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METHOD OF AND APPARATUS FOR ADDING LIQUID TO PULVERULENT OR GRANULAR MATERIALS

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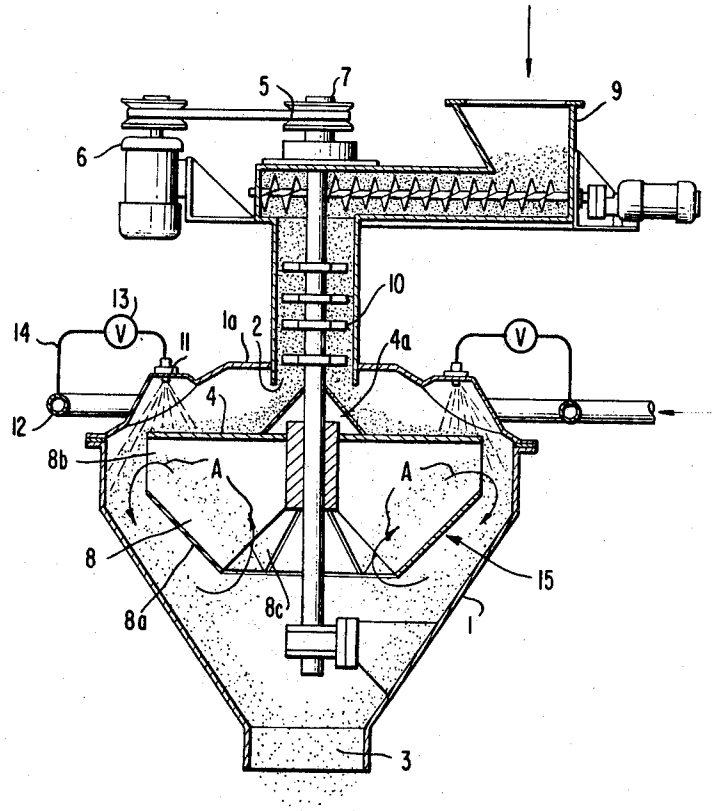
FIG. 1



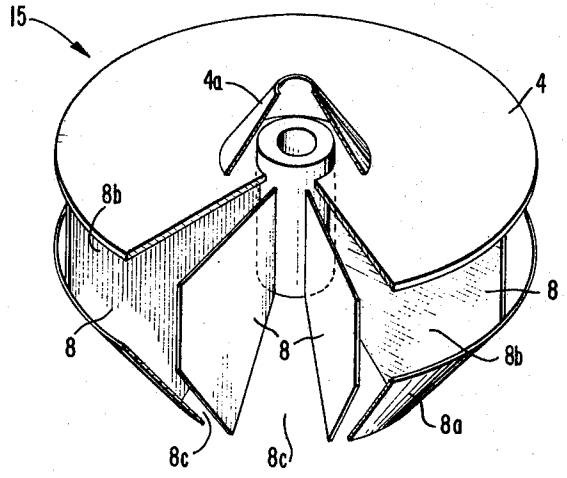


FIG. 2

INVENTOR

Gustav Grün

BY Edwin C. Greigg

ATTORNEY

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METHOD OF AND APPARATUS FOR ADDING LIQUID TO PULVERULENT OR GRANULAR MATERIALS

Gustav Grün, Lissberg, Germany, assignor to Gebruder Grun KG., Maschinenfabrik, Lissberg, Upper Hesse, Germany, a company of Germany

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U.S. Cl. 259—8 6 Claims

ABSTRACT OF THE DISCLOSURE

For a thorough mixing of a liquid with a pulverulent or granular material there is provided a treating chamber in which there rotates a mixer comprising a horizontal distributor disc on which the continuously fed dry material is sprayed by nozzles. The material thereafter is drawin into a double whirl consisting of a circulating main stream and a superimposed secondary stream orbiting in a planetary manner. The dual whirl is caused by a plurality of vanes secured radially to the underside of said distributor disc and carrying a frusto-conicla shell.

BACKGROUND OF THE INVENTION; PRIOR ART

The invention relates to a method of injecting and finely distributing a liquid in pulverulent or granular materials for various purposes. Thus, for example, a reaction may be triggered by the addition of a liquid, or fine pulverulent materials may be rendered dust-free or granular. Or, it may be desired to add to the solid materials an aromatic liquid or a dye solution.

