

Description

The present invention relates to a rotary-type metering device making it possible to dispense reliably determined quantities of a granular substance. This device is particularly applicable to the introduction of a granular substance with catalytic activity into an alpha-olefin polymerisation reactor wherein the polymerisation is performed under relatively low pressure, and more especially into a gas-phase alpha-olefin polymerisation reactor operated, for example under fluidised bed conditions.

One difficulty encountered in processes of low-pressure alpha-olefin polymerisation resides in obtaining reliable and regular introduction of determined quantities of granular substance with catalytic activity into a polymerisation reactor. The granular substance with catalytic activity is generally introduced into continuous polymerisation processes in a sequenced manner. When the quantity of granular substance introduced into the reactor varies considerably from one introduction to the next, it is found that the quality of polymers produced is irregular and that the concentration of the granular substance with catalytic activity in the polymerisation medium becomes so irregular that zones where the speed of reaction is excessive may be produced and bring about the formation of "hot spots", and on occasions, of agglomerates of molten polymer, liable to lead to the stoppage of polymerisation.

This difficulty usually originates from the nature of the granular substance to be introduced. This granular substance may be difficult to handle or may flow with difficulty, especially when it consists of fine particles having a mean diameter by mass, for example, comprised between 10 and 500 microns. This is the case, in particular, with granular substances with catalytic activity employed in low-pressure alpha-olefin polymerisation processes consisting of catalyst systems of the Ziegler-Natta type, or of catalysts based on chromium oxide compounds, or again of prepolymers containing these catalyst systems or these catalysts. Furthermore, when these granular substances with catalytic activity are subjected to physical stresses, such as pressure, on introduction into a polymerisation reactor, the cohesive forces of these granular substances, and also the forces of adhesion to the walls of the chamber where they are located, increase considerably, thus making them difficult to manipulate. In addition, these difficulties may be amplified by electrostatic phenomena when the granular substance consists of prepolymer.

A further difficulty also arises from the fact that usually the granular substance is introduced into a pipe or chamber where a pressure greater than atmospheric pressure prevails, for example comprised between 0.5 and 5 MPa. Because of this the metering device employed to dispense the granular substance must provide satisfactory gas-tightness at all times, in order to avoid losing large quantities of gas or causing a premature reaction inside the metering device which thus runs the risk of becoming blocked.

The use of a rotary-type metering device consisting of a cock valve rotating around an axis inside a casing is already known; this cock is provided with an internal cavity with two openings, which cavity is alternately filled with granular substance, for example from a storage chamber, and emptied of this granular substance under the pressure of a carrier gas which entrains the granular substance into the pipe towards the desired chamber. However, this device has the drawback of permitting large quantities of carrier gas to pass through the chamber, owing to the double opening in the cavity.

A rotary-type metering device has also been proposed which consists of a valve with a cylindrical or conical cock rotating around a horizontal axis inside a casing; this conical cock is provided with at least one recessed cavity which, while it rotates, may be alternately placed in communication with the inlet orifice and outlet orifice of this valve. This recessed cavity generally has the shape of a cylinder of revolution or of a truncated cone the bottom of which may be more or less spherical. However, for mechanical reasons, this metering device cannot usually dispense large quantities of granular substance. Furthermore, a valve with cylindrical or conical cock is not suitable for providing satisfactory gas-tightness, when the granular substance employed is subjected to relatively high pressures. It has also been observed that the granular substance to be dispensed tends to pass into the clearance between the casing of the device and the cylindrical or conical cock thus causing erosion of the moving parts of the device and reducing the gas-tightness. The granular substance passing into the said clearance may also cause the blockage or seizure of the device. Metering devices with a conical cock have been found particularly unsatisfactory owing to the fact that the cock is generally pressed horizontally into the casing of the device to increase the gas-tightness. However, this horizontal pressure increases the erosion of the moving parts and aggravates the problems of blockage, seizure and gas-tightness.

It is also known to use a rotary type metering device comprising a stationary casing containing a spherical core which is rotatable around a horizontal axis and which is provided with sealing rings around the inlet and outlet orifices of the device. The spherical core contains at least one outwards open cavity which has the shape of a cylinder with a flat bottom according to DE-A 2 527 412. However, this type of cavity is unable to deliver a powder consisting of fine particles which remain blocked in the cavity. According to DE-A 3 145 781, the shape of the cavity may consist of one truncated cone with a flat bottom. However, a metering device having such a cavity delivers a quantity of powder smaller than a cylinder-shaped cavity. Hence, it is not suitable for feeding large-capacity industrial vessels or reactors.

