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(54) Finishing apparatus.

(57) The invention relates to a finishing apparatus in which a workpiece and finishing media are agitated together in a finishing chamber. Hitherto, vibratory workpiece finishing apparatus have comprised an annular finishing chamber which is generally satisfactory for the mass finishing of small workpieces, but will not normally facilitate the finishing of relatively large items. The invention provides a finishing apparatus for a workpiece comprising a cylindrical container having a bottom wall 56 and an upstanding peripheral wall 54 defining therebetween a finishing chamber 57 for the workpiece and finishing media and which is uninterrupted between diametrically opposite wall portions. Means 64 is provided for imparting vibratory movement to the container.

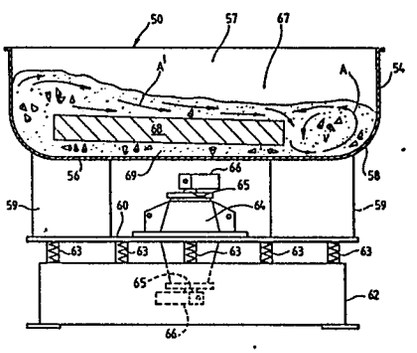

Fig.6.

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Description

FINISHING APPARATUS

This invention relates to finishing apparatus, and is particularly concerned with finishing apparatus of the type in which a workpiece and finishing media are agitated together in a finishing chamber.

Various types of finishing apparatus of the above type have been proposed hitherto, two examples of such being shown in Figs. 1 to 4.

Fig.1 is a cross section through a vibratory finishing machine on line I - I in the plan view in Fig.2. The machine comprises a recangular container 10 having flat side walls 9 and a semi-circular bottom wall 12. The container is mounted resiliently on a base 13 through springs 14. An electric motor 15 is mounted on a plate 16 carried beneath the container and has a drive spindle 17. The spindle 17 carries eccentric weights 18. The container holds suitable finishing media 19, (e.g. cones of ceramic or plastics material) and workpieces 20. With the electric motor 15 running, the eccentric weights 18 vibrate the container 10 thereby causing the media and workpieces to undergo a rotary motion as indicated by arrows A in Figs. 1 and 2. The media 19 has an abrasive action on the workpieces 20 and smooths the workpieces. Even with the largest machines of this type, e.g. measuring 4m x 1.25 m in plan, it is difficult to effect smoothing of large workpieces, e.g. a workpiece that would occupy more than 50 % of the plan area of the container as such workpieces tend to "ride" on top of the m edia and are generally pushed to one side as indicated at 21 unless held in a desired postion by a jig. If the rectangular container is made bigger in plan area to accommodate larger workpieces, the rotary movement of the media diminishes substantially or disappears completely and the effectiveness of the media to provide overall smoothing of the workpiece is reduced.

Another type of vibratory finishing machine is shown in Figs. 3 and 4 where Fig.3 is a diametrical cross-section through the machine on line III - III in the plan view in Fig.4. Machines of this type are shown in my GB Patents Nos. 2098109 and 2102316 and comprise a container 30 having a cylindrical outer wall 32, a cylindrical inner wall 33 and an annular bottom wall 34 of semi-circular cross section. The walls define an annular finishing chamber 31 between them. The container is resiliently mounted on a base 35 through circumferentially spaced springs 36. An electric motor 37 is mounted on a plate 38 beneath the container 30 and has a drive spindle 39 carrying two eccentric weights 40. Unlike the motor 15 in Fig.1, the spindle 39 of motor 37 is vertical and is housed partly within a space 42 defined by the inner wall 33. As before, running of the motor causes the eccentric weights to vibrate the container 31 and a mixture of media 43 and workpieces 44 in the chamber. Whereas in the machine of Figs. 1 and 2 the mixture follows a plain rotary path, the mixture in the machine of Figs. 3 and 4 follows a helical path as indicated in broken lines in Fig.4 resulting from a radial rotation R combined with a circumferential movement C. The largest machine of this kind known to me has a finishing chamber width W of around 80 cm e.g. A workpiece (e.g. a plate-like workpiece 45 indicated in broken lines in Figs. 3 and 4) having a dimension exceeding the width W is normally regarded as being too large to smooth in such a machine. Such workpieces have a tendency to "ride" on top of the media and are pushed against the inner wall. Therefore even the largest machines of this type known to me could not normally be used successfully to smooth plate-like workpieces having a dimension greater than 80 cm.

