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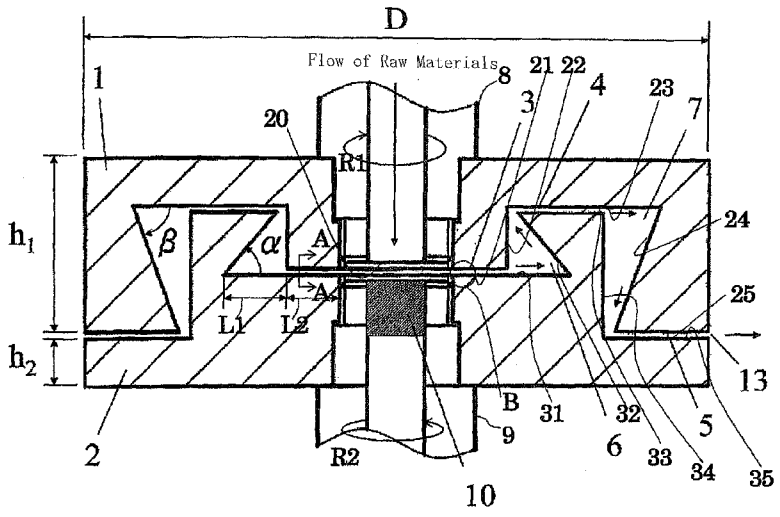
(54) **Title**: A DEVICE FOR A CONTINUOUS DISPERSION BY A STRONG SHEARING

[Fig. 1]



(57) **Abstract**: The object of the present invention is to provide a dispersing device that can efficiently and continuously disperse raw materials by definitely imparting shearing forces to all of the raw materials. The dispersing device by shearing of the present invention comprises a first rotor (1) and a second rotor (2) that face each other. The raw materials are dispersed while passing between the first and second rotors to the outer circumferences of the rotors. It comprises a first means (8) for rotating the first rotor in a first direction (R1), and a second means (9) for rotating the second rotor in the second direction (R2), which is opposite the first direction. An outlet (20) for supplying the raw materials is provided at the center of rotation of the first rotor or the second rotor.

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DESCRIPTION

A DEVICE FOR A CONTINUOUS DISPERSION BY A STRONG SHEARING

Technical Field

[0001]

The present invention relates to a device that continuously and effectively disperses a plurality of liquids or powdery substances in a slurry (a mixture of powdery substances and a liquid).

Background Art

[0002]

A device that uniformly and continuously disperses a plurality of liquids or powdery substances in a slurry has been known. In the device the plurality of liquids or the slurry pass through a narrow space between a high-speed rotating circular rotor and a stationary stator. Thus the plurality of liquids or the powdery substances in the slurry are uniformly and continuously dispersed by strong centrifugal forces and strong shearing forces that are generated by the high-speed rotation (e.g., see Fig. 1 of Japanese Patent Laid-open Publication No. 2000-153167). The term "disperse" used herein means to uniformly disperse powdery substances in a slurry or to uniformly mix a plurality of liquids.

Disclosure of Invention

[0003]

However, since the flow rate of the raw materials on the surface of the stationary stator is zero, little shearing energy is imparted to the materials near the surface of the stator. Thus the conventional device has been disadvantageous, in that efficiency in dispersion is low.

Further, though the raw materials are dispersed in a small area by shearing forces, on the whole the portions where the materials are differently dispersed are unevenly distributed. Thus, there has been a need to again mix the raw materials in a large area to obtain a uniform mixture. For this reason, a batch-type dispersing device must be installed in the later process.

If the desired dispersed condition is not achieved by one process, the raw materials may need to be circulated, or the raw materials may need to be repeatedly dispersed by a plurality of dispersing devices that are connected in series. Thus the cost and area for installing an additional circulating system or installing the plurality of dispersing devices, or the time for processing, may increase. These are problems.

The present invention was conceived to solve those problems. Accordingly, one object of the present invention is to provide a dispersing device that can efficiently and continuously disperse the raw materials by definitely imparting shearing forces to all of the raw materials and by incorporating in the device both an ability to disperse within a small area by means of shearing forces and an ability to disperse within a large area.

[0004]

To achieve that object, as shown in Figs. 1 and 2, for example, a dispersing device by shearing of the first aspect of the present invention comprises a first rotor 1 and a second rotor 2 that face each other. Raw materials are dispersed while passing between the rotors 1, 2 to the outer circumferences of the rotors. It comprises a first means 8 for rotating the first rotor 1 in a first direction R1, and a second means 9 for rotating the second rotor 2 in the second direction R2, which is opposite the first direction R1. An outlet 20 for supplying the raw materials is provided at the center of ~~the~~ rotation of the first rotor 1 or the second rotor 2.

[0005]

By configuring the device as discussed above, the first rotor 1 and

the second rotor 2 rotate in opposite directions. Thus shearing energy is definitely imparted to all of the raw materials. Thus a dispersing device that effectively and continuously disperses materials can be obtained.

[0006]

As shown in Fig. 1, for example, in the dispersing device by shearing of the first aspect, a space 3 is formed on the outer side of the outlet 20, by the flat face 21 of the first rotor 1 and the flat face 31 of the rotor 2. A buffering section 6, in which the distance between the first and second rotors is greater than that in the space 3, is formed on the outer side of the space 3. A side 32 on the outer circumference is formed on the second rotor 2 on the outer side of the buffering section 6. The side 32 on the outer circumference causes the distance between the first rotor 1 and the second rotor 2 to be less than that in the buffering section 6. This is the second aspect of the present invention.

By configuring the device as discussed above, the space has a dispersing function within a small area caused by means of shearing forces and the buffering section has a dispersing function within a large area. Thus a dispersing device by shearing that effectively and continuously disperses materials can be obtained.