A rotary type metering device is also known, being similar to that described by DE-A 2 527 412. In the cylindrical cavity, there slides a moving object having a diameter close to that of the recessed cavity such as a piston or a ball which, depending on the

position of the cavity, makes it possible alternately to allow a given quantity of granular substance to penetrate into this cavity and to discharge it from the latter. Experience has shown that when this device operates in an industrial plant repeatedly and at a high rate, the moving object sliding inside the recessed cavity frequently becomes blocked because of fine particles present in the granular substance, which prevents the metering device from operating satisfactorily.

A rotary-type metering device has now been found which is capable of solving the difficulties referred to above. In particular, the present invention relates to a device which provides satisfactory gas-tightness and reliably dispenses, without the risk of blockage, large quantities of granular substance, consisting of fine particles, into a pipe, a vessel or a reactor liable to be under a relatively high pressure. This metering device presents the best arrangement between the facility of delivering a powder regularly in a short time and the possibility of dispensing the largest volume of powder in order to reduce the wearing of the device. Furthermore, the metering device in particular makes it possible to handle granular substances which flow with difficulty and which are liable to settle comparatively easily under a low pressure and to form aggregates due to forces of cohesion existing between the particles.

The metering device according to the invention is suitable in particular for granular substances which cannot flow through a hopper according to the ASTM-D-18 956 977 standardised method.

With respect to the prior art known from DE-A 3 145 781, which discloses a rotary type metering device for dispensing large quantities of a granular substance, comprising a stationary casing having in its upper part an inlet circular orifice and in its lower part an outlet circular orifice arranged in a vertical axis, the said casing containing a spherical core rotatable on horizontal axis having at least one outwards open cavity with a circular opening and seals and around the inlet and outlet orifices, the device according to a first aspect of the present invention is characterised in that the or each cavity has a shape defined by:

(a) two successive volumes of revolution V1 and V2 having a common axis perpendicular to the axis of rotation of the spherical core,

— the circular opening having a diameter D equal to the greatest diameter of the cavity and smaller than or equal to the diameter of the outlet orifice of the casing,

— the volume V1 defining the lower part of the cavity and consisting of at least one truncated cone of revolution having at its virtual apex an angle A1 of 10° to 90°, oriented inwardly in relation to the opening of the cavity, and comprising a small circular base and a large circular base of diameter D1,

— the volume V2 defining the upper part of the cavity and consisting of at least one truncated cone of revolution having at its virtual apex an angle A2, such that $0^\circ \leq A2 < A1$, oriented inwardly in relation to the opening of the cavity, and comprising a small circular base of diameter D1 and a large circular

base of diameter D corresponding to the opening of the cavity,

— the diameter D and the heights H1 and H2 of the volumes V1 and V2 respectively, being such that $0.1 D \leq (H1 + H2) \leq 1.5 D$, with the proviso that the volume V2 can comprise a cylinder of revolution wherein the diameter D1 and D are equal, and

(b) a bottom surface corresponding to the small circular base of the volume V1.

According to a second aspect of the present invention, a process to dispense a granular substance is provided, as defined in claim 7.

The rotary type metering may comprise one or more cavities depending on the size of the spherical core of the metering device and the volume of the cavities. The number of cavities also depends on the manner in which the metering device operates, as will be described subsequently. If the spherical core comprises more than one cavity, the cavities must be distanced from each other, in a manner such that at any instant during the rotation of the core, the inlet orifice and the outlet orifice of the casing can each be placed only in communication with a single cavity. In this case, it is preferable that at the moment when one cavity is placed in communication with the inlet orifice, another cavity is in communication with the outlet orifice.

The inlet and outlet orifices for granular substance are preferably located at the top and bottom respectively of the casing. Preferably they are diametrically opposed in relation to the centre of the spherical core and arranged on an axis vertical and perpendicular to the axis of rotation of the spherical core, so that the filling and emptying of the cavity is provided by the force of the gravity exerted on the granular substance. The inlet and outlet orifices in the casing are preferably circular and of equal diameter.

The diameter D of the cavity is less than or preferably equal to the diameter of the outlet orifice of the casing. It has been observed that when the diameter D of the cavity opening is greater than the diameter of the outlet orifice of the casing, the granular substance is more difficult to discharge from the cavity; because of this the quantities of granular substance are no longer dispensed in such a reliable and regular manner by the metering device.

