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(54) DEVICE FOR MIXING CEMENT SLURRY, AND METHOD AND APPARATUS FOR PRODUCING CEMENT SLURRY

VORRICHTUNG ZUM MISCHEN VON ZEMENTSCHLAMM UND VERFAHREN UND VORRICHTUNG ZUR HERSTELLUNG VON ZEMENTSCHLAMM

DISPOSITIF DE MÉLANGE DE COULIS DE CIMENT, PROCÉDÉ ET APPAREIL DE PRODUCTION DE COULIS DE CIMENT

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Description

[0001] This invention relates to a method for producing cement slurry, and a device for mixing cement slurry usable in that method, as well as an apparatus for producing cement slurry which incorporates the device.

[0002] As is known, cement slurry is a viscous liquid product which comprises a mixture of water and powdered cement, if necessary with the addition of specific additives (for example pigments).

[0003] It may be used either as the base for producing concrete by adding aggregate, or on its own for making various types of construction products (such as paving, plaster, etc.).

[0004] Cement slurry is commonly made by simply mixing water and powdered cement. However, it is known that, the composition being the same, cement slurry obtainable with different mixing actions may have considerably different characteristics. In particular, the composition being the same, the mixing method and its duration may have a major impact both on the workability and cohesion of the cement slurry, and on the mechanical properties of the product after drying. Indeed, cement slurry is not a simple dispersion of solid cement particles in water, but also involves the development of chemical reactions between water and cement, which are rendered evident by the development of heat inside the mass being processed.

[0005] In particular, what the Applicant has observed, is also that, depending on the mixing method adopted (and consequently its duration), it is possible to obtain the same results in terms of both workability (or consistency) and cohesion of the cement slurry, and of mechanical properties of the product after drying.

[0006] Since the main operating cost linked to producing cement slurry is that of the powdered cement used, it immediately appears evident that managing to mix water and cement powder in the optimum way could allow savings in cement powder, and considerably reduce the operating cost of producing the cement slurry.

[0007] However, so far, in most real applications the poor quality of mixing is such that it always requires the use of a quantity of powdered cement much greater than that strictly necessary.

[0008] WO01/28671 and US2015/266206 describe devices according to the preamble of claim 1 and US4904089 describes a method according to the preamble of claim 13.

[0009] In this context the technical purpose which forms the basis of this invention is to provide a method for producing cement slurry and to make a device for mixing cement slurry, which overcome the above-mentioned disadvantages. In particular, the technical purpose of this invention is to provide a method for producing cement slurry, and to make a device for mixing cement slurry, which allow the obtainment of cement slurries with optimum characteristics in terms of both workability (or consistency) and cohesion of the cement slurry, and of mechanical strength properties of the product obtainable after drying, using quantities of cement powder significantly lower than in the methods and devices currently commonly used in the sector.

[0010] A further technical purpose of this invention is to provide a method for producing cement slurry, and to make a device for mixing cement slurry, which allow the production of cement slurry of optimum quality in shorter times than in the plants commonly used.

[0011] The technical purpose and the aims indicated are substantially achieved by a method for producing cement slurry and by a device for mixing cement slurry as described in appended claims.

[0012] Further characteristics and the advantages of this invention will be more apparent from the detailed description of several preferred, non-limiting embodiments of this invention, with reference to the accompanying drawings, in which:

- Figure 1 shows, in vertical axial section (except for some details such as the driving shaft), a device for mixing cement slurry made in accordance with this invention;
- Figure 2 shows an enlarged detail of Figure 1;
- Figure 3 is a front view (from the right compared with Figure 1) of an impeller which is part of the device of Figure 1;
- Figure 4 shows the impeller of Figure 3 in cross-section according to the line IV - IV;
- Figure 5 shows, in an axonometric view, a fixed pierced wall which is part of the device of Figure 1;
- Figure 6 shows the pierced wall of Figure 5 in side view;
- Figure 7 shows, in schematic side view, with some parts transparent, an apparatus for producing cement slurry comprising the device of Figure 1;
- Figure 8 shows, in front view with some parts transparent, the apparatus of Figure 7;
- Figure 9 shows, enlarged, the detail IX of the apparatus of Figure 7;
- Figure 10 shows in schematic side view a part of the apparatus of Figure 7, illustrating several tubes for introducing slurry into the tank; and
- Figure 11 shows, in horizontal section view, perpendicular to the generatrix of the tank and at one of the tubes of Figure 10, a possible distribution of tubes for introducing slurry around the tank.

[0013] Hereinafter there is initially a description of the mixing device which is the subject matter of this invention, followed by the apparatus which comprises it, and finally the method for producing the cement slurry disclosed by this invention.

[0014] It should be noticed that hereinafter in the description of this patent application "cement slurry" and "mixture of water and cement powder" will often be used interchangeably with reference to all of the intermediate production steps. Indeed, whilst it is proper to refer only

to "mixture of water and cement powder" before its processing in accordance with this invention beings, and only to refer to "cement slurry" after the end of the processing, in all of the intermediate processing steps it is possible to consider the product as a mixture being converted into an actual slurry.

[0015] With reference to the figures indicated, the device for mixing cement slurry according to this invention has been labelled with the reference number 1 as a whole.

[0016] As shown in Figure 1 and 2, the device 1 comprises first a containment structure 2 which forms a mixing chamber 3 inside it.

[0017] A driving shaft 4 is mounted with a liquid-tight seal through the containment structure 2, and has a first end 5 positioned in the mixing chamber 3, and a second end 6 which is outside the containment structure 2. The second end 6 is connectable in use to a driving motor suitable for driving the rotation of the driving shaft 4 about its axis of rotation 41.

[0018] In the preferred embodiment, illustrated in the accompanying figures, there is also a supporting structure 7 which is fixed to the containment structure 2 and is suitable for supporting, centring, and keeping in position axially, the driving shaft 4 at an intermediate portion thereof between the first end 5 and the second end 6.

[0019] The containment structure 2 comprises an inlet 8 and an outlet 9, which allow fluid communication between the mixing chamber 3 and the outside. The inlet 8 is aligned with the axis of rotation 41 and is centred on it. Mounted in the mixing chamber 3 there is a pierced wall 10, which is centred on the axis of rotation 41, and which divides the mixing chamber 3 into an inner part 11 and an outer part 12 which are coaxial. The outer part 12 advantageously extends in an annular fashion and surrounds the inner part 11, being positioned in a position radially further out relative to the axis of rotation 41.

[0020] The inlet 8 is directly facing the inner part 11 of the mixing chamber 3, whilst the outlet 9 is facing the outer part 12 of the mixing chamber 3. Therefore, the pierced wall 10 intercepts the fluid paths which extend from the inlet 8 to the outlet 9.

[0021] In the preferred embodiment (Figures 4 and 5), the pierced wall 10 has frustoconical extension coaxial with the axis of rotation 41, and with the larger base of the truncated cone towards the inlet 8 of the mixing chamber 3.

[0022] Advantageously, the pierced wall 10 has a plurality of through holes 13 evenly distributed along the entire extent of the self-same pierced wall 10. In particular, in the embodiment illustrated, the through holes 13 are organised along four circular rows each of sixty equally spaced holes, centred on the axis of rotation 41 and spaced from each other, parallel to the axis of rotation 41, with a constant pitch. Moreover, preferably, the pierced wall 10 has a plurality of through holes 13 each with a passage area of between 40 and 200 mm^2, advantageously of between 60 and 130 mm^2. Moreover, in the preferred embodiments, the pierced wall 10 is made in such a way as to have a ratio of pierced surface area to total surface area facing the mixing chamber 3, of between 1 to 5 and 1 to 3.

[0023] The first end 5 of the driving shaft 4 is positioned at the inner part 11 of the mixing chamber 3, and fixed to it there is a centrifugal impeller 14 also positioned in the inner part 11 of the mixing chamber 3. In use, as described in more detail below, the centrifugal impeller 14, driven to rotate by means of the driving shaft 4, forces the water-based mixture (slurry) to pass from the inner part 11 to the outer part 12 of the mixing chamber 3, through the through holes 13 of the pierced wall 10.

[0024] In general, the centrifugal impeller 14 comprises a plurality of blades 15, but advantageously their number is between 3 and 9. As shown in the accompanying figures, each blade 15 preferably extends cantilever-style, towards the inlet 8, starting from a circular supporting plate 16 located near a wall of the mixing chamber 3. Each blade 15 also has an external edge 17 (that is to say, the edge radially furthest from the axis of rotation 41) which is substantially shaped to match the pierced wall 10 and near it (advantageously the distance between the external edge 17 and the pierced wall 10 is less than 2 mm, preferably less than 1 mm). The profile of the blade 15 is also such that the blade 15 has a height decreasing from its internal edge 18 towards the external edge 17.

