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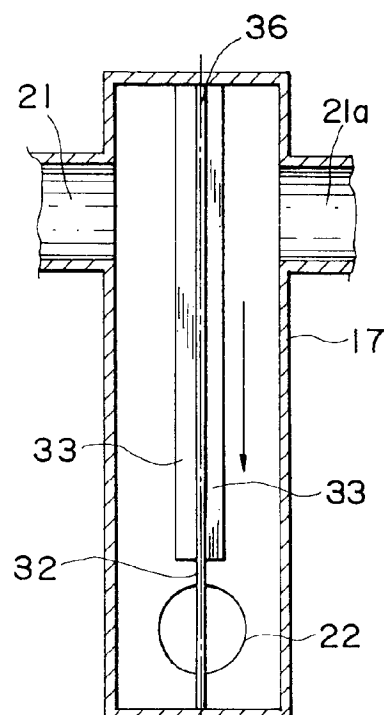
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(54) **Method and apparatus for mixing solid containing foodstuff.**

(57) A mixer (17) for mixing solid containing foodstuff in the course of material conveyance prior to a step of filling, comprising inlets (21,21a) through which a fluid (14) of high solid content ratio and a fluid (13) being free from solids or of low solid content ratio are fed, respectively, an outlet (22) through which the mixed foodstuff is discharged, and impellers (33,36) adapted to be rotated and/or reciprocated by drive means substantially only in the direction transverse to the direction of material conveyance. The impellers (33,36) extend from immediately below the fluid inlets (21,21a) to immediately above the fluid outlet (22) or are at least partially cut off so as to clear the fluid inlets (21,21a) and outlets (22). Control means is provided to synchronously stop the impellers (33,36) as the foodstuff begins to enter the mixer (17). To improve the mixing effect, the impellers (33,36) are arranged so as to define spaces between outer peripheries of the impellers (33,36) and the mixer's inner wall and/or between the impellers (33,36) and a rotary shaft (32) thereof.

FIG. 1



The present invention relates to method and apparatus for mixing solid containing foodstuff without injuring the solids contained therein in a process for filling such foodstuff and more particularly in a continuous in-line process through pipe line or the like for dosing and filling such foodstuff.

In the continuous in-line conveyance of food-stuff which contains solid foodstuff or other solids through the pipe line or the like, it has been conventionally difficult to assure a form stability and the process has often been accompanied with problems such as forming injuries of the solids and plugging in the pipe line. To avoid such problems, relatively large solids have been conveyed manually or by open-type conveyor such as belt conveyor or bucket conveyor.

In continuous process for manufacturing the foodstuff which contains solid foodstuff or the other solids, these solid foodstuff or the other solids have been usually added to the base fluid at a predetermined mixing ratio prior to the steps of dosing and filling, followed by mixing them adequately. In-line mixing process has usually employed the static mixer (e.g., supplied from Japan, NORITAKE CO., Ltd.).

Conveyance by manual operation or by open-type conveyor such as belt conveyor or bucket conveyor has made the sanitary management difficult and therefore has been limited to applications such as processing of daily delivered foodstuff of relatively short relishable period or canned or retorted foodstuff sterilized after being packaged. Although the solids have been added precisely at a predetermined mixing ratio and then mixed together adequately before the steps of dosing and filling also in the conventional process for continuously manufacturing the product containing therein solid foodstuff or the other solids, the number of solids contained in the filled product often statistically scatter when a solid content ratio in the product is relatively low.

To solve this problem, it will be effective to alleviate said scatter possibly appearing in the number of solids contained in the product to dose an amount of solids to be contained in each unit product under a condition of relatively high solid content ratio and to join this with the base mix having been separately dosed before being mixed together. However, according to such method of prior art, such that the fluid of high solid content and the base mix are separately dosed and then mixed together, the materials should be mixed together for each container.

When the materials are mixed together after the step of filling, a mixing effect largely depends on dimensions such as diameter, depth and circumferential shape (e.g., circular, elliptical, etc.) of the container within which a desired operation of mixing is performed. For example, a glass-shaped container is most convenient for mixing and, the more complicated the container's shape is, the more difficult the operation of mixing is. For pouch-type package, corners

of this container prevent the content within the pouch from being uniformly mixed and for pillow-type package it is difficult to insert a mixer into this container.

Severe sanitary requirement is imposed on the filling equipment in the course from the filling step to the sealing step. Under such environmental condition, a space available for installation of the mixer adjacent the moving container is strictly limited and it is very difficult to remove a residual filling materials clinging to impellers when the mixer is taken out from the container after completion of the mixing step. When the procedure is adopted in which the materials are mixed together within the container after completion of the filling step, a particular mixer should be developed depending on the type of container and, in addition, transfer means should be interposed between the mixer and the container. Such arrangement will disadvantageously result in a complicated and bulky system as a whole.