The shape of the cavity is one of the essential features of the metering device which makes it possible, according to the invention, to manipulate granular substances which have inherently poor flow properties. The truncated cone of revolution V1 has an angle A1 such that $10^\circ \leq A1 \leq 90^\circ$ and preferably such that $10^\circ \leq A1 \leq 60^\circ$. It has in fact been found that when the angle A1 is less than 10°, the granular substance is difficult to discharge from the cavity. In particular, when the lower side and bottom surfaces of the cavity are composed not of a truncated cone of revolution but by a cylinder of revolution, it is noted that the granular substance can remain partially or even totally blocked inside the cavity. These difficulties are aggravated still further when the virtual apex of V1 is oriented outwardly, (i.e. toward the opening of the cavity) and under these circumstances the granular substance

cannot be easily discharged from the cavity and frequently remains partially or even totally blocked inside the cavity. A similar observation has been made when the virtual apex of the truncated cone V_2 is oriented in the direction of the opening of the cavity.

The truncated cone of revolution V_1 is also characterised by two circular bases. The smaller of these two bases corresponds to the bottom surface of the cavity. This bottom surface preferably consists of a plain surface or a flattened dome.

The diameter D and the heights H_1 and H_2 of the volumes of revolution V_1 and V_2 respectively are such that;

$$0.1 D \leq H_1 + H_2 \leq 1.5 D$$

and preferably such that:

$$0.5 D \leq H_1 + H_2 \leq 1.2 D$$

Preferably the ratio of the heights H_2/H_1 is less than or equal to 2, more preferably less than or equal to 1.5, in order to permit easy discharge of the granular substance from the cavity.

According to one embodiment of the present invention, the volume of revolution forming the cavity of the metering device comprises more than one truncated cone of revolution complying with the definition of the volume V_1 and/or more than one truncated cone of revolution complying with the definition of volume V_2 .

The truncated cones of revolution complying with the definition of the volume of revolution V_1 are arranged successively contiguously between the circular bases of diameter comprised between that comprising the bottom of the cavity and D_1 , the larger base of each of these truncated cones constituting the small base of the truncated cone immediately following in the direction going from the bottom to the opening of the cavity. The value of the angle A_1 of the virtual apex of each of these truncated cones of revolution decreases in order of sequence from the bottom towards the opening of the cavity.

In the same way, the truncated cones of revolution complying with the definition of the volume V_2 are arranged contiguously between the circular bases of a diameter comprised between the extreme values D_1 and D , the larger base of each of these truncated cones constituting the smaller base of the truncated cone next following in the direction going from the bottom towards the opening of the cavity. The value of the angle A_2 of the virtual apex of each of these truncated cones of revolution complying with the definition of the volume V_2 decreases in order of sequence of the truncated cones of revolution oriented towards the opening of the cavity.

However, in order to produce in a practical manner a cavity of this type in the spherical core of the metering device, it is preferable that the number of truncated cones of revolution complying with the definition of the volumes V_1 and V_2 respectively should be less than or equal to 3.

In order to reduce the risk of adhesion of the granular substance to the wall of the cavity, it is preferred that the latter should be as smooth as possible.

In order to ensure tightness between the spherical core and the casing in which it rotates, these latter are preferably provided with sealing devices such as gaskets or packings. These sealing devices advantageously comprise annular or preferably toroidal bodies, for example O-rings, arranged in the casing of the device, providing a housing in which the spherical core rotates. Preferably an annular or toroidal seal is located horizontally around the inlet orifice at the upper part of the casing and a similar seal is located around the outlet aperture at the lower part of the casing. With this particular embodiment, it has been observed that the opening of the cavity slides easily in contact with the upper seal, the latter pressing against, and gently compacting the granular substance located in the cavity. Using seals of this type, it is possible to provide substantial clearance between the spherical core and the casing and thereby to reduce problems arising from erosion and seizure of the core. Despite the fact that the granular substance is slightly compressed by the seals, the defined shape of the cavity facilitates good flow of the granular substance during discharge from the outlet orifice. Similar results can be obtained when two annular or toroidal seals are arranged vertically in the solid body, provided that the seals are placed in vertical planes which are substantially parallel to the axis of rotation of the core.

The metering device of the present invention may be used to dispense granular substances consisting of relatively fine particles, for example particles having a mean diameter by mass comprised between 10 and 500 microns, preferably comprised between 50 and 300 microns. These granular substances may consist of substances with a catalytic activity, for example alpha-olefin polymerisation catalysts of the Ziegler-Natta type based for example on a titanium compound, or catalysts based on chromium oxide compounds, or supported catalytic systems in which the support may in particular consist of silica, alumina or a magnesium compound, such as magnesium chloride. The granular substances employed in the metering device of the present invention may also consist of a prepolymer of alpha-olefins.