An object of the present invention is to provide a finishing machine which can accommodate large workpieces without the attendant disadvantages of the machines shown in Figs. 1 to 4.

According to one aspect of the invention there is provided finishing apparatus for a workpiece comprising a container having an upstanding cylindrical peripheral wall surrounding a finishing chamber for a mixture comprising finishing media and the workpiece, and drive means for imparting vibratory movement to the container so as to agitate the mixture, the finishing chamber being substantially uninterrupted between diametrically opposite portions of the peripheral wall and movement of the media, in use, being arranged to urge the workpiece into a position spaced from the peripheral wall whereby the media can move over the workpiece.

As the media urges the workpiece into a position spaced from the wall, e.g. by applying inward forces to portions thereof, vibrating media is able to move through the space and act on the upper surface of the workpiece. The workpiece does not, therefore, ride on top of the media as in the prior art. Also the uninterrupted finishing chamber lends itself to receiving much larger workpieces than the annular type of finishing chamber having a peripheral wall of the same diameter.

According to another aspect of the invention there is provided finishing apparatus comprising a container having an upstanding peripheral wall surrounding a finishing chamber for a mixture comprising finishing media and a workpiece, and drive means for imparting vibratory movement to the container so as to agitate the mixture and cause at least part of the media to follow a helical path in the finishing chamber, the finishing chamber being substantially uninterupted between directly opposite portions of the peripheral wall.

According to a further aspect of the invention there is provided finishing apparatus comprising a container having an upstanding peripheral wall surrounding a finishing chamber, a mixture comprising finishing media and a workpiece in said finishing chamber and means imparting vibratory movment to said container, said finishing chamber being substantially uninterrupted between directly opposite portions of the peripheral wall and the workpiece being spaced from the peripheralwall by the vibrating media, the media moving over an upwardly facing

surface of the workpiece due to the vibratory movement.

Preferably the finishing chamber has a bottom surface a major part of which is flat. The flat bottom surface and the peripheral wall may be joined by an intermediate curved wall section. The curve may be a quarter circle in cross section giving a part torroidal formation at the bottom of the peripheral wall. Such a curved formation enhances the movement of the media. In a preferred embodiment approximately75% of the plan area of the finishing chamber has the flat bottom surface.

Preferably the vibrating movement imparted by the drive means causes, in use, at least some of the finishing media to follow a helical path around the finishing chamber .The above curved section assists the media to move from the flat bottom surface upwardly into engagement with the wall or vice-versa during the vibratory movement.

The entire means for vibrating the container, e.g. an electric motor and eccentric weight arrangement, may be arranged beneath the lowest portion of the container or to one side thereof.

Preferably the means for imparting vibratory movement comprises a weight arranged eccentrically on a rotatable shaft, e.g. a rotatable vertical shaft, and positioned eg adjacent said bottom surface of the container. The shaft may be a drive shaft of a motor.

Finishing apparatus in accordance with the invention will now be described, by way of example only, with reference to Figs. 5 to 8 of the accompanying drawings in which:

Fig.5 is a plan view of apparatus in accordance with the invention, housing a workpiece in the finishing chamber,

Fig.6 is a cross section of the apparatus in Fig.5 on line VI-VI in Fig.5,

Figs. 7 and 8 are views similar to Figs. 5 and 6 showing the machine holding a different workpiece.

The finishing apparatus in Figs. 5 and 6 comprises a cylindrical container 50 having a single upstanding peripheral wall 54 a flat bottom wall 56 and an intermediate curved wall portion 58 which is of quadrant cross section giving a smooth torroidal-like section at the lower end of wall 54. A finishing chamber 57 is defined between the wall 54, wall 56 and wall portion 58. Unlike the container 30 of Figs. 3 and 4, the finishing chamber 57 is uninterrupted between diametrically opposite sections due to the absence of a cylindrical inner wall. The container is therefore a U-shaped bowl in cross section as seen in Fig.5. The container 50 is rigidly fixed via arms 59 to a supporting plate 60. The plate is resiliently mounted on a ground engaging base 62 by springs 63 which are circumferentially spaced around plate 60. An electric motor 64 having a central drive spindle 65 with eccentric weights 66 mounted thereon is rigidly mounted on the plate 60. The motor and weights are positioned completely beneath the bottom wall 56. One weight 66 may be heavier then the other if desired and their relative angular positions (preferably 90° out of phase) may be adjustable to vary vibration characteristics.