[0025] Moreover, in accordance with the preferred embodiments, in use the centrifugal impeller 14 is activated with a speed of rotation of between 500 and 5000 revolutions per minute, and/or a maximum tangential speed of between 10 and 80 m/s.

[0026] Joined to the inlet 8 there is a feed duct 19 and, in accordance with a further innovative aspect of this invention, the feed duct 19 and/or the inlet 8 (the inlet 8 in Figure 1, but in general the one of the two which effectively guides the flow of cement slurry entering the mixing chamber 3) are shaped in such a way as to form at least one introducing duct 20. That introducing duct 20 has a cross-section increasing towards the centrifugal impeller 14, and is directly facing the inner part 11 of the mixing chamber 3 and the centrifugal impeller 14. The aim of the introducing duct 20 is to cause a sudden increase in the pressure of the mixture, faced with a sudden reduction in speed compared with the speed which, the mixture itself, has upstream of the introducing duct 20 (in the accompanying figures the feed duct 19 has a stretch 21 with constant cross-section immediately upstream of the introducing duct 20 with increasing cross-section).

[0027] In particular, in the preferred embodiments, the introducing duct 20 is sized in such a way as to cause, in use, an increase in the pressure of between 0.1 and 1 bar, in the fluid to be mixed which passes through it (that is to say, between entering and exiting the self-same introducing duct 20).

[0028] The mixing device 1 described so far may be inserted in various types of apparatuses 22 for producing cement slurry, and in particular in apparatuses 22 both

of the continuous type (solution not illustrated), and of the batch type (solution illustrated in the accompanying figures).

[0029] In general, all of the apparatuses 22 comprise at least one first mixing device 1, and a feeder 23 of a fluid mixture connected to the feed duct 19. Depending on requirements, the apparatus 22 may also comprise, connected in series to the outlet 9 of the first mixing device 1, one or more further mixing devices 1 which are also mounted in series relative to one another. The use of multiple mixing devices 1 in series is preferably always applied in the case of continuous type apparatuses 22, whilst in the case of batch type apparatuses 22 the use of a single mixing device 1 combined with a system for recirculating the mixture is the preferred solution for limiting the costs of the apparatus 22.

[0030] In the case of continuous type apparatuses 22, the apparatus 22 will comprise a number of mixing devices 1 equal to the number of mixing actions which, at the design stage, has been considered optimal. In contrast, in the case of batch type plants, the slurry will advantageously be made to pass in the mixing device or devices 1 a number of times equal to the number of mixing actions which, at the design stage, has been considered optimal, divided by the number of mixing devices 1 positioned in series which are present.

[0031] In the case of a batch type apparatus 22, the feeder 23 comprises at least one tank 24 connected to the feed duct 19, and at least one return duct 25 (visible only in Figure 10) connected between the outlet 9 of the mixing device 1 (or of the last mixing device 1) and the tank 24. Moreover, advantageously, a stirrer 26 is mounted in the tank 24 for mixing the mixture contained therein, before the mixture is sent to the mixing device 1.

[0032] In the preferred embodiment, illustrated in the accompanying figures, the tank 24 is equipped with one or more delivery openings 27 positioned at its bottom portion, and the stirrer 26 is positioned near the one or more delivery openings 27, in particular just above them. In the case of the embodiment illustrated in the accompanying figures, the stirrer 26 consists of a plurality of angled vanes 28, which are fixed to a vertical shaft 29 which passes through the entire tank 24 and which is driven at the top by an auxiliary electric motor 30 of the apparatus 22. The vanes 28 extend downward from a lower end of the vertical shaft 29, and each of them is adjacent to an underlying conical wall 31 of the tank 24, whose axis coincides with the axis of the vertical shaft 29. The one or more delivery openings 27 which put the tank 24 in fluid communication with the feed duct 19 are made along the perimeter of the lower part of the conical wall 31. It should be noticed that, advantageously, at the stirrer 26, the lateral wall of the tank 24 is near the conical wall 31 (in the embodiment illustrated this stretch of lateral wall is a cylindrical wall with internal diameter equal to the external diameter of the base of the conical wall 31).

[0033] Indeed, advantageously, the tank 24 has a funnel-shaped lateral wall 32 with a cylindrical-shaped upper containment part 33 and a lower part 34 which is also cylindrical which houses the stirrer 26.

[0034] Moreover, preferably, the stirrer 26 is activated with a speed of rotation of between 150 and 500 revolutions per minute, and/or with a maximum tangential speed (at the lower tip of the vanes 28) of between 3 and 50 m/s. As regards operation of the centrifugal impeller 14 of the mixing device 1, a belt drive 35 connects the driving shaft 4 to a main electric motor 36.

[0035] As is schematically illustrated in Figure 10 and 11, in a preferred embodiment of this invention, the return duct 25 comprises a main duct 37 connected to the outlet 9 of the mixing device 1, from which main duct a plurality of tubes 38 branches in parallel, those tubes reaching the tank 24 at different heights (heights measured vertically relative to a common reference).

[0036] Moreover, each tube 38 opens into the tank 24 at the cylindrical lateral wall 32 and according to an introducing line at a tangent to the cylindrical lateral wall 32 (Figure 11).

[0037] Depending on requirements, at a predetermined height there may be a single tube 38 which enters the tank 24, just as it may be the case that the tubes 38 are grouped in groups, with the tubes 38 of each group opening into the tank 24 at the same height, and the tubes 38 of different groups in contrast opening into the tank 24 at different heights. Figure 11 schematically illustrates a group comprising three tubes 38 which enter the tank 24 at the same height.

[0038] Moreover, preferably, the tubes 38 are not all the same as each other; the tubes 38 which open into the tank at a predetermined height have larger cross-sections than the tubes 38 which open into the tank at lower heights. Moreover, in the preferred embodiment, the return duct 25 is as a whole suitable for dividing the flow rate of fluid which passes through it, in such a way that the speed of the mixture which enters the tank 24 through the tubes 38 located at a predetermined height, is greater than the speed of the mixture which enters the tank 24 through the tubes 38 located at higher heights.

[0039] Operation of the apparatus 22 and of the mixing device 1 described above correspond to specific embodiments respectively of the entire method for producing cement slurry according to this invention and of several steps thereof.

[0040] In its most general embodiment, the method comprises first the operating step of incorporating a predetermined quantity of powdered cement, and additives if necessary, in a predetermined volume of water, creating a mixture. During implementation of this step it is appropriate to pay attention to the fact that the cement powder (and additives if necessary) mix with the water, avoiding, or in any case minimising, the formation of lumps or the powder floating on the water. Since the step of incorporating the cement powder in the water while avoiding lumps and floating is in itself part of the normal know-how of the cement slurry production sector, it will not be described in further detail herein.

[0041] Once the cement powder has been incorporated in the water and the mixture has been formed, the mixture is subjected to a mixing step (carried out with the stirrer 26 in the apparatus 22 described above) and, then, to a step during which the mixture is fed along a duct (the feed duct 19 in the apparatus 22 described above) and is fed to a centrifugal impeller 14 (that of the mixing device 1 described above).

[0042] However, in accordance with this invention, at mixture entry into the centrifugal impeller 14, there is a step of varying the pressure and the average feed speed of the mixture, during which the average feed speed of the mixture is reduced, with simultaneous generation of an increase in the pressure of the mixture which will strike the centrifugal impeller 14. Preferably, the pressure increase which is generated during this step is between 0.1 and 1 bar.

[0043] Finally, the method comprises a step during which the mixture exiting the centrifugal impeller 14 is forced through a fixed pierced wall 10 which radially surrounds the centrifugal impeller 14, partly reducing its tangential motion components and increasing the counterpressure downstream of the self-same centrifugal impeller 14.

[0044] In most embodiments, the steps described above of feeding the mixture, reducing the speed, increasing the pressure and pushing the mixture, are repeated a plurality of times. Advantageously, the repetition may be performed either by making the mixture circulate a plurality of times through the same mixing device 1, or making it pass in sequence through various mixing devices 1 in series.

[0045] Particularly in the case of use of multiple passes in a single mixing device 1, it is advantageously the case that the step of mixing the mixture is also repeated before each repetition of the step of feeding the mixture. Moreover, in the preferred embodiment, the (or each) step of mixing the mixture is advantageously carried out using a stirrer 26 located in a lower part of a cylindrical tank 24 having a predetermined internal diameter, and keeping a height of the mixture above the stirrer 26 which is in a ratio relative to the internal diameter, of between 3 to 1 and 5 to 1.

[0046] This invention brings important advantages.