The granular substances employed in the metering device can contain liquid compounds which increase the faculty of aggregation of the particles to each other, it being possible for the content by weight of these liquid compounds to be comprised for example between 0.1 and 10%. It is possible to employ using the metering device granular substances comprising catalysts or catalytic systems and a liquid compound such as an organometallic compound, for example an organoaluminium compound.

The metering device is suitable for dispensing in a reliable manner granular substances which may have a bulk density at rest which is particularly low, comprised for example between 0.20 and 0.60 g/cm³ and preferably comprised between 0.25 and 0.40 g/cm³. The metering device is particularly useful for feeding large-capacity industrial reactors with granular substance. In this way, it is possible to dispense reliably quantities of granular substance

which may amount for example for each introduction to 3000 g and generally quantities comprised between 500 and 2000 g. The operation making it possible to introduce into the industrial reactor a determined quantity of granular substance may be repeated at a frequency which may amount to up to 6 times per minute, and is generally comprised between 1 and 3 times per minute. In particular this metering device is suitable for feed rates of granular substance generally comprised between 30 and 1000 kg per hour.

The metering device of the present invention is particularly advantageous for dispensing reliably, regularly and for long periods of time comparatively large quantities of granular substances which are difficult to handle, into a pipe or a chamber liable to be under a high pressure, at the same time providing satisfactory freedom from leakage of gas present in the pipe or the chamber.

The metering device of the present invention and its mode of operation are described in more detail below, with respect to the accompanying drawings, in which

- Figure 1 represents a simplified diagram of the rotary-type metering device, consisting of a casing in which a spherical core rotates;
- figures 2, 3, and 4 represent various forms of embodiment of the cavity comprised in the spherical core;
- Figures 5 and 6 represent improvements to the rotary-type metering device.

Figure 1 is a simplified diagram of the rotary-type metering device, which shows;

at (1) a spherical core rotating around a horizontal axis (2) inside a casing (3),

- at (4) a cavity consisting of the contiguous volumes of two truncated cones of revolution V_1 and V_2 ,
- at (5) the opening of the cavity,
- at (6) the bottom of the cavity,
- at (7) the inlet orifice for granular substance, located at the top of the casing (3)
- at (8) the outlet orifice located at the bottom of the casing (3) and
- at (9) and (10) the seals providing gas-tightness between the top and the bottom of the casing (3).

Figure 2 shows in diagram form the spherical core (1) of Figure 1, comprising a cavity (4) consisting of the contiguous volumes of two truncated cones of revolution V_1 and V_2 in which the angle A_2 is less than the angle A_1 . The truncated cone of revolution V_2 comprises a large circular base of diameter D defining the opening (5) of the cavity, a small circular base of diameter D_1 defining the boundary (17) between V_1 and V_2 , and a truncated conical surface (15) defining the upper side surface of cavity (4). The truncated cone of revolution V_1 comprises a large circular base of diameter D_1 corresponding to boundary (17), a small circular base corresponding to the planar surface (6) forming the bottom of the cavity, and a truncated conical surface (16) de-

fining the lower side surface of the cavity (4).

Figure 3 is a simplified diagram of a spherical core (1) comprising a cavity (4) identical to that of Figure 2, except for the fact that the bottom (6) of the cavity consists of a flattened dome.

Figure 4 is a simplified diagram of a spherical core (1) comprising a cavity (4) consisting of the contiguous volumes V_1 and V_2 , the volume V_2 consisting of a cylinder of revolution.

Figure 5 is a simplified diagram of a spherical core (1) comprising a cavity (4) consisting of the contiguous volumes V_1 and V_2 ; the cavity (4) contains a helical spring (11) fixed at (12) to the bottom (6) of the cavity (4).

Figure 6 is a simplified diagram of a spherical core (1) comprising a cavity (4) consisting of the contiguous volumes V_1 and V_2 ; the cavity (4) contains a curved elastic membrane (13), fixed to the bottom (6) of the cavity (4).