In use, finising media 67 and a single large workpiece 68 are placed in the finishing chamber 57. With the electric motor running, the eccentric weights 66 cause the container 50 to vibrate. The vibration agitates the finishing media 67 and the workpiece 68 therein. Initial upward movement of the media from the flat bottom wall 56 and along the curved section 58 has the effect of spacing the workpiece from the wall 57. The vibrating media gradually moves from beneath the workpiece causing it to sink deeper into the media until it comes to rest on a layer 69 of vibrating media adjacent the flat bottom wall 56. The workpiece remains substantially at that level in the media. In Figs. 5 and 6 the workpiece shown is a circular plate 58. The media circulates substantially as shown by arrows. The media tends to urge the plate to a slightly off-centre position as shown in Fig.5 and the media in the gap between the wall 54 and plate 68 over arc 100 undergoes a helical action as shown by arrows A causing media to build up over arc 101 to a higher level. The media from that area then moves substantially linearly across the upper surface of the workpiece as shown by arrows A′. The media moves en masse circumferentially and the plate is carried around (spaced from wall 54) by the media. The continual abrasive action of the vibrating media 56 on the upper, lower and edge surfaces of the workpiece 68 has the effect of removing burrs from the surfaces. The media generates inward forces F on the plate which maintains it spaced all round from the wall 54.

In Figs. 7 and 8 the workpice comprises a circular plate 68 formed with alarge central aperture 69. The plate again is moved off centre by the vibrating media which spaces it from the wall 54. Media in the space between the plate 68 and the wall 54 over arc 100 again circulates helically as indicated by arrows A causing a build up of media over arc 101. Media from the regions of arcs 100 and 101 also travels towards the aperture 69 as indicated by arrows A′ and a circulation of the media through the aperture and beneath the plate takes place as shown by the arrows. The media again applies inward forces F on the plate which maintain it spaced all round from the wall 54.

Although one large workpiece is illustrated in the finishing chamber, it is envisaged that several smaller workpieces may be placed therein. Also workpieces of shapes other than circular can be smoothed in the finishing chamber.

The motor and eccentric weights which vibrate the container 14 may be replaced by other vibratory means. Additionally, it is contemplated that the motor 30 may be located to one side of the container and connected to a weight carrying spindle on the container by a suitable drive transmission. The rate of vibration may be controlled by varying the speed of the motor 30.

It should be noted that there is no limitation on the minimum size of workpieces which may be finished with finishing apparatus according to this invention and that the maximum size is limited only by the diameter of the container. With a container of the type shown it is possible to finish large components

which would be impossible to finish in the previously known annular containers of similar diameter to container 54.

It will be appreciated from Figs. 5 to 8 that the finishing chamber 57 will hold workpieces which extend from a position adjacent one portion of the wall 54 to a position beyond the middle of the chamber and the machine is most advantageous in that respect.

The flat bottom wall 56 constitutes approximately 75% of the total plan area of the finishing chamber as viewed in Figs. 6 and 8.

It is envisaged that the inner surfaces of the container will be coated with plastics materials, e.g. polyurethane, to give protection against wear.

The preferred diameter of the finishing chamber is around 165 cm although it is envisaged that larger diameter chambers could be used.

Claims

1. Finishing apparatus for a workpiece(68) comprising a container(50) having an upstanding cylindrical peripheral wall(54)surrounding a finishing chamber(57) which, in use, contains a mixture comprising finishing media (67) and the workpiece, and drive means(64)for imparting vibratory movement to the container so as to agitate the mixture, characterised in that the finishing chamber(57) is substantially uninterrupted between diametrically opposite portions of the peripheral wall and movement of the media(67), in use, urges the workpiece (68) into a position spaced from the peripheral wall (54) whereby the media can move over the workpiece.

2. Finishing apparatus according to Claim 1 characterised in that the finishing chamber has a bottom surface (56) a major part of which is flat.

3. Finishing apparatus according to Claim 2 characterised in that the flat bottom surface(56) and the peripheral wall are joined by an intermediate curved wall section(58).

4. Finishing apparatus according to Claim 2 or 3 characterised in that substantially75%of the plan area of the finishing chamber (57) has said flat bottom surface (56).

5. Finishing apparatus according to any preceding claim characterised in that the vibratory movement imparted by the drive means(64)causes, in use,at least some of the finishing media to follow a helical path around the finishing chamber (57).