[0047] First, thanks to this invention it has been possible to provide a method for producing cement slurry, and to make a device for mixing cement slurry, which according to the results of experimental tests carried out by the Applicant, allow the obtainment of cement slurries with optimum characteristics in terms of both workability (consistency) and cohesion, and of mechanical properties of the product after drying, using quantities of cement powder significantly lower than in the methods and devices currently commonly used in the sector.

[0048] Second, thanks to this invention it is possible to produce cement slurries of optimum quality in shorter times than in the plants commonly used. Therefore, thanks to this invention, it has been possible to provide a method for producing cement slurry, and to make a device for mixing cement slurry, which allow the obtainment of greater economies in the production of cement slurry and if necessary of concrete than has been possible until now, as well as allowing a more favourable water/cement ratio (understood to be the quantity by weight) than the prior art methods and devices, by virtue of the improved homogenisation which can be achieved between cement and water.

[0049] Finally, it should be noticed that this invention is relatively easy to produce and that even the cost linked to implementing the invention is not very high.

Claims

1. A device for mixing cement slurry, comprising:

a containment structure (2) which forms a mixing chamber (3) inside it;
a driving shaft (4) mounted through the containment structure (2), and which has a first end (5) positioned in the mixing chamber (3), and a second end (6) outside the containment structure (2) and in use connectable to a driving motor, the driving shaft (4) having an axis of rotation (41);
a pierced wall (10) mounted in the mixing chamber (3), the pierced wall (10) being centred on the axis of rotation (41) and dividing the mixing chamber (3) into an inner part (11) and an annular outer part (12) which are coaxial; and
a centrifugal impeller (14), fixed to the first end (5) of the driving shaft (4) and positioned in the inner part (11) of the mixing chamber (3), in use the centrifugal impeller (14) forcing a water-based mixture to pass through the pierced wall (10);

wherein moreover:

the containment structure (2) comprises an inlet (8), centred relative to the axis of rotation (41) and facing the inner part (11) of the mixing chamber (3), and an outlet (9) facing the outer part (12) of the mixing chamber (3), the pierced wall (10) intercepting a fluid path which extends from the inlet (8) to the outlet (9);
a feed duct (19) is joined to the inlet (8); and **characterized in that**
the feed duct (19) and/or the inlet (8) are shaped in such a way as to form at least one introducing duct (20) with cross-section increasing towards the centrifugal impeller (14), directly facing the inner part (11) of the mixing chamber (3).

2. The device according to claim 1, wherein the pierced wall (10) has frustoconical extension coaxial with the

axis of rotation (41), with a larger base of the truncated cone towards the inlet (8).

3. The device according to claim 1 or 2, wherein the pierced wall (10) has a plurality of evenly distributed through holes (13), and/or has a plurality of through holes (13) each with a passage area of between 40 and 200 mm^2, preferably between 60 and 130 mm^2, and/or has a ratio of pierced surface area to total surface area of between 1 to 5 and 1 to 3.

4. The device according to any of claims 1 to 3, wherein the centrifugal impeller (14) comprises a plurality of blades (15), each having a radially external edge which is substantially shaped to match the pierced wall (10) and near it.

5. The device according to any of claims 1 to 4, wherein the centrifugal impeller (14) comprises between 3 and 9 blades (15), and/or has a speed of rotation of between 500 and 5000 revolutions per minute, and/or has a maximum tangential speed of between 10 and 80 m/s.

6. The device according to any of claims 1 to 5, wherein the introducing duct (20) is sized in such a way as to cause, in use, an increase in the pressure in the fluid to be mixed which passes through it, of between 0.1 and 1 bar.

7. An apparatus for producing cement slurry comprising:

at least one first mixing device (1) according to any of the preceding claims; and
a feeder (23) of a fluid mixture connected to said feed duct (19).

8. The apparatus for producing cement slurry according to claim 7, also comprising, connected to the outlet (9) of the first mixing device (1), one or more further mixing devices (1) mounted in series relative to one another.

9. The apparatus for producing cement slurry according to claim 7, wherein the apparatus (22) is of the batch type, wherein the feeder (23) comprises at least one tank (24), at least one return duct (25) connected between the outlet (9) of the mixing device (1) and the tank (24), and a stirrer (26) mounted in the tank (24), and wherein the tank (24) is connected to the feed duct (19).

10. The apparatus for producing cement slurry according to claim 9, wherein the tank (24) is equipped with one or more delivery openings (27) positioned at its bottom portion, and wherein the stirrer (26) is positioned near the delivery opening.

11. The apparatus for producing cement slurry according to claim 9 or 10, wherein the tank (24) has a cylindrical lateral wall (32), wherein the return duct (25) comprises a main duct (37) connected to the outlet (9) from which main duct a plurality of tubes (38) branches in parallel, and wherein each tube (38) opens into the tank (24), at the cylindrical lateral wall (32) and according to an introducing line at a tangent to the cylindrical lateral wall (32).

12. The apparatus for producing cement slurry according to claim 11, wherein said tubes (38) are grouped in groups, wherein the tubes (38) of each group open into the tank (24) at the same height, wherein the tubes (38) of different groups open into the tank (24) at different heights, and wherein the tubes (38) which open into the tank at greater heights, have larger cross-sections than the tubes (38) which open into the tank at lower heights.

13. A method for producing cement slurry comprising the operating steps of:

incorporating a predetermined quantity of powdered cement, and additives if necessary, in a predetermined volume of water, creating a mixture;
mixing the mixture;
then feeding the mixture along a duct for feeding it to a centrifugal impeller (14); **characterized by**
at mixture entry into the centrifugal impeller (14), reducing the average feed speed of the mixture and generating an increase in the pressure of the mixture; and
by means of the centrifugal impeller (14), pushing the mixture through a fixed pierced wall (10) which radially surrounds the centrifugal impeller (14).

14. The method according to claim 13, wherein the steps of feeding the mixture, reducing the speed, increasing the pressure and pushing the mixture, are repeated a plurality of times.

15. The method according to claim 14, wherein the step of mixing the mixture is also repeated before each repetition of the step of feeding the mixture.

16. The method according to claim 15, wherein the step of mixing the mixture is carried out using a stirrer (26) located in a lower part of a cylindrical tank (24) having an internal diameter, and keeping a height of the mixture above the stirrer (26) which is in a ratio relative to the internal diameter, of between 3 to 1 and 5 to 1.

17. The method according to any of claims 13 to 16, wherein during the step of generating an increase in

the pressure of the mixture the pressure is increased by a value of between 0.1 and 1 bar.

Patentansprüche

1. Eine Vorrichtung zum Mischen von Zementschlamm, Folgendes umfassend:

   eine Behälterstruktur (2), die in ihrem Inneren eine Mischkammer (3) bildet;
   eine Antriebswelle (4), die durch die Behälterstruktur (2) hindurch montiert ist und die ein erstes Ende (5) hat, das in der Mischkammer (3) positioniert ist, und ein zweites Ende (6) außerhalb der Behälterstruktur (2), und die im Gebrauch an einen Antriebsmotor anschließbar ist, die Antriebswelle (4) hat dabei eine Rotationsachse (41);
   eine perforierte Wand (10), die in der Mischkammer (3) montiert ist, die perforierte Wand (10) ist dabei an der Rotationsachse (41) zentriert und trennt die Mischkammer (3) in einen inneren Teil (11) und einen ringförmigen äußeren Teil (12), die koaxial sind; und
   ein Radiallaufrad (14), das am ersten Ende (5) der Antriebswelle (4) befestigt ist und im inneren Teil (11) der Mischkammer (3) positioniert ist, im Gebrauch forciert das Radiallaufrad (14) dabei, dass eine Mischung auf Wasserbasis durch die perforierte Wand (10) hindurch fließt;

   worin außerdem:

   die Behälterstruktur (2) einen Einlauf (8) beinhaltet, der im Verhältnis zur Rotationsachse (41) zentriert ist und zum inneren Teil (11) der Mischkammer (3) gerichtet ist, und einen Auslauf (9), der zum äußeren Teil (12) der Mischkammer (3) gerichtet ist, die perforierte Wand (10) unterbricht dabei einen Verlauf einer Flüssigkeit, der sich vom Eingang (8) zum Auslauf (9) erstreckt; ein Zufuhrkanal (19) mit dem Einlauf (8) verbunden ist; und **dadurch gekennzeichnet, dass** der Zufuhrkanal (19) und/oder der Einlauf (8) solcherart geformt sind, dass sie mindestens einen Einführungskanal (20) mit einem Querschnitt, der in Richtung des Radiallaufrads (14) zunimmt und dabei direkt zum inneren Teil (11) der Mischkammer (3) gerichtet ist, bilden.