[0007]

As shown in Fig. 1, for example, in the dispersing device by shearing of the second aspect, the side 32 on the outer circumference is disposed to be parallel to the axis 8 of rotation of, or inclined to the center of rotation of, the first rotor 1. This is the third aspect of the present invention.

By configuring the device as discussed above, since the side 32 on the outer circumference is disposed to be parallel to the axis of rotation of, or inclined to the center of rotation of, the first rotor, the raw materials do not flow out of the buffering section, unless they have a volume that is more than that of the buffering section. Thus the raw materials accumulate in that section. Since additional raw materials from the space

flow toward the accumulated raw materials in the buffering section at a high speed and vigorously intermingle with them, the raw materials are uniformly dispersed in the buffering section.

[0008]

As shown in Fig. 4, for example, in the dispersing device by shearing of the second or third aspect, the tip of the side 32 on the outer circumference is formed as an overhang 62 that extends toward the center of rotation. This is the fourth aspect of the present invention.

By configuring the device as discussed above, since the tip of the side 32 on the outer circumference is formed as an overhang that extends toward the center of rotation, the raw materials do not flow out of the buffering section, unless they have a volume that is more than that of the buffering section. Thus the raw materials accumulate in that section. Since additional raw materials from the space flow toward the accumulated raw materials in the buffering section at a high speed and vigorously intermingle with them, the raw materials are uniformly dispersed in the buffering section.

[0009]

As shown in Fig. 1, for example, in the dispersing device by shearing of the second or third aspect, the space 3 is located adjacent to the outlet 20 for supplying the raw materials. This is the fifth aspect of the present invention.

By configuring the device as discussed above, centrifugal forces caused by the rotation of the first and second rotors are applied to the raw materials in the space. Thus, as the raw materials flow outward, their flow rates increase. Further, a negative pressure is generated on the inner side of them. Thus the additional raw materials are sucked through the outlet for supplying the raw materials into the space.

[0010]

As shown in Fig. 1, for example, in the dispersing device by shearing

of the second or third aspect, a second space 4 is formed, by the flat surface 23 of the first rotor 1 and the flat surface 33 of the second rotor 2, on the outer side of the buffering section 6. The distance between the first and second rotors in the second space 4 is equal to or less than that in the space 3. A second buffering section 7 is formed on the outer side of the second space 4. The distance between the first and second rotors 1, 2 in the second buffering section 7 is greater than that in the second space 4. A second side 24 on the outer circumference is formed on the first rotor 1 on the outer side of the second buffering section 7. The second side 24 on the outer circumference causes the distance between the first and second rotors 1, 2 to be less than that in the second buffering section 7. This is the sixth aspect of the present invention.

By configuring the device as discussed above, in addition to the space and the buffering section, the second space has a function to disperse the raw materials in a small area by means of shearing forces. The second buffering section has a function to disperse them within a large area. Thus a dispersing device by shearing that effectively, continuously, and repeatedly disperses the raw materials can be obtained.

[0011]

As shown in Fig. 1, for example, in the dispersing device by shearing of the sixth aspect, the buffering section 6 is formed by indenting the first rotor 1. The side 32 on the outer circumference is formed on the second rotor 2. The second buffering section 7 is formed by indenting the second rotor 2. The second side 24 on the outer circumference is formed on the first rotor 1. This is the seventh aspect of the present invention.

By configuring the device as discussed above, the space, the buffering section, the side on the outer circumference, the second space, the second buffering section, and the second side on the outer circumference, are all formed by indenting the first rotor and the second rotor so that they mesh. Thus this facilitates manufacturing a dispersing

device that alternately and effectively carries out dispersion in a small area by means of shearing forces and then carries out mixing in a large area to cause the materials to be homogenized.

[0012]

The present invention provides a dispersing device by shearing that effectively and continuously disperses raw materials by effectively imparting shearing energy to all the raw materials. The device comprises a first rotor 1 and a second rotor 2 that face each other. The raw materials are dispersed while passing between the two rotors to the outer circumferences of the rotors. It comprises a first means for rotating the first rotor in a first direction, and a second means for rotating the second rotor in the second direction, which is opposite the first direction. An outlet for supplying the raw materials is provided at the center of ~~the~~ rotation of the first rotor.

A space is formed by the flat surface of the first rotor and the flat surface of the second rotor on the outer side of the outlet for supplying the raw materials. A buffering section, in which the distance between the first and second rotors is greater than that in the space, is formed on the outer side of the space. A side on the outer circumference is formed on the first rotor or the second rotor or both on the outer side of the buffering section. The side on the outer circumference causes the distance between the first and second rotors to be less than that in the buffering section. Thus the function to mix the raw materials in a large area to cause the materials to be homogenized is generated after the function to disperse them in a small area by means of shearing forces is generated. These functions are combined to effectively disperse the raw materials.

[0013]

The basic Japanese Patent Application, No. 2009-222997, filed September 28, 2009, is hereby incorporated by reference in its entirety in the present application.

The present invention will become more fully understood from the detailed description given below. However, the detailed description and the specific embodiment are only illustrations of desired embodiments of the present invention, and so are given only for an explanation. Various possible changes and modifications will be apparent to those of ordinary skill in the art on the basis of the detailed description.

The applicant has no intention to dedicate to the public any disclosed embodiment. Among the disclosed changes and modifications, those which may not literally fall within the scope of the present claims constitute, therefore, a part of the present invention in the sense of the doctrine of equivalents.

The use of the articles "a," "an," and "the" and similar referents in the specification and claims are to be construed to cover both the singular and the plural, unless otherwise indicated herein or clearly contradicted by the context. The use of any and all examples, or exemplary language (e.g., "such as") provided herein, is intended merely to better illuminate the invention, and so does not limit the scope of the invention, unless otherwise claimed.

Brief Description of Drawings

[0014]

[FIG. 1]

Fig. 1 shows a schematic sectional view of the two rotors as they are arranged.