6. Finishing apparatus according to any preceding claim characterised in that the entire means (64) for imparting vibratory movement is connected to the container (50) beneath the lowest portion of the container.

7. Finishing apparatus according to any preceding claim characterised in that in which the means (64) for imparting vibratory movement includes a weight (66) eccentrically mounted on a vertical rotatable shaft (65) and positioned adjacent said bottom surface of the container.

8. Finishing apparatus comprising a container having an upstanding peripheral wall (54) surrounding a finishing chamber (57) containing, in use, a mixture comprising finishing media (67) and a workpiece (68) and drive means (64) for imparting vibratory movement to the container so as to agitate the mixture and cause at least part of the media to follow a helical path in the finishing chamber, characterised in that the finishing chamber (57) is substantially uninterrupted between directly opposite portions of the peripheral wall (54).

9. Finishing apparatus according to any preceding claim characterised in that a workpiece (68) is contained in the finishing chamber (57) and extends from a position adjacent one portion of the upstanding peripheral wall (54) to a position over a middle section of the finishing chamber.

10. Finishing apparatus according to any preceding claim characterised in that at least some of the media (67), in use, moves substantially linearly over the workpiece (68)

11. Finishing apparatus comprising a container having an upstanding peripheral wall (54) surrounding a finishing chamber (67) a mixture comprising finishing media (67) and a workpiece (68) in said finishing chamber and drive means (64) imparting vibratory movement to said container characterised in that said finishing chamber (57) is substantially uninterrupted between directly opposite portions of the peripheral wall (54) and the workpiece is spaced from the peripheral wall by the vibrating media (67) to enable the media to move over an upwardly facing surface of the workpiece.

12. Finishing apparatus according to Claim 11 characterised in that the media (67) applies inward forces (F) to opposite portions of the workpiece (68).

13. Finishing apparatus according to Claim 11 or 12 characterised in that some of the media (67) moves substantially linearly over the workpiece (68).

14. Finishing apparatus according to any of Claims 11 to 13 characterised in that some of the media (67) follows a helical path around the finishing chamber (57).

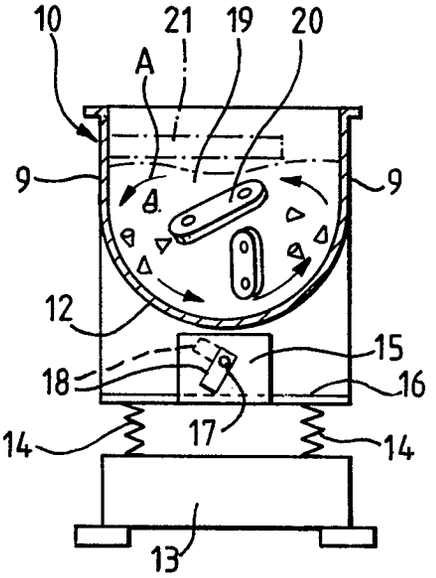

Fig.1.

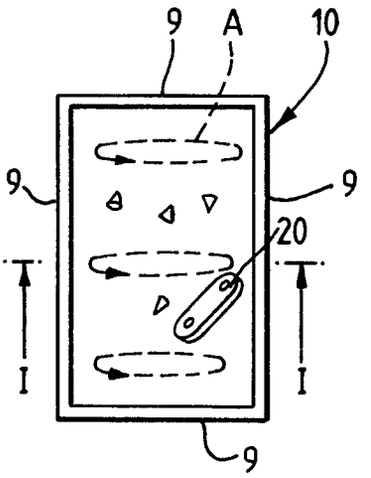

Fig.2.

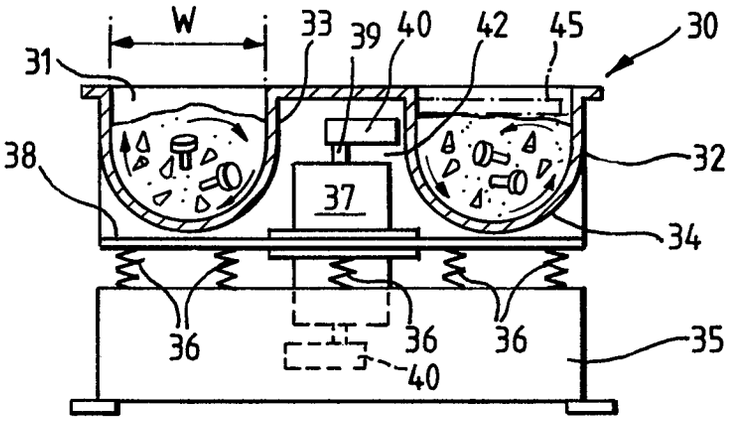

Fig.3.