2. Die Vorrichtung nach dem Patentanspruch 1, wobei die perforierte Wand (10) eine kegelstumpfförmige Ausdehnung hat, die koaxial zur Rotationsachse (41) ist, mit einer breiteren Grundfläche des abgestumpften Kegels in Richtung des Einlaufs (8).

3. Die Vorrichtung nach dem Patentanspruch 1 oder 2, wobei die perforierte Wand (10) eine Mehrzahl gleichmäßig verteilter Durchgangsbohrungen (13) hat und/oder eine Mehrzahl von Durchgangsbohrungen (13) hat, die jeweils einen Durchgangsbereich zwischen 40 und 200 mm^2 haben, vorzugweise zwischen 60 und 130 mm^2, und/oder ein Verhältnis zwischen perforierter Fläche und Gesamtfläche zwischen 1 zu 5 und 1 zu 3 hat.

4. Die Vorrichtung nach jedem der Patentansprüche 1 bis 3, wobei das Radiallaufrad (14) eine Mehrzahl von Schaufeln (15) beinhaltet, von denen jede eine radiale Außenkante hat, die im Wesentlichen so geformt ist, dass sie zur perforierten Wand (10) passt und in deren Nähe ist.

5. Die Vorrichtung nach jedem der Patentansprüche 1 bis 4, wobei das Radiallaufrad (14) zwischen 3 und 9 Schaufeln (15) umfasst und/oder eine Rotationsgeschwindigkeit zwischen 500 und 5000 Umdrehungen pro Minute hat und/oder eine maximale Tangentialgeschwindigkeit zwischen 10 und 80 m/s hat.

6. Die Vorrichtung nach jedem der Patentansprüche 1 bis 5, wobei der Einführungskanal (20) so bemessen ist, dass er im Gebrauch eine Erhöhung des Drucks der zu mischenden Flüssigkeit, die durch ihn durchfließt, zwischen 0,1 und 1 bar verursacht.

7. Eine Apparatur zur Herstellung von Zementschlamm, Folgendes umfassend:

   mindestens eine erste Mischvorrichtung (1) nach jedem der vorherigen Patentansprüche; und
   einen Förderer (23) einer Flüssigkeitsmischung, die mit besagtem Zufuhrkanal (19) verbunden ist.

8. Die Apparatur zur Herstellung von Zementschlamm nach dem Patentanspruch 7, auch - verbunden mit dem Auslauf (9) der ersten Mischvorrichtung (1) - eine oder mehrere weitere Mischvorrichtungen (1) beinhaltend, die im Verhältnis zueinander seriell montiert sind.

9. Die Apparatur zur Herstellung von Zementschlamm nach dem Patentanspruch 7, wobei es sich um eine Apparatur (22) mit Dosierung handelt, wobei der Förderer (23) mindestens einen Tank (24), mindestens einen Rückführungskanal (25), der zwischen dem Auslauf (9) der Mischvorrichtung (1) und dem Tank (24) montiert ist, und ein Rührwerk (26), das im Tank (24) montiert ist, beinhaltet und wobei der Tank (24) mit dem Zufuhrkanal (19) verbunden ist.

10. Die Apparatur zur Herstellung von Zementschlamm nach dem Patentanspruch 9, wobei der Tank (24)

mit einer oder mehreren Ausgabeöffnungen (27) ausgestattet ist, die in seinem Bodenabschnitt positioniert sind, und wobei das Rührwerk (26) in der Nähe der Ausgabeöffnung positioniert ist.

11. Die Apparatur zur Herstellung von Zementschlamm nach dem Patentanspruch 9 oder 10, wobei der Tank (24) eine zylindrische Seitenwand (32) hat, wobei der Rückführungskanal (25) einen Hauptkanal (37) beinhaltet, der mit dem Auslauf (9) verbunden ist, wobei sich von diesem Hauptkanal eine Mehrzahl von Rohren (38) parallel verzweigen, und wobei sich jedes Rohr (38) an der zylindrischen Seitenwand (32) und in Übereinstimmung mit einer Einführungslinie tangential zur zylindrischen Seitenwand (32) in den Tank (24) öffnet.

12. Die Apparatur zur Herstellung von Zementschlamm nach dem Patentanspruch 11, wobei besagte Rohre (38) in Gruppen gruppiert sind, wobei sich die Rohre (38) jeder Gruppe in derselben Höhe in den Tank (24) öffnen, wobei sich die Rohre (38) verschiedener Gruppen in verschiedenen Höhen in den Tank (24) öffnen und wobei die Rohre (38), die sich in größeren Höhen in den Tank öffnen, breitere Querschnitte haben als die Rohre (38), die sich in niedrigeren Höhen in den Tank öffnen.

13. Ein Verfahren zur Herstellung von Zementschlamm, folgende Arbeitsschritte umfassend: Aufnahme einer vorher festgelegten Menge von Zementstaub und gegebenenfalls von Zusatzstoffen in einem vorher festgelegten Volumen an Wasser, dabei eine Mischung herstellend;

Mischen der Mischung;
dann Zuführung der Mischung durch einen Kanal, um damit ein Radiallaufrad (14) zu beschicken;
gekennzeichnet dadurch, dass
beim Einfließen der Mischung in das Radiallaufrad (14) die durchschnittliche Zufuhrgeschwindigkeit der Mischung gesenkt wird und eine Erhöhung des Drucks der Mischung erzeugt wird; und
mithilfe des Radiallaufrads (14) die Mischung durch eine feststehende perforierte Wand (10) gedrückt wird, die das Radiallaufrad (14) radial umringt.

14. Das Verfahren nach dem Patentanspruch 13, wobei die Schritte der Zufuhr der Mischung, der Senkung der Geschwindigkeit, der Erhöhung des Drucks und des Durchdrückens der Mischung mehrere Male wiederholt werden.

15. Das Verfahren nach dem Patentanspruch 14, wobei der Schritt des Mischens der Mischung vor jeder Wiederholung des Schritts der Zufuhr der Mischung ebenfalls wiederholt wird.

16. Das Verfahren nach dem Patentanspruch 15, wobei der Schritt des Mischens der Mischung unter Verwendung eines Rührwerks (26) ausgeführt wird, das sich in einem unteren Teil eines zylindrischen Tanks (24) befindet, der einen Innendurchmesser hat und der die Mischung auf einer Höhe oberhalb des Rührwerks (26) hält, die zum Innendurchmesser in einem Verhältnis zwischen 3 zu 1 und 5 zu 1 ist.

17. Das Verfahren nach jedem der Patentansprüche 13 bis, wobei während des Schritts der Erzeugung einer Erhöhung des Drucks auf die Mischung der Druck um einen Wert zwischen 0,1 und 1 bar erhöht wird.

Revendications

1. Un dispositif de mélange de coulis de ciment, comprenant :

une structure de confinement (2) qui forme une chambre de mélange (3) à l'intérieur d'elle ;
un arbre d'entraînement (4) monté à travers la structure de confinement (2), et qui a une première extrémité (5) positionnée dans la chambre de mélange (3), et une deuxième extrémité (6) à l'extérieur de la structure de confinement (2) et pouvant être reliée, en utilisation, à un moteur d'entraînement, l'arbre d'entraînement (4) ayant un axe de rotation (41) ;
une paroi perforée (10) montée dans la chambre de mélange (3), la paroi perforée (10) étant centrée sur l'axe de rotation (41) et divisant la chambre de mélange (3) en une partie intérieure (11) et une partie extérieure (12) annulaire qui sont coaxiales ; et
un rotor centrifuge (14), fixé à la première extrémité (5) de l'arbre d'entraînement (4) et positionné dans la partie intérieure (11) de la chambre de mélange (3), en utilisation le rotor centrifuge (14) forçant un mélange à base d'eau à passer à travers la paroi perforée (10) ;

dans lequel en outre :

la structure de confinement (2) comprend une entrée (8), centrée par rapport à l'axe de rotation (41) et faisant face à la partie intérieure (11) de la chambre de mélange (3), et une sortie (9) faisant face à la partie extérieure (12) de la chambre de mélange (3), la paroi perforée (10) interceptant un parcours de fluide qui s'étend de l'entrée (8) à la sortie (9) ;
un conduit d'alimentation (19) est raccordé à l'entrée (8) ; et **caractérisé en ce que** le conduit

d'alimentation (19) et/ou l'entrée (8) sont conformés de manière à former au moins un conduit d'admission (20) ayant une section transversale croissant vers le rotor centrifuge (14), directement face à la partie intérieure (11) de la chambre de mélange (3).

2. Le dispositif selon la revendication 1, dans lequel la paroi perforée (10) a une extension tronco-conique coaxiale à l'axe de rotation (41), avec une grande base du cône tronqué orientée vers l'entrée (8).