[FIG. 2]

Fig. 2 shows a schematic sectional view of the main portion of the dispersing device.

[FIG. 3]

Fig. 3 shows schematic diagrams of the distributions of flow rates along sections of the device of the present invention and of the

conventional device.

[FIG. 4]

Fig. 4 shows a structural diagram of an example in which the volume of the buffering section is increased.

Best Mode for Carrying Out the Invention

[0015]

Below, the best mode for carrying out the invention is described. In the drawings, identical numbers refer to identical or corresponding elements, for which duplicate descriptions are omitted. The present invention relates to a device for uniformly dispersing a plurality of raw materials. In the device two rotors that rotate at high speeds in opposite directions are arranged. Centrifugal forces cause the raw materials to pass through the narrow space formed by the rotors. As shown in Fig. 1, two indented rotors 1, 2 are arranged on the same rotating axes to face each other in the vertical direction. By matching the respective concavities and convexities, narrow spaces 3, 4, 5 and wide spaces 6, 7 are alternately formed. As used herein, the narrow spaces 3, 4, 5, which cause strong shearing forces to be generated, are called sections for generating shearing forces. The wide spaces 6, 7, which cause the raw materials to be mixed within the large areas, are called buffering sections. As shown in Fig. 2, the rotors 1, 2 are connected to rotating hollow shafts 8, 9, respectively. The rotating shafts 8, 9 are supported through bearings 15 by respective cases 16 for the bearings. The cases 16 are rigidly fixed (the method of fixing the cases is not shown in the drawings). The rotating shafts 8, 9 are driven by respective electric motors (not shown) through belts, chains, or gears to rotate in opposite directions. Clockwise rotations are assumed as viewed from ports 12, 14 for supplying raw materials. The speeds of the rotation of the shafts are arbitrarily selected in accordance with the kinds of raw materials, the targeted degree of dispersion, etc. The raw

materials that are supplied to the ports 12, 14 for supplying the raw materials pass through the hollow parts of the rotating hollow shafts to be delivered between the two rotors through the outlets 20 for supplying the raw materials, which are disposed at the centers of rotations of the rotors 1, 2. In this embodiment, the outlet for supplying the raw materials of the rotating hollow shaft 9 is closed by a plug 10 to prevent the raw materials from flowing back in and then out again.

[0016]

In the dispersing device of Fig. 1, the outside diameter D of each of the rotors 1, 2 is 200 mm, and the heights h1, h2 are 55 mm and 15 mm, respectively. The gaps of the sections 3, 4, 5 for generating shearing forces are adjustable from 0.05 mm to 2 mm, but need not necessarily be the same. They are arbitrarily modified in accordance with the shapes and sizes of the rotors 1, 2 and the intended use. For example, the gaps gradually decrease starting from the section 3 for generating shearing forces, the section 4 for generating shearing forces, and the section 5 for generating shearing forces, in that order. By doing so, agglomerated particles in the raw materials are sequentially dissolved into finer particles to be uniformly dispersed. The angles α, β of the sides 32, 24 on the outer circumferences of the buffering sections 6, 7 are 50 degrees and 70 degrees, respectively. However, they are not limited to such values. In accordance with the shapes and sizes of the rotors 1, 2, they are arbitrarily selected to be acute angles or right angles, i.e., being inclined to the directions toward the centers of rotations (the directions toward the rotating hollow shafts 8, 9), or parallel to the rotating hollow shafts 8, 9. In the dispersing device, the speeds of rotation are adjusted from 0 to 1,720 rpm by means of an inverter control. They are arbitrarily modified by selecting electric motors, pulleys, gears, etc.

[0017]

By referring to Fig. 1, the structures of the sections 3, 4, 5 for

generating shearing forces and the buffering sections 6, 7 are now described. The surface of the upper rotor 1 that faces the lower rotor 2 is formed on the outer side of the outlet 20 as a flat surface 21 that is perpendicular to the axis of rotation. On the outer side of the flat surface 21 an indentation is formed by a side 22 on the inner circumference, a flat surface 23, and a side 24 on the outer circumference. The flat surface 23 is parallel to the flat surface 21. The side 24 on the outer circumference extends over the flat surface 21 and toward the side of the lower rotor 2. At the tip of it a flat surface 25, which is also parallel to the flat surface 21, is formed. On the surface of the lower rotor 2 that faces the upper rotor 1, a flat surface 31, which is parallel to and faces the flat surface 21, is formed. The flat surface 31 extends over the side 22 on the inner circumference and toward the outer circumference. A side 32 on the outer circumference is formed from the flat surface 31 toward the upper rotor 1. A flat surface 33, which is parallel to the flat surface 23, is formed from the tip of the side 32 on the outer circumference. The flat surface 33 forms an indentation with the side 34 on the inner circumference and the flat surface 35, which is parallel to and faces the flat surface 25. The side 34 is located on the inner side of the side 24.

[0018]

By so arranging the upper rotor 1, which has the surfaces as discussed above, and the lower rotor 2, the section 3 for generating shearing forces is formed by the flat surface 21 and the flat surface 31. The section 4 for generating shearing forces is formed by the flat surface 23 and the flat surface 33. The section 5 for generating shearing forces is formed by the flat surface 25 and the flat surface 35. The buffering section 6 is formed as a region surrounded by the side 22, the flat surface 23, the side 32, and the flat surface 31. The buffering section 7 is formed as a region surrounded by the side 34, the flat surface 23, the side 24, and the flat surface 35. The side 24 extends over the flat surface 21 and

toward the lower rotor 2 to form the buffering section 7. Thus the volume of the buffering section 7 becomes larger, to thereby cause the raw materials to be homogenized by dispersion in a large area.