Use of said static mixture certainly allows the in-line mixing to be achieved by a combined effect of "division", "inversion" and "conversion" without utilizing power for mixing. However, use of this static mixer for mixing of solid containing foodstuff is principally to disperse small solids into liquid and consequently limited to applications in which the solids are relatively small and the solid content is relatively low. If the static mixer is used to mix the foodstuff which contains relatively large solids, these large solids are apt to be injured or damaged under said effect of "division". Moreover, two streams are formed within the static mixer and will be ready for generation of a deflection. In consequence, a distribution of time for which individual solids stay within the static mixer will become uneven and the unit amount of solids which has been dosed by the dosing step may cause again unevenness of the solid content in the final product.

It is an object of the invention to provide a method for mixing solid containing foodstuff, said method comprising steps of separately dosing a fluid of high solid content and a fluid of low solid content, mixing these fluids with each other and filling a container with the mixture, wherein operation of mixing is performed in the course from the dosing step to the filling step;

- (1) in non-open type sanitary in-line mode using pipe line or the like,
- (2) in continuous manner adapted for automation of high production efficiency,
- (3) without injuring solids, and
- (4) without varying a solid content in the final product.

It is another object of the invention to provide an apparatus used to execute the above-mentioned method.

To achieve the first object set forth above, the invention generally resides in a method for mixing solid containing foodstuff, said method comprising steps of

separately dosing a fluid of high solid content and a fluid of low solid content, mixing these fluids with each other, and filling a container with the mixture, wherein the solid containing foodstuff is mixed together prior to the filling step substantially only in a direction transverse to the direction of material conveyance.

To achieve the second object set forth above, the invention also resides in a mixer for mixing solid containing foodstuff in the course of material conveyance prior to a step of filling, said mixer comprising inlets through a fluid of high solid content and a fluid free from solids or of low solid content are fed respectively, an outlet through which the mixed food-stuff is discharged, and impellers adapted to be rotated and/or reciprocated by drive means substantially only in a direction transverse to the direction of material conveyance.

Preferably, the impellers extend from immediately below the fluid inlets to immediately above the fluid outlet or at least partially cut off so as to clear said fluid inlets and outlet.

Alternatively, there is provided control means functioning to stop the impellers synchronously as the foodstuff begins to enter the mixer.

Preferably, the impellers are arranged so as to define spaces between outer peripheries of the impellers and the mixer's inner wall and/or between the impellers and a rotary shaft thereof.

In order that the materials can be adequately mixed together in the course from the dosing step to the filling step, a section must be available for mixing. However, such additional section interposed between the dosing step and the filling step, including the case of a simple piping, may disadvantageously increase unevenness again in the number of solids contained in the unit product, since the number of solids contained in each dosed quantity of materials will be mixed with previously or subsequently dosed quantity of materials. The inventors solved this problem by providing a mixing effect substantially only in a direction transverse to the direction of material conveyance instead of providing a mixing effect in the line extending from the dosing step to the filling step in the material conveyance direction.

Two methods for mixing were selectively examined by the inventors depending on degrees of solid's fragility. Generally, when the solid containing fluid is fed to the impellers, the solids partially run against the impellers and they are heavily damaged. The larger the solids are or the higher the r.p.m. of the impellers is, the more heavily the solids are damaged.

For the solids which are extremely fragile, damage of the solids can be alleviated with lower r.p.m. and longer period of mixing operation. However, to lengthen a period of mixing operation, internal volume of the mixer must be dimensioned correspondingly larger or conveying speed must be correspondingly

reduced. Such measure may cause said unevenness to be increased again, since the volume of the mixer often becomes excessively large compared to a predetermined volume of the individual product container. Reduction of the conveying speed, on the other hand, necessarily reduces the production speed and is not practical. In view of these problems, the inventors conducted a series of experiments in which the materials were mixed together under various conditions and found that shocks exerted by the impellers on the solids can be alleviated by feeding the solids to the impellers being at a standstill and allowing rotation of the impellers afterwards. Usually, operation of filling and conveyance of the containers are alternated in the filling equipment of prior art and accordingly the fluid is intermittently conveyed. The inventors found it preferable for the fragile solids preferred to rotate the impellers intermittently so that the solids are subjected to a mixing effect of the impellers while conveyance of the fluid is stopped. It is also contemplated that a complicated control may be employed to change the r.p.m. of the impellers immediately before conveyance of the fluid is stopped and thereby to reduce the shocks exerted by the impellers on the solids.