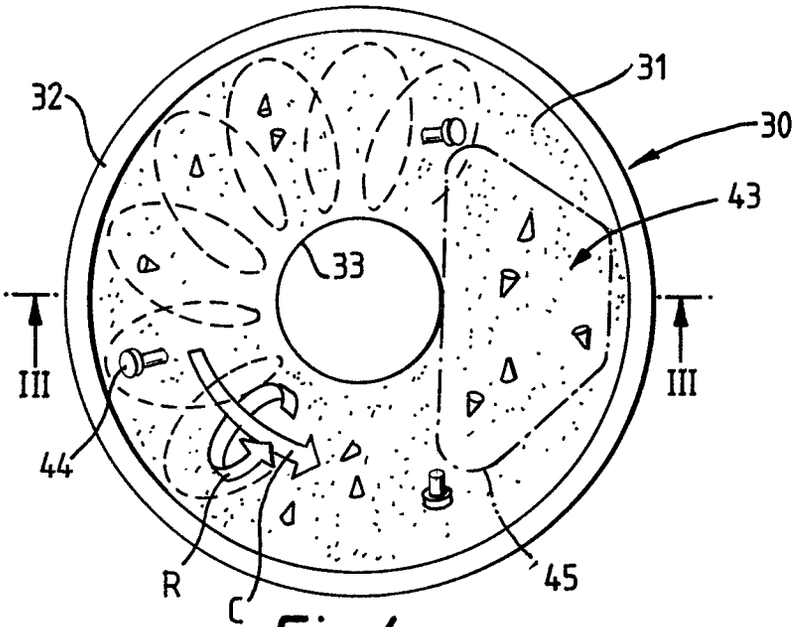

Fig.4.