[0019]

Though in the embodiment discussed above, the side 24 on the outer circumference extends over the flat surface 21 and toward the lower rotor 2, the side 24 may extend to be at the same level as that of the flat surface 21. That is, the flat surface 21 and the flat surface 25 may be disposed on the same plane. In such a structure, three sections 3, 4, 5 for generating shearing forces and two buffering sections 6, 7 can be formed by forming one indentation on the upper rotor 1 and forming one projection on the lower rotor 2 (the portion surrounded by the side 32, the flat surface 33, and the side 34). Thus this facilitates manufacturing a dispersing device that alternately and continuously carries out dispersion in a small area by means of shearing forces and then carries out mixing in a large area to cause the materials to be homogenized. Further, the side 24 need not extend beyond the flat surface 21.

[0020]

Though the flat surfaces 21, 23, 25, 31, 33, 35 are described to be perpendicular to the axes of rotations and be parallel to each other, it is not necessary that they be so arranged. Further, the flat surfaces for forming the sections 3, 4, 5 for generating shearing forces are not necessarily parallel to each other. By making the gaps of the sections 3, 4, 5 become narrower toward the outer circumference, agglomerated particles in the raw materials are sequentially dissolved into finer particles.

[0021]

The buffering sections 6, 7 are the regions for accumulating liquids. Those regions have large volumes in order to mix the raw materials that have been subjected to dispersion in a small area at the sections 3, 4. For this purpose the radius L1 of the flat surface 31, which forms the buffering

section 6, is, for example, at least half of the radius L2, but is normally equal to or more than the radius L2, of the flat surface that faces the flat surface 21 to form the section 3 for generating shearing forces. The height of the buffering section 6 (the sum of the gap of the space at the section 3 plus the height of the side 22) is at least three times, but is normally five or more times, the height of the gap of the space of the section 3.

[0022]

In Fig. 1, the flow of the raw materials is indicated by an arrow. Though for simplicity only one arrow is drawn, similar flows are generated all over the regions that are formed by the rotors 1, 2. In addition Fig. 2 is again referred to. While the rotors 1, 2 rotate, the raw materials are supplied through the port 12 for supplying them on a joint 11 that twists, which is connected to the rotating hollow shaft 8 and equipped with a stopper to stop the rotation (not shown). The raw materials are supplied through the outlet 20 for supplying them into a space between the rotors 1, 2. They flow in the direction of the centrifugal forces through the section 3 for generating shearing forces, through the buffering section 6, through the section 4 for generating shearing forces, through the buffering section 7, and through the section 5 for generating shearing forces, all of which are formed by the rotor 1 and the rotor 2. They are discharged from a section 13 for discharging the raw materials. It is located on the outer circumference of the rotors. Since the raw materials flow by means of the centrifugal forces in the direction toward the outer circumference, the flow rate increases. The pressure at the outlet 20 for supplying the raw materials becomes negative. Thus the flow of the raw materials from the outlet 20 increases.

[0023]

The plug 10 may be removed from the outlet of the rotating hollow shaft 9 to supply other raw materials from the port 14 for supplying raw

materials. Thus the raw materials from the port 14 and those from the port 12 can be mixed. However, in this case the central axes of the rotors and shafts must be horizontal, or a pump for the raw materials must be installed, because normally the negative pressure at the outlet 20 is not so great that it can draw the raw materials as high along the entire length of the rotating hollow shaft 9.

[0024]

In the dispersing device, two rotating shafts are described as being driven by separate electric motors. However, they may be driven by just one electric motor if the driving force is separated by gears, etc. These electric motors, belts, chains, gears, etc., constitute a means for rotating the rotating hollow shafts 8, 9.

[0025]

With reference to Fig. 1, the process for dispersing the raw materials is described. First, the raw materials are subjected to strong shearing forces when passing through the first section 3 for generating shearing forces. Thus, emulsifying or dissolving agglomerated particles is carried out. If the two rotors 1, 2 rotate at the same speed, then the distributions of the speeds of the raw materials taken along line A-A and at section B are to be those as in Fig 3(a). No part at which the speed is zero exists. In contrast, in the conventional system, where one of the rotors 1, 2 is stationary, and if the stationary rotor is assumed to be the lower rotor 2, then the distributions of the speeds are to be those as in Fig. 3(b). The speeds on the surface of the lower rotor 2 are zero in the direction of the rotation and the radial direction, which is the same direction as that of the centrifugal forces. Thus the raw materials near the surface of the lower rotor 2 are poorly dispersed. In the device of the present invention, even at the central position between the two rotors 1, 2, where the speed in the direction of the rotation is zero, the speed in the radial direction is not zero, because of the movement caused by the centrifugal forces. That is, the

movements caused by the centrifugal forces on both sides adjacent to the central position are in the same outward direction. Thus the raw materials at the central position are drawn outwardly by shearing forces (viscous behaviors) caused by those movements. Since no part at which the speed is zero exists, shearing forces are definitely imparted to all of the raw materials. Thus effective dispersion is obtained. In detail, the shearing force at the central position between the two rotors is weak, as shown in the figure taken along the line A-A in Fig. 3(a). However, unlike the stationary rotor, of which the speed is zero, the fluctuation of the speed is great, due to the rotation at the high speed. Thus the shearing force does not affect the effective dispersion. The raw materials are imparted strong shearing forces at the section 3 for generating shearing forces so that emulsifying, or dissolving agglomerated particles, or dispersing particles, is carried out in a small area. After being discharged from the section 3 they flow into the first buffering section 6. In the buffering section 6, the side 32 on the outer circumference is formed to make the distance between the rotors 1, 2 smaller. Thus the raw materials that flow into the buffering section 6 accumulate there without flowing out, unless the volume of the raw materials exceeds that of the buffering section 6. The raw materials in the buffering section 6 are pressed against the side 32 by the centrifugal forces. As shown in Fig. 1, the side 32 of the buffering section 6 is inclined so as to resist the flow of the raw materials. Thus the raw materials must flow into the buffering section 6 at an amount that exceeds the volume of the section 6, to thereby cause the raw materials to flow out of the section 6. The raw materials that have flowed into the buffering section 6 and accumulate there vigorously intermingle with the raw materials that later flow into the section 6 from the section 3 for generating shearing forces. Thus raw materials that have been emulsified or dispersed in a small area are homogenized by intermingling in a large area. Then the raw materials flow through the second section 4 for generating

shearing forces and the second buffering section 7 to be subjected to dispersion similar to that in the first section 3 for generating shearing forces and the first buffering section 6. They flow through the last section, namely, the third section 5, for generating shearing forces to be subjected to further dispersion.

