber and the rotary cylinder, according to the partial section J-J in Figure 21;
- Figure 23 represents a side view of the mounted sub-assembly of the machine illustrated in figure 1, which comprises the rotary conical chamber and the rotary cylinder, according to the partial section J-J in Figure 21;
- Figure 24 represents a perspective front view of the mounted sub-assembly of the machine illustrated in Figure 1, which corresponds the rotary conical chamber and the rotary cylinder, according to the partial section J-J in Figure 21;
- Figure 25 represents an exploded view of a sub-assembly formed by conducting ducts, one as outlet for solids, one duct as outlet for liquids, a solid collecting chamber, a liquid collecting chamber, a hopper, a support and a fixation panel;
- Figure 26 represents a side view of the machine illustrated in Figure 1, illustrating variations in position of its liquid pouring chute;
- Figure 27 represents a front view of the machine illustrated in Figure 1, illustrating variations in position of its solid collecting chamber;
- Figure 28 represents possible positions of installation and operation of the machine illustrated in Figure 1;
- Figure 29 represents a perspective partial view of the machine

illustrated in Figure 1, pointing out its internal portion; and

- Figure 30 represents a perspective view of the solid collecting chamber illustrated in Figure 1, pointing out its internal portion.

Detailed Description of the Invention

5 Figure 1 illustrates a perspective view of a centrifugal machine 1 for granular solid materials according to a preferred embodiment of the present invention. Such granular solid materials consist preferably of coffee beans. However, it should be understood that any types of solid materials with granular characteristic or behavior can be treated by the machine 1 of
10 the present invention, such as for example seeds, various vegetable bagasse, granular synthetic materials, bran, fibrous chips, pellicles, etc. As already mentioned before, in some applications it is desirable that these granular solid materials be free from moisture (liquid portion, arranged externally and/or permeating the solid material). Naturally, in order for this ideal condi-
15 tion to be achieved, it is necessary to use a technical solution capable of removing the moisture from the granular solid materials. In the present invention, this technical solution consists of the novel arrangement/embodiment of the centrifugal machine 1 illustrated in Figures 1 to 30.

 The machine 1 comprises at least one hopper 2 capable of
20 enabling the entry of the granular solid materials coming from any external source. This hopper 2 is preferably fixed to the machine 1 by a flange and can be easily replaced by other variants that will be suitable for the needs of each application. Besides, the hopper 2 is positioned at a reduced height (e.g. about 700 mm) with respect to the apparatus base, which facilitates its
25 connection with the external source, often preventing the need to raise the granular solid materials previously. In addition, the hopper 2 has a strong inclination to the inside of the machine 1, which prevents accumulation of rests of granular solid materials and the possible need to push them during or at the end of each service. Generally speaking, the hopper 2 has the shape
30 of an "inclined cone slice", the inclination in its central line being smaller, corresponding to about 40 geometrical degrees. In most of the hopper 2 the inclination increases gradually until it reaches about 80 geometric degrees. It is

important to note that the side of the machine 1, through which the granular solid materials to be centrifuged go in, is free from support elements, axles, bearings or transmission, which facilitates the approximation with external pieces of equipment, chiefly in reduced spaced.

5 As can be seen in Figures 2, 12, 13 and 14, the machine 1 also comprises at least one centrifuging mechanism 3, associated to the hopper 2, provided with at least one rotary helical device 6 capable of enabling the transport of the granular solid materials. Besides, the centrifuging mechanism 3 is provided with a rotary perforated piece 7, which involved the rotary heli-
10 cal device 6 externally. The rotary piece 7 may have a cylindrical shape, as shown in the drawings, or a slightly conical shape. It may also have the shape of a basket or revolving drum.

 The rotary cylinder 7 is configured to remove by centrifugal force free liquids adhered to the surface of the granular solid materials, providing
15 the centrifugation proper. Thus, the rotary cylinder 7 retains the solids, but allows the liquid to flow through its orifices. Preferably, the rotary helical device 6 is installed concentrically and tightly with respect to the rotary cylinder 7, which prevents the granular solid materials from being pressed and crushed by its movement. The rotary helical device 6 turns in the same direc-
20 tion as the rotary cylinder 7 and has the function of conducting, pushing and transporting the granular solid materials along an internal wall of the rotary cylinder 7 in a directional way. Besides, the rotary helical device 6 is provided with pitches that can be dimensioned according to the need and the type of granular solid material. For instance, for a given type, it may be necessary to
25 use a smaller or larger pitch, according to its characteristics, such as fragility/rusticity/light/heavy, sliding/rough, etc. – the use of a smaller pitch implies an increase in the residence type of the granular solid materials inside the rotary cylinder 7. Analogously, one may also alter the length of the rotary cy-
30 linder 7 according to the needs of each application – the use of a longer length implies an increase in the residence time of the granular solid materials inside the rotary cylinder 7.

 As shown in Figures 1, 2 and 25, the machine 1 also comprises

at least one outlet duct for solids 5, associated to the centrifuging mechanism 3, capable of enabling the centrifuged granular solid materials to come out.

Further according to figures 1, 2, 25, 29 and 30, the machine 1 also comprises at least one solid collecting chamber 8, arranged between the centrifuging mechanism 3 and the outlet duct for solids 5. Such a solid collecting chamber 8, capable of receiving the granular solid materials centrifuged from the rotary cylinder 7, is provided with a solid conducting rotor 9, which comprises radial blades 10 configured to push the granular solid material and impart to them an increase in tangential velocity, as can be seen in Figures 2 and 3. This increase in tangential velocity inside the solid collecting chamber 8 is also provided by the size of its radius, being larger with respect to the radius of the rotary cylinder 7 by about 10%. Thus, considering that the angular velocities of the granular solid materials in the solid collecting chamber and of the rotary cylinder 7 are substantially the same, the increase in tangential velocity is proportional to the increase of the radius of the solid collecting chamber 8, enabling a high processing capacity. It should be noted that the solid conducting rotor 9 is fixed to a back end of the rotary cylinder 7, so that said rotary cylinder 7 accounts for the rotation of the solid conducting rotor 9.

Preferably, the solid collecting chamber 8 comprises an inner wall provided with an end projection 11 substantially curved, capable of preventing damage to the granular solid materials upon rotation of the solid conducting rotor 9, as can be seen in Figure 30. Therefore, this specific configuration of the solid collecting chamber 8 guarantees the physical integrity of the granular solid material transported, unlike the centrifugal machines known at present. By virtue of this, one eliminates or minimizes waste without impairing the output, effectiveness and processing speed.

The machine 1 further comprises at least one solid conducting rotor 12, associated in a fixed manner to the solid collecting chamber 8 and to the solid outlet duct 5, and being arranged between these two elements. This solid conducting duct 12 is capable of leading centrifuged granular materials coming from the solid collecting chamber 8 to the solid outlet duct 5. It

should be noted that it is possible to implement connections, accessories and adapters of different types, sizes and shapes (rectangular, circular, etc.) between the solid conducting duct 12 and the solid outlet duct 5, in order to provide greater facility of fitting the pieces together and better integration of the machine 1 with the destination of the granular solid materials. The solid conducting duct 12, preferably constituted by a metallic material, is provided with side flanges 36 that can be fixed to the outlet of the solid collecting chamber 8. Besides, the solid conducting duct 12 is provided with a cylindrical sheath 37, the function of which is to receive the solid outlet duct 5, preferably constituted by PVC, snap-fitting. Said side flanges 36 support the cylindrical sheath 37 with some spacing from the outlet of the solid collecting chamber 8, so that the granular solid materials take a free flight in this segment. So, in case of a possible clogging of the solid outlet duct 5, the granular solid materials can be expelled through this opening, without clogging of the solid collecting chamber 8.

According to figures 1, 2, 25 and 29, the machine 1 also comprises at least one liquid collecting chamber 16, which involves the rotary cylinder 7 concentrically and externally. First, the solid collecting chamber 8 is rotary with respect to the liquid collecting chamber 16, so that this rotation enables the configuration of the angular position of the solid conducting duct 12 and of the solid outlet duct 5, as shown in Figure 27, thus providing greater versatility, flexibility of use and adaptability to the environment in which the machine 1 is installed. It should be noted that the angular variation of the assembly (solid conducting duct 12 and solid outlet duct 5) can reach up to 360 degrees with respect to the axis, having the composition illustrated in the project with capacity to reach 242 degrees. If the centrifuged solid granular materials depend on the direction angle of the solid outlet duct 5, they will follow a ballistic path in which they will reach the longest vertical or horizontal distance, in order to reach the next point of interest.

Figures 1, 2 and 25 show that the machine 1 also comprises at least one liquid-material outlet duct 23, associated to the liquid collecting chamber 16, capable of enabling drainage of the liquid resulting from the

centrifugation out of the machine 1. Preferably, the liquid material outlet duct 23 has an angular position that is configurable through the rotation of the liquid collecting chamber 16 with respect to the liquid collecting chamber 8. Preferably, the solid collecting chamber 8 supports the liquid collecting chamber 16 by means of its front flange 35, provided with a plurality of orifices arranged radially. In this way, the liquid collecting chamber 16 can be turned around its own axis to provide the best fixation position, which enables one to maintain the angular relationship between the solid collecting chamber 8 and the liquid collecting chamber 16 in their original configuration, regardless of the position chosen for the solid collecting chamber 8.

As can be seen in Figures 7 to 13, 16, 21 to 24, the machine 1 further comprises at least one rotary conical chamber 27, arranged between the hopper 2 and the rotary cylinder 7. The rotary conical chamber 27 is capable of receiving the granular solid materials coming from the hopper 2 and delivering them to the rotary cylinder 7. Figures 9, 12, 13, 22 to 24 illustrate the rotary conical chamber 27 provided with radial blades 13, also configured for providing an increase in tangential speed of the granular solid materials, so as to improve the processing capacity of the machine 1. These radial blades 13 are provided with projections configured with wedge shape, and such configuration can enable the retention of the granular solid materials inside the rotary conical chamber 27. Particularly, the angle of the edges of the radial blades 13 guides the incoming material always into the rotary conical chamber 27, not towards the outside. In this way, the radial blades 13 prevent the granular solid materials from being thrown out of the machine 1, so as to prevent waste.

The machine 1 further comprises a rotary front base-disc 14, arranged between the rotary conical chamber 27 and the rotary cylinder 7, as shown in figures 12, 18 and 20. This rotary front base disc 14 is provided with at least one passageway opening 15, capable of enabling flow of the granular solid materials. Preferably, the rotary front base disc 14 comprises a plurality of passageway openings 15.

It should be noted that the differential angular velocity between

the rotary front base disc 14 and the radial blades 13 is configurable so as to enable adjustment of the entry of the granular solid materials into the rotary cylinder 7. In other words, the rotary front base disc 14 and the radial blades 13 form an adjusting mechanism capable of enabling adjustment of the velocity of flow of the granular solid materials to be centrifuged. This adjustment is quite important, since it prevents a large amount of granular solid materials, larger than the processing capacity of the machine, from going into the rotary cylinder 7. Thus, in the event of excess material, said adjusting mechanism is capable of preventing overload of the machine 1, thus preventing clogging. In this regard, there is accumulation of granular solid materials close to the radial blades 13, rotary conical chamber 27 and rotary cylinder 7, which cannot be captured by the rotary helical device 6, because the rotary front base disc 14 has closed portions. With the difference in angular velocity between the rotary front base disc 14 and the radial blades 13, the granular solid materials pass through the passageway opening 15 and are captured by the rotary helical device 6, going into the rotary cylinder 7, the magnitude of opening of the passageway 15 will limit the entry of the granular solid materials. It should be pointed out that the processing capacity of the machine 1 is defined by the characteristics of its motor, mechanical resistance, among other factors.

