(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 609 997 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
03.07.2013 Bulletin 2013/27

(51) Int Cl.:
B01F 3/12 *(2006.01)* ***B01F 7/00*** *(2006.01)*

(21) Application number: **12194952.3**

(22) Date of filing: **30.11.2012**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

(30) Priority: **26.12.2011 JP 2011283054**

(71) Applicant: **JTEKT CORPORATION**
Osaka-shi
Osaka 542-8502 (JP)

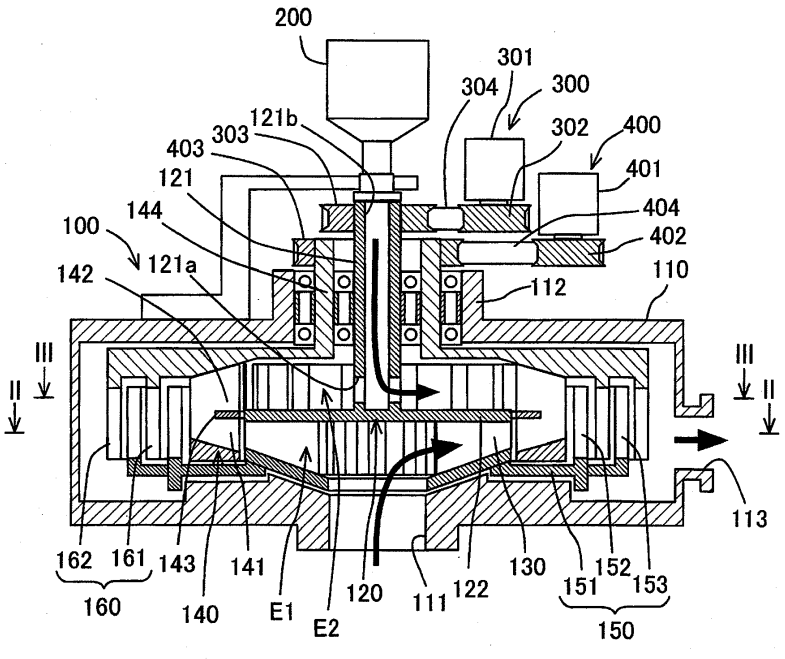
(72) Inventors:
- **Fukaya, Yoshifumi**
  Osaka-shi,, Osaka 542-8502 (JP)
- **Kondo, Yoshihiko**
  Osaka-shi,, Osaka 542-8502 (JP)
- **Kono, Takashi**
  Toyota-shi,, Aichi 471-8572 (JP)

(74) Representative: **TBK**
Bavariaring 4-6
80336 München (DE)

(54) Mixing and dispersing device

(57) A mixing and dispersing device is provided with a partition plate (122) dividing a fluidity material side area (E1) on an inlet port (111) side for the fluidity material and a powder side area (E2) on an inlet port (121 b) side for the powder material; rotary vanes (130) that are arranged rotatably in a fluidity material side area (E1) and that send radially outward fluidity material drawn from a radial inside thereof; and an inducing member (140) that has fluidity material guide passages (141) for speeding up and sending out the fluidity material sent from the rotary vanes (130), toward a mixing area being further radially outside thereof and that induces the powder material in the powder side area (E2) to the mixing area with the flow of the fluidity material in the mixing area. The inducing member (140) is rotated in an opposite direction to the rotational direction of the rotary vanes (130).

FIG. 1



EP 2 609 997 A1

Description

INCORPORATION BY REFERENCE

[0001] This application is based on and claims priority under 35 U.S.C. 119 with respect to Japanese patent application No. 2011-283054 filed on December 26, 2011, the entire content of which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

Field of the Invention:

[0002] The present invention relates to a mixing and dispersing device for mixing fluidity material and powder material and for dispersing the mixture.

Discussion of the Related Art:

[0003] In recent years, lithium-ion rechargeable batteries have been applied to hybrid vehicles, electric vehicles and the like. Electrodes of the lithium-ion rechargeable batteries are formed by applying slurry of active material to a base material made of aluminum foil or the like and by baking the base material. This manufacturing method is described in, for example, JP2010-033786 A.

[0004] The slurry of the active material is made by mixing powder of active material in liquid and by dispersing the mixture. As described in JP2005-537912 A (equivalent of US6,997,598 B2) for example, the manufacturing method of the slurry is carried out by sending out radially outward the material drawn by rotary vanes (a centrifugal pump impeller), by mixing the material by positive-going rotors and negative-going rotors, and by dispersing the mixture.

[0005] As a means for sending out material radially outward, it is able to utilize such a diffuser pump as described in JP5-187398 A, in addition to such a device with only rotary vanes as described in JP2005-537912 A. The diffuser pump is constructed to fix a diffuser having flow passages, radially outside of rotary vanes.

[0006] In the device described in JP2005-537912 A, it is necessary to increase the rotational speed of the rotary vanes for improving the capability of drawing the material. However, when the rotary vanes are rotated at a high speed, it becomes liable to generate vibrations caused by imbalance in rotation. Further, a problem also arises in noises resulting from the high speed rotation.