From the viewpoint of a mixing effect, stop or speed down of the impellers leads to a time loss. To overcome this problem, the inventors modified configuration of the impellers as shown by Figs. 6 through 8 so as to reduce shocks exerted by the impellers on the solids as they are fed into or discharged from the mixer and found that the desired mixing effect can be achieved without significantly injuring the solids even when the solids are fed into or discharged from the mixer while the impellers are continuously rotated.

Such modification of the impeller's configuration is based on the discovery that the solids are injured substantially at the moment when they enter or leave the mixer. It is necessary for the fluid to have a viscosity of 100 cp or higher. With the viscosity lower than this limit, the solids will no more behave together with the fluid.

The present invention provides an effect as will be described below. According to the invention, unevenness of the solid content ratio in the unit product container can be effectively reduced by the unique method comprising the steps of separately dosing the fluid of higher solid content ratio and the fluid free from solids or of low solid content ratio, and then mixing them together substantially only in a direction transverse to the direction of in-line material conveyance to the filling step. Accordingly, the number of solids contained in respective dosed shots are successively conveyed without loss of dosing accuracy. Each unit quantity provided by each dosing shot is mixed then with each unit quantity of base mix provided by the simultaneous dosing shot and thereby

the accuracy in the number of solids to be introduced into the final product is assured.

The above and other objects of the invention will be seen by reference to the description taken in connection with the accompanying drawings, in which:

Figs. 1 through 3 show an embodiment of the invention, comprising impellers 33, 33, 36, 36 arranged around a rotary shaft so as to define a cruciform cross-section with the impellers 36, 36 being spaced from the rotary shaft 32, of these figures:

Fig. 1 shows this embodiment in axial section as viewed from the front;

Fig. 2 shows the same in axial section as viewed from the side;

Fig. 3 shows the same in cross-section;

Fig. 4 shows, in axial section as viewed from the front, a second embodiment of the invention, comprising a pair of impellers arranged to be spaced from each other on either side of the rotary shaft;

Fig. 5 shows the embodiment of Fig. 4 in cross-section;

Fig. 6 shows, in axial section as viewed from the front, a third embodiment of the invention, comprising impellers partially cut off so as to clear material inlets;

Fig. 7 shows, in axial section as viewed from the front, a fourth embodiment of the invention, comprising impellers having their portions opposed to the inlets dimensioned to be narrower than the remaining portions;

Fig. 8 shows, in axial section as viewed from the front, a fifth embodiment of the invention, comprising impellers having their portions opposed to the inlets and outlet, respectively, dimensioned to be narrower than the remaining portions;

Fig. 9 shows, in front view, an embodiment of the inventive impellers comprising a pair of solid impellers and a pair of inner portion punched impellers arranged in cruciform configuration;

Fig. 10 is a plan view corresponding to Fig. 9;

Fig. 11 is a side view corresponding to Fig. 9;

Fig. 12 is a front view showing a variant of the embodiment shown by Fig. 9, comprising only the pair of inner portion punched impellers;

Fig. 13 is a plan view corresponding to Fig. 12;

Fig. 14 is a side view corresponding to Fig. 12;

Fig. 15 is a front view showing another embodiment of impellers comprising a pair of fence-shaped impellers diametrically extending from the rotary shaft;

Fig. 16 is a plan view corresponding to Fig. 15;

Fig. 17 is a side view corresponding to Fig. 15;

Figs. 18, 20 and 22 are perspective views showing embodiments of impeller which are circle-, circular-arc- and L-shaped in cross-sections, respectively;

Figs. 19, 21 and 23 are perspective views show-

ing embodiments of impeller, comprising the respective impellers shown by Figs. 18, 20 and 22 and plates connected between these impellers and the rotary shafts, respectively;

Fig. 24 is a schematic diagram illustrating a first embodiment of manufacturing process using the mixer of the invention;

Fig. 25 is a schematic diagram illustrating a second embodiment of manufacturing process using the mixer of the invention, comprising a pre-mixer 24 used to mix the materials before being fed into the mixer;

Fig. 26 is a schematic diagram illustrating a third embodiment of manufacturing process using the mixer of the invention, comprising a two stage dosing mode;

Fig. 27 is a schematic diagram illustrating a fourth embodiment of manufacturing process using the mixer of the invention in which the mixing operation is performed after a two dosing stage;

Fig. 28 is a graphic diagram indicating the number of solids contained in the individual product on the axis of abscissa and frequency on the axis of ordinate, comparing mixing effects obtained by manual operation, by using the conventional static mixer and by using the mixer of the invention;

Fig. 29 is a graphic diagram indication r.p.m. of the mixer on the axis of abscissa and the number of flawless solids contained in the individual product on the axis of ordinate, comparing effects of the mixer shown by Figs. 1 and 4, respectively; and

Fig. 30 is a graphic diagram similar to Fig. 29, comparing effects of the mixer shown by Figs. 1, 4, and 6 through 8.