Figure 2 illustrates a machine 1 that further comprises a driving mechanism 4, operatively associated to the centrifuging mechanism 3, configured to provide adjustment of angular velocities of the rotary helical device 6 and of the rotary cylinder 7 around their central axes, so as to enable controlled transport of the granular solid materials by the rotary cylinder 7.

As shown in Figures 7 to 20 and 29, the driving mechanism 4 is associated to the centrifuging mechanism 3 by means of a first central axle 20 comprised by the machine 1. More specifically, the first central axle 20 enables association of the rotary helical device 6 to the driving mechanism 4.

Preferably, the driving mechanism 4 comprises a motor, pulleys, gears, chains, belts and a secondary axle 28, operatively associated to each other. Such a secondary axle 28, shown in Figure 6, is configured to aid in

transmitting torque from said motor to the centrifuging mechanism 3. The driving mechanism 4 also comprises a protection box for the transmission 22, shown in Figure 29, which involves the above-mentioned transmission and driving elements. Further, as shown in Figure 5 and 6, the driving mechanism 4 also comprises a stabilizing bar 32 configured to stabilize ends of the second central axle 21 and of the secondary axle 28, so as to nullify the attraction forces between these axles, which will contribute to providing a compact machine having reduced dimensions.

It should be noted that the driving mechanism 4 is configured to provide adjustment of the specific angular velocity for the rotary helical device 6 around its central axis and adjustment of specific angular velocity for the rotary cylinder 7 around its central axis. Preferably, the driving mechanism 4 is configured to adjust the angular velocity of the rotary helical device 6 by a value higher than the angular velocity of the rotary cylinder 7. It should be noted that the high processing capacity of the machine 1 takes place with greater differentials between these velocities, since the factor that accounts for the separation of the liquid is the centrifugation force. The intensity of this centrifugal force influences directly the quality of the solid-liquid separation and its correct configuration provides low mechanical damage to the centrifuged material. For instance, if the centrifugal force is smaller than the attraction force of the liquid to the solid, no separation will take place. This happens with the portion of liquid that is closest to the surface of the granular solid material. On the other hand, exposing the granular solid materials to a too high pressure may damage their cells, especially upon impact of deceleration in a relatively short space. Anyway, if a given application requires transport by throwing the material to greater heights, one can adopt a greater centrifugal force. Control of the force can be made by implementing a frequency inverter or an asynchronous motor, varying the number of poles or still by modifying the transmission relationship between pulleys. For instance, when increasing the velocity of the motor or altering the pulley relationship without altering the relationship of gears, the rotation velocity of the secondary axle 28 will also increase. As a result, two effects are obtained, namely: a

greater centrifugal force and a shorter residence time of the granular solid materials under centrifugation, since the velocity of transport of the rotary helical device 6 increases as well.

Besides, the driving mechanism 4 also is configured to adjust the angular velocity of the rotary conical chamber 27 and the angular velocity of the rotary front base disc 14 at different values, to enable the adjustment of the flow of granular solid materials.

As shown in Figures 1, 2 and 3, the machine 1 further comprises a main chassis 17, capable of housing the driving mechanism 4. In addition, the machine 1 comprises a fixation panel 24, shown in figure 4, capable of separating the main chassis 17 from the solid collecting chamber 8. In figure 4, one can observe that the fixation panel 24 comprises a plurality of air-passage orifices 25, capable of alleviating the negative pressure inside the solid collecting chamber 8, thus increasing the air volume coming out together with the granular solid materials through the solid outlet duct 5, which minimizes the loss of velocity thereof due to aerodynamic friction inside the solid conducting duct 12. Additionally, the fixation panel 24 supports, from the flanging 34 with the solid collecting chamber 8, the whole collecting gears assembly formed by the solid collecting chamber 8 and by the liquid collecting chamber 16. For this reason, the need for other support points is dispensed with, which makes the machine 1 more compact and provides greater ease of approximation and integration between the source and the destination of the granular solid materials. Further, the fixation panel 24 is provided with threadable orifices 26, which, in combination with the flanging 34 of the solid collecting chamber 8, provides the capacity of turning and directing the solid outlet duct 5 in multiple directions, so as to provide high flexibility in integrating it with other pieces of equipment.

The machine 1 further comprises a liquid chute 33 arranged between the liquid collecting chamber 16 and the liquid outlet duct 23, as shown in figure 25. The liquid chute 33 has the function of canalizing the centrifuged liquids that are inside it and comes from the liquid collecting chamber 16. Such a liquid chute 33 can be moved angularly (figure 26), so as to enable

better integration with the environment in which the machine 1 is installed.

Further, the machine 1 comprises a bearing assembly 18, 19, arranged inside the main chassis 17, capable of enabling support of the centrifugation mechanism 3, as shown in figures 7, 8, and 29. Such a bearing assembly 18, 19 comprises first 18 and second 19 bearings fixed to the first central axle 20 to enable support of the centrifugation mechanism 3. More specifically, the first bearing 18 is positioned on the first central axle 20, adjacent the fixation panel 24. On the other hand, the second bearing 19 is positioned on the central axle 20, opposite the first bearing 18 and adjacent the transmission protection box 22 comprised by the driving mechanism 4.

The bearing assembly 18, 19 dispenses additional bearings and a specific support structure for the front portion of the machine 1, allowing free access to the hopper 2 and to the rotary conical chamber 27, so as to facilitate approximation and integration to the existing pieces of equipment, thus reducing installation costs.

According to figures 8 to 14, 16 and 29, the machine 1 further comprises a second central axle 21, capable of associating the rotary cylinder 7 to the driving mechanism 4. Such a central axle 21 is arranged inside and concentrically with the first central axle 20. Further according to figure 29, the second central axle 21 is mounted on roller bearings 29 arranged between the first central axle 20 and the second central axle 21. The second central axle 21 has a front end 30 which, in conjunction with the solid conducting rotor 9, serves as a support for the rotary cylinder 7. Thus, one of the functions of the roller bearings 29 is to enable the solid conducting rotor 9 to turn freely on the first central axle 20.

It should be noted that the first central axle 20 and the second central axle 21 are turnable by the driving mechanism 4 independently of each other.

The machine 1 also comprises a third bearing 31, shown in figure 29, positioned inside the solid collecting chamber 8. The third bearing 31 is fixed to the first central axle 20 and has the function of supporting the solid conducting rotor 9 and the rotary cylinder 7 that rest on each other. In other

words, the third bearing 31 is supported by the first central axle 20.

Thus, the present invention provides a continuous-flow centrifugal machine capable of removing liquids from the surface of granular solid materials in an efficient and controllable manner, which further aggregates, in an unheard-of manner, the function of multidirectional transporter, in order to enable transport of the centrifuged solid materials to variable heights and distances.

In addition, the present invention enables one to combine various parts of the machine 1 having different functionalities in the same light and compact assembly, namely: the rotary conical chamber 27 which accelerates the granular solid materials, the rotary cylinder 7, which separates them, the rotary helical device 6 which pulls them, and the solid conducting rotor 9, which provides the final thrust for throwing the centrifuged granular solid materials.

Additionally, the machine 1 of the present invention can be installed in multiple functions, as shown in figure 28, besides the horizontal position on the floor, which represents a great flexibility of use and adaptability to the environment in which is it installed, without impairing its efficiency in the centrifugation and transport process.

Further, the machine 1 of the present invention exhibits great capability of integration with the other external pieces of equipment that interacts with it, for example the piece of equipment that supplies (source) the granular solid materials to the machine 1 and the external piece of equipment that receives (destination) the granular solid materials from the machine 1. This integration capability results chiefly from the compact configuration of the machine 1, besides the optimized arrangement to support parts and internal pieces of the machine 1 and besides easy access to the inlet (hopper 2) and outlet (solid outlet duct 5) of the machine 1.

Finally, for better understanding of the functioning of the machine 1, we present below the operation steps carried out by it.

Centrifugation:

As already mentioned before, the material to be centrifuged by the

machine 1 is a mixture comprising a solid part having granular characteristic, and a liquid part, which is external and/or permeated by the solid part, depending on its characteristics. This material to be centrifuged is called "Incoming Material" to facilitate the reading, but it can be understood as being the granular solid material having moisture.

(i) The incoming material is received in the machine 1 by the hopper 2.

(ii) The incoming material flows through the hopper 2 wall by gravity into the rotary conical chamber 27.

(iii) In the rotary conical chamber 27, the incoming material is caught by the radial blades 13 and is accelerated, thus gaining tangential velocity.

(iv) The incoming material in tangential path is caught by the internal wall of the rotary conical chamber 27, on which it exerts a centrifugal force.

(v) The incoming material, under the action of the centrifugal force, then slides over the inclined surface of the rotary conical chamber 27.

(vi) The radial blades 13, welded onto the inner surface of the rotary conical chamber 27, again catch and accelerate the incoming material continuously, since as the radius of the rotary conical chamber 27 increases, the tangential velocity increases as well.

(vii) The incoming material slides over the inner wall of the rotary conical chamber 27 towards the junction with the rotary cylinder 7.

(viii) In an end portion of the rotary conical chamber 27, close to the rotary cylinder 7, the incoming material, especially the solid part thereof, fully accelerated, can be retained by a closed portion of the rotary front base disc 14. The rotary front base disc 14, associated to the rotary helical device 6, has rotation slightly higher than the rotary conical chamber 27, which in turn is associated to the rotary cylinder 7. As the rotary front base disc 14 turns at a higher rotation than the rotary conical chamber 27, the incoming material is not retained by the closed portion of the rotary front base disc 14 and finds its passageway opening 15, to go into the rotary cylinder 7. It

should be noted that the force required for moving the incoming material results also from the inclination of the end portion of the rotary conical chamber 27. This configuration enables the incoming material to be fully accelerated prior to going into the rotary cylinder 7, besides preventing a sudden overload of the incoming material from going into the rotary cylinder 7 and causing clogging of the machine 1.

(ix) Considering that the incoming material reaches the inner surface of the rotary cylinder 7, both keep the same angular velocity, remaining static with respect to each other.

(x) The liquid part of the incoming material detaches from the solid part by centrifugal force. This liquid part goes through the perforated wall of the rotary cylinder 7 through the many orifices distributed over it. The solid fragments of smaller size than the orifices will also pass through the perforated wall of the rotary cylinder 7.

(xi) The solid part of the incoming material is retained by the perforated wall of the rotary cylinder 7 and is caught by the rotary helical device 6. In this way, the end edge of the rotary helical device 6, which slides quite close to the inner wall of the rotary cylinder 7, catches the solid part of the incoming material and carries it at a deflection angle along the rotary cylinder 7, until it comes out through the back edge thereof.

(xii) The liquid part of the incoming material goes into tangential route with respect to the rotary cylinder 7 and is caught by the inner surface of the liquid collecting chamber 16.