3. Le dispositif selon la revendication 1 ou 2, dans lequel la paroi perforée (10) a une pluralité de trous traversants (13) uniformément répartis, et/ou a une pluralité de trous traversants (13) chacun avec une zone de passage comprise entre 40 et 200 mm^2, de préférence entre 60 et 130 mm^2, et/ou a un rapport entre surface perforée et surface totale allant de 1 à 5 et de 1 à 3.

4. Le dispositif selon l'une quelconque des revendications de 1 à 3, dans lequel le rotor centrifuge (14) comprend une pluralité de pales (15), chacune ayant un bord radialement externe qui est essentiellement conformé pour correspondre à la paroi perforée (10) et à proximité de celle-ci.

5. Le dispositif selon l'une quelconque des revendications de 1 à 4, dans lequel le rotor centrifuge (14) comprend entre 3 et 9 pales (15), et/ou a une vitesse de rotation comprise entre 500 et 5 000 tours par minute, et/ou a une vitesse tangentielle maximale comprise entre 10 et 80 m/s.

6. Le dispositif selon l'une quelconque des revendications de 1 à 5, dans lequel le conduit d'admission (20) est dimensionné de manière à déterminer, en utilisation, une augmentation de la pression dans le fluide à mélanger qui passe à travers lui, comprise entre 0,1 et 1 bar.

7. Un appareil de production de coulis de ciment comprenant :

au moins un premier dispositif de mélange (1) selon l'une quelconque des revendications précédentes ; et
un alimentateur (23) d'un mélange fluide raccordé audit conduit d'alimentation (19).

8. L'appareil de production de coulis de ciment selon la revendication 7, comprenant également, raccordés à la sortie (9) du premier dispositif de mélange (1), un ou plusieurs autres dispositifs de mélange (1) montés en série les uns par rapport aux autres.

9. L'appareil de production de coulis de ciment selon la revendication 7, dans lequel l'appareil (22) est de type discontinu, dans lequel l'alimentateur (23) comprend au moins un réservoir (24), au moins un conduit de retour (25) relié entre la sortie (9) du dispositif de mélange (1) et le réservoir (24), et un agitateur (26) monté dans le réservoir (24), et dans lequel le réservoir (24) est raccordé au conduit d'alimentation (19).

10. L'appareil de production de coulis de ciment selon la revendication 9, dans lequel le réservoir (24) est équipé d'une ou plusieurs ouvertures de distribution (27) positionnées au niveau de sa portion de fond, et dans lequel l'agitateur (26) est positionné à proximité de l'ouverture de distribution.

11. L'appareil de production de coulis de ciment selon la revendication 9 ou 10, dans lequel le réservoir (24) a une paroi latérale (32) cylindrique, dans lequel le conduit de retour (25) comprend un conduit principal (37) raccordé à la sortie (9), une pluralité de tubes (38) se ramifiant en parallèle à partir dudit conduit principal, et dans lequel chaque tube (38) débouche dans le réservoir (24), au niveau de la paroi latérale (32) cylindrique et selon une direction d'admission tangente à la paroi latérale (32) cylindrique.

12. L'appareil de production de coulis de ciment selon la revendication 11, dans lequel lesdits tubes (38) sont regroupés en groupes, dans lequel les tubes (38) de chaque groupe débouchent dans le réservoir (24) à la même hauteur, dans lequel les tubes (38) de groupes différents débouchent dans le réservoir (24) à des hauteurs différentes, et dans lequel les tubes (38) qui débouchent dans le réservoir à des hauteurs supérieures ont des sections transversales plus grandes que les tubes (38) qui débouchent dans le réservoir à des hauteurs inférieures.

13. Un procédé de production de coulis de ciment comprenant les étapes opérationnelles consistant à :

incorporer une quantité prédéfinie de ciment en poudre, et des additifs si nécessaire, dans un volume d'eau prédéfini, afin de créer un mélange ;
mélanger le mélange ;
puis faire avancer le mélange le long d'un conduit pour l'alimenter à un rotor centrifuge (14) ;
caractérisé en ce que
au niveau d'une entrée du mélange dans le rotor centrifuge (14), diminuer la vitesse moyenne d'avance du mélange et générer une augmentation de la pression du mélange ; et
au moyen du rotor centrifuge (14), pousser le mélange à travers une paroi perforée (10) fixe qui entoure radialement le rotor centrifuge (14).

14. Le procédé selon la revendication 13, dans lequel les étapes consistant à faire avancer le mélange, à diminuer la vitesse, à augmenter la pression et à pousser le mélange, sont répétées une pluralité de fois.

15. Le procédé selon la revendication 14, dans lequel l'étape consistant à mélanger le mélange est elle aussi répétée avant chaque répétition de l'étape d'avance du mélange.

16. Le procédé selon la revendication 15, dans lequel l'étape consistant à mélanger le mélange est effectuée en utilisant un agitateur (26) situé dans une partie inférieure d'un réservoir cylindrique (24) ayant un diamètre intérieur, et en maintenant une hauteur du mélange au-dessus de l'agitateur (26) qui est un rapport relativement au diamètre intérieur, allant de 3 à 1 et de 5 à 1.

17. Le procédé selon l'une quelconque des revendications de 13 à 16, dans lequel, pendant l'étape consistant à générer une augmentation de la pression du mélange, la pression est augmentée d'une valeur comprise entre 0,1 et 1 bar.

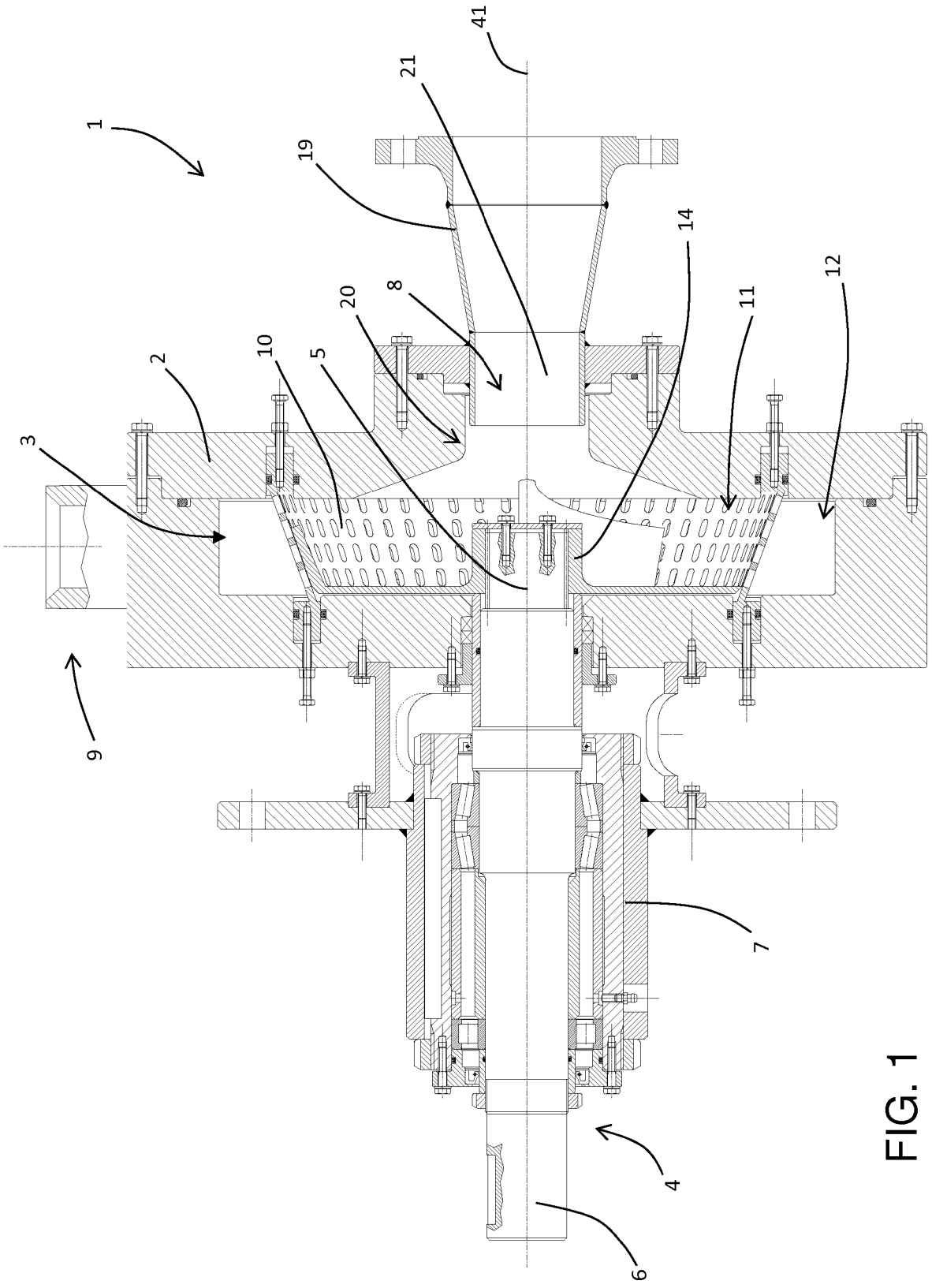


FIG. 1

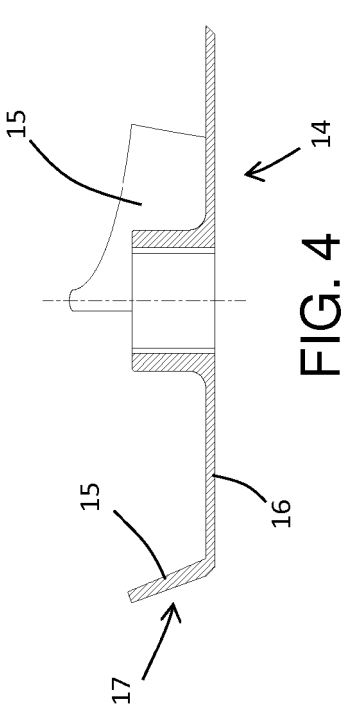


FIG. 4

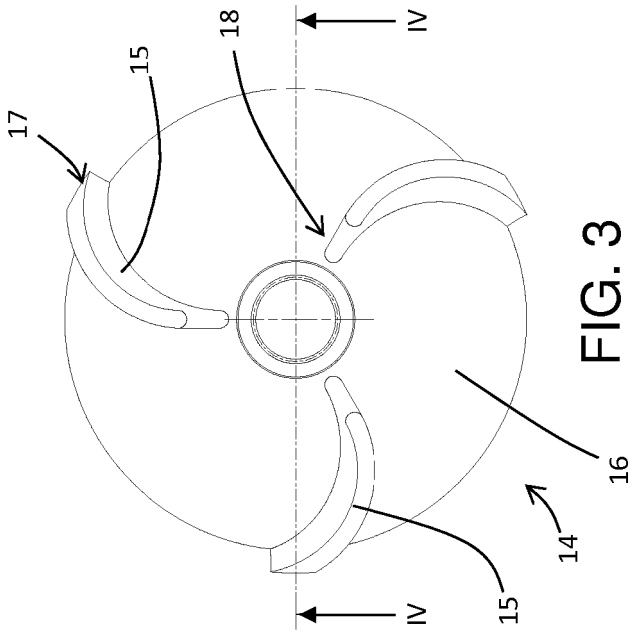


FIG. 3

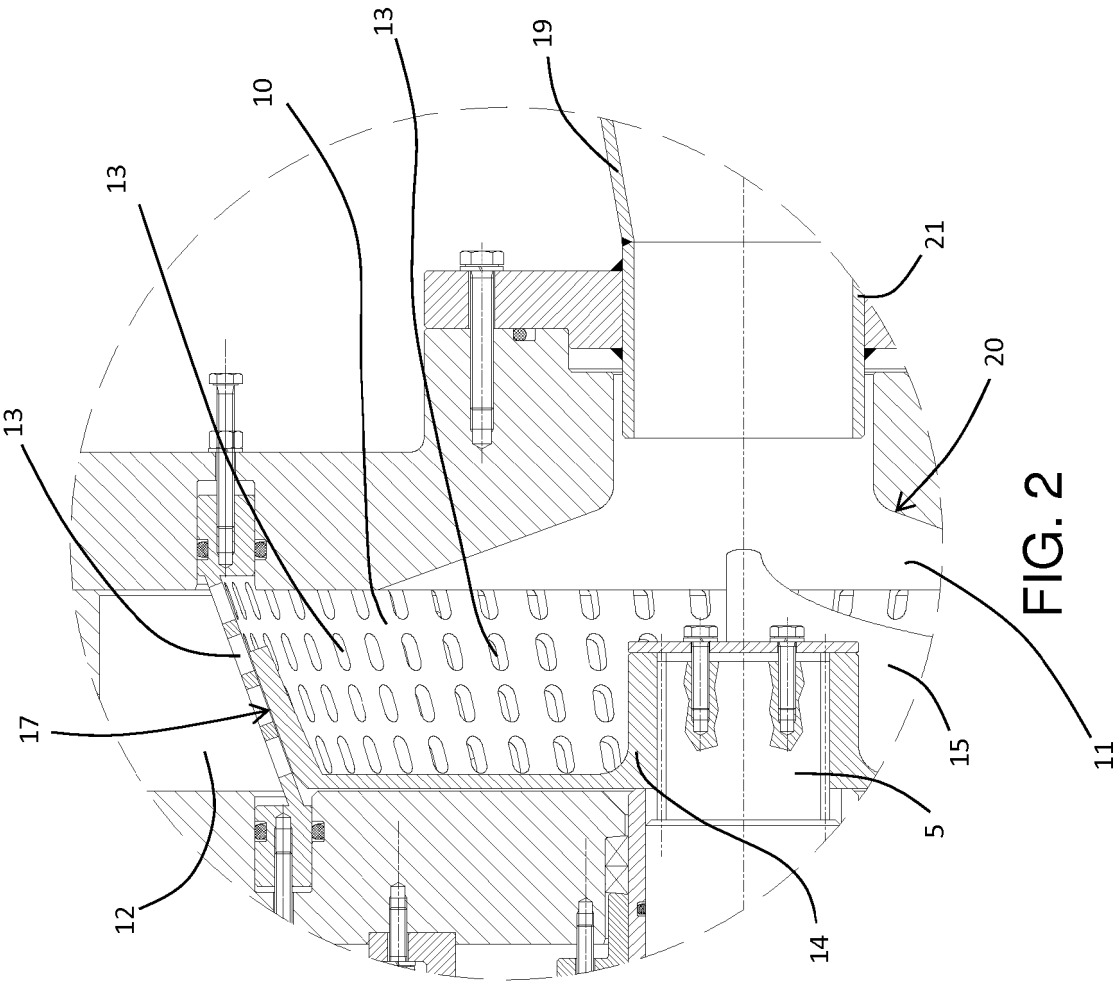


FIG. 2

FIG. 6

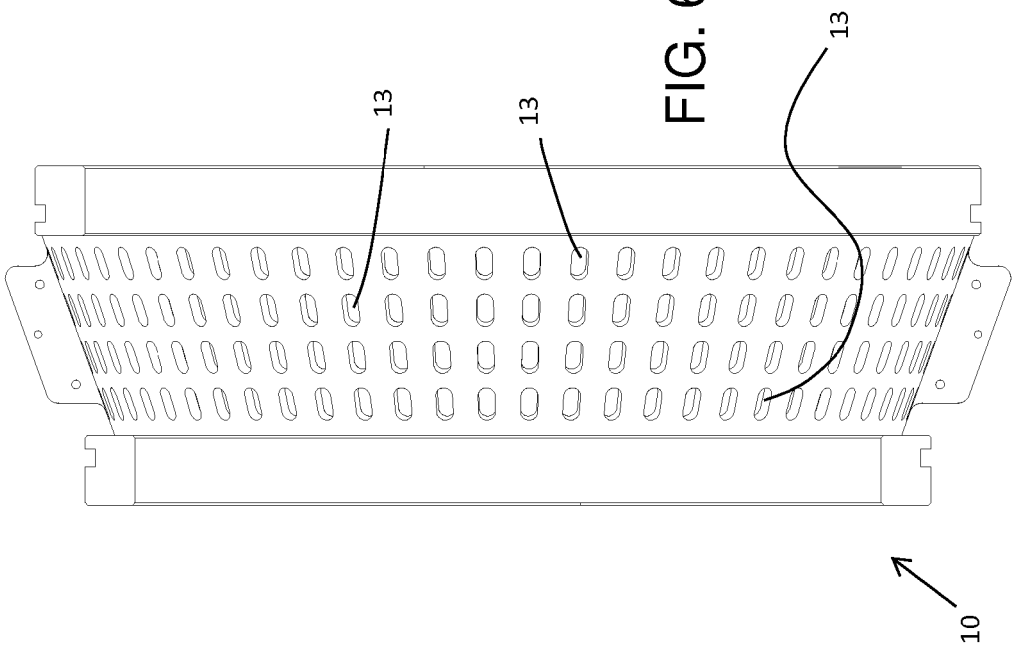
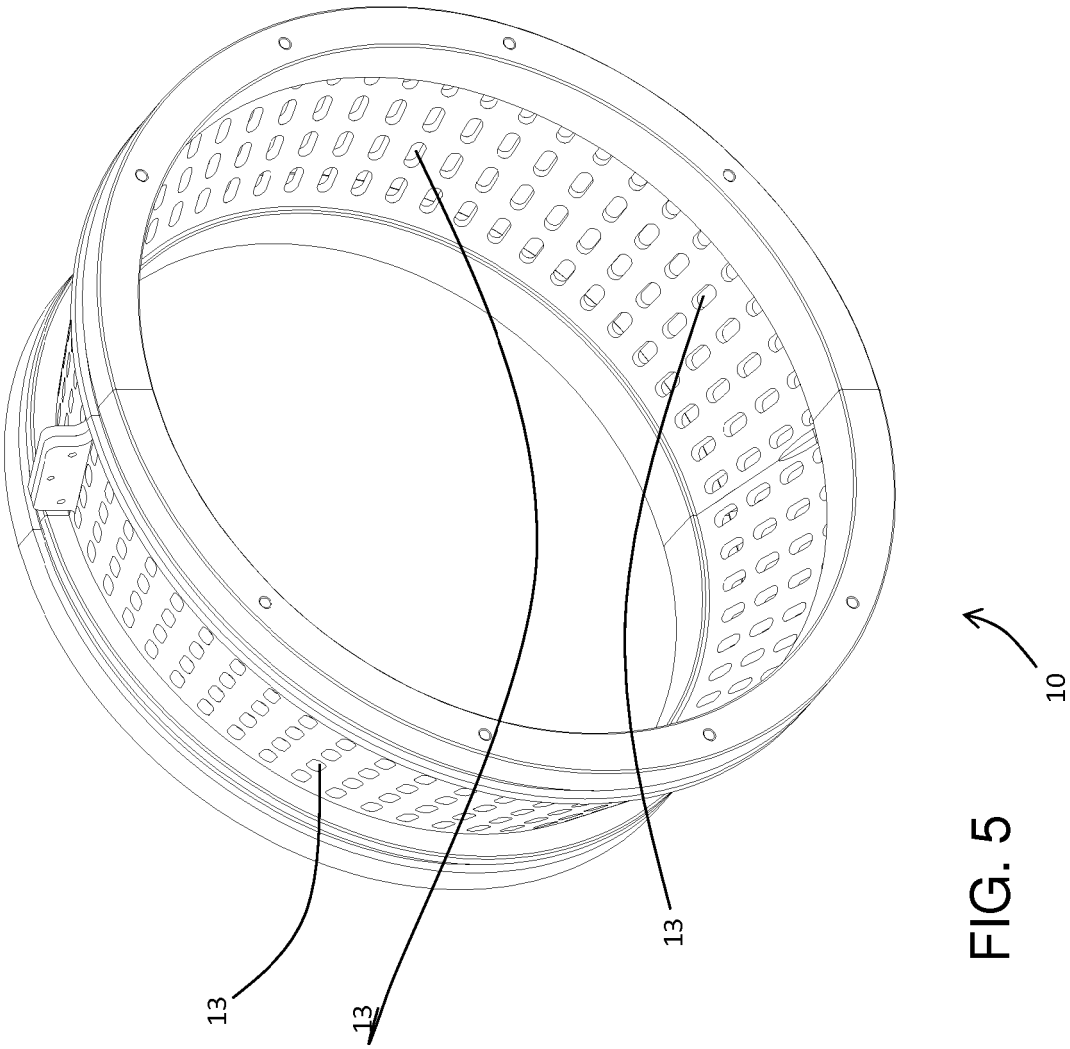


FIG. 5



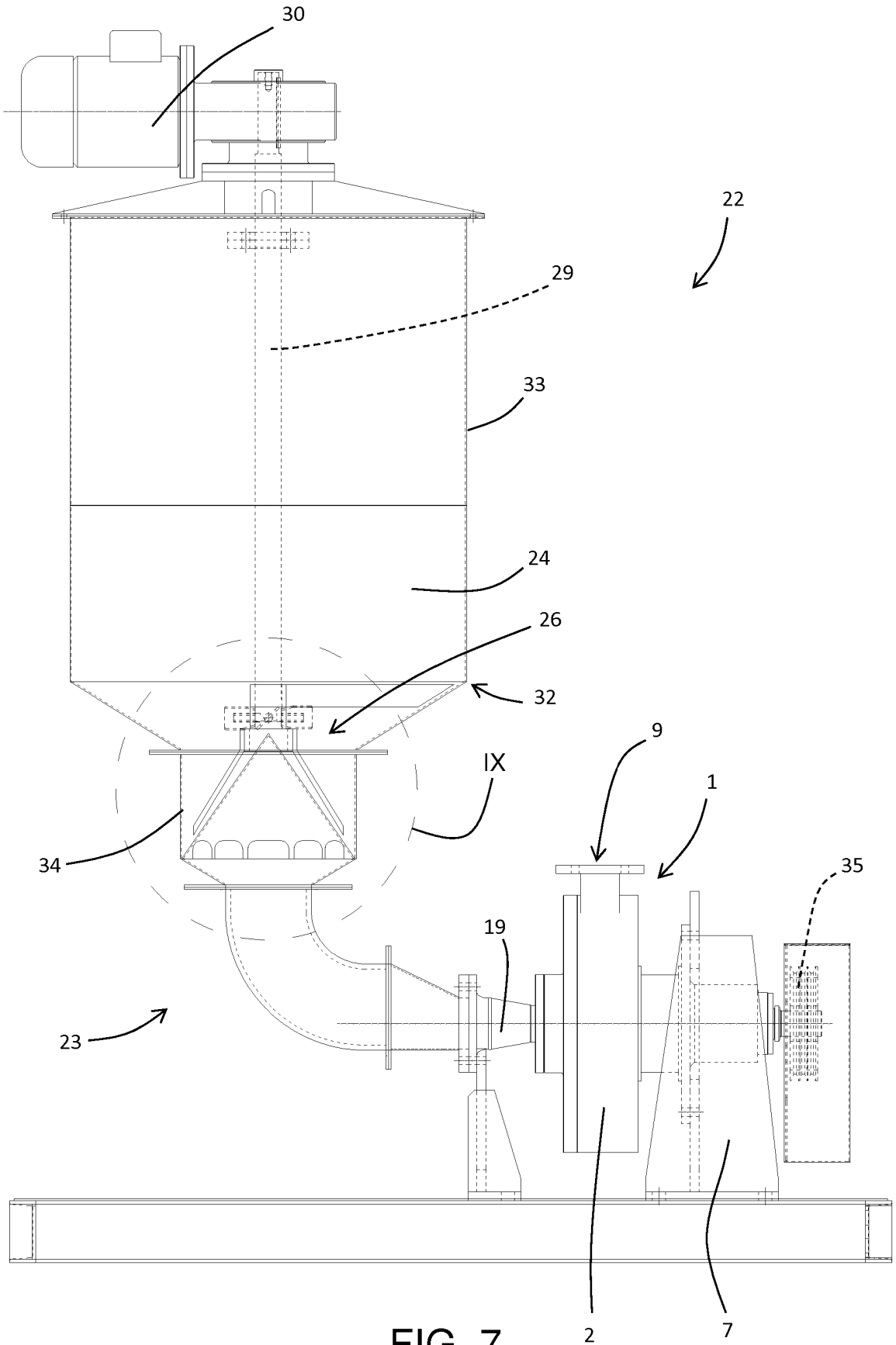


FIG. 7

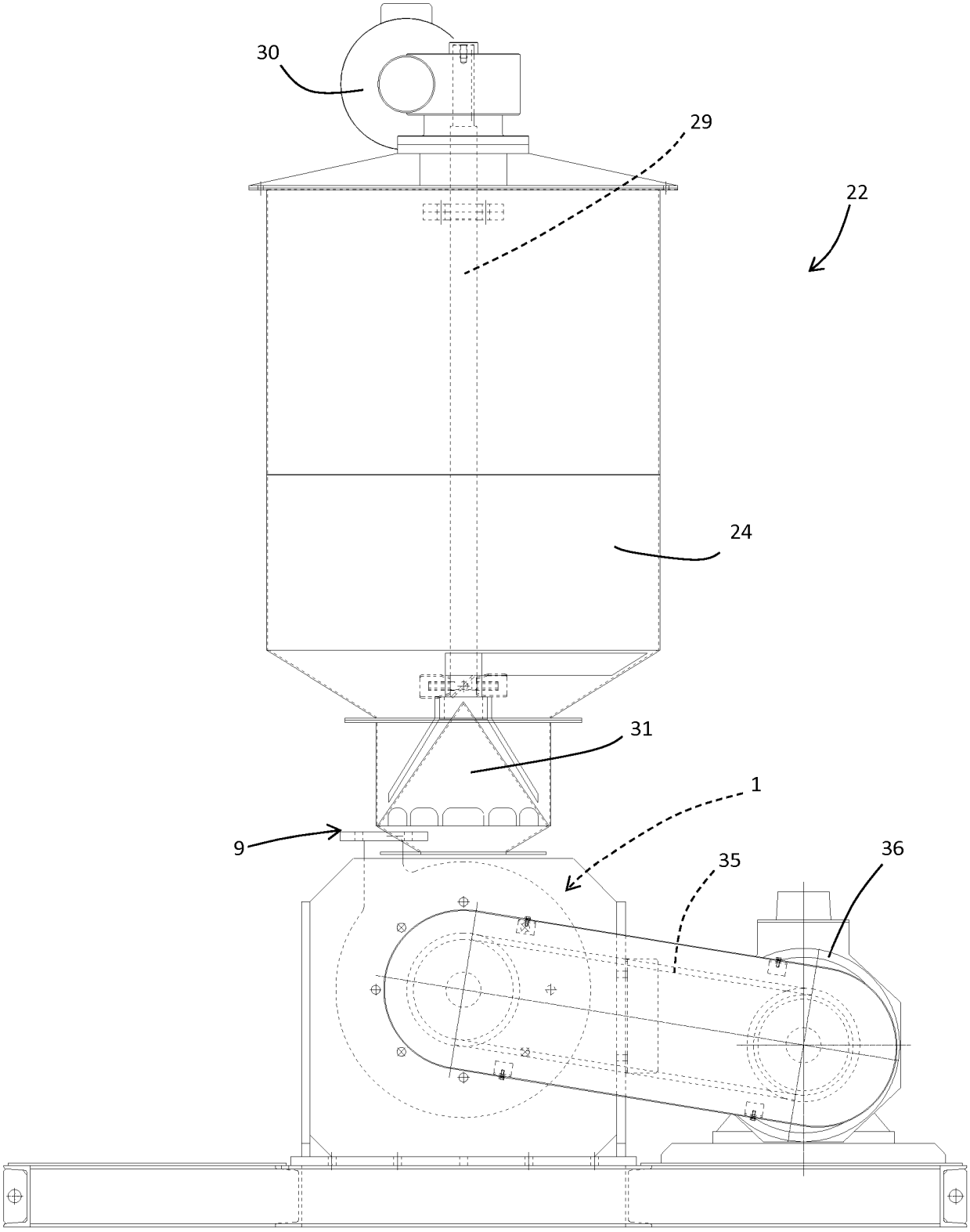


FIG. 8

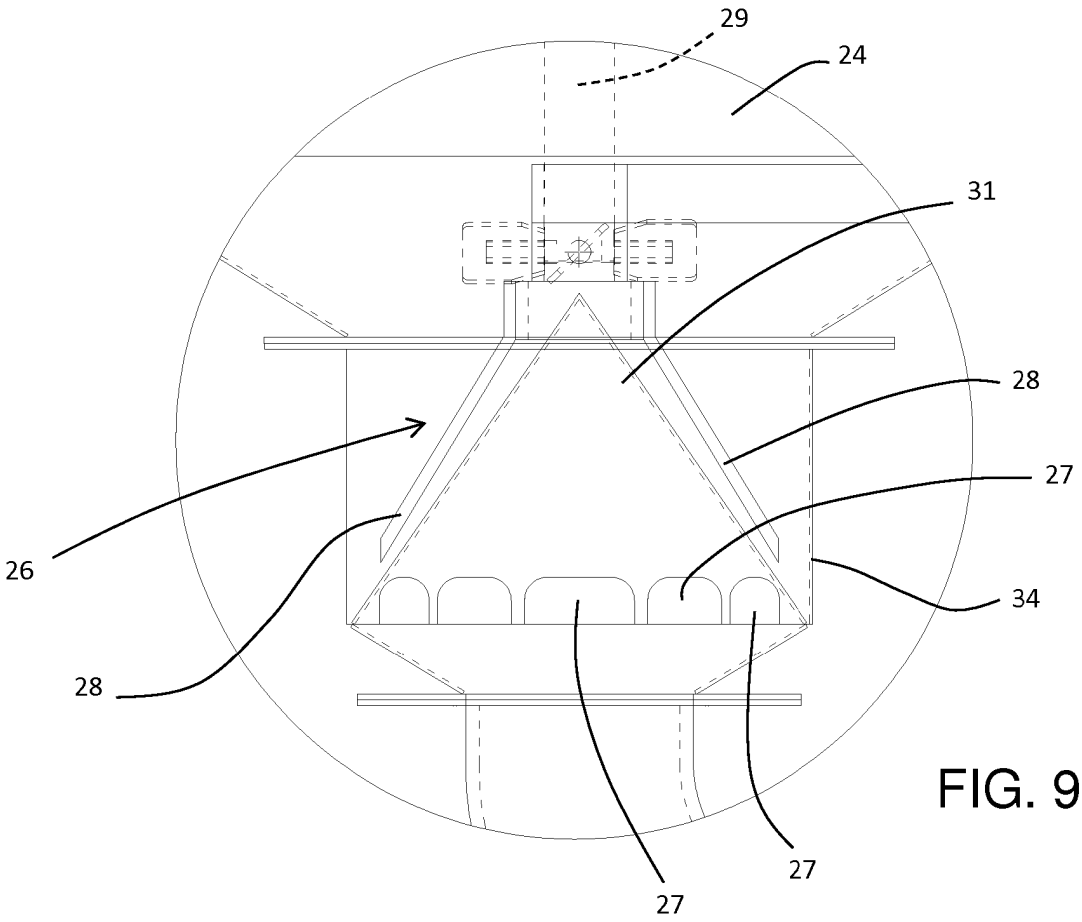


FIG. 9

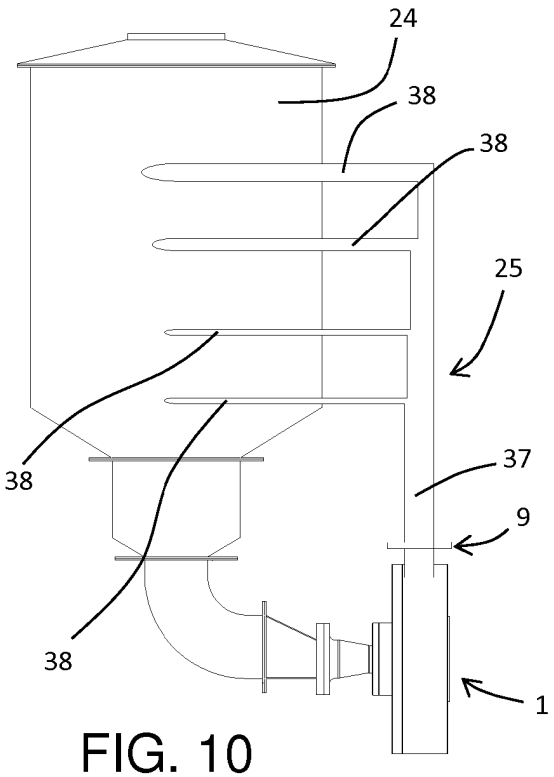


FIG. 10

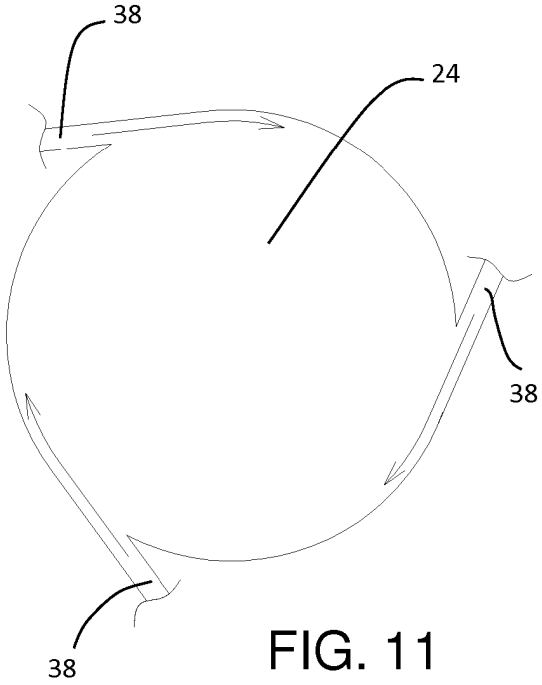


FIG. 11

REFERENCES CITED IN THE DESCRIPTION

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