SUMMARY OF THE INVENTION

[0007] The present invention has been made taking the aforementioned circumstances into consideration, and an object of the present invention is to provide a mixing and dispersing device which is capable of improving the drawing capability of material while suppressing the generations of noises and vibrations.

[0008] To this end, as a result of engaging in enthusiastic study and repeating one trial and error after another, the present inventors have conceived of, in the utilization of the basic concept of a diffuser pump, rotating a diffuser which has been fixed in the prior art, in an opposite direction to the rotational direction of rotary vanes and have completed the present invention.

[0009] According to the present invention in a first aspect, there is provided a mixing and dispersing device for mixing fluidity material and powder material and for dispersing the mixture. The device comprises a partition plate dividing a fluidity material side area on an inlet port side for the fluidity material and a powder side area on an inlet port side for the powder material; rotary vanes that are arranged rotatably in the fluidity material side area and that send radially outward the fluidity material drawn from a radial inside thereof; and an inducing member that has fluidity material guide passages for speeding up and sending out the fluidity material sent from the rotary vanes, toward a mixing area being further radially outside thereof and that induces the powder material in the powder side area to the mixing area with the flow of the fluidity material in the mixing area. The inducing member is rotated in an opposite direction to the rotational direction of the rotary vanes.

[0010] With this construction in the first aspect, with the rotation of the rotary vanes, the inducing member is rotated in the opposite direction to the rotational direction of the rotary vanes, and thus, it is possible to increase the difference in rotational speed between the rotary vanes and the inducing member. Therefore, even when the rotational speed of the rotary vanes is set to be low, it is possible to speed up the fluidity material flowing from the fluidity material guide passages to the mixing area. As a result, it is possible to reliably induce the powder material from the powder side area to the mixing area. Furthermore, because the rotational speed of the rotary vanes is not set to be high, it is possible to suppress the generations of vibrations and noises caused by imbalance in rotation. The inducing member is a member that corresponds to a diffuser constituting a diffuser pump.

BRIEF DESCRIPTION OF THE ACCOMPANYING DRAWINGS

[0011] The foregoing and other objects and many of the attendant advantages of the present invention may readily be appreciated as the same becomes better understood by reference to the preferred embodiment of the present invention when considered in connection with the accompanying drawings, wherein like reference numerals designate the same or corresponding parts throughout several views, and in which:

Figure 1 is a longitudinal sectional view of a mixing and dispersing device in an embodiment according to the present invention;

Figure 2 is a cross sectional view of the device taken

along the line II-II in Figure 1; and
Figure 3 is a cross sectional view of the device taken along the line III-III in Figure 1.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0012] A mixing and dispersing device in the present embodiment constitutes a device for manufacturing electrodes (positive electrodes and negative electrodes) for lithium-ion rechargeable batteries, for example. Electrodes of the lithium-ion rechargeable batteries are formed by applying slurry of active material to a base material made of aluminum foil, copper foil or the like and then by baking the base material. The mixing and dispersing device in the present embodiment is a device for manufacturing slurry of active material. Specifically, the slurry is manufactured by mixing metal powder of active material in liquid such as water or the like and by dispersing the mixture. Hereinafter, the slurry with the powder material mixed and dispersed therein is called "fluidity mixed material", and the liquid before having the powder material mixed therein is called "fluidity base material". Both of the fluidity mixed material and the fluidity base material have fluidity. However, the fluidity mixed material is made to be high in viscosity in comparison with the fluidity base material.

[0013] The mixing and dispersing device in the present embodiment will be described with reference to Figures 1-3. The mixing and dispersing device draws the fluidity base material from the bottom side in Figure 1 into a housing 110, draws the powder material from the upper side in Figure 1 into the housing 110, and generates fluidity mixed material by mixing and dispersing the fluidity base material and the powder material in the housing 110. Then, the device discharges the generated fluidity mixed material from the outer circumferential surface of the housing 110 outward in a radial direction.

[0014] The mixing and dispersing device is provided with a device body 100, a powder hopper 200 containing the powder material of active material, a first drive device 300 and a second drive device 400. The powder hopper 200, the first drive device 300 and the second drive device 400 are supported by the housing 110 of the device body 100.

[0015] The device body 100 is provided with the housing 110, a rotary partition member 120, rotary vanes 130, an inducing member 140, a first annular dispersing member 150 and a second annular dispersing member 160.

[0016] The housing 110 takes a hollow disc shape. The housing 110 is formed at the center of a lower surface thereof with a fluidity material inlet port 111 for drawing the fluidity base material. The housing 110 is formed with a cylindrical opening portion 112 in the vicinity of the center on an upper surface thereof. The cylindrical opening portion 112 draws the powder material in the powder hopper 200 through the rotary partition member 120. Then, in the housing 110, the fluidity base material drawn from the fluidity material inlet port 111 and the powder material drawn from the cylindrical opening portion 112 are mixed and dispersed to generate the fluidity mixed material. Further, the housing 110 is formed at a part of the outer circumferential surface thereof with a discharge port 113 for discharging the fluidity mixed material generated in the housing 110.