(xiii) The liquid part of the incoming material, by force of gravity, flows over the inner surface of the liquid collecting chamber 16 as far as the lower portion where the liquid-outpour chute 33 is flanged.

(xiv) The liquid outpour chute 33 concentrates and canalizes the whole centrifuged liquid part of the incoming material.

(xv) The solid part of the incoming material, which is carried by the rotary helical device 6 along the inner surface of the rotary cylinder 7, reaches the back edge of the rotary cylinder 7, where it takes a free tangential path through the solid collecting chamber 8.

When the centrifugation phase comes to an end, the machine 1 provides increase in tangential velocity of the centrifuged material inside the solid collecting chamber 8 and uses it to transport this material directed by the outlet duct 5.

5 Multidirectional Transport

i) The solid part of the incoming material, in a free tangential path inside the solid collecting chamber 8, it is caught by the inner surface of its wall, which is static, where it again takes circular path sliding over this surface.

10 ii) In this way, the solid part of the incoming material loses tangential velocity inside the solid collecting chamber 8, due to the friction with the inner surface of its wall, which is static.

iii) With the loss of tangential velocity, the solid part of the incoming material is caught by the radial blades 10 of the solid conducting rotor 9, the outer edges of which slide very close to the inner surface of the wall of the solid collecting chamber 8. Such radial blades 10 of the solid conducting rotor 9 impart greater tangential velocity to the solid part of the incoming material.

iv) The solid part of the incoming material is pushed by the radial blades 10 of the solid conducting rotor 9 over the stretch that remains until the wall of the solid collecting chamber 8 leaves its circular portion and goes on to a tangent portion.

v) At this tangent portion, the solid part of the incoming material goes into a path of escape and leaves the solid collecting chamber 8 by inertia, passes through the solid conducting duct 12 and then through the solid outlet ducts 5.

It should be noted that the vertical and horizontal distances which the solid part of the incoming material will reach are dependent on the following factors:

30 a) the physical characteristics of the solid part of the incoming material;

b) the rotation velocity of the rotary helical device 6, of the rota-

ry cylinder 7, of the solid conducting rotor 9, of the radial blades 13 and of the rotary front base disc 14;

- c) the outlet angle of the solid collecting chamber 8, and
- d) the length of the solid conducting duct 12.

5 A preferred embodiment having been described, it should be understood that the scope of the present invention embraces other possible variations, being limited only by the contents of the accompanying claims, which include the possible equivalents.

CLAIMS

1. A centrifugal machine (1) for granular solid materials, comprising at least:

5 - a hopper (2) capable of enabling the entry of the granular solid materials;

 - a centrifuging mechanism (3) associated to the hopper (2), the centrifuging mechanism (3) being provided with at least one rotary helical device (6) capable of enabling the transport of the granular solid materials, the centrifuging mechanism (3) being provided with a perforated rotary piece
10 (7) which involves the rotary helical device (6) externally, the rotary piece (7) being configured to remove, by centrifugal force, free liquids adhered to the surface of the granular solid materials; and

 - a solid outlet duct (5) associated to the centrifuging mechanism (3), the solid outlet duct (5) being capable of enabling the centrifuged
15 granular solid materials to come out,

 the centrifugal machine (1) being characterized by comprising at least one solid collecting chamber (8), arranged between the centrifuging mechanism (3) and the solid outlet duct (5), the solid collecting chamber (8) being capable of receiving the centrifuged granular solid materials from the
20 rotary piece (7), the solid collecting chamber (8) being provided with a solid conducting rotor (9) that comprises radial blades (10) configured to pushing the granular solid materials and imparting an increase in tangential velocity to them.

2. A machine according to claim 1, characterized by comprising
25 at least one solid conducting duct (12), associated fixedly to the solid collecting chamber (8) and to the solid outlet duct (5), the solid conducting duct (12) being arranged between the solid collecting chamber (8) and the solid outlet duct (5), the solid conducting duct (12) being capable of enabling one to direct the centrifuged granulate solid materials coming from the solid collecting
30 chamber (8) to the solid outlet duct (5).

3. A machine according to claim 2, characterized by comprising a liquid collecting chamber (16) that involves concentrically and externally the

rotary piece (7), the solid collecting chamber (8) being turnable with respect to the liquid collecting chamber (16), the solid conducting duct (12) and the solid outlet duct (5) having an angular position configurable through rotation of the solid collecting chamber (8) with respect to the liquid collecting chamber (16).

4. A machine according to claim 3, characterized by comprising at least one liquid material outlet duct (23), associated to the liquid collecting chamber (16), the liquid material outlet duct (23) having an angular position configurable through rotation of the liquid collecting chamber (16) with respect to the solid collecting chamber (8), the liquid material outlet duct (23) being capable of enabling drainage of the liquid resulting from centrifugation out of the machine.

5. A machine according to any one of the preceding claims, characterized in that the solid collecting chamber (8) comprises an inner wall provided with an end projection (11) substantially curved, capable of preventing damage to the granular solid materials upon rotation of the solid conducting rotor (9).

6. A machine according to any one of the preceding claims, characterized by comprising at least one rotary conical chamber (27), arranged between the hopper (2) and the rotary piece (7), the rotary conical chamber (27) being capable of receiving the granular solid material coming from the hopper (2) and delivering them to the rotary piece (7), the rotary conical chamber (27) being provided with radial blades (13) configured to provide an increase in tangential velocity of the granular solid materials.

7. A machine according to claim 6, characterized in that the radial blades (13) are provided with projections configured substantially with the shape of a wedge, such configuration being capable of retaining the granular solid materials inside the rotary chamber.

8. A machine according to claim 6 or 7, characterized by comprising a rotary front base disc (14) arranged between the rotary conical chamber (27) and the rotary piece (7), the rotary front base disc (14) being provided with at least one passageway opening (15) capable of enabling flow

of the granular solid materials, wherein the rotary front base disc (14) and the radial blades (13) form an adjusting mechanism capable of enabling adjustment of the flow velocity of the granular solid materials to be centrifuged through configuration of the differential angular velocity between the rotary front base disc (14) and the radial blades (13).

9. A machine according to any one of the preceding claims, characterized by comprising a driving mechanism (4), operatively associated to the centrifuging mechanism (3), the driving mechanism (4) being configured to provide adjustment of angular velocities of the rotary helical device (6) and of the rotary piece (7) around their central axes.

10. A machine according to claim 9, characterized by comprising:

- a main chassis (17) capable of housing the driving mechanism (4); and
- a fixation panel (24) capable of separating the main chassis (17) from the solid collecting chamber (8),

wherein the fixation panel (24) comprises air-passage orifices (25) capable of alleviating negative pressure inside the solid collecting chamber (8).

11. A machine according to any one of the preceding claims, characterized in that the rotary helical device (6) is installed concentrically and tightly with respect to the rotary piece (7).

12. A machine according to any one of the preceding claims, characterized by comprising a liquid output chute (33) arranged between the liquid collecting chamber (16) and the liquid outlet duct (23), the liquid output chute (33) being angularly moveable.

13. A centrifugal machine (1) for granular solid material, comprising at least:

- a hopper (2) capable of enabling entry of the granular solid materials;
- a centrifuging mechanism (3) associated to the hopper (2), the centrifuging mechanism (3) being provided with at least one rotary helical

device (6) capable of enabling the transport of the granular solid materials, the centrifuging mechanism (3) being provided with a perforated rotary piece (7) that involves the rotary helical device (6) externally, the rotary piece (7) being configured to remove, by gravity, free liquids adhered to the surface of the granular solid materials;

- a solid outlet duct (5) associated to the centrifuging mechanism (3), the solid outlet duct (5) being capable of enabling the centrifuged granular solid materials to come out;
- a driving mechanism (4) associated to the centrifuging mechanism (3), the driving mechanism (4) being capable of enabling rotation of the rotary helical device (6) and of the rotary piece (7) around their central axes;
- a main chassis (17) capable of housing the driving mechanism (4),

the centrifugal machine (1) being characterized by comprising a bearing assembly (18, 19) arranged inside the main chassis (17), the bearing assembly (18, 19) being capable of enabling support of the centrifugal mechanism (3).

14. A machine according to claim 13, characterized in that the centrifuging mechanism (4) is associated to the centrifuging mechanism (3) by means of a first central axle (20), the bearing assembly (18, 19) comprising a first bearing (18), a second bearing (19), both fixed to the first central axle (20) to enable support of the centrifuging mechanism (3).

15. A machine according to claim 14, characterized by comprising a fixation panel (24) that separates the main chassis (17) of the solid collecting chamber (8), the first bearing (18) being positioned on the first central axle (20) adjacent the fixation panel (24), and the second bearing (19) being positioned on the first central axle (20) opposite the first bearing (18) and adjacent a transmission protection box (22) comprised by the driving mechanism (4).

16. A machine according to claim 14 or 15, characterized by comprising a second central axle (21) capable of associating the rotary piece

(7) to the driving mechanism (4), the second central axle (21) being arranged internally and concentrically with respect to the first central axle (20), the second central axle (21) being supported by means of roller bearings (29) arranged between the first central axle (20) and the second central axle (21).

5 17. A machine according to any one of claims 14 to 16, characterized in that the rotary piece (7) rests on a front end (30) of the second central axle (21) and on the solid conducting rotor (9), the rotary piece (7) and the solid conducting rotor (9) being supported by means of a third bearing (31), the third bearing (31) being positioned inside the solid collecting
10 chamber (8), the third bearing (31) being fixed onto the first central axle (20).

18. A centrifugal machine (1) for granular solid materials, comprising at least:

- a hopper (2) capable of enabling the entry of granular solid materials;
 - 15 - a centrifuging mechanism (3) associated to the hopper (2), the centrifuging mechanism (3) being provided with at least one rotary helical device (6) capable of enabling the transport of the granular solid materials, the centrifuging mechanism (3) being provided with a perforated rotary piece (7) that involves the rotary helical device (6) externally, the rotary piece (7)
20 being configured to remove, by centrifugal force, free liquids adhered to the surface of the granular solid materials;
 - a solid outlet duct (5) associated to the centrifugal mechanism (3), the solid outlet duct (5) being capable of enabling the centrifuged granular solid materials to come out;
 - 25 - a driving mechanism (4) associated to the centrifuging mechanism (3), the driving mechanism (4) being capable of enabling rotation of the rotary helical device (6) and of the rotary piece (7);
- the centrifugal machine (1) being characterized in that:
- the rotary helical (6) is associated to the driving mechanism
30 (4) by means of a first central axle (20), the first central axle (20) being comprised by the centrifugal machine (1); and
 - the rotary piece (7) is associated to the driving mechanism

(4) by means of a second central axle (21), the second central axle (21) being comprised by the centrifugal machine (1), the second central axle (21) being arranged internally and concentrically with the first central axle (20),

wherein the first central axle (20) and the second central axle (21) are turnable by the driving mechanism (4) independently of each other, the driving mechanism (4) being configured to provide:

- specific adjustment of angular velocity for the rotary helical device (6) around its central axis through the first central axle (20); and
- specific adjustment of angular velocity for the rotary piece (7) around its central axis through the second central axle (21).