The present invention likewise relates to a process for employing the rotary-type metering device described below, based on Figure 1. At the commencement of each operation for dispensing a determined quantity of granular substance, the opening (5) of the cavity is placed opposite the inlet orifice (7) from a feed hopper (not shown) located above the inlet orifice. The cavity (4) then fills with granular substance. The spherical core (1) turns around its axis of rotation (2), so as to place the opening (5) of the cavity opposite the outlet orifice (8). The granular substance contained in the cavity (4) then empties into the outlet orifice (8). The operation may then be repeated, either at a fixed frequency determined in advance, or in a manner modulated according to requirements. The rotation of the spherical core (1) can be performed continuously at a more or less constant speed, sufficiently slowly to enable each cavity (4) to be completely filled and emptied successively. The rotation may also be effected in a continuous manner but at a variable speed, this speed being lower when the opening (5) of each cavity is in communication with the inlet orifice (7) or with the outlet orifice (8), so as to facilitate the filling and emptying of the cavity (4). The rotation of the spherical core (1) can also be performed discontinuously, so that the spherical core (1) pauses for a suitable length of time when each cavity is in the filling and emptying position. In certain cases, the cohesive forces of the particles of the granular substance and the forces of adhesion of these particles to the wall of the cavity (4) are added together and attain a value such that the granular substance can no longer easily flow away from the cavity (4), when the opening (5) of the cavity is facing the outlet orifice (8).

This effect may in certain cases prevent the granular substance contained in the cavity (4) from pouring into the outlet orifice (8), either wholly or partially, and by this fact render the operation of the metering device erratic. These difficulties may be increased when the rotary movement of the spherical cock is slow and continuous.

Improvements such as represented on Figure 5 and 6 are useful for solving the above mentioned difficulties.

An improvement aimed at facilitating the emptying of the granular substance out of the metering device consists in fixing in the cavity (4) an elastic member, which is capable of restoring the energy of compression to which the contents of the cavity (4) are subjected during the rotation of the spherical core (1). In the mode of embodiment of this improvement shown in Figure 5, a helical spring (11), ballasted at its free end, is fixed on the bottom (6) of the cavity (4). When the opening (5) of the cavity is oriented upwards and placed in communication with the feed orifice (7) the helical spring (11) the upper part of which is below the opening (5) is compressed under the effect of its own weight, the weight of the granular substance which penetrates into the cavity (4) and of the static pressure engendered by the granular substance present in the hopper, not shown in Figure 1, which surmounts the metering device. When the opening (5) of the cavity is then oriented downwards and placed in communication with the outlet orifice (8), the helical spring (11) springs back and causes a shearing force which breaks the force of adhesion between the wall of the cavity (4) and the granular substance, which facilitates the discharge of the latter out of the cavity (4).

In another mode of embodiment of this improvement shown in Figure 6, a curved membrane (13) in an elastic material, such as a thin metallic foil, is fixed in the bottom (6) of the cavity (4). Under the effect of the pressure of the granular substance, this membrane is deformed towards the bottom (6) of the cavity (4) during the filling of the cavity (4). When the opening (5) of the cavity is in communication with the outlet orifice (8), the metallic foil resumes its initial shape, which facilitates the discharge of the granular substance present in the cavity (4). The shape and elastic properties of the membrane are chosen so that the membrane can be sufficiently deformed to obtain the effect sought.

The spherical core of the metering device is designed so as not to permit a direct passage between the feed orifice and the outlet orifice at any instant in the rotation of the spherical core. It is therefore possible to operate the metering device with substantial pressure differences, for example, 5MPa, between the inlet orifice and the outlet orifice.

Claims

1. A rotary type metering device for dispensing large quantities of a granular substance, comprising a stationary casing (3) having in its upper part an inlet circular orifice (7) and in its lower part an outlet circular orifice (8) arranged in a vertical axis, the said casing (3) containing a spherical core (1) rotatable on a horizontal axis (2) having at least one outwards open cavity (4) with a circular opening (5) and seals (9) and (10) around the inlet (7) and the outlet orifices (8), the device being characterised in that the or each cavity (4) has a shape defined by:

- (a) two successive volumes of revolution V1 and V2 having a common axis perpendicular to the axis of rotation (2) of the spherical core (1),
 - the circular opening (5) having a diameter D equal to the greatest diameter of the cavity (4)

and smaller than or equal to the diameter of the outlet orifice (8) of the casing,

- the volume V1 defining the lower part of the cavity (4) and consisting of at least one truncated cone of revolution having at its virtual apex an angle A1 of 10° to 90° , oriented inwardly in relation to the opening (5) of the cavity, and comprising a small circular base and a large circular base of diameter D1,
- the volume V2 defining the upper part of the cavity (4) and consisting of at least one truncated cone of revolution having at its virtual apex an angle A2, such that $0^\circ \leq A2 < A1$, oriented inwardly in relation to the opening (5) of the cavity, and comprising a small circular base of diameter D1 and a large circular base of diameter D corresponding to the opening (5) of the cavity,
- the diameter D and the heights H1 and H2 of the volumes V1 and V2 respectively, being such that $0.1 D \leq (H1 + H2) \leq 1.5 D$, with the proviso that the volume V2 can comprise a cylinder of revolution wherein the diameters D1 and D are equal, and

- (b) a bottom surface (6) corresponding to the small circular base of the volume V1.