[0026]

To uniformly mix the raw materials by the dispersing device, the particles in the raw materials that are to be supplied to the device are preferably dissolved to be emulsions or agglomerated particles that are smaller than the minimum gap at the sections for generating shearing forces. Further, they are uniformly mixed in a unit that has a volume that at least equals that of the smallest section for generating shearing forces (the volume = the area the section for shearing forces × the gap). This process is carried out by a preliminary mixing as a prior process. If they are not dissolved to be emulsions or agglomerated particles that pass through the gap at the section 3 for generating shearing forces, liquid drops or agglomerated particles that are larger than the gap could hardly flow into the space of the section 3 when the raw materials flow there. Thus this could cause the raw materials to be unevenly dispersed or the flow path to be clogged. That may also cause the device to be damaged by undue shearing forces. Being uniformly mixed in a unit that has a volume that equals that of the smallest section for generating shearing forces means that, when a part of the preliminarily-mixed raw materials that has the same volume as that of the smallest section for generating shearing forces is taken out from the raw materials, the contents of a plurality of raw materials in each part are constant. That does not relate to any conditions for emulsifying or dissolving agglomerated particles. For example, in Fig. 1, the smallest section for generating shearing forces is the space within the section 3. When the gap is 0.1 mm, the volume is about 0.3 ml. However, if the device of the present invention is used for a

preliminary mixing, some of the above requirements are not necessarily complied with.

[0027]

The configurations of the buffering sections 6, 7 are not limited to the inclined ones that are shown as the sides 32, 24 on the outer circumferences in Fig. 1. As shown in Fig. 4, the overhangs 62, 54 that extend toward the center of rotation (to the rotating hollow shafts 8, 9) may be formed at the tips of the sides 6, 7 on the outer circumferences, to increase the volumes of the buffering sections 6, 7. Since the flat surface 63 of the overhang 62, which faces the flat surface 23 of the upper rotor 41, is a part of the section 4 for generating shearing forces, the section 4 is enlarged in the radial direction. Thus greater dispersion in a small area is carried out. Similarly, the flat surface 55, which faces the flat surface 35 of the lower rotor 42, causes the section 5 for generating shearing forces to be enlarged. Thus greater dispersion in a small area is carried out.

[0028]

The number of sections for generating shearing forces and buffering sections are specified to be three and two, respectively. However, the numbers not limited to these, and may be adjusted in accordance with the raw materials to be processed and the targeted degree of dispersion.

CLAIMS

[Claim 1]

A device for continuous dispersion by a shearing force, comprising a first rotor and a second rotor that face each other and that disperse raw materials while the raw materials pass between the rotors to outer circumferences of the rotors, the device comprising:

a first means for rotating the first rotor in a first direction; and

a second means for rotating the second rotor in a second direction that is opposite the first direction;

wherein an outlet for supplying the raw materials is provided at a center of rotation of the first rotor or the second rotor.

[Claim 2]

The device for continuous dispersion by a shearing force of claim 1,

wherein a first space is formed on an outer side of the outlet, by a flat surface of the first rotor and a flat surface of the second rotor;

wherein a first buffering section, in which a distance between the first rotor and the second rotor is greater than the distance in the first space, is formed on an outer side of the first space; and

wherein a first side on an outer circumference is formed on the second rotor on an outer side of the first buffering section, the first side on the outer circumference causing the distance between the first rotor and the second rotor to be less than the distance in the first buffering section.

[Claim 3]

The device for continuous dispersion by a shearing force of claim 2,

wherein the first side on the outer circumference is disposed to be parallel to an axis of rotation of, or inclined toward a center of rotation of, the first rotor.

[Claim 4]

The device for continuous dispersion by a shearing force of claim 2 or 3,

wherein a tip of the first side on the outer circumference is formed as an overhang that extends toward a center of rotation.

[Claim 5]

The device for continuous dispersion by a shearing force of claim 2 or 3,

wherein the first space is located adjacent to the outlet for supplying the raw materials.

[Claim 6]

The device for continuous dispersion by a shearing force of claim 2 or 3,

wherein a second space is formed, by a flat surface of the first rotor and a flat surface of the second rotor, on an outer side of the first buffering section, a distance between the first rotor and the second rotor in the second space being equal to or less than the distance in the first space;

wherein a second buffering section is formed on an outer side of the second space, the distance between the first rotor and the second rotor in the second buffer being greater than the distance in the second space; and

wherein a second side on the outer circumference is formed on the first rotor on an outer side of the second buffering section to cause the distance between the first rotor and the second rotor to be less than the distance in the second buffering section.