[0017] The rotary partition member 120 is provided with a cylindrical shaft portion 121 and a partition plate 122. The cylindrical shaft portion 121 takes a tubular or cylindrical shape and has a plurality of through holes 121a that radially cross the cylindrical shaft portion 121, on the lower end side as viewed in Figure 1. The cylindrical shaft portion 121 is supported rotatably and coaxially in the internal surface of the cylindrical opening portion 112 of the housing 110. The cylindrical shaft portion 121 is formed at an upper end thereof with a powder inlet port 121b that enables an discharge end for powder material of the powder hopper 200 to be attached thereinto and that draws the powder material from the powder hopper 200. That is, the powder material supplied from the powder hopper 200 is drawn from the powder inlet port 121b residing at the upper end of the cylindrical shaft portion 121, passes through the interior of the cylindrical shaft portion 121, and is discharged from the through holes 121a residing at the lower end of the cylindrical shaft portion 121 to reach a powder side area E2.

[0018] The partition plate 122 takes a disc shape and a center portion thereof is fixed on a lower end in Figure 1 of the cylindrical shaft portion 121. That is, the partition plate 122 is arranged in the housing 110 to be rotatable together with the cylindrical shaft portion 121 about the center axis of the same. The partition plate 122 divides the vicinity of the center of the housing 110 in the vertical direction into an area E1 (fluidity material side area) on the fluidity material inlet port 111 side residing on the lower side and the area E2 (powder side area) on the cylindrical opening portion 112 side residing on the upper side.

[0019] The rotary vanes 130 constituting a fluidity material suction impeller are provided at radially outward portions on the lower surface of the partition plate 122 to be plural in the circumferential direction. That is, the plurality of rotary vanes 130 rotate with the rotation of the partition plate 120. The rotary vanes 130 operate as pump vanes that send radially outward the fluidity base material drawn from the fluidity material inlet port 111 residing at the radially inside thereof or the fluidity mixed material. The respective rotary vanes 130 are formed to deviate or shift their phases in an opposite direction to the rotational direction of the rotary vanes 130 as they go radially outward. As viewed in Figure 2, since the rotational direction of the rotary vanes 130 is clockwise, the phases of the respective rotary vanes 130 are shifted counterclockwise as they go radially outward.

[0020] The inducing member 140 is arranged radially outside of the partition plate 122 (i.e., on the downstream side of the partition plate 122 and the rotary vanes 130).

The inducing member 140 is provided with a rotary supported portion 144 that is rotatably supported through outside and inside bearings (not numbered) between the internal surface of the cylindrical opening portion 112 of the housing 110 and an outer circumferential surface of the cylindrical shaft portion 121 of the rotary partition member 120. That is, the inducing member 140 is arranged rotatably relative to the housing 110 and the rotary partition member 120. The inducing member 140 is rotated in an opposite direction to the rotational direction of the rotary vanes 130.

[0021] The inducing member 140 is provided with a plurality of fluidity material guide passages 141 for speeding up and sending out the fluidity base material sent out from the rotary vanes 130 or the fluidity mixed material, toward a mixing area being further radially outside thereof. The fluidity material guide passages 141 are formed to deviate or shift their phases in an opposite direction to the rotational direction of the inducing member 140 (i.e., in the rotational direction of the rotary vanes 130) as they go radially outward. That is, the rotary vanes 130 and the fluidity material guide passages 141 of the inducing member 140 serve as a diffuser pump. Each of the fluidity material guide passages 141 is formed to decrease a flow passage cross section thereof as it goes radially outward. By decreasing the flow passage cross section of each fluidity material guide passage 141 in the downstream direction, it is possible to further speed up the flow of the fluidity base material.

[0022] Further, the inducing member 140 is provided with a plurality of powder guide passages 142 for guiding the powder material in the powder side area E2 toward the mixing area residing radially outside thereof. The powder guide passages 142 are formed by a partition portion 143 on at least the radially inner side of the inducing member 140 independently of the fluidity material guide passages 141. However, at the radial outer portions thereof, the powder guide passages 142 are in communication with the fluidity material guide passages 141 in the radially outward directions. That is, with the flow of the fluidity base material or the fluidity mixed material in the mixing area located radially outside of the fluidity material guide passages 141, it is possible to induce the powder material in the powder side area E2 to the mixing area through the powder guide passages 142.

[0023] The powder guide passages 142 are formed to extend in the same direction as the fluidity material guide passages 141 do and are formed to deviate or shift their phases in the opposite direction to the rotational direction of the inducing member 140 (i.e., in the rotational direction of the rotary vanes 130) as they go radially outward. Further, each of the powder guide passages 142 is formed to decrease a fluid passage cross section thereof as it goes radially outward. By forming the fluidity material guide passages 141 and the powder guide passages 142 like this, it can be realized to induce the powder material in the powder side area E2 to the mixing area further effectively. Further, by decreasing the flow passage cross section of each powder guide passage in the downstream direction, it becomes easier to guide the powder material to the mixing area.