The present invention principally resides in a mixing process carried on transversely of a material conveying direction in a production line extending from a step of dosing to a step of filling foodstuff which contains solid foodstuff or the other solids.

<FIRST EMBODIMENT OF MANUFACTURING PROCESS>

A first embodiment of manufacturing process using the mixer of the invention is schematically illustrated by Fig. 24. This embodiment is an example of the process for manufacturing fruit containing yogurt and strawberry is used here as a fruit to be mixed with yogurt.

Yogurt base mix 13 is fed from a tank 11 into a yogurt base mix dosing apparatus 16a which then doses yogurt base mix at a flow rate of 100 g/sec into a mixer 17 via a pipe 21a and simultaneously strawberry preserve 14 is fed from a tank 12 into a preserve dosing apparatus 16 which then doses preserve at a flow rate of 50 g/sec into the mixer 17 via a pipe 21. The mixer 17 has a volume sufficient to fill

approximately three containers with product and each unit quantity of product having been mixed in this mixer 17 is discharged via a discharge pipe 22 into a container 18.

The container 18 is transferred by transfer means 23 by conveyer belt 19 to the subsequent process one second after completion of filling and a next container 18 is transferred to a position immediately below the discharge pipe 22. The mixer 17 operates at a timing associated with transfer of the container 18 under control of device control means 20 for impellers (not shown).

<SECOND EMBODIMENT OF MANUFACTURING PROCESS>

Fig. 25 illustrates the second embodiment of manufacturing process using the mixer of the invention. In this embodiment also, yogurt base mix and preserve are separately dosed before being fed into the mixer. This embodiment employs a pre-mixer 24 used to mix the materials before they are fed into the mixer 17. The pre-mixer 24 may be arranged, for example, so that the yogurt base mix is fed into the pre-mixer 24 through a nozzle and thereby a mixing effect is provided by a jet stream of yogurt base mix. Provision of such pre-mixer makes it possible to alleviate a burden of the mixer 17. Such pre-mixing can be achieved, in addition to said jet stream of yogurt base mix, by utilizing a stream contracting effect, turbulence due to orifice or the like.

<THIRD EMBODIMENT OF MANUFACTURING PROCESS>

The processes as illustrated by Figs. 24 and 25 rely on a single primary dosing step. However, a two-stage dosing mode may be adopted, i.e., primary and secondary dosing steps may be provided before final mixing.

Fig. 26 illustrates a third embodiment of manufacturing process using the mixer of the invention, in which the strawberry preserve 14 is fed from the tank 12 into the primary dosing apparatus 16 which then doses the preserve 14 into the mixer 17 while the yogurt base mix 13 is fed from the tank 11 directly into the mixer 17, and the materials thus mixed with each other are then fed into a secondary dosing apparatus 16b which then doses them into the container 18 via the discharge pipe 22.

<FOURTH EMBODIMENT OF MANUFACTURING PROCESS>

Fig. 27 illustrates a fourth embodiment of manufacturing process using the inventive mixer, in which the strawberry preserve 14 is fed from the tank 12 into the primary preserve dosing apparatus 16 and

then into a secondary dosing apparatus 16c into which the yogurt base mix 13 is directly fed from the tank 11, and said secondary dosing apparatus 16c doses the materials into the mixer 17 which discharges the mixed materials into the container 18 via the discharge pipe 22.

When the two-stage dosing mode as illustrated by Figs. 26 and 27 is adopted, high solid content liquid (or low solid content liquid) is dosed on the first stage and the quantity of liquid thus dosed on the first stage is dosed together with the base mix on the second stage. Relative position of in- and outlets on the second stage may be inverted with respect to that on the first stage to minimize an error in dosing the final product, since the quantity dosed on the first stage is entirely contained in the quantity dosed on the second stage. In this way, an efficient mixing effect can be achieved whether the mixing operation is performed between two dosing stages or after these two dosing stages.

Now the mixer used for the inventive method will be described in reference with several preferred embodiments shown by Figs. 24, 25, 26 and 27. It should be understood here that the mixer 17 is of the type adapted to be used exclusively for processing the solid containing foodstuff.

Referring to Figs. 1, 2, and 3, an inlet 21 is connected to a supply source that intermittently feeds a predetermined quantity of fluid having high solid content ratio, and another inlet 21a is connected to a supply source that intermittently feeds a predetermined quantity of fluid being free from solids or having low solid content ratio. In contrast with the embodiment of Fig. 1 including these paired inlets 21, 21a provided so as to be opposed to each other, there is provided a single inlet in the embodiment of Fig. 27, because those fluids of two types are fed into the mixer 17 after they have been mixed together in a dosing apparatus 16c. It is not critical to provide paired and/or opposed inlets.