[Claim 7]

The device for continuous dispersion by a shearing force of claim 6,

wherein the first buffering section is formed by indenting the first

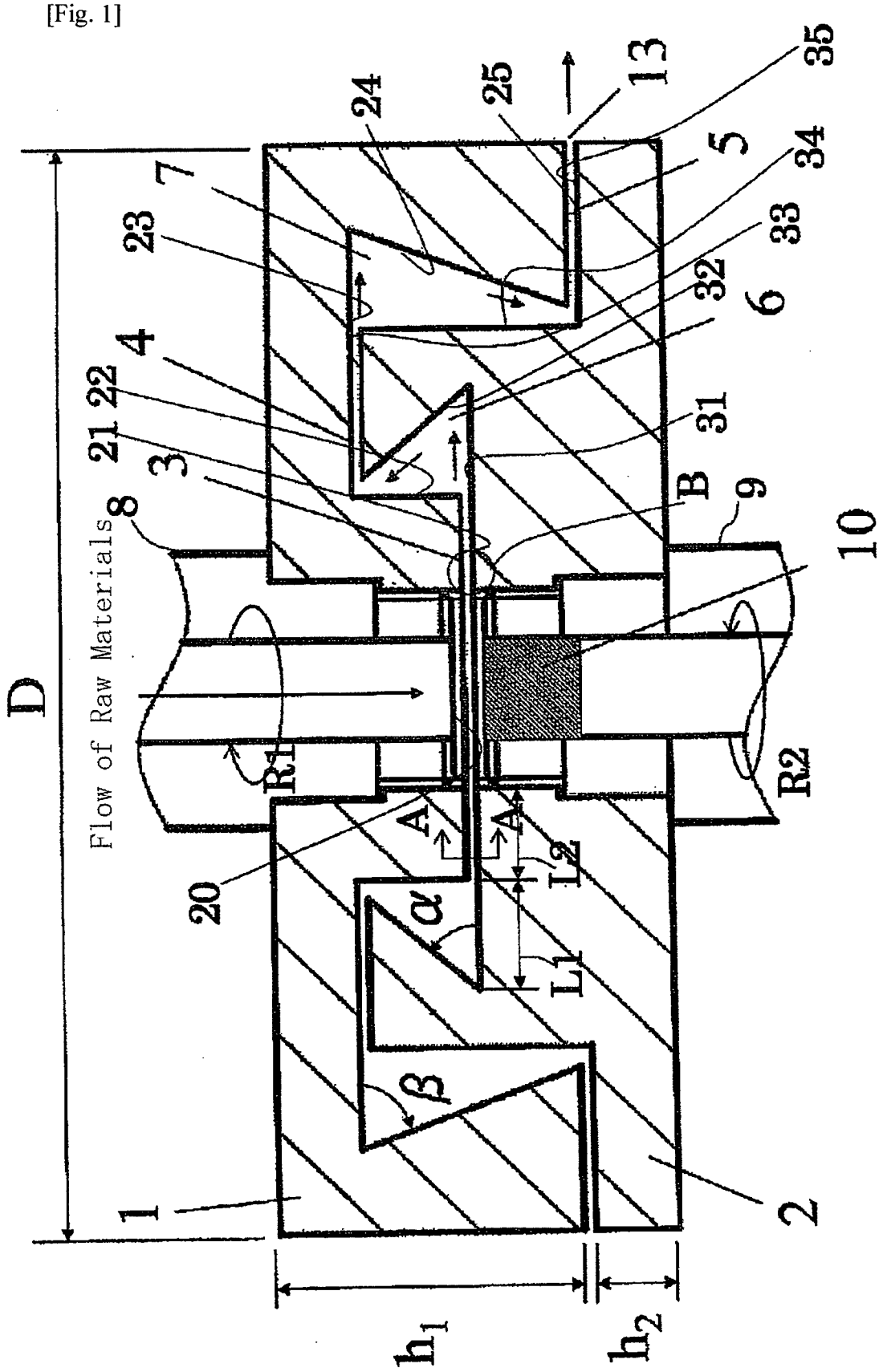
rotor;

wherein the first side on the outer circumference is formed on the second rotor;

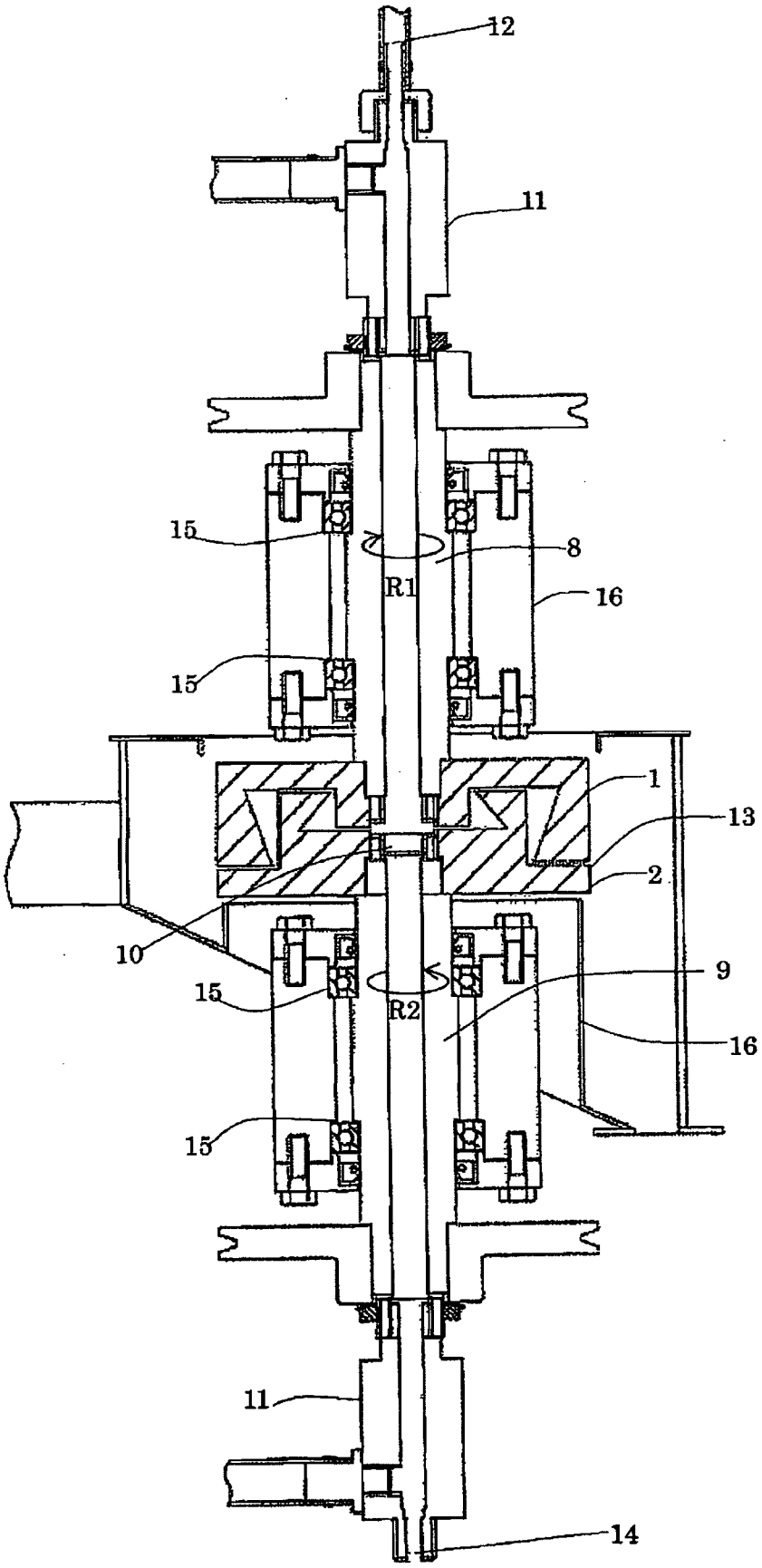
wherein the second buffering section is formed by indenting the second rotor; and