[0024] The first annular dispersing member 150 (first rotary body) is formed to an annular shape having a through hole in the center thereof and is bodily fixed to lower ends of the rotary vanes 130. The first annular dispersing member 150 is provided with a disc shape portion 151, first internal side protruding teeth 152 and first external side protruding teeth 153. The disc shape portion 151 is coupled to the lower ends of the rotary vanes 130, and its center hole is in communication with the fluidity material inlet port 111. The first internal side protruding teeth 152 are arranged in the mixing area being radially outside of the inducing member 140 (i.e., in the downstream side of the inducing member 140) and are formed to protrude from an upper surface of the disc shape portion 151 upward in the axial direction (in a direction orthogonal to the flow direction of the fluidity mixed material) and to be plural in the circumferential direction, that is, to form a circular array of the protruding teeth 152. The first external side protruding teeth 153 are formed radially outside of the first internal side protruding teeth 152 and are provided to protrude from an outer circumferential part of the disc shape portion 151 upward in the axial direction and to be plural in the circumferential direction, that is, to form a circular array of the protruding teeth 153.

[0025] Thus, the first internal side protruding teeth 152 and the first external side protruding teeth 153 are formed to take a circular comb shape which has end portions directed upward in the axial direction and whose teeth are successive in the circumferential direction. Tooth tips of these first internal side protruding teeth 152 and the first external side protruding teeth 153 have a little gap relative to the second annular dispersing member 160 to be rotatable relative to the same. Further, the end surfaces in the circumferential direction of the first internal side protruding teeth 152 and the first external side protruding teeth 153 are formed so that the width of a gap between each tooth and the next thereto in the circumferential direction is almost the same on the tip side and the base side of each tooth. That is, the end surfaces in the circumferential direction of the protruding teeth 152, 153 extend in parallel with the axis of the first annular dispersing member 150.

[0026] The second annular dispersing member 160 (second rotary body) disperses the fluidity mixed material by its operation relative to the first annular dispersing member 150. The second annular dispersing member 160 is coupled to the external surface of the inducing member 140 to reside radially outside thereof. That is, the second annular dispersing member 160 is rotatable integrally or bodily with the inducing member 140. The second annular dispersing member 160 is provided with second internal side protruding teeth 161 and second external side protruding teeth 162.

[0027] The second internal side protruding teeth 161

and the second external side protruding teeth 162 are formed to protrude downward in the axial direction (i.e., in an opposite direction to the protruding direction of the first internal side protruding teeth 152) and to be plural in the circumferential direction, that is, to form circular arrays of the protruding teeth 161, 162. The second internal side protruding teeth 161 are arranged on the downstream side of the first internal side protruding teeth 152 (radially outside of the same) and on the upstream side of the first external side protruding teeth 153 (radially inside of the same) and faces the first internal and external side protruding teeth 152, 153 to be put therebetween in the flow direction of the fluidity mixed material.

[0028] Tooth tips of these second internal side protruding teeth 161 and second external side protruding teeth 162 have a little gap relative to the disc shape portion 151 of the first annular dispersing member 150. Further, the end surfaces in the circumferential direction of the second internal side protruding teeth 161 and the second external side protruding teeth 162 are formed so that the width of a gap between each tooth and the next thereto in the circumferential direction is almost the same on the tip side and the base side of each tooth. That is, the end surfaces in the circumferential direction of the protruding teeth 161, 162 extend in parallel with the axis of the inducing member 140.

[0029] The first drive device 300 rotationally drives an upper end of the cylindrical shaft portion 121 of the rotary partition member 120. The first drive device 300 is provided with a motor 301, a drive pulley 302 fixed on an output shaft of the motor 301, a driven pulley 303 fixed on the outer surface of the cylindrical shaft portion 121, and a belt 304 wound around the drive pulley 302 and the driven pulley 303. That is, with the operation of the motor 301, the driving rotation of the drive pulley 302 is transmitted to the driven pulley 303 through the belt 304. In this way, rotation is given to the rotary partition member 120, the rotary vanes 130 coupled to the rotary partition member 120 and the first annular dispersing member 150.

[0030] The second drive device 400 rotationally drives an upper end of the rotary supported portion 144 of the inducing member 144. The second drive device 400 is provided with a motor 401, a drive pulley 402 fixed on an output shaft of the motor 401, a driven pulley 403 fixed on the outer surface of the rotary supported portion 144, and a belt 404 wound around the drive pulley 402 and the driven pulley 403. That is, with the operation of the motor 401, the driving rotation of the drive pulley 402 is transmitted to the driven pulley 403 through the belt 404. In this way, rotation is given to the inducing member 140 and the second annular dispersing member 160 coupled to the inducing member 140. The rotational direction of the motor 401 in the second drive device 400 is set to be opposite to the rotational direction of the motor 301 in the first drive device 300.

[0031] The operation of the mixing and dispersing device in the aforementioned construction will be described hereinafter. When the motor 301 of the first drive device 300 rotates in a positive-going direction, the rotary partition member 120, the rotary vanes 130 and the first annular dispersing member 150 are rotated relative to the housing 110 in the positive-going direction (clockwise as viewed in Figures 2 and 3). On the other hand, the motor 401 of the second drive device 400 rotates in a reverse direction (in an opposite direction to the positive-going rotational direction of the motor 301), whereby the inducing member 140 and the second annular dispersing member 160 are rotated in the reverse direction relative to the housing 110 (counterclockwise as viewed in Figures 2 and 3).