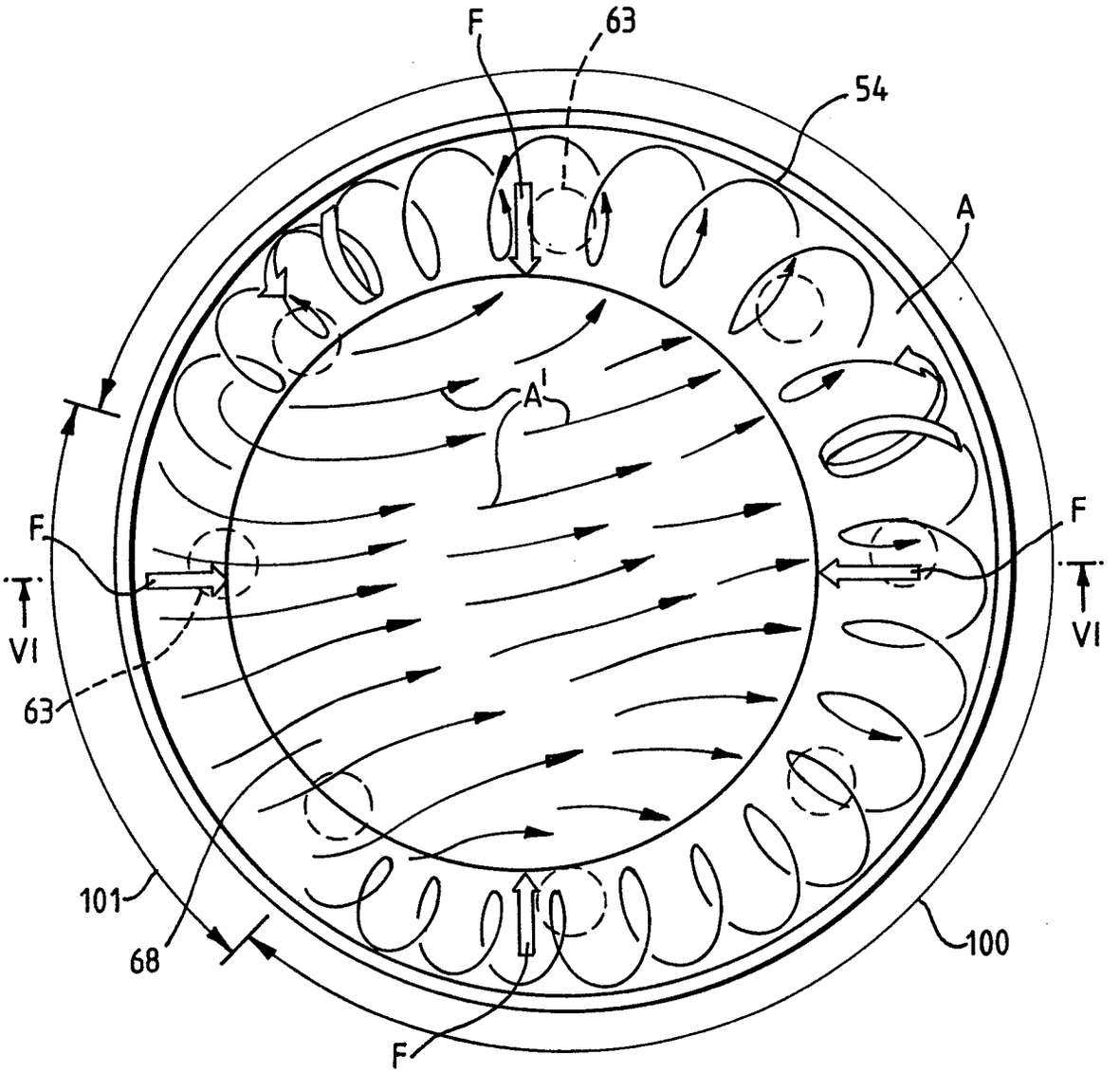

Fig.5.