wherein the second side on the outer circumference is formed on the first rotor.

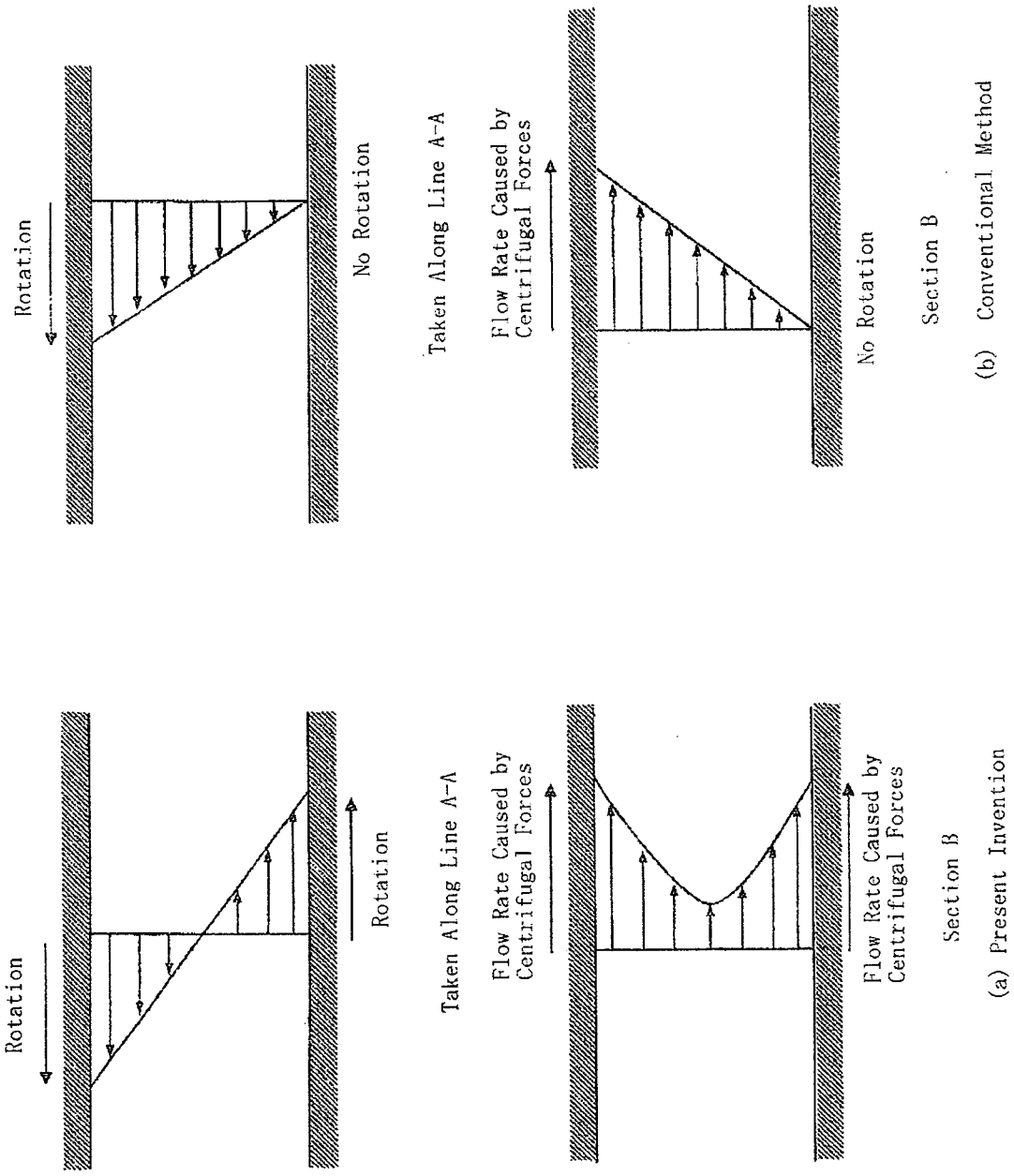
[Fig. 1]


D
Flow of Raw Materials
1
2
3
4
5
6
7
8
9
10
13
20
21
22
23
24
25
31
32
33
34
35
B
R1
R2
A
A
L1
L2
α
β
h1
h2