[0032] Then, through the relative rotation of the rotary vanes 130 and the inducing member 140, the rotary vanes 130 and the inducing member 140 operate as a diffuser pump, whereby the fluidity base material is drawn from the fluidity material inlet port 111 to the fluidity material side area E1. The drawn fluidity base material passes through the rotary vanes 130 and the fluidity material guide passages 141 and is sent out to the mixing area. Then, with the flow of the fluidity base material, the powder material is drawn from the powder inlet port 121b to the powder side area E2. The drawn powder material passes through the powder guide passages 142 and is induced to the mixing area.

[0033] The first annular dispersing member 150 and the second annular dispersing member 160 are arranged in the mixing area. Further, the first internal side protruding teeth 152, the second internal side protruding teeth 161, the first external side protruding teeth 153 and the second external protruding teeth 162 are arranged in this order from the radially inner side in the radially outward directions and are rotating mutually relatively. Thus, the fluidity base material and powder material sent out from the inducing member 140 are mixed and then dispersed by the shearing force produced by the respective protruding teeth 152, 153, 161, 162. Then, the fluidity mixed material after passing through the second external side protruding teeth 162 is discharged outside from the discharge port 113. In this way, the fluidity mixed materials being homogeneous are generated.

[0034] In order to make the fluidity base material flow to the mixing area, the rotary vanes 130 are rotated and the inducing member 140 is rotated in the opposite direction to the rotational direction of the rotary vanes 130. By doing like this, it becomes possible to increase the difference in rotational speed between the rotary vanes 130 and the inducing member 140. Thus, even when the rotational speed of the rotary vanes 130 is set to be low, it is possible to speed up the fluidity material flowing from the fluidity material guide passages 141 to the mixing area. Consequently, it is possible to reliably induce the powder material from the powder side area E2 to the mixing area. Furthermore, because the rotational speed of the rotary vanes 130 need not be set to be high, it is possible to suppress the generations of vibrations and noises caused by imbalance in rotation.

[0035] Further, the first annular dispersing member 150 and the second annular dispersing member 160 are coupled respectively to the rotary vanes 130 and the inducing member 140. Accordingly, without providing additional drive devices that are dedicated to rotating these members 150, 160, it is possible to acquire the dispersing capability thanks to the first annular dispersing member 150 and the second annular dispersing member 160.

[0036] Various features and many of the attendant advantages in the foregoing embodiment will be summarized as follows:

[0037] As the feature in the first aspect, in the mixing and dispersing device of the embodiment typically shown in Figures 1 and 2, with the rotation of the rotary vanes 130, the inducing member 140 is rotated in the opposite direction to the rotational direction of the rotary vanes 130, and thus, it is possible to increase the difference in rotational speed between the rotary vanes 130 and the inducing member 140. Therefore, even when the rotational speed of the rotary vanes 130 is set to be low, it is possible to speed up the fluidity material flowing from the fluidity material guide passages 141 to the mixing area. As a result, it is possible to reliably induce the powder material from the powder side area E2 to the mixing area. Furthermore, because the rotational speed of the rotary vanes 130 is not set to be high, it is possible to suppress the generations of vibrations and noises caused by imbalance in rotation.

[0038] As the feature in a second aspect, in the mixing and dispersing device of the embodiment typically shown in Figures 1 and 2, because the inducing member 140 is provided with the powder guide passages 142 that guide the powder material in the powder side area E2 toward the mixing area, it is possible more effectively induce the powder material in the powder side area E2 to the mixing area.

[0039] As the feature in a third aspect, in the mixing and dispersing device of the embodiment typically shown in Figures 1 and 2, the fluidity material guide passages 141 and the powder guide passages 142 are formed to shift their phases in the opposite direction to the rotational direction of the inducing member 140 as they go radially outward. Therefore, it is possible to speed up the fluidity material in the mixing area. Thus, it is possible to more effectively induce the powder material in the powder side area E2 to the mixing area. Furthermore, the fluidity material guide passages 141 and the powder guide passages 142 are formed to shift their phases in the same direction, it becomes easier to guide the powder material to the mixing area.

[0040] As the feature in a fourth aspect, in the mixing and dispersing device of the embodiment typically shown in Figures 2 and 3, each fluidity material guide passage 141 and each powder guide passage 142 are formed to decrease the flow passage cross section thereof as it goes radially outward. Thus, because the flow of fluidity material can be speed up further, it becomes easier to more effectively guide the powder material in the powder side area E2 to the mixing area. Further, by decreasing the flow passage cross section of each powder guide passage 142 in the downstream direction, it becomes easier to guide the powder material to the mixing area.

[0041] As the feature in a fifth aspect, in the mixing and dispersing device of the embodiment typically shown in Figures 1 and 2, the first and second rotary bodies 150, 160 are coupled respectively to the rotary vanes 130 and the inducing member 140. Thus, without providing additional drive devices dedicated thereto, it is possible to acquire the dispersing capability thanks to the first annular dispersing member 150 and the second annular dispersing member 160.

(Supplementary Notes)

[0042] The present invention may be practiced as the mixing and dispensing device with the following additional features.