For the above-listed and other purposes it is usually a requirement to achieve a possibly fine distribution of the liquid. Methods and apparatuses are known wherein the liquid is injected into a pneumatically or mechanically accelerated stream of material. Further methods are known according to which the liquid is injected by means of spraying nozzles into a whirling mixture of air and material. Here, the sprayed particles leave the treating chamber against the upwardly moving gas current, while the non-sprayed particles are re-introduced into the spray area. Methods of this type and apparatuses for performing such methods are very expensive and require spraying chambers of large volume. Further, even when spraying towers are used, sediments are often deposited at the walls or at the conical exit, necessitating a frequent cleaning of the spraying chamber. It is a further disadvantage during the spraying process that the deposited particles may be freed and as a result, form lumps in the mixture. Furthermore, in the known methods the liquid may be commingled only up to a certain percentage. If the proportion of the liquid is exceeded, the sedimentation increases to such an extent that the feasibility of the entire mode of operation becomes questionable. There is further known a process in which the pulverulent materials are introduced into a vertical pug mill comprising rapidly rotating knife blades and the liquid is injected into the input stream. The rapidly rotating knife blades prevent the formation of lumps. The apparatus for performing the last named method requires a very high power input.

SUMMARY AND ADVANTAGES OF THE INVENTION

According to the invention, the afore-described disadvantages are avoided by the novel method which includes the following steps: imparting a rotary motion

to the pulverulent or granular materials in a horizontal plane; spraying the materials in the range of their highest velocity normal to their direction of motion and subsequently exposing the materials to a rotary dual whirl which is formed of a horizontally rotating main stream having the shape of a hollow conical ring and of a secondary stream superimposed on the first named stream and circulating about the said hollow conical ring in a planetary manner.

According to a further characteristic of the invention, the particles wetted by the liquid are separated by centrifugal force and are guided downward along the wall of the conical treating chamber to an outlet, while the drier particles, drawn into the planetary secondary stream, are introduced into the circular motion of the inflowing sheet of wetted pulverulent materials to continuously commingle therewith and then separate after attaining a certain saturation.

The circulating main stream of the hollow conical ring prevents a deposition in the treating chamber of the particles saturated with liquid and effects a continuous cleaning of the internal walls. It has been found that even in case of a 40% proportion of fat, a caking or deposition did not take place.

A further important advantage resides in that by means of the afore-described novel method the pulverulent materials are treated in a protective manner so that even larger delicate pieces that may be present in the pulverulent material (such as mushrooms or noodles in soup mixtures) are not damaged.

Briefly stated, the apparatus for performing the aforenoted method comprises substantially a downwardly narrowing conical treating chamber provided in its upper portion with an axially aligned inlet and in its lower portion with an axianlly aligned outlet, a horizontal distributor disc disposed in said chamber and provided on its underside with a plurality of radial vanes carrying at their lower edge portion an axially aligned-frustoconical shell. The disc is keyed to a vertical shaft extending into the treating chamber and rotated by motor means disposed externally thereof.

The invention will be better understood and further advantages as well as objects will become more apparent from the ensuing detailed specification of a preferred embodiment taken in conjunction with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic sectional elevational view of the preferred embodiment, and

FIG. 2 is a perspective view of one part of the preferred embodiment.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Turning now to FIG. 1, the apparatus shown therein comprises a downwardly narrowing conical treating chamber **1** having at its upper portion a central inlet tube **2** and at its lower end a central outlet **3**. The top of the chamber **1** is covered by a conical lid **1***a* in which there is disposed in a horizontal circular array a plurality of spaced spraying nozzles **11** which communicate with a circumferentially arranged liquid conduit **12** through branch conduits **14** each provided with a manually operable valve **13**. Within the treating chamber **1** there is vertically disposed, in axial alignment with inlet **2** and outlet **3**, a shaft **7** extending through the inlet tube **2** and driven by motor **6** through transmission elements **5**. To shaft **7** there is secured a mixer generally indicated at **15** formed of a horizontal distributor disc **4** carrying on its upper face a concentric conical distributor shute **4***a*, a plurality of vertical vanes **8** radially affixed to the underside of disc **4** and a frusto-conical shell **8***a* secured

to and surrounding the vanes **8** in a shroud-like manner. As best seen in FIG. 2, the space immediately under the distributor disc **4** is partitioned by vanes **8** and is delimited by shell **8***a* leaving for each space between two adjacent vanes a radial opening **8***b* and an axial opening **8***c*. To that portion of the shaft **7** which extends through the inlet tube **2**, there are secured a plurality of radial beaters **10**. The dry material is introduced into the inlet tube **2** in equal quantities by means of a feeding device **9**. The beaters **10** cause disintegration of any agglomeration of material. The loose material is evenly distributed on the rotating distributor disc **4** by means of conical shute **4***a* in such a manner that there is formed a coherent sheet of material which is sprayed in the region of its greatest circumferential velocity by means of spray nozzles **11**, emitting liquid in a direction substantially normal to the motion of the particles. As the uniformly sprayed material is, due to centrifugal forces, propelled tangentially off the distributor disc **4**, it is exposed to the mixing effect of the vanes **8** of the mixer **15**. These vanes cause the partices to circulate about the longitudinal axis of chamber **1** in a main stream having the shape of a hollow conical ring. The lighter, drier particles are drawn into a secondary stream travelling about the conical shell **8***a*, as indicated by arrows A, into and out of the spaces defined by adjacent vanes **8**. In addition to the aforenoted motion, said secondary stream orbits in a planetary manner about the longitudinal axis of treating chamber **1**. As the particles become saturated with liquid due to the mixing effect of the above-described dual whirl, they travel downwardly along the conical wall of chamber **1** and eventually leave through outlet **3**.