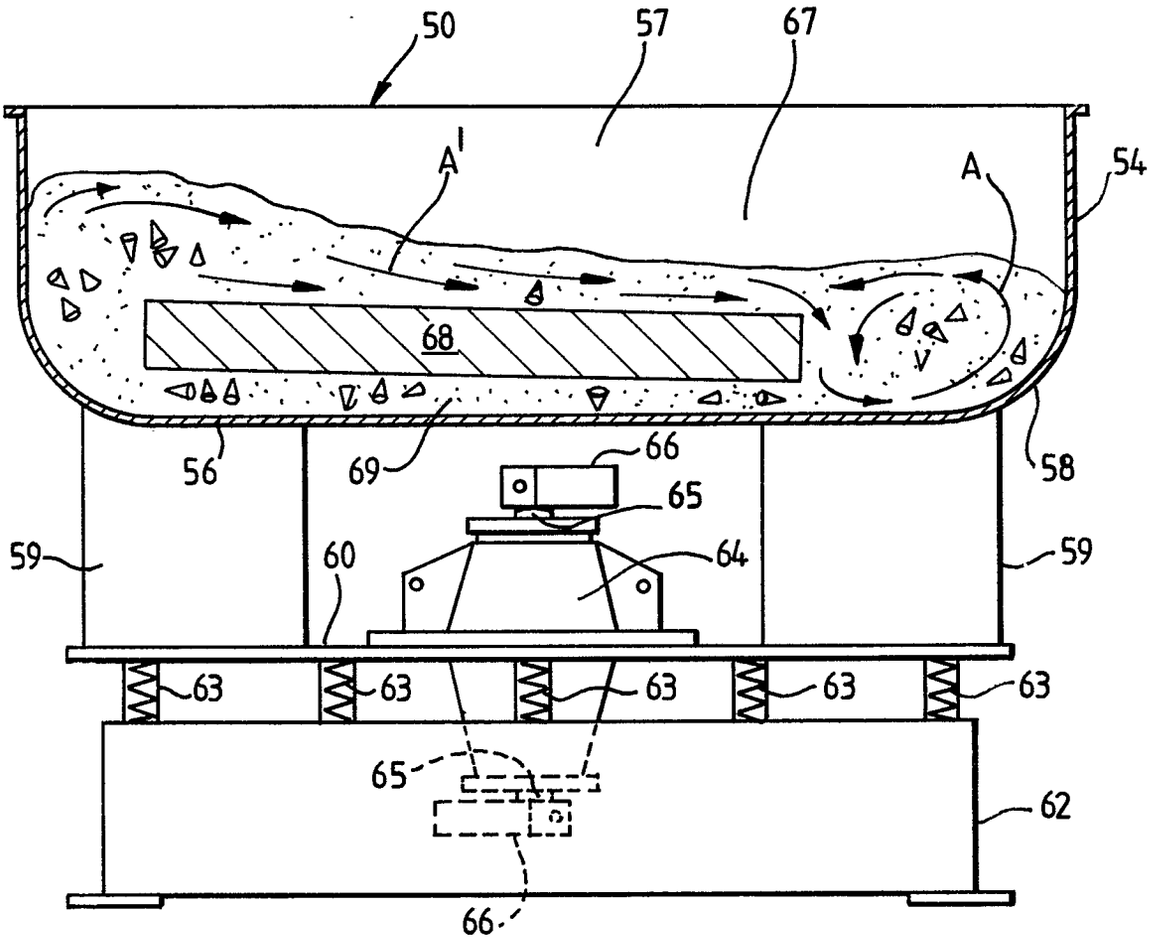

Fig.6.

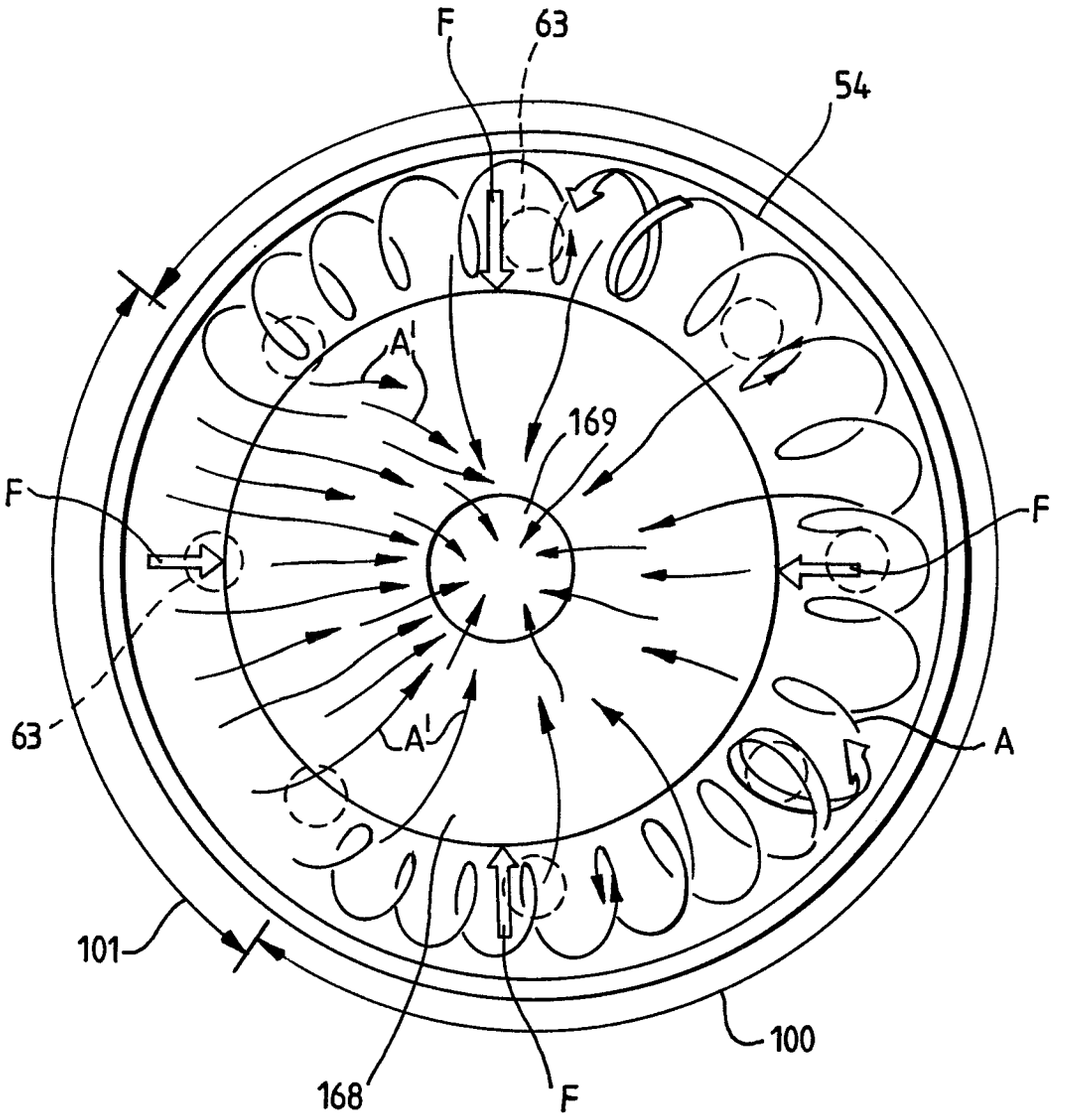

Fig.7.