2. Device according to Claim 1, characterised in that the volume V2 is a cylinder of revolution and that the ratio of the heights H2/H1 is less than or equal to 2.

- 3. Device according to Claim 1, characterised in that the bottom surface (6) of the cavity consists of a plain surface or a flattened dome.

- 4. Device according to Claim 1, characterised in that an elastic member is provided in the cavity (4) to assist discharge of the granular substance.

- 5. Device according to Claim 4, characterised in that the elastic member is a helical spring or metallic foil fixed to the bottom (6) of the cavity.

- 6. Device according to Claim 1, characterised in that two annular or toroidal seals (9) and (10) are arranged between the casing (3) and the spherical core (1), these seals being placed in horizontal planes around the inlet (7) and outlet orifices (8) or in vertical planes parallel to the axis (2) of rotation of the spherical core (1).

- 7. Process to dispense a given quantity of granular substance, employing the metering device according to one of Claims 1 to 6.

- 8. Process according to Claim 7, characterised in causing the spherical core (1) to rotate continuously at a constant speed, which is sufficiently slow to enable the cavity (4) successively to fill and empty completely.

- 9. Process according to Claim 7, characterised in causing the spherical core (1) to rotate discontinuously so that the spherical core (1) pauses when each cavity (4) is in a filling and emptying position.

Patentansprüche

1. Dosiervorrichtung vom Rotationstyp zur Abgabe großer Mengen einer körnigen Substanz, umfassend ein stationäres Gehäuse (3), welches in seinem oberen Teil eine kreisförmige Einlaßöffnung (7) und in seinem unteren Teil eine kreisförmige Auslaß-

An improvement aimed at facilitating the emptying of the granular substance out of the metering device consists in fixing in the cavity (4) an elastic member, which is capable of restoring the energy of compression to which the contents of the cavity (4) are subjected during the rotation of the spherical core (1). In the mode of embodiment of this improvement shown in Figure 5, a helical spring (11), ballasted at its free end, is fixed on the bottom (6) of the cavity (4). When the opening (5) of the cavity is oriented upwards and placed in communication with the feed orifice (7) the helical spring (11) the upper part of which is below the opening (5) is compressed under the effect of its own weight, the weight of the granular substance which penetrates into the cavity (4) and of the static pressure engendered by the granular substance present in the hopper, not shown in Figure 1, which surmounts the metering device. When the opening (5) of the cavity is then oriented downwards and placed in communication with the outlet orifice (8), the helical spring (11) springs back and causes a shearing force which breaks the force of adhesion between the wall of the cavity (4) and the granular substance, which facilitates the discharge of the latter out of the cavity (4).

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The spherical core of the metering device is designed so as not to permit a direct passage between the feed orifice and the outlet orifice at any instant in the rotation of the spherical core. It is therefore possible to operate the metering device with substantial pressure differences, for example, 5MPa, between the inlet orifice and the outlet orifice.

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and smaller than or equal to the diameter of the outlet orifice (8) of the casing,

- the volume V1 defining the lower part of the cavity (4) and consisting of at least one truncated cone of revolution having at its virtual apex an angle A1 of 10° to 90°, oriented inwardly in relation to the opening (5) of the cavity, and comprising a small circular base and a large circular base of diameter D1,

- the volume V2 defining the upper part of the cavity (4) and consisting of at least one truncated cone of revolution having at its virtual apex an angle A2, such that $0^\circ \leq A2 < A1$, oriented inwardly in relation to the opening (5) of the cavity, and comprising a small circular base of diameter D1 and a large circular base of diameter D corresponding to the opening (5) of the cavity,

- the diameter D and the heights H1 and H2 of the volumes V1 and V2 respectively, being such that $0.1 D \leq (H1 + H2) \leq 1.5 D$, with the proviso that the volume V2 can comprise a cylinder of revolution wherein the diameters D1 and D are equal, and

- (b) a bottom surface (6) corresponding to the small circular base of the volume V1.

2. Device according to Claim 1, characterised in that the volume V2 is a cylinder of revolution and that the ratio of the heights H2/H1 is less than or equal to 2.

3. Device according to Claim 1, characterised in that the bottom surface (6) of the cavity consists of a plain surface or a flattened dome.