[0043] The mixing and dispensing device in the first aspect, further comprising a device body 100 having a housing 110 that coaxially and rotatably receives therein the partition plate 122, the rotary vanes 130 and the inducing member 140, wherein the rotary vanes 130 are fixed on one side surface of the partition plate 122 to be rotated in a direction opposite to the rotational direction of the inducing member 140.

[0044] The mixing and dispensing device in the first aspect, wherein the rotary vanes 30 are provided at radially outward portions on one surface of the partition plate 122 taking a disc shape, the device further comprising a first and second drive devices 300, 400 for respectively rotating the partition plate 122 and the inducing member 140 in opposite directions.

[0045] The mixing and dispensing device in the first aspect, wherein the partition plate 122 and the inducing member 140 are bodily connected respectively to respective ends of a cylindrical shaft portion 121 and a rotary supported portion 144 which are supported rotatably and coaxially and wherein the powder material is drawn to the powder side area E2 through an interior of the cylindrical shaft portion 121 and through holes 121a formed to radially cross an end portion of the cylindrical shaft portion 121 and to open to the powder side area E2.

[0046] The mixing and dispensing device in the fifth aspect, wherein the first rotary body 150 and the second rotary body 160 are provided respectively with at least one circular array of protruding teeth 152 and at least one circular array of protruding teeth 161 which are arranged in a concentric relation and which extend in opposite directions along the axis of the first and second rotary bodies 150, 160.

[0047] The mixing and dispensing device in the fifth aspect, wherein the first rotary body 150 and the second rotary body 160 are provided respectively with two circular arrays of protruding teeth 152, 153 and two circular arrays of protruding teeth 161, 162; wherein the two circular arrays of the protruding teeth 152, 153 extend con-

centrically of the axis of the first body 150 in a first direction opposite to a second direction in which the two circular arrays of the protruding teeth 161, 162 extend concentrically of the axis of the second body 160; and wherein the two circular arrays of the protruding teeth 152 and 153 put therebetween one circular array, being radially inside, of the two circular arrays of the protruding teeth 161, 162.

[0048] Obviously, numerous further modifications and variations of the present invention are possible in light of the above teachings. It is therefore to be understood that within the scope of the appended claims, the present invention may be practiced otherwise than as specifically described herein.

[0049] A mixing and dispersing device is provided with a partition plate (122) dividing a fluidity material side area (E1) on an inlet port (111) side for the fluidity material and a powder side area (E2) on an inlet port (121b) side for the powder material; rotary vanes (130) that are arranged rotatably in a fluidity material side area (E1) and that send radially outward fluidity material drawn from a radial inside thereof; and an inducing member (140) that has fluidity material guide passages (141) for speeding up and sending out the fluidity material sent from the rotary vanes (130), toward a mixing area being further radially outside thereof and that induces the powder material in the powder side area (E2) to the mixing area with the flow of the fluidity material in the mixing area. The inducing member (140) is rotated in an opposite direction to the rotational direction of the rotary vanes (130).

Claims

1. A mixing and dispersing device for mixing fluidity material and powder material and for dispersing the mixture, comprising:

   a partition plate (122) dividing a fluidity material side area (E1) on an inlet port (111) side for the fluidity material and a powder side area (E2) on an inlet port (121b) side for the powder material; rotary vanes (130) that are arranged rotatably in the fluidity material side area (E1) and that send radially outward the fluidity material drawn from a radial inside thereof; and
   an inducing member (140) that has fluidity material guide passages (141) for speeding up and sending out the fluidity material sent from the rotary vanes (130), toward a mixing area being further radially outside thereof and that induces the powder material in the powder side area (E2) to the mixing area with the flow of the fluidity material in the mixing area;
   wherein the inducing member (140) is rotated in an opposite direction to the rotational direction of the rotary vanes (130).

2. The mixing and dispersing device in Claim 1, wherein the inducing member (140) is provided with powder guide passages (142) that guide the powder material in the powder side area (E2) toward the mixing area.

3. The mixing and dispersing device in Claim 2, wherein the fluidity material guide passages (141) and the powder guide passages (142) are formed to shift their phases in an opposite direction to the rotational direction of the inducing member (140) as they go radially outward.

4. The mixing and dispersing device in Claim 2 or 3, wherein the fluidity material guide passages (141) and the powder guide passages (142) are formed to decrease in flow passage cross section as they go radially outward.

5. The mixing and dispersing device in any one of Claims 1 to 4, further comprising:

   a first rotary body (150) arranged on a downstream side of the inducing member (140) and coupled to the rotary vanes (130) to be rotatable bodily with the rotary vanes (130); and
   a second rotary body (160) arranged on a downstream side of the first rotary body (150) and coupled to the inducing member (140) to be rotatable bodily with the inducing member (140) for cooperating with the first rotary body (150) to disperse mixed material of the fluidity material and the powder material.