EXAMPLE 1

For making soup products, a pulverulent food mixture was introduced through inlet **2** and was uniformly fed to the distributor disc **4**. The material was sprayed through the nozzles **11** with a liquid consisting of various fats. It was found that even at slow rotational speeds (which was necessary for the protective handling of large ingredients such as muchrooms, noodles, etc.) and fat proportions of 20–30%, a very good mixture of the liquid and the pulverulent dry material was achieved.

EXAMPLE 2

20% moist potato starch was introduced into the treating chamber **1** and was sprayed through spray nozzle **11** with a dye solution. It was found that the obtained product was homogenously mixed and had a highly uniform coloring.

EXAMPLE 3

Cocoa powder was introduced into the apparatus and was sprayed with water. Here too, a completely uniform distribution and granulation was obtained.

In none of the three afore-described examples was there any trace of lump formation or sedimentation in the treating zone.

In addition to the above exemplary uses, the novel apparatus may be advantageously used as a premixer. The premixture obtained by the novel method may be then added to other dry materials in an adjoining air mixer. In such case, the novel apparatus is connected upstream of the inlet of the batch mixer or another continuously operating mixer. The thorough mixture obtained from the novel apparatus is commingled with additional dry components which directly mix only poorly or not at all with liquids.

What is claimed is:

1. A method of mixing loose dry material with a liquid comprising the following steps:

(A) introducing said material in a downwardly narrowing conical chamber,

(B) forming a horizontally rotating and continuously radially outwardly moving sheet of particles of said material,

(C) spraying said horizontally rotating sheet with liquid in a direction substantially normal to its travel and in a region of maximum speed,

(D) drawing the particles leaving said sheet into a dual whirl formed of

(1) a horizontally circulating main stream travelling substantially about the longitudinal axis of said chamber and having the shape of a hollow conical ring and of

(2) a secondary stream superimposed on said main stream and travelling about said ring while orbiting about said axis in a planetary manner.

2. A method as defined in claim **1**, wherein the particles of sufficient saturation are separated through said main stream while the drier particles are drawn into said secondary stream and are repeatedly reintroduced into said main stream until said drier particles, due to their contact with sprayed particles in said main stream, pick up moisture to such an extent that they are separated out from said main stream.

3. An apparatus for performing the method as defined in claim **1** comprising,

(A) a downwardly narrowing conical treating chamber having

(1) an axially aligned inlet in its upper portion and

(2) an axially aligned outlet in its lower portion,

(B) a mixer rotatably disposed in said treating chamber and including

(1) a horizontally disposed distributor disc, the upper face of which being adapted to receive loose dry material introduced through said inlet,

(2) a plurality of downwardly extending vanes radially secured to the underside of said distributor disc,

(3) a continuous shell carried by said vanes, the underside of said distributor disc, said vanes and said shell defining a plurality of spaces each having a radial and an axial opening,

(C) a plurality of spray nozzles disposed above said distributor disc in a circular array and adapted to apply liquid at least to the marginal area of said distributor disc, and

(D) means for rotating said mixer.

4. An apparatus as defined in claim **3**, wherein said shell is frusto-conical.

5. An apparatus is defined in claim **3**, wherein said means for rotating said mixer includes a shaft disposed axially in said chamber and extending outwardly thereof into said inlet, a plurality of beater elements keyed to said shaft in said inlet.

6. An apparatus as defined in claim **3** including a liquid conduit surrounding said circular array of said spray nozzles externally of said chamber, branch conduits associated with each of said nozzles to connect them individually with said liquid conduit, and a manually operable valve disposed in each of said branch conduits.

References Cited

UNITED STATES PATENTS

1,855,548	4/1932	Forster	259—8
2,625,305	1/1953	Conkling	259—8 X
3,051,454	8/1962	Goos	259—6
3,163,402	12/1964	Yamashita	259—6

ROBERT W. JENKINS, Primary Examiner