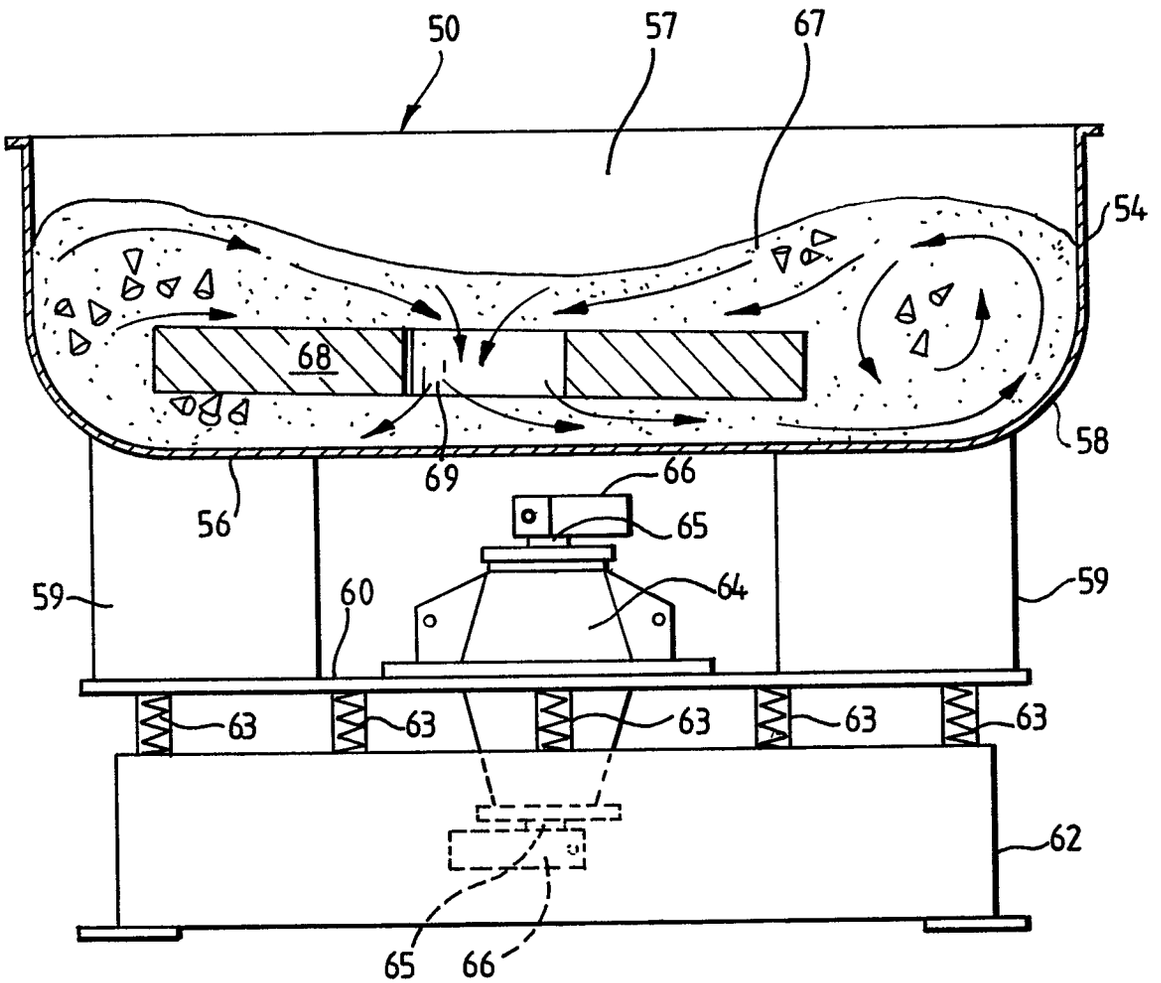

Fig.8.