19. A machine according to claim 18, characterized in that the driving mechanism (4) is configured to adjust the angular velocity of the rotary helical device (6) by a value higher than the angular velocity of the rotary piece (7).

20. A machine according to claim 18 or 19, characterized by comprising at least:

- a rotary conical chamber (27) arranged between the hopper (2) and the rotary piece (7), the rotary conical chamber (27) being capable of receiving the granular solid materials coming from the hopper (2) and delivering them to the rotary piece (7), the rotary conical chamber (27) being provided with radial blades (13) configured to provide an increase in tangential velocity of the granular solid materials;
- a rotary front base disc (14) arranged between the rotary conical chamber (27) and the rotary helical device (6), the rotary front base disc (14) being provided with at least one passageway opening (15) capable of enabling flow of the granular solid materials,
- the driving mechanism (4) being configured to adjust the angular velocity of the rotary conical chamber (27) and the angular velocity of the rotary front base disc (14) by different values to enable adjustment of the flow of the granular solid materials.

21. A machine according to any one of claims 18 to 20, characterized in that the driving mechanism (4) comprises a motor, pulleys, gears,

chains, belts and a secondary axle (28), associated to each other, the secondary axle (28) being configured to aid in transmitting torque from said motor to the centrifuging mechanism (3).

22. A machine according to claim 21, characterized in that the
- 5 driving mechanism (4) comprises a stabilizing bar (32) configured to stabilize ends of the second central axle (21) and the secondary axle (28).

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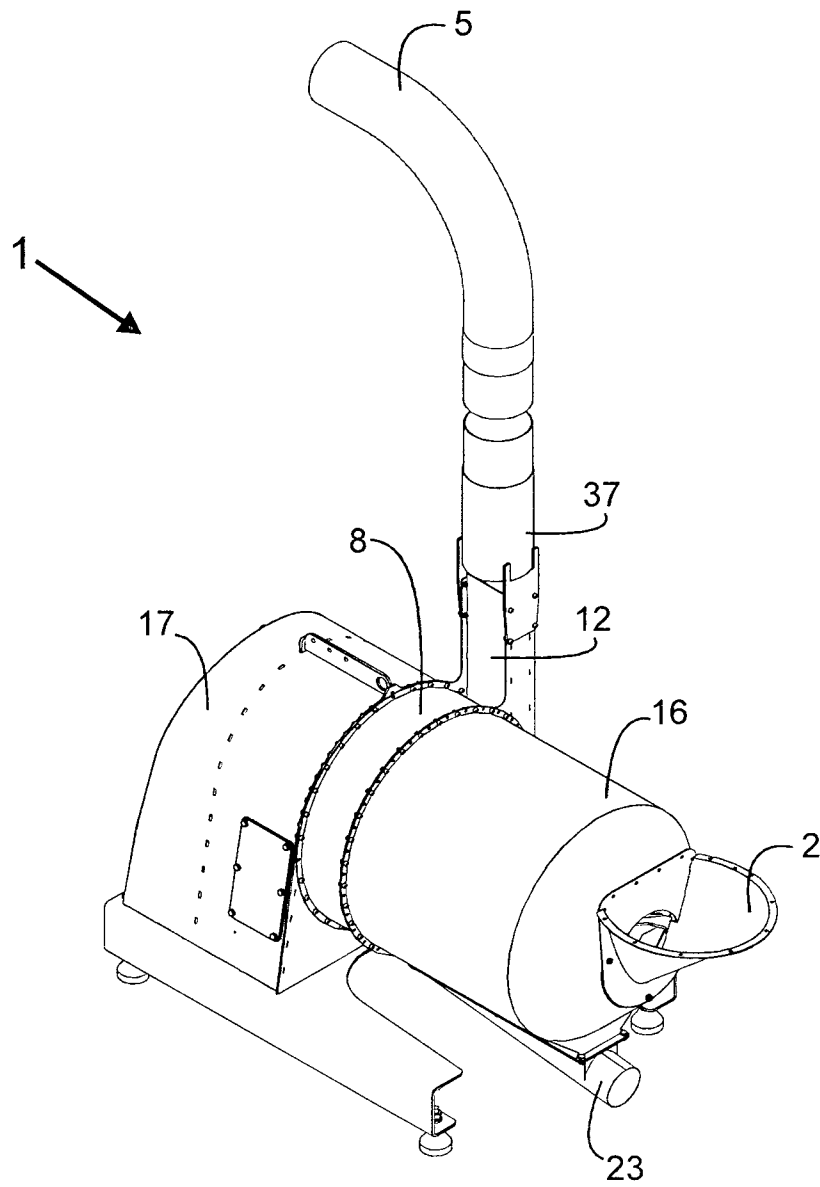


FIG. 1

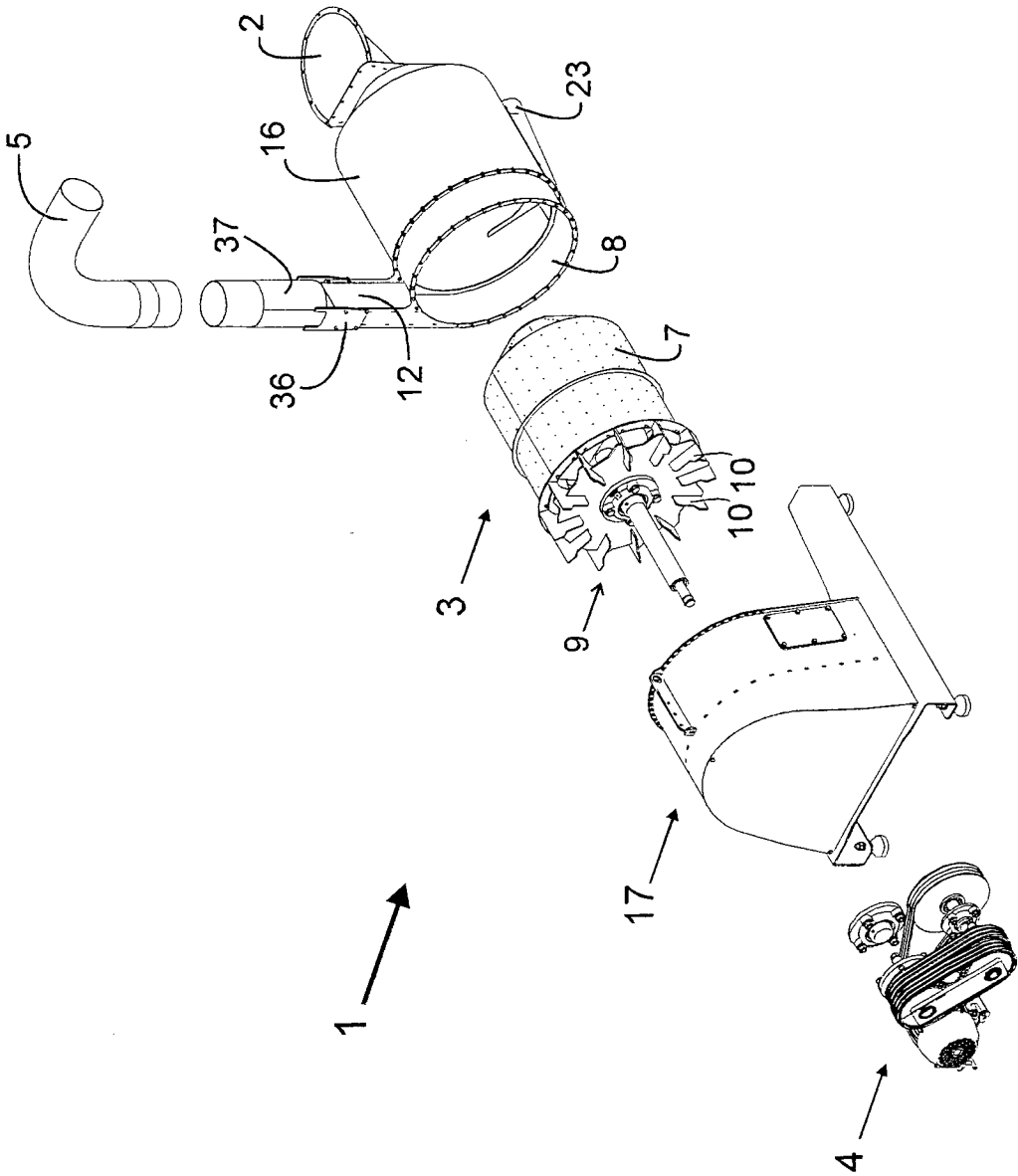


FIG. 2

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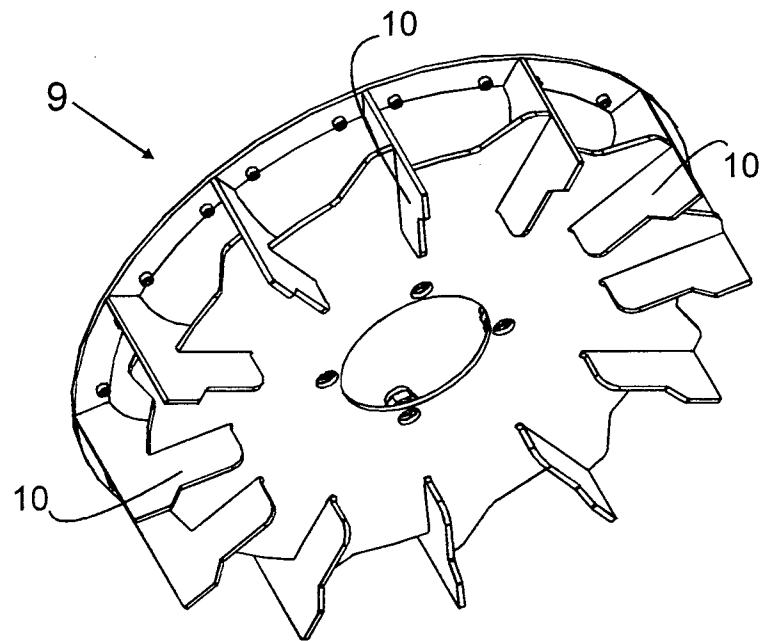