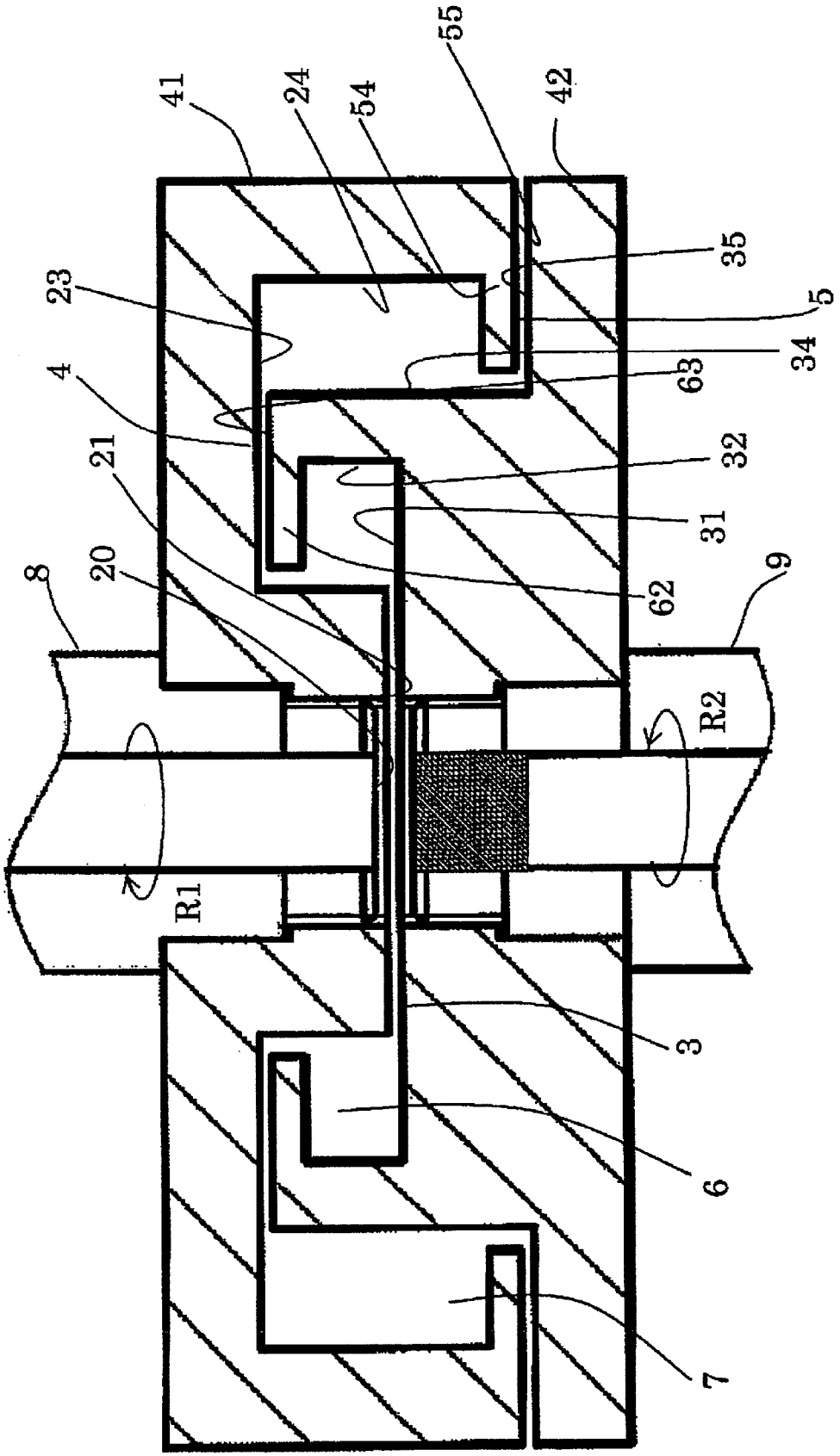
[Fig. 2]



[Fig. 3]


Rotation
No Rotation
Taken Along Line A-A
Flow Rate Caused by Centrifugal Forces
No Rotation
Section B
(b) Conventional Method
Rotation
Rotation
Taken Along Line A-A
Flow Rate Caused by Centrifugal Forces
Flow Rate Caused by Centrifugal Forces
Section B
(a) Present Invention

[Fig. 4]



INTERNATIONAL SEARCH REPORT

International application No
PCT/JP2010/063136

A. CLASSIFICATION OF SUBJECT MATTER
INV. B01F3/12 B01F7/00
ADD.

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B01F

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

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 42 09 527 A1 (DORR OLIVER DEUTSCHLAND [DE]) 30 September 1993 (1993-09-30)	1
A	column 1, line 3 - line 12 column 2, line 22 - line 67 figure 1	2-7
X	US 4 889 428 A (HODSON HARRY [US]) 26 December 1989 (1989-12-26)	1
A	column 1, line 6 - line 8 column 4, line 62 - column 5, line 5 figure 2	2-7
X	EP 0 013 547 A1 (WAROP IND) 23 July 1980 (1980-07-23)	1
A	page 1, line 1 - line 6 page 5, line 3 - line 29 figure 1	2-7

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
19 November 2010	06/12/2010

Name and mailing address of the ISA/	Authorized officer
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INTERNATIONAL SEARCH REPORT

International application No
PCT/JP2010/063136

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2005/016499 A1 (CHOI KWANG NAM [KR]) 24 February 2005 (2005-02-24)	1
A	page 1, line 5 - line 8 page 5, line 22 - page 6, line 12 figure 1	2-7

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/JP2010/063136

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 4209527 A1	30-09-1993	NONE	
US 4889428 A	26-12-1989	NONE	
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		KR 20050018471 A	23-02-2005