FIG. 1

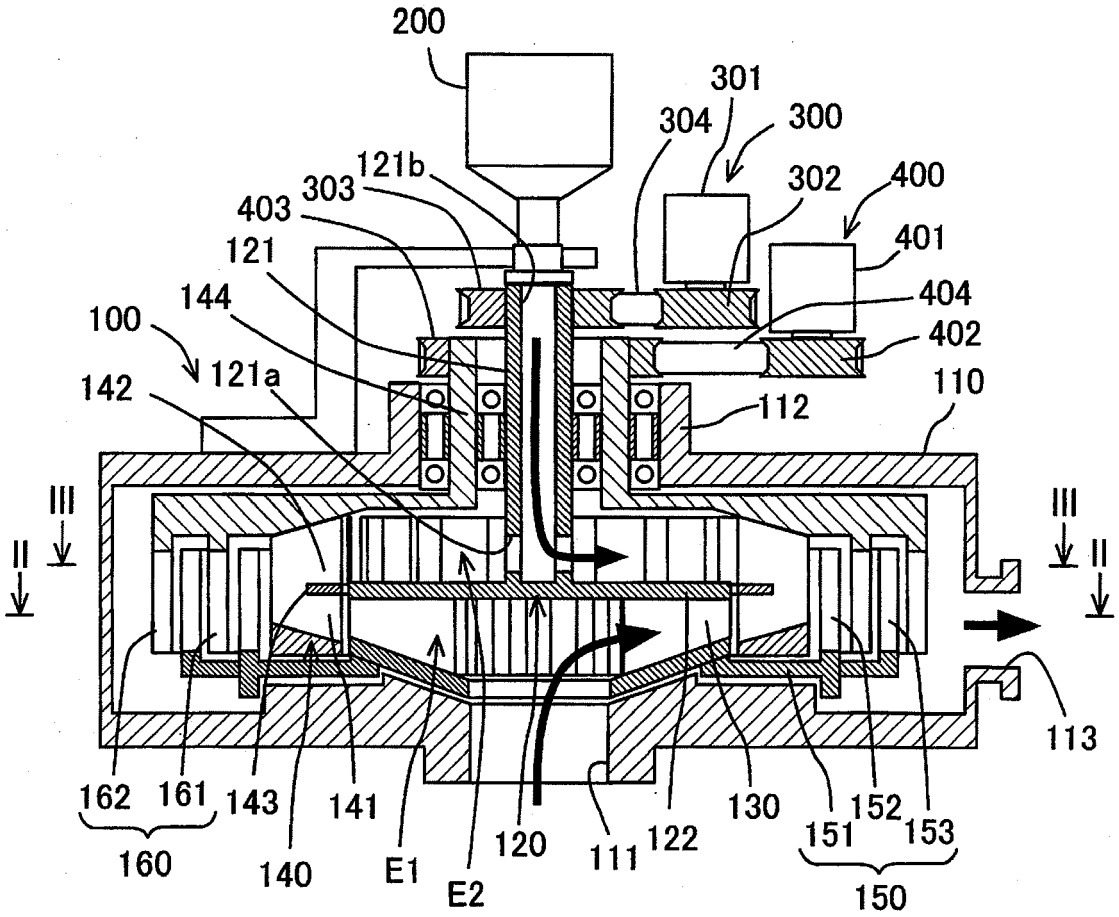

200
301
304
300
121b
303
302
400
403
401
121
404
144
402
100
121a
142
112
110
III
II
III
II
113
162
161
143
141
130
152
153
160
140
E1
E2
120
111
122
151
150