FIG. 3

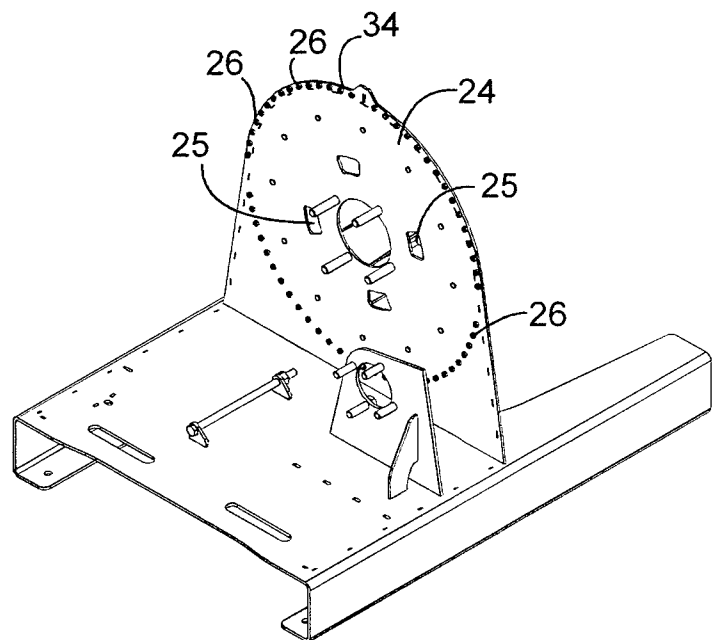


FIG.4

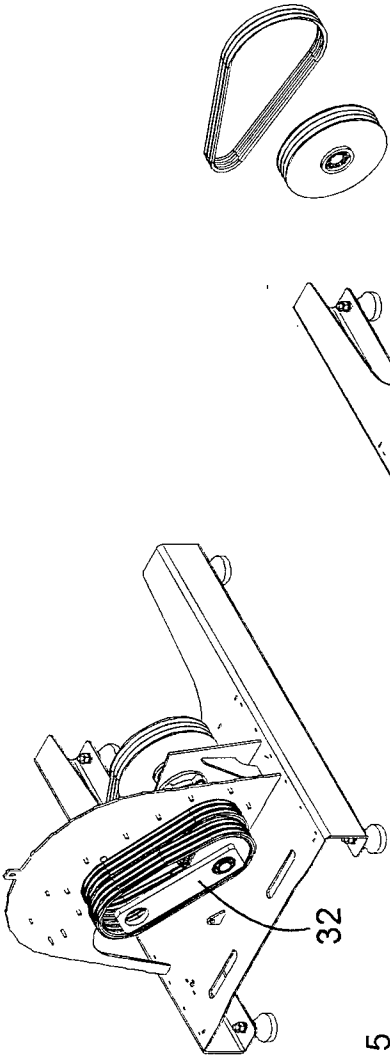


FIG. 5

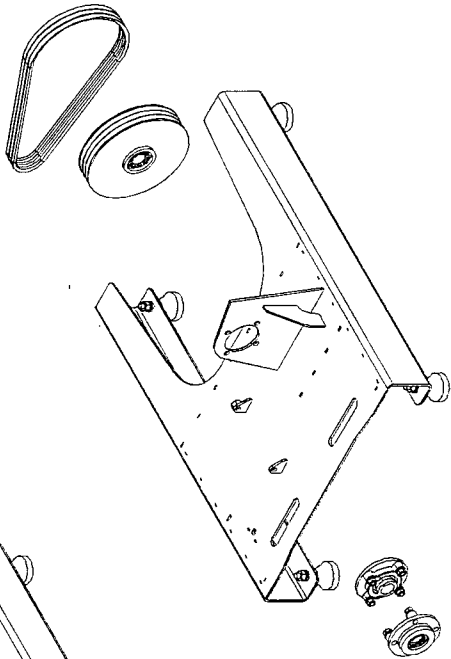


FIG. 6

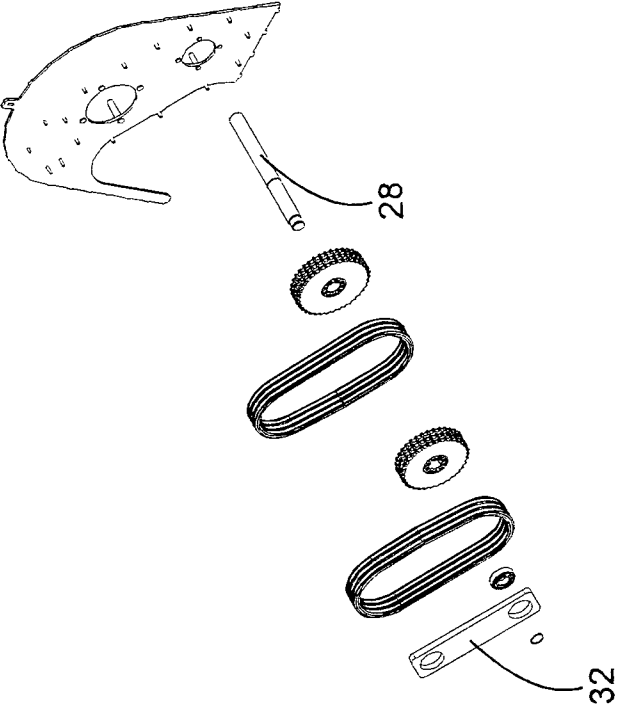
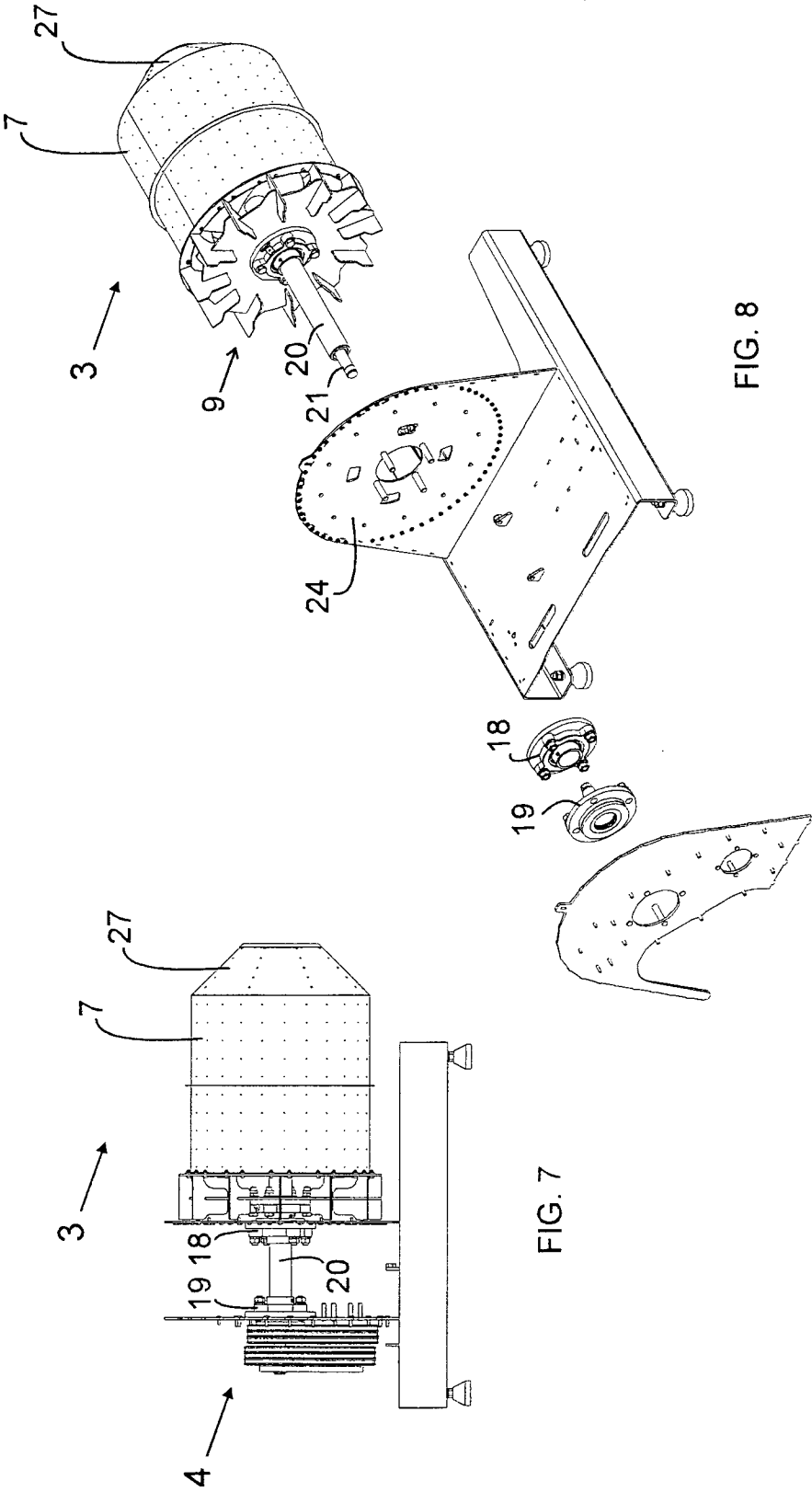
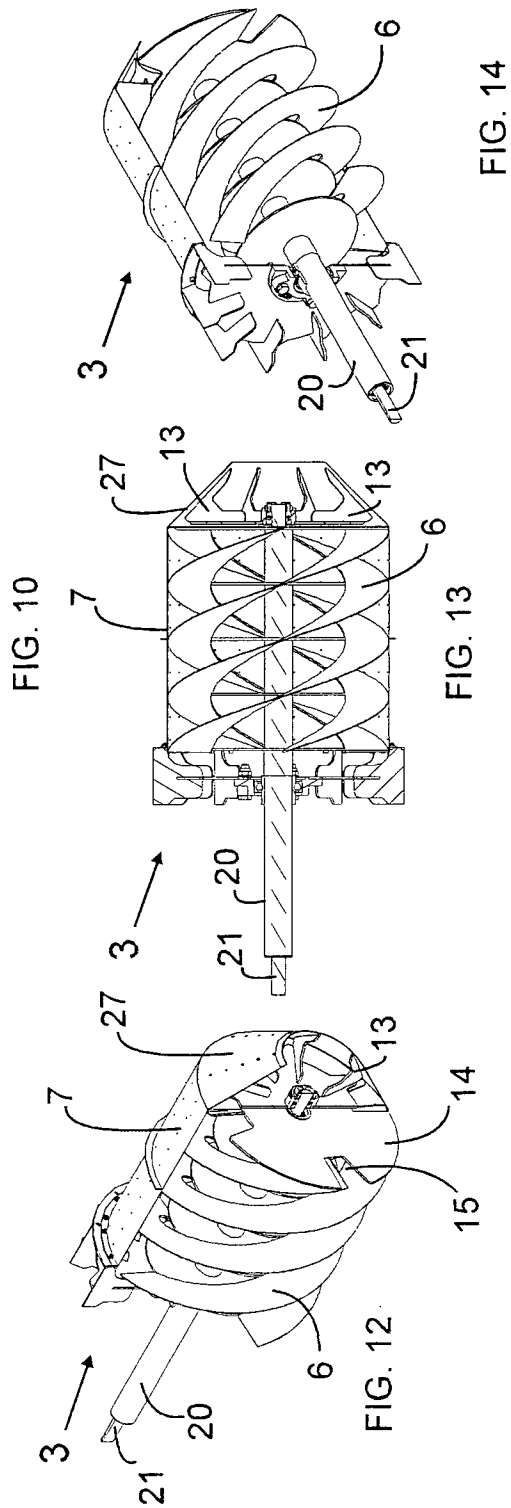