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6. Device according to Claim 1, characterised in that two annular or toroidal seals (9) and (10) are arranged between the casing (3) and the spherical core (1), these seals being placed in horizontal planes around the inlet (7) and outlet orifices (8) or in vertical planes parallel to the axis (2) of rotation of the spherical core (1).

7. Process to dispense a given quantity of granular substance, employing the metering device according to one of Claims 1 to 6.

8. Process according to Claim 7, characterised in causing the spherical core (1) to rotate continuously at a constant speed, which is sufficiently slow to enable the cavity (4) successively to fill and empty completely.

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Patentansprüche

1. Dosiervorrichtung vom Rotationstyp zur Abgabe großer Mengen einer körnigen Substanz, umfassend ein stationäres Gehäuse (3), welches in seinem oberen Teil eine kreisförmige Einlaßöffnung (7) und in seinem unteren Teil eine kreisförmige Auslaß-



öffnung (8), die in einer vertikalen Achse angeordnet sind, besitzt, welches Gehäuse (3) einen kugelförmigen, um eine horizontale Achse (2) rotierbaren Kern (1) mit mindestens einem nach außen offenen Hohlraum (4) mit einer kreisförmigen Öffnung (5), und Dichtungen (9) und (10) um die Einlaß- (7) und die Auslaßöffnungen (8) beinhaltet, welche Vorrichtung dadurch gekennzeichnet ist, daß der oder jeder Hohlraum (4) eine Form besitzt, die definiert ist durch:

(a) zwei aufeinanderfolgende Rotationsvolumina V1 und V2 mit einer gemeinsamen, zur Rotationsachse (2) des kugelförmigen Kernes (1) senkrechten Achse, wobei

– die kreisförmige Öffnung (5) einen Durchmesser D aufweist, der gleich dem größten Durchmesser des Hohlraumes (4) und kleiner als oder gleich dem Durchmesser der Auslaßöffnung (8) des Gehäuses ist,

– das Volumen V1 den unteren Teil des Hohlraumes (4) definiert und aus mindestens einem Rotationskegelstumpf besteht, der in Bezug auf die Öffnung (5) des Hohlraumes nach innen orientiert ist, welcher an seiner virtuellen Spitze einen Winkel A1 von 10° bis 90° aufweist, und der eine kleine kreisförmige Basis und eine große kreisförmige Basis vom Durchmesser D1 besitzt,

– das Volumen V2 den oberen Teil des Hohlraumes (4) definiert und aus mindestens einem Rotationskegelstumpf besteht, der in Bezug auf die Öffnung (5) des Hohlraumes nach innen orientiert ist, welcher an seiner virtuellen Spitze einen Winkel A2 aufweist, sodaß $0^\circ \leq A2 < A1$ ist, und der eine kleine kreisförmige Basis vom Durchmesser D1 und eine große kreisförmige Basis vom Durchmesser D, entsprechend der Öffnung (5) des Hohlraumes, besitzt,

– der Durchmesser D und die Höhe H1 und H2 der Volumina V1 bzw. V2 so sind, daß $0,1 D \leq (H1 + H2) \leq 1,5 D$ ist, mit der Maßgabe, daß das Volumen V2 einen Rotationszylinder umfassen kann, worin die Durchmesser D1 und D gleich sind, und

(b) eine Bodenfläche (6), die der kleinen kreisförmigen Basis des Volumens V1 entspricht.

2. Vorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß das Volumen V2 ein Rotationszylinder ist und daß das Verhältnis der Höhen H2/H1 geringer als oder gleich 2 ist.

3. Vorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die Bodenfläche (6) des Hohlraumes aus einer ebenen Fläche oder einer abgeflachten Wölbung besteht.

4. Vorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß im Hohlraum (4) ein elastischer Teil geschaffen wird, um die Entnahme der granulären Substanz zu unterstützen.

5. Vorrichtung nach Anspruch 4, dadurch gekennzeichnet, daß der elastische Teil einer Spiralfeder oder einer metallischen Folie, die am Boden (6) des Hohlraumes fixiert sind, ist.

6. Vorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß zwei ring- oder torusförmige Dichtungen (9) und (10) zwischen dem Gehäuse (3) und dem kugelförmigen Kern (1) angeordnet sind, welche Dichtungen in Horizontalebene um die Ein-

laß- (7) und die Auslaßöffnungen (8) oder in Vertikalebene parallel zur Rotationsachse (2) des kugelförmigen Kernes (1) angebracht sind.

7. Verfahren zur Abgabe einer gegebenen Menge körniger Substanz unter Anwenden der Meßvorrichtung nach einem der Ansprüche 1 bis 6.