Assembly of impellers incorporated in the mixer 17 is connected to impeller drive means and rotated and/or reciprocated by this drive means. The drive means may be an electric motor, a rotary actuator or the like. Furthermore, a servo motor or a motor provided with clutch brake may be employed to facilitate r.p.m. or rotational direction of the impellers to be changed or reversed, respectively.

Now the impellers used for the method of the invention will be described.

Referring to Figs. 1, 2, and 3, a rotary shaft 32 is longitudinally provided with impellers 33, 33, 36, 36. These impellers 33, 33, 36, 36 arranged so as to define a cruciform cross-section as seen in Fig. 3 are supported at longitudinally opposite ends by upper and lower supporting rods 34, 35 radially extending from longitudinally opposite ends of the rotary shaft 32. Referring to Fig. 2, the impellers 36, 36 are

spaced from the rotary shaft 32. In this embodiment, the impellers 33, 36 have their upper ends located above both the inlet 21 for solid containing fluid and the inlet 21a for base fluid. Solids may be fed onto the impellers being at a standstill and then impellers may be rotated to protect the solids against injuries. In other words, the impellers may be intermittently rotated and the solid containing fluid and the base fluid may be fed into the mixer while the impellers are at a standstill to avoid injuries of the solids. The impellers have their lower ends located above an outlet 22 so as to discharge the solids without being caught by the impellers.

Fig. 4 and 5 show a variant of the impellers. One of longitudinal sides of the impeller 33 is secured directly to the rotary shaft 32. As will be apparent from Fig. 5, the upper and lower supporting rods 34, 35 radially extend from longitudinally opposite ends of the rotary shaft 32 and the impeller 36 is supported by outer ends of these supporting rods 34, 35 so as to be spaced from the impeller 33 by an angular distance of 180°. The impeller 36 is spaced from the rotary shaft 32 to define a space therebetween as shown by Fig. 4.

Base fluid for the solid containing foodstuff generally has sufficiently high viscosity to prevent the solids from sinking in the base fluid. Accordingly, the impeller 33 directly secured to and radially extending outward from the rotary shaft may be combined with the impeller 36 radially extending inward from the outer edge of this impeller 36 toward the rotary shaft to define spaces between the inner wall of the mixer 17 and the impeller 33, on one hand, and between the impeller 36 and the rotary shaft 32, on the other hand. Such arrangement can contribute to improve a mixing effect achieved in a direction transverse to the direction of material conveyance.

In order to assure that no mixing effect should occur in the direction of material conveyance, it is important to employ flat impellers configured to have neither twist nor torsion.

Since the method of the invention is required to achieve the mixing effect substantially only in the direction transverse to the direction of material conveyance, it is preferred to employ the impellers each configured, for example, to have uniform longitudinal section and/or uniform cross-section such as a rectangle so that, when the impellers are rotated or reciprocated by the drive means, no thrust be generated in the direction of material conveyance, for example, in the direction as indicated by an arrow in Fig. 1.

Variants of the impellers include those in the forms of round bars 38 as shown by Fig. 18, impellers 39 each being circular-arc-shaped in cross-section as shown by Fig. 20 and impellers 40 being L-shaped in cross-section as shown by Fig. 22. In addition, impellers 38, 39 and 40 may be connected by plates 38a, 39a and 40a to the rotary shaft 32, as shown by Figs.

19, 21 and 23, respectively.

Configuration of each impeller depends on shape and size of each solid as well as on viscosity of the fluid as will be described in reference with Figs. 9 through 17.

Referring first to Figs. 9 through 11, a pair of impellers 41, 41 are longitudinally mounted on the rotary shaft 32. Specifically, each impeller 41 itself comprises an elongate plate having branches transversely extending toward and connected to the rotary shaft 32 so as to define a space between the impeller and the rotary shaft 32. Another pair of impellers 42, 42 are arranged to define, together with said pair of impellers 41, 41, a cruciform cross-section.

Figs. 12 through 14 show an arrangement comprising only one pair of impellers 43 corresponding to the pair of impellers 41 shown by Figs. 9 through 11.

Figs. 15 through 17 show another arrangement comprising the rotary shaft 32, branches 47, 48 radially outward extending from longitudinally opposite ends of the rotary shaft 32, impellers 45, 46 in the form of round bars extending in parallel to each other between said branches 47, 48 at outer ends and middle points of these branches, respectively, so that a space 49 is defined between the impellers 45 and 46 and a space 50 is defined between the impeller 46 and the rotary shaft 32. Such assembly of these branches 47, 48 and the impellers 45, 46 is pairly provided on either side of the rotary shaft 32.

As has previously been mentioned, the impellers are connected to the drive means which is, in turn, actuated under a control of the control means 20 as shown by Fig. 24 so that functions of in- and outlets of each dosing apparatus are inverted as the rotary shaft of the mixer 17 is intermittently rotated. Both the impellers 33, 36 as shown by Figs. 1, 2 and 3 and the impellers 33, 36 as shown by Figs. 4 and 5 function to mix the respective fluids fed through the inlets 21, 21a in a direction transverse to the direction of material conveyance. In order to assure that a period for which the respective solids stay in the mixer be practically uniform and the solids be protected against injuries, it is preferred to dimension and install the impellers so as to have their upper ends above the level of the respective inlets.

Shocks exerted by the impellers on the solids may be further alleviated by feeding the solids onto the impellers being at a standstill and then rotating the impellers.

Dispensing nozzle (not shown) may be connected to the outlet 22 of the mixer 17 to dispense a predetermined unit quantity of the solid containing foodstuff which has been processed in the mixer into the container.

However, the mode of intermittent rotation as has been mentioned just above will necessarily complicate the control means. From the viewpoint of the mixing effect, the period for which the impellers are

at a standstill is a time loss and therefore such processing mode is inefficient so far as a productivity is concerned. Accordingly, if a mixing effect comparable with the mixing effect obtained from the intermittent rotation can be obtained and no significant injuries of the solids can be avoided, continuous rotation will be preferred. To this end, the inventors examined how the solids are injured during continuous rotation of the impellers and found that most of injuries occur due to shocks exerted by the impellers on the solids at the moment when the solids are fed into or discharged from the mixer. On account of this finding, upper ends of the impellers may be located immediately below the inlets and lower ends of the impellers may be located immediately above the outlet to avoid the injuries of the solids during the mixing process. The impellers shown by Fig. 6 are partially cut off so as to clear both the inlets and the outlet. Specifically, both the inlet 21 for the fluid of high solid content ratio and the inlet 21a for the base fluid are located above the upper ends of the impellers 33, 36 and the outlet 22 is located below the lower ends of these impellers so that these impellers may be continuously rotated without significantly injuring the solids.

It was also found that the shocks exerted by the impellers on the solids can be effectively alleviated by configuring the impeller 36a to have a narrower portion opposed to the inlets as shown by Fig. 7 or configuring the impellers 36a, 36b to have narrower portions opposed to both the inlets and the outlet as shown by Fig. 8.

In the embodiments as have been described hereinabove, the fluid has preferably a viscosity of 100 cp or higher and with the viscosity being lower than this limit the solids sometimes could not behave together with the fluid.

Now experiments using the method of the invention will be exemplarily described.

<EXPERIMENT 1>

Aqueous solution of carboxy methyl cellulose (CMC) having a viscosity of approximately 3000 cp was used as base mix and strawberry preserve was used as solid containing fluid to obtain 150 g product. To compare filling accuracy achieved by various mixers, distribution exhibited by the number of solids in final products filled into respective containers is graphically shown by Fig. 28, in which the number of solids in each unit product is indicated on the axis of abscissa and frequency thereof is indicated on the axis of ordinate.

Case A is the case in which no mixer was used and materials were manually mixed together, case B is the case in which the conventional static mixer was used and case C is the case in which the inventive mixer was used. The mixer of the invention used in case C was 5 cm in diameter, about 30 cm in length

and adapted to be rotated at 30 r.p.m. In case B, 2 inch-6 element type static mixer (5 cm in diameter, about 40 cm in length) was used. A mixing effect achieved by using the inventive mixer in case C was excellent and color of the strawberry preserve was evenly blended in aqueous solution of CMC. In case B using the static mixer, the strawberry preserve presented a marble pattern in the base mix, suggesting a poor mixing effect. In spite of the fact the mixers of substantially same sizes were used in cases B and C, the mixer of the invention achieved a mixing effect higher than that achieved by the static mixer. In the case B, the number of solids contained in each product exhibited significant unevenness while case C maintained a filling accuracy similar to that in case A. Case D is the case in which yogurt base mix and strawberry were mixed under the same condition as in case C. Case D also maintained the filling accuracy similar to those in cases C and A, verifying an excellent mixing effect of the inventive mixer. In these experiments, the dosing step was followed by the mixing step. For the same product, the inventors experimentally inverted the sequence of these steps and found that the number of solids contained in the final product exhibits more significant unevenness when the mixing step is followed by the dosing step than when the dosing step is followed by the mixing step.

<EXPERIMENT 2>

Yogurt of about 4000 cp was used as the base mix and strawberry preserve was used as the fluid of high solid content ratio to obtain 600 g product. Result of this experiment is graphically shown in Fig. 29.

Polygonal line A plots the number of strawberry contained in the final product when the mixer provided with the impellers as shown by Figs. 1, 2 and 3 was continuously rotated. It should be understood that substantially flawless strawberry which can be regarded as whole fruit was counted as the number of strawberry. Polygonal line B plots the result obtained by continuously rotating the mixer provided with the impellers as shown by Figs. 4 and 5. Polygonal line C plots the number of strawberry contained in the final product when the mixer provided with the impellers as shown by Figs. 1, 2, and 3 was intermittently rotated. In experiment 2, the mixer of the invention having the same size as the mixer used in Experiment 1 was rotated at various r.p.m in order to compare degrees of injuries depending on r.p.m. Average number ($n = 25$) of solids contained in the final product under various r.p.m. is graphically shown by Fig. 29, in which the r.p.m. of the mixer is indicated on the axis of abscissa and the number of flawless solids contained in the final product is indicated on the axis of ordinate. Polygonal lines C indicates that the mixing effect is negligibly affected by the r.p.m. while polygonal lines A and B indicate that the number of solids contained

in the final product remarkably decreases as the r.p.m. increases.

It was found in the Experiment 2 that the result obtained by intermittently rotating the mixer of the invention is better than the result obtained by continuously rotating the mixer of the invention.

<EXPERIMENT 3>

Yogurt of about 4000 cp was used as the base mix and strawberry preserve was used as the fluid of high solid content ratio to obtain 600 g product. The result is graphically shown by Fig. 30.

Polygonal line A plots the number of strawberry contained in the final product when the mixer provided with the impellers as shown by Figs. 1, 2 and 3 was continuously rotated. Polygonal line B plots the case in which the mixer provided with the impellers as shown by Figs. 4 and 5 was continuously rotated. Polygonal line C plots the number of strawberry contained in the final product when the mixer provided with the impellers as shown by Figs. 6, 7 and 8 was continuously rotated. In every case, it should be understood here also that substantially flawless strawberry which can be regarded as whole fruit was counted as the number of strawberry. So far as similar samples were mixed in similar manner, the best result was obtained by the mixer provided with the impellers as shown by Figs. 6, 7 and 8 even when this mixer was continuously rotated.

In view of such experimental result, the solids can be further effectively protected against injuries by using the impellers partially cut off so as to clear the inlets and the outlet of the mixer even when the mixer is continuously rotated.

Claims

1. A method for mixing solid-containing foodstuff, the method comprising the steps of
separately dosing a fluid (14) of high solid content ratio and a fluid (13) of low solid content ratio;
mixing these fluids with each other; and
filling a container (18) with the mixture, wherein solid containing foodstuff is mixed together, prior to filling the container, substantially only in a direction transverse to the direction of material conveyance.
2. A method according to claim 1, wherein the direction of material conveyance is horizontal.
3. A method according to claim 2, wherein the direction transverse to the direction of material conveyance is vertical.
4. A mixer (17) for mixing solid containing foodstuff in the course of conveyance prior to a step of filling, the mixer comprising inlets (21,21a) through which a fluid (14) of high solid content ratio and a fluid (13) being free from solids or of low solid content ratio are fed, respectively, an outlet (22) through which the mixed foodstuff is discharged, and impellers (33,36) adapted to be rotated and/or reciprocated by drive means substantially only in a direction transverse to the direction of material conveyance.
5. A mixer (17) according to claim 4, wherein the inlets (21,21a) for foodstuff are provided on the upper portion and the outlet (22) for foodstuff is provided on the lower portion of the mixer.
6. A mixer (17) according to claim 4, wherein the impellers (33,36) are arranged so as to define spaces between outer peripheries of the impellers and the mixer's inner wall and/or between the impellers and a rotary shaft (32) thereof.
7. A mixer (17) according to claim 4, wherein the impellers (33,36) extend from immediately below the fluid inlets (21,21a) to immediately above the fluid outlet (22) or are at least partially cut off so as to clear the fluid inlets and outlets.
8. A mixer (17) according to claim 7, further comprising control means to synchronously stop the impellers (33,36) as the foodstuff begins to enter the mixer.

FIG. 1

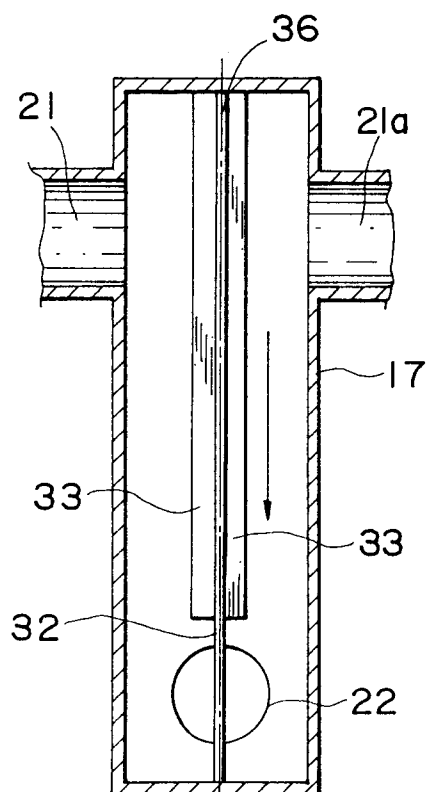


FIG. 2

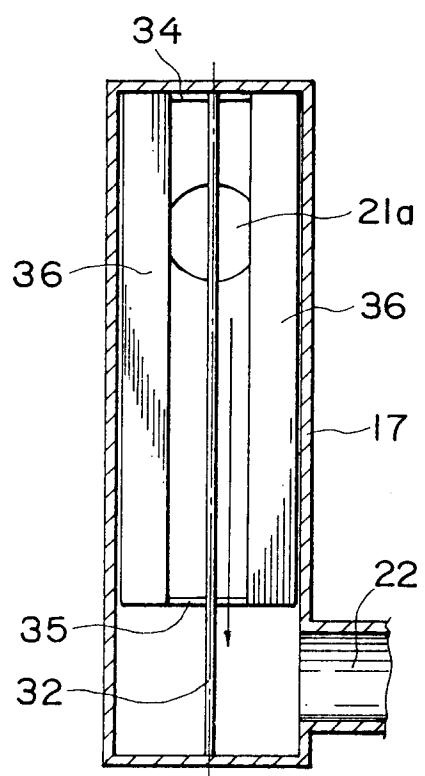


FIG. 3

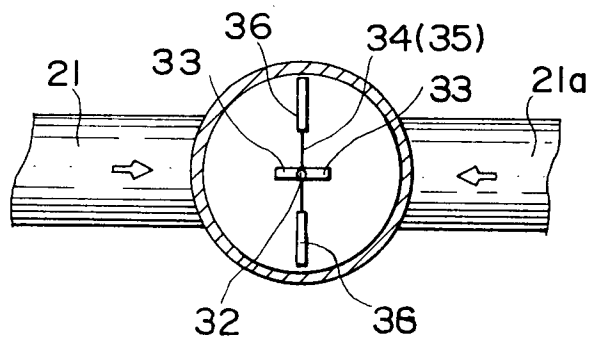


FIG. 4

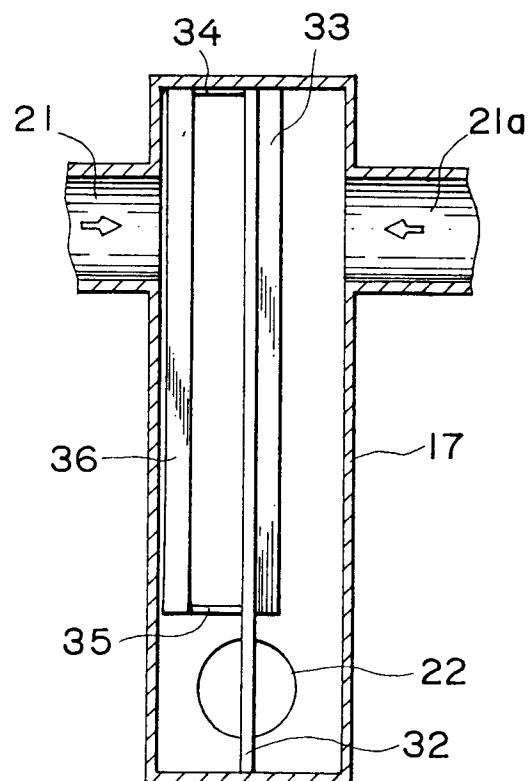


FIG. 5

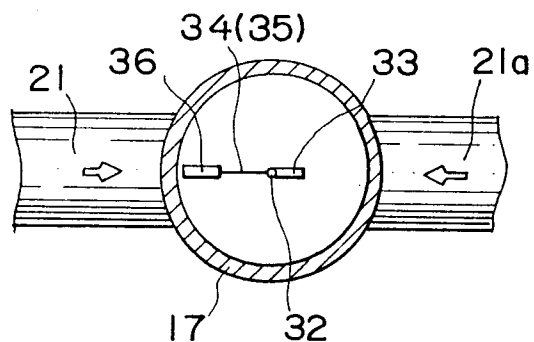


FIG. 6