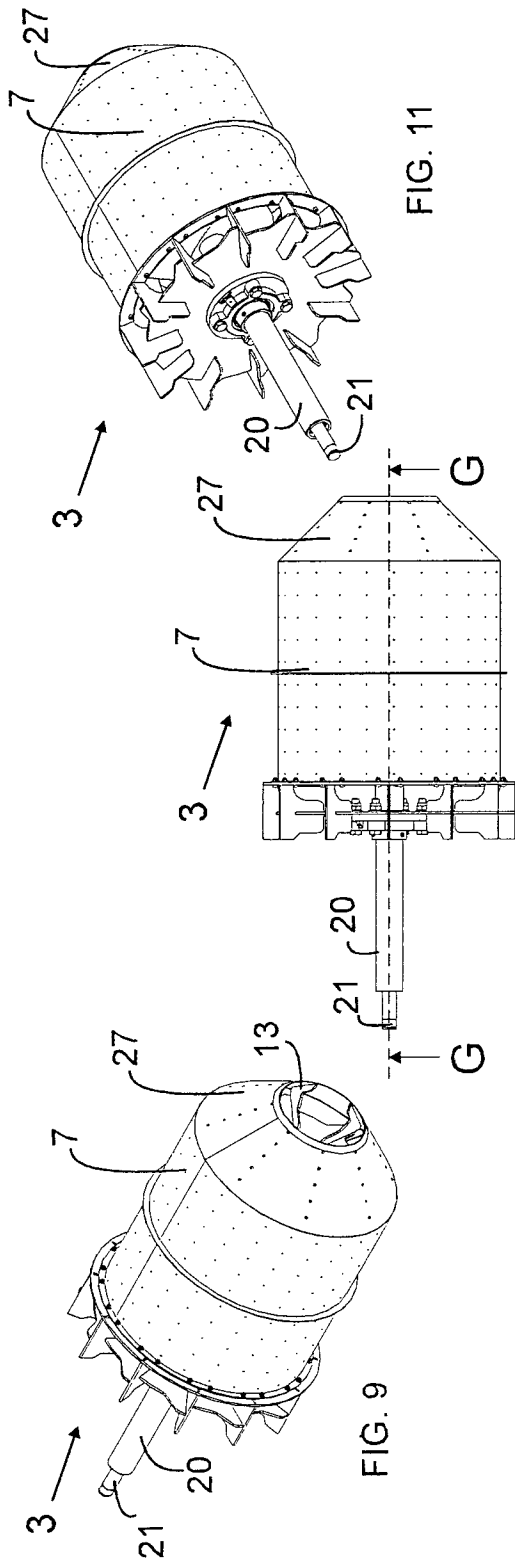
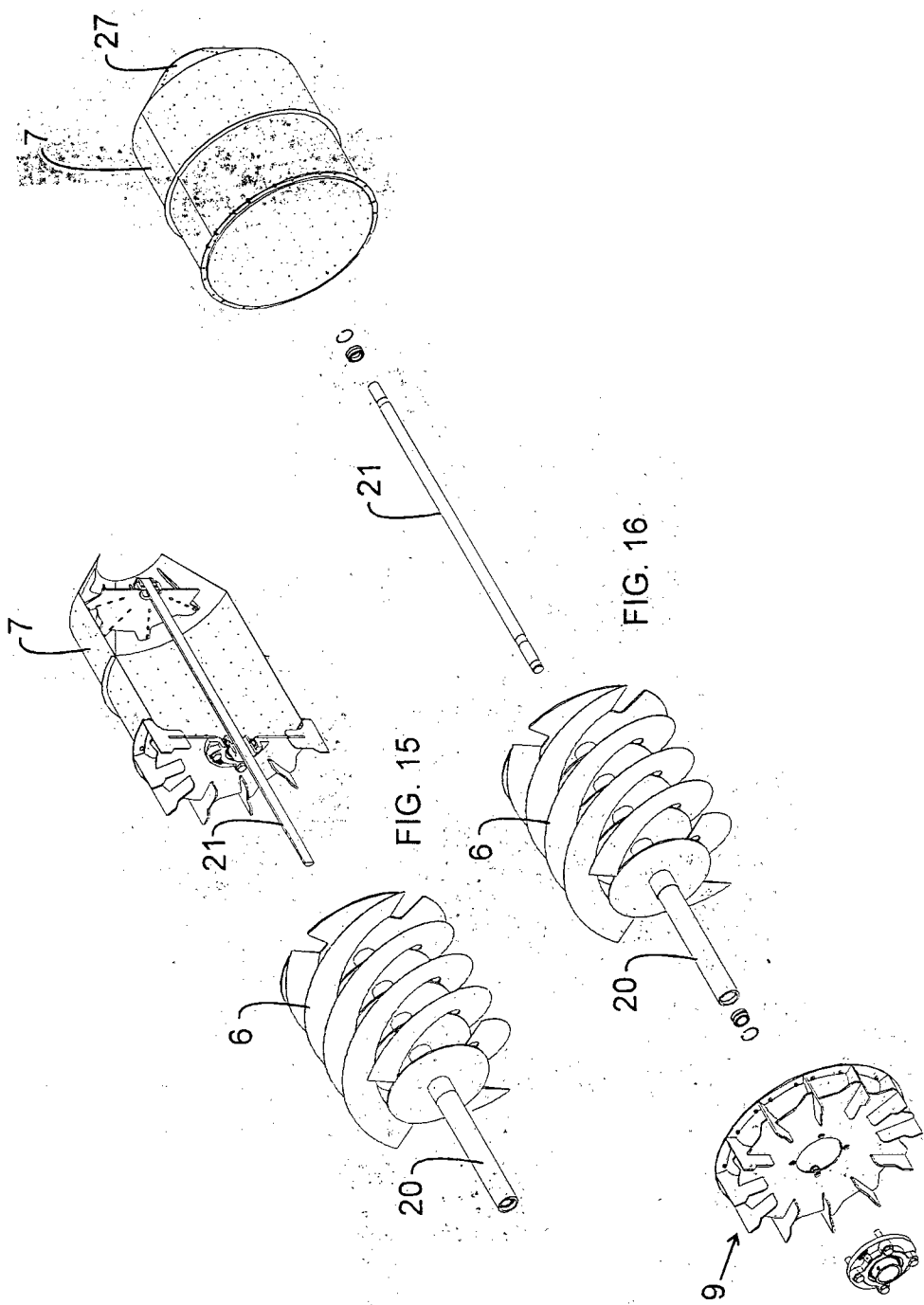
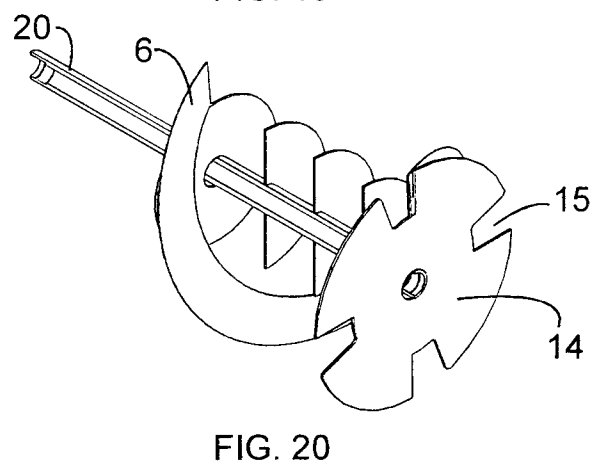
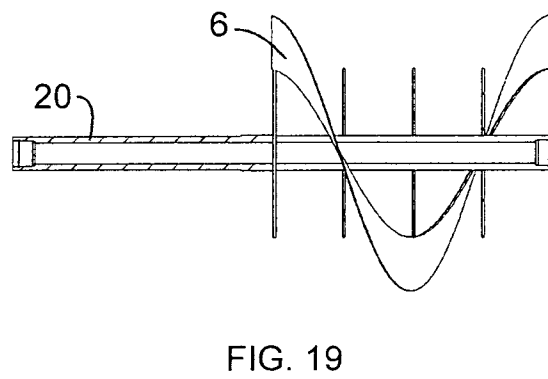
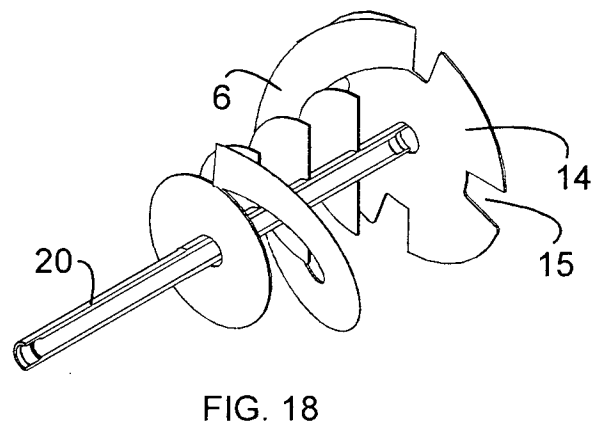
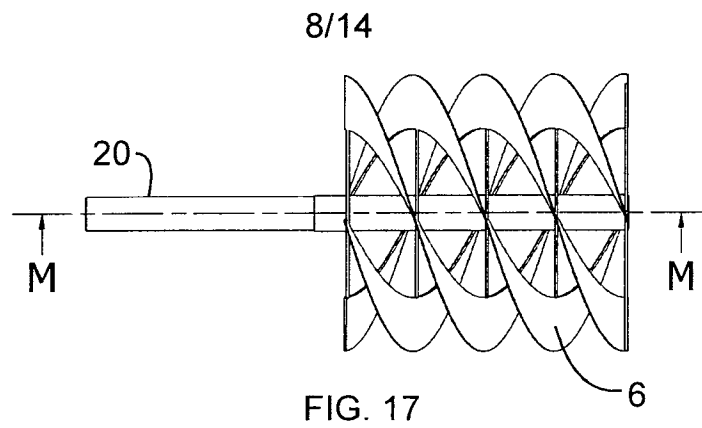


FIG. 5









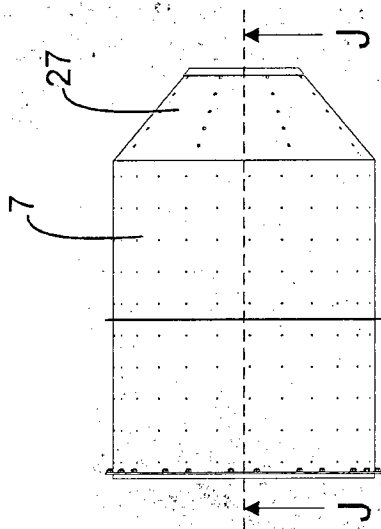


FIG. 21

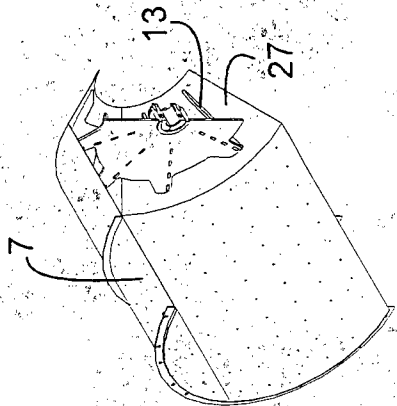


FIG. 22

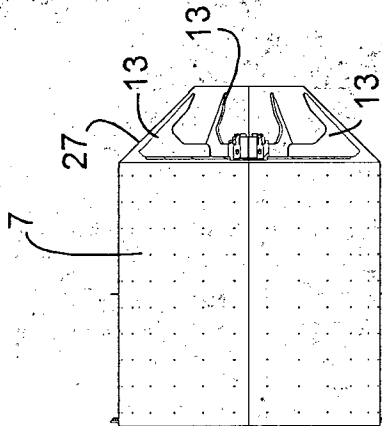


FIG. 23

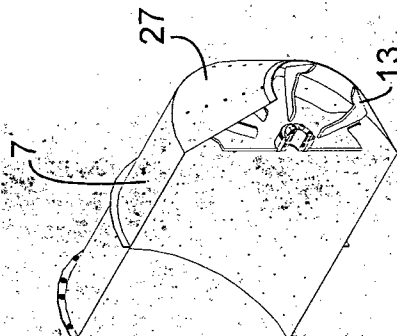


FIG. 24

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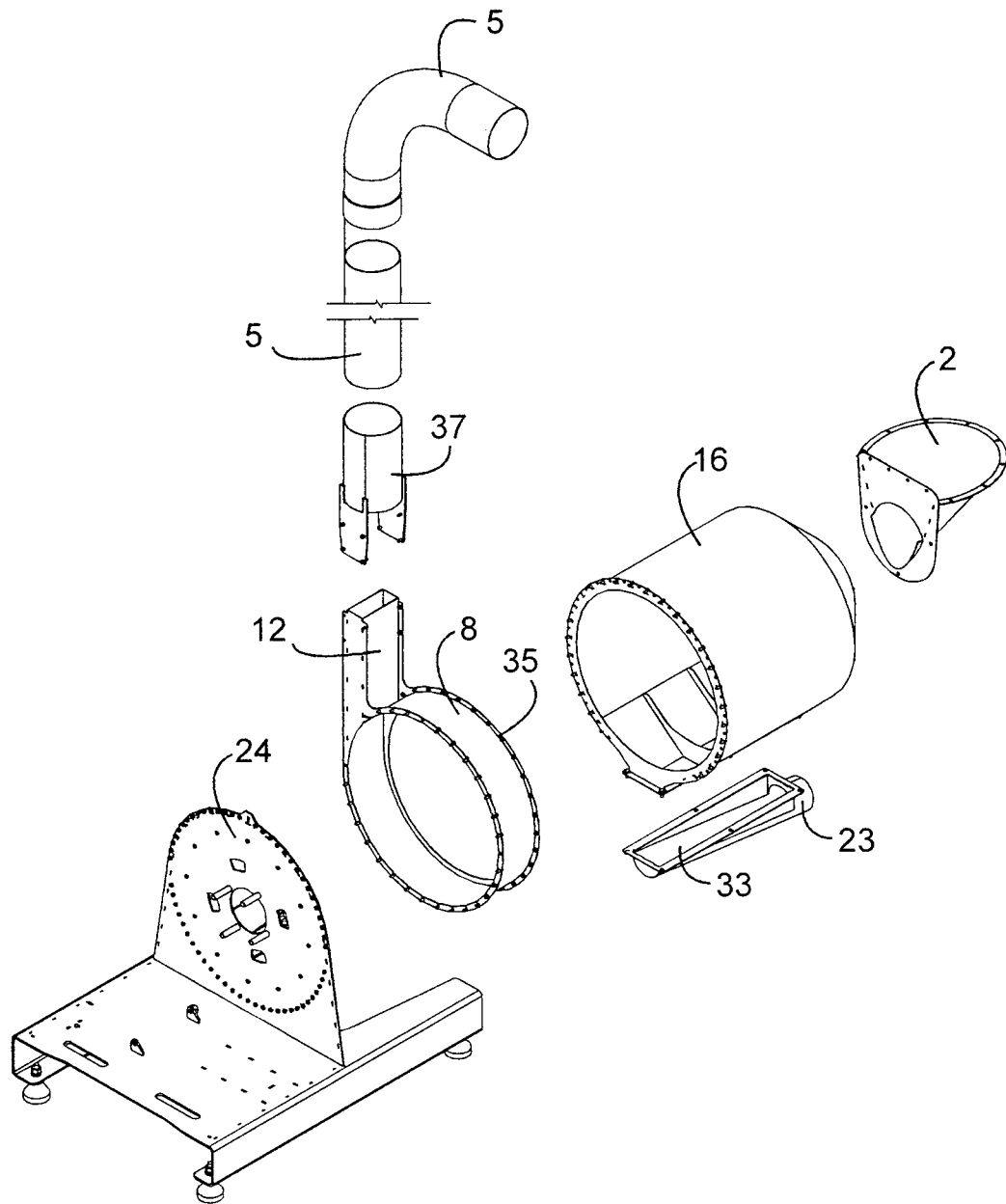


FIG. 25

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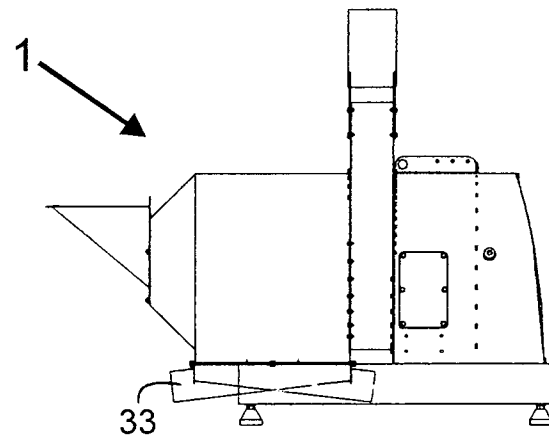


FIG. 26

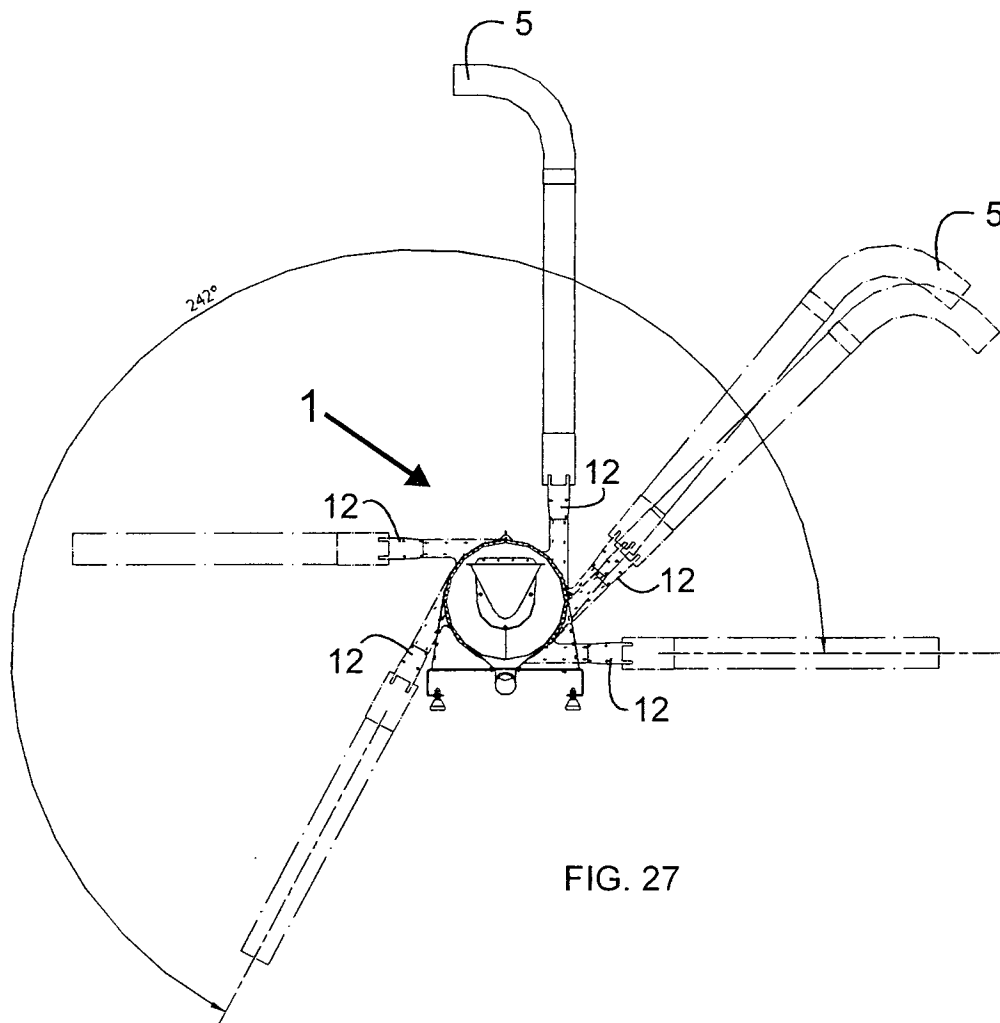


FIG. 27

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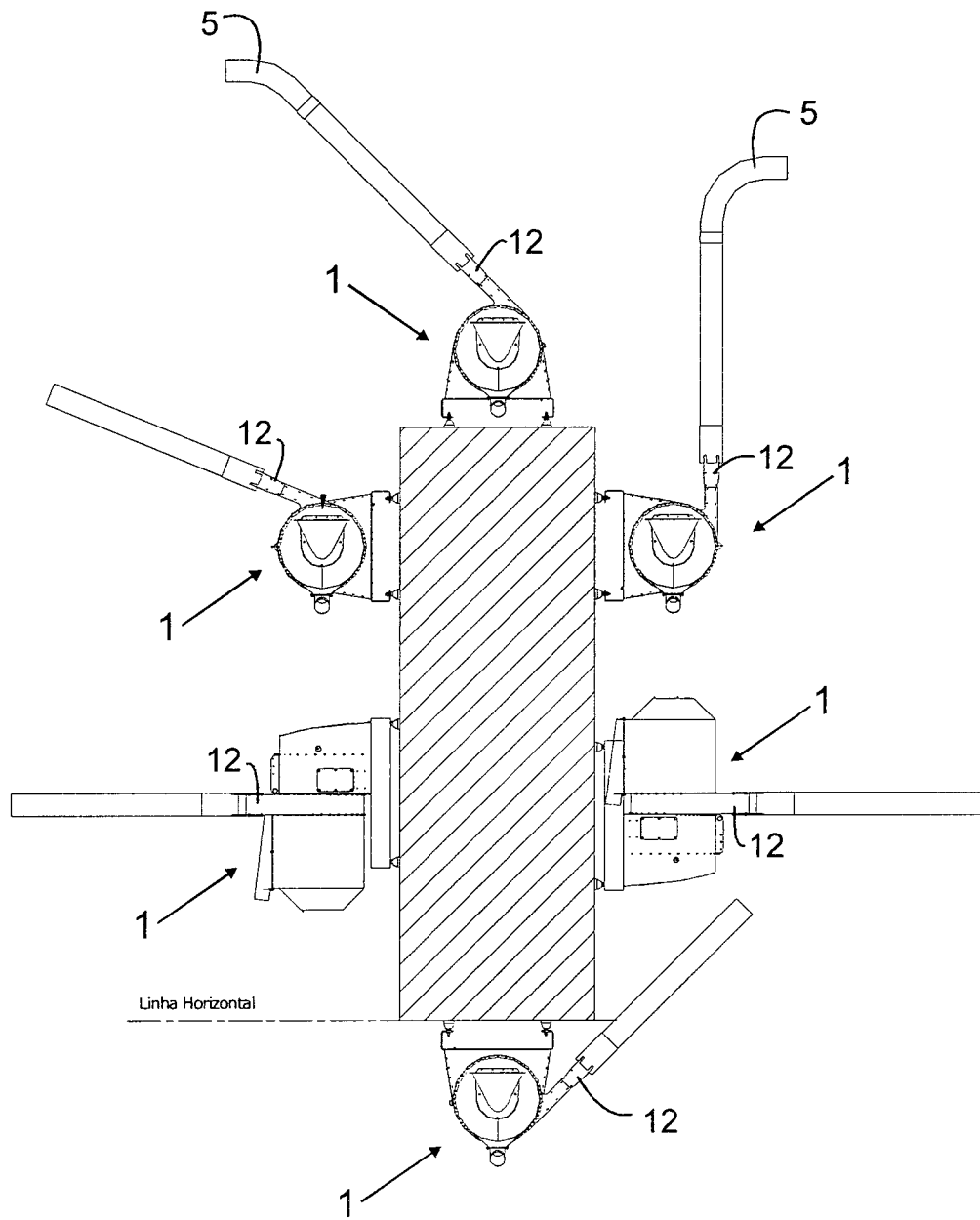


FIG. 28

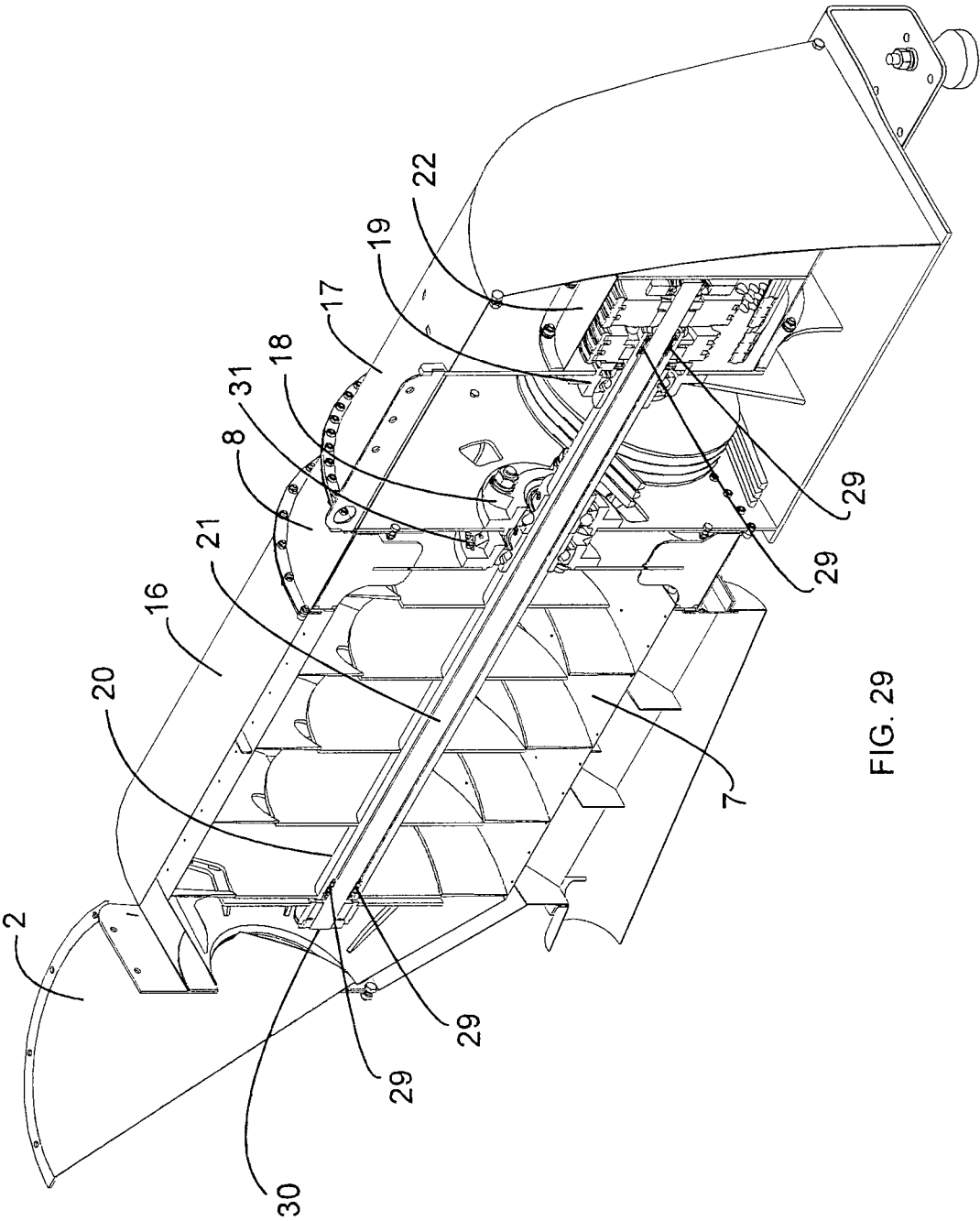


FIG. 29

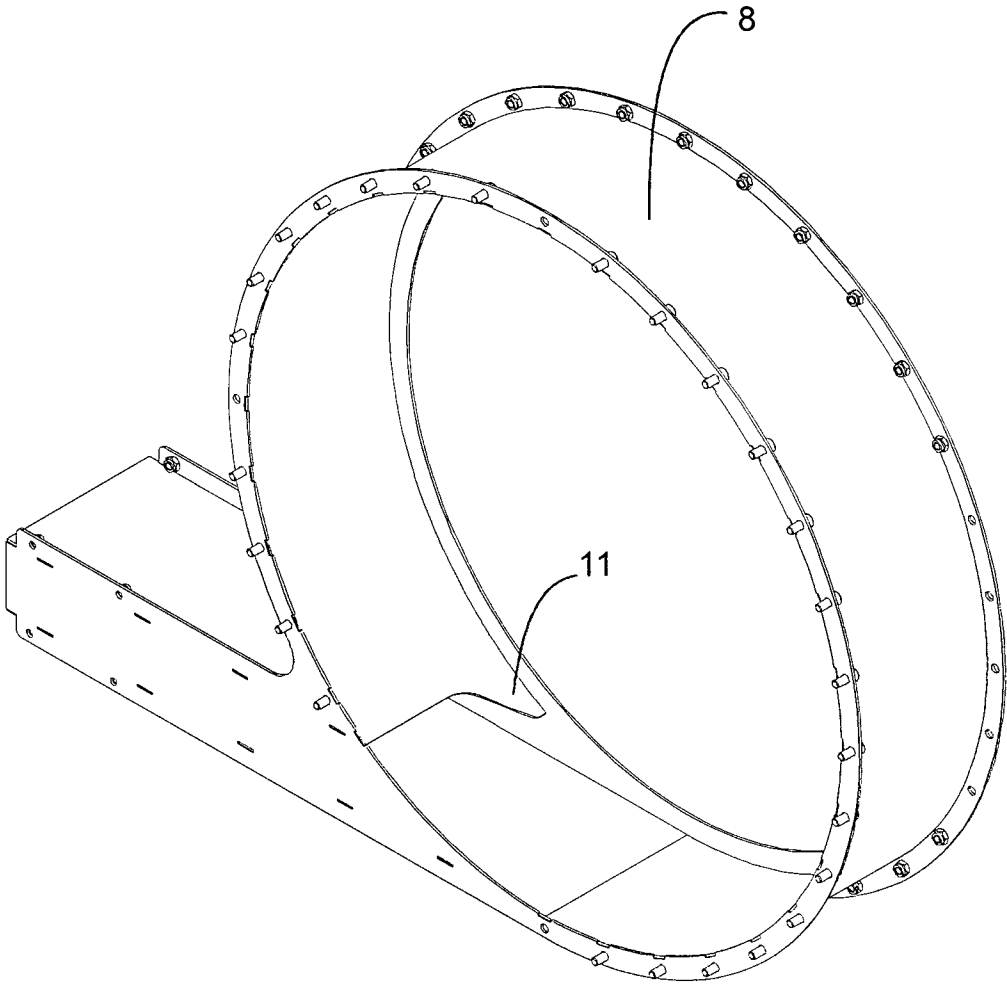


FIG. 30

INTERNATIONAL SEARCH REPORT

International application No

PCT/BR2011/000137

A. CLASSIFICATION OF SUBJECT MATTER
INV. F26B5/08
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

A23N F26B B65G A01D B04B

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

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

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 1 541 163 A (WESTHAFFER TERRENCE O ET AL) 9 June 1925 (1925-06-09)	1,2,9,11
Y	page 1, line 16 - line 20; figures 1-3	3
A	page 1, line 77 - page 3, line 12	4
Y	JP 58 157631 A (TAKADA SUNAO) 19 September 1983 (1983-09-19) abstract; figures 1,2	3
A	DE 85 35 469 U1 (HIRLINGER, MATHIAS) 4 December 1986 (1986-12-04) page 9, line 7 - line 12; figures 1-4	3
X	US 1 756 194 A (JOSEPH HAUG ANTON) 29 April 1930 (1930-04-29)	1-3,6,7, 9,11
Y	page 1, lines 1-9,17-22; figures 1,3,5	13,14
A	page 1, line 53 - page 2, line 94	8,18
	-/--	

☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

13 April 2012

Date of mailing of the international search report

25/04/2012

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
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Fax: (+31-70) 340-3016

Authorized officer

Hauck, Gunther

INTERNATIONAL SEARCH REPORT

International application No.
PCT/BR2011/000137

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☒ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No

PCT/BR2011/000137

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	FR 1 296 799 A (ORLANDO VICCI) 22 June 1962 (1962-06-22)	1,2,6,9
A	page 1, column 1, lines 1-9, 14-18; figures 1,2 page 1, column 1, line 30 - column 2, line 9 page 1, column 2, line 30 - page 2, column 1, line 1 page 2, column 1, lines 15-17, 29-31 page 2, column 1, line 54 - column 2, line 5	18
Y	----- US 4 135 659 A (DERTON HARRY E ET AL) 23 January 1979 (1979-01-23) column 1, line 5 - line 12; figures 1-5 column 2, line 15 - line 52 column 3, line 43 - column 6, line 17 -----	13,14
A	FR 2 635 989 A1 (DEMOISY PHILIPPE [FR]) 9 March 1990 (1990-03-09) page 1, lines 1-5; figures 1,2 page 2, line 4 - line 24 -----	1,11

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/BR2011/000137

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 1541163	A	09-06-1925	NONE	
JP 58157631	A	19-09-1983	NONE	
DE 8535469	U1	04-12-1986	NONE	
US 1756194	A	29-04-1930	NONE	
FR 1296799	A	22-06-1962	NONE	
US 4135659	A	23-01-1979	NONE	
FR 2635989	A1	09-03-1990	NONE	

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-4, 11

Centrifugal machine for drying granular solid materials with turnable solid collection chamber to angularly position the solid material outlet

2. claim: 5

Centrifugal machine for drying granular solid materials with solid collection chamber featuring a substantially curved inner wall end projection

3. claims: 6-8, 18-22

Centrifugal machine for drying granular solid materials with rotary conical section featuring radial blades for increase in tangential velocity of fed granular material

4. claims: 9, 10, 13-17

Centrifugal machine for drying granular solid materials comprising a main chassis housing the driving mechanism and comprising a separation panel

5. claim: 12

Centrifugal machine for drying granular solid materials with a liquid output chute being angularly moveable