8. Verfahren nach Anspruch 7, dadurch gekennzeichnet, daß der kugelförmige Kern (1) veranlaßt wird, kontinuierlich bei einer konstanten Geschwindigkeit zu rotieren, welche ausreichend langsam ist, um zu ermöglichen, daß der Hohlraum (4) nacheinander vollständig befüllt und entleert wird.

9. Verfahren nach Anspruch 7, dadurch gekennzeichnet, daß der kugelförmige Kern (1) veranlaßt wird, diskontinuierlich zu rotieren, so daß der kugelförmige Kern (1) innehält, wenn jeder Hohlraum (4) in einer Füll- und Entleerungsposition ist.

Revendications

1. Dispositif de dosage de type rotatif destiné à distribuer de grandes quantités d'une substance granulaire, comprenant un boîtier fixe (3) ayant, à sa partie supérieure, un orifice circulaire (7) d'entrée et, à sa partie inférieure, un orifice circulaire (8) de sortie disposés suivant un axe vertical, le boîtier (3) contenant une clé sphérique (1) qui peut tourner autour d'un axe horizontal (2) ayant au moins une cavité (4) débouchant vers l'extérieur et ayant une ouverture circulaire (5), et des joints (9) et (10) entourant les orifices d'entrée (7) et de sortie (8), le dispositif étant caractérisé en ce que la cavité (4) ou chaque cavité a une configuration délimitée par:

(a) deux volumes successifs de révolution V1 et V2 ayant un axe commun perpendiculaire à l'axe de rotation (2) de la clé sphérique (1),

– l'ouverture circulaire (5) ayant un diamètre D égal au plus grand diamètre de la cavité (4) et inférieur ou égal au diamètre de l'orifice (8) de sortie du boîtier,

– le volume V1 délimitant la partie inférieure de la cavité (4) et comportant au moins un tronc de cône de révolution dont le sommet virtuel fait un angle A1 compris entre 10° et 90°, orienté vers l'intérieur par rapport à l'ouverture (5) de la cavité, et comportant une petite base circulaire et une grande base circulaire de diamètre D1,

– le volume V2 délimitant la partie supérieure de la cavité (4) et étant formé d'au moins un tronc de cône de révolution ayant, à son sommet virtuel, un angle A2 tel que $0^\circ \leq A2 < A1$, orienté vers l'intérieur par rapport à l'ouverture (5) de la cavité, et comprenant une petite base circulaire de diamètre D1 et une grande base circulaire de diamètre D correspondant à l'ouverture (5) de la cavité,

– le diamètre D et les hauteurs H1 et H2 des volumes V1 et V2 respectivement étant tels que $0,1 D \leq (H1 + H2) \leq 1,5 D$ le volume D2 pouvant être un cylindre de révolution, les diamètres D1 et D étant alors égaux, et

(b) une surface de fond (6) correspondant à la petite base circulaire du volume V1.

2. Dispositif selon la revendication 1, caractérisé



en ce que le volume V2 est un cylindre de révolution, et en ce que le rapport des hauteurs H2/H1 est inférieur ou égal à 2.

3. Dispositif selon la revendication 1, caractérisé en ce que la surface du fond (6) de la cavité est une surface plate ou en dôme aplati.

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4. Dispositif selon la revendication 1, caractérisé en ce qu'un organe élastique est placé dans la cavité (4) afin qu'il facilite l'évacuation de la substance granulaire.

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5. Dispositif selon la revendication 4, caractérisé en ce que l'organe élastique est un ressort hélicoïdal ou une feuille métallique, fixé au fond (6) de la cavité.

6. Dispositif selon la revendication 1, caractérisé en ce que deux joints annulaires ou toroïdaux (9) et (10) sont placés entre le boîtier (3) et la clé sphérique (1), ces joints étant placés dans des plans horizontaux autour des orifices d'entrée (7) et de sortie (8) ou dans des plans verticaux parallèles à l'axe (2) de rotation de la clé sphérique (1).

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7. Procédé de distribution d'une quantité déterminée d'une substance granulaire, mettant en œuvre le dispositif de dosage selon l'une quelconque des revendications 1 à 6.

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8. Procédé selon la revendication 7, caractérisé par la mise de la clé sphérique (1) en rotation continue à une vitesse constante, suffisamment faible pour que la cavité (4) puisse se remplir et se vider complètement de manière successive.

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9. Procédé selon la revendication 7, caractérisé par la mise en rotation discontinue de la clé sphérique (1) de manière que la clé sphérique (1) s'arrête lorsque chaque cavité (4) se trouve dans une position de remplissage et de vidange.

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