FIG. 2

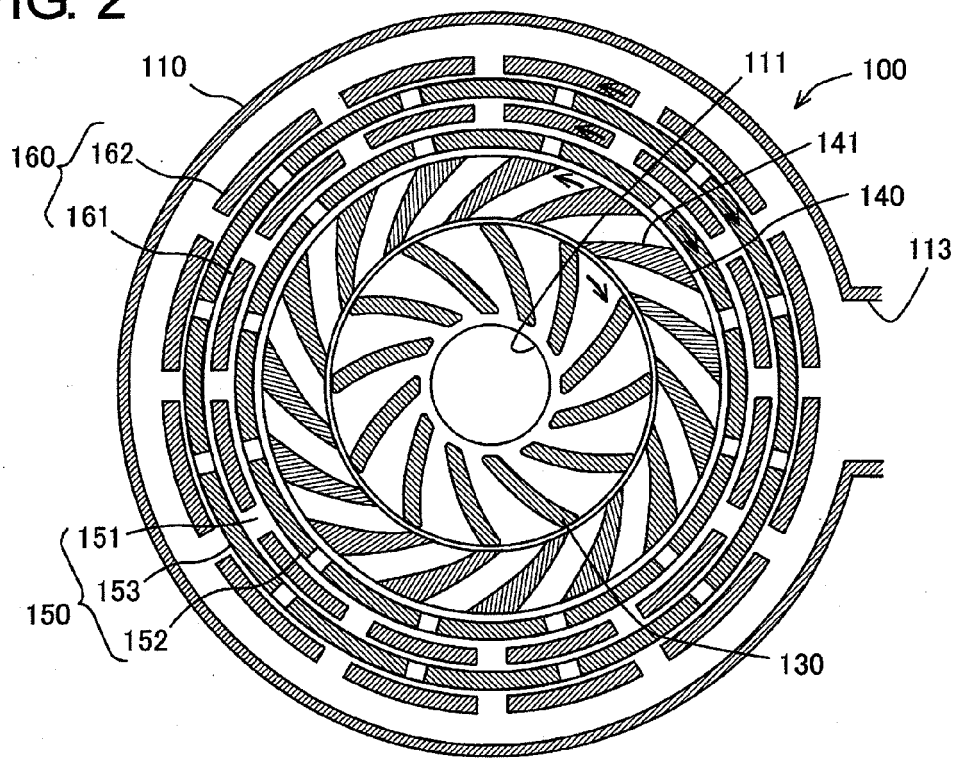
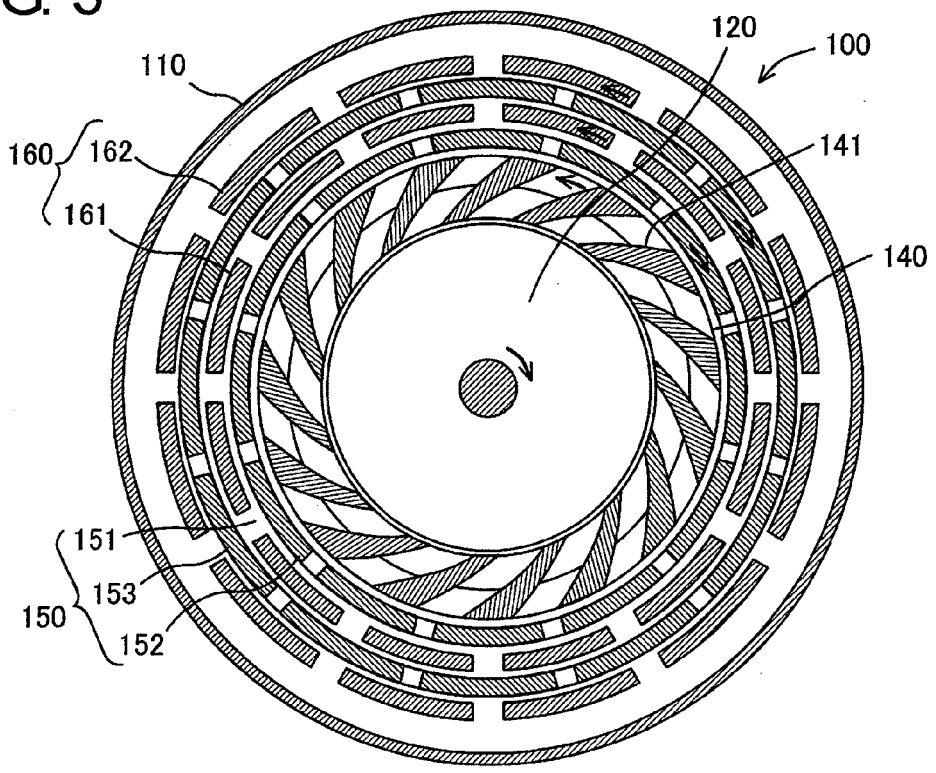

110
111
100
160
162
141
161
140
113
151
153
150
152
130

FIG. 3


120
100
110
160
162
141
161
140
151
153
150
152

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 12 19 4952

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A,D	JP 5 187398 A (HITACHI LTD) 27 July 1993 (1993-07-27) * abstract * * figure 6 *	1-5	INV. B01F3/12 B01F7/00
A,D	US 6 997 598 B2 (DING NAN [CN]) 14 February 2006 (2006-02-14) * column 1, line 8 - line 13 * * column 2, line 37 - column 3, line 33 * * figures *	1-5	
A	GB 665 981 A (ROBERT JOHN JAY) 6 February 1952 (1952-02-06) * page 1, line 6 - line 27 * * page 5, line 5 - line 39 * * page 6, line 51 - line 64 * * figures *	1-5	
A	DE 22 16 986 A1 (RAYNERI, PAUL, MONTREUIL SOUS BOIS) 9 November 1972 (1972-11-09) * page 1, paragraph 1 * * page 3, paragraph 5 - page 4, paragraph 2 * * page 6, paragraph 4 - page 7, paragraph 2 * * figure 1 *	1-5	

TECHNICAL FIELDS SEARCHED (IPC)
B01F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	4 April 2013	Real Cabrera, Rafael

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 12 19 4952

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

04-04-2013

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 5187398 A	27-07-1993		
US 6997598 B2	14-02-2006	AU 2003227168 A1	10-11-2003
		CA 2426829 A1	26-10-2003
		CN 1386570 A	25-12-2002
		JP 2005537912 A	15-12-2005
		US 2003202421 A1	30-10-2003
		WO 03090913 A1	06-11-2003
GB 665981 A	06-02-1952	NONE	
DE 2216986 A1	09-11-1972	DE 2216986 A1	09-11-1972
		FR 2133341 A5	24-11-1972
		NL 7204842 A	18-10-1972

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 2011283054 A **[0001]**
- JP 2010033786 A **[0003]**
- JP 2005537912 A **[0004] [0005] [0006]**
- US 6997598 B2 **[0004]**
- JP 5187398 A **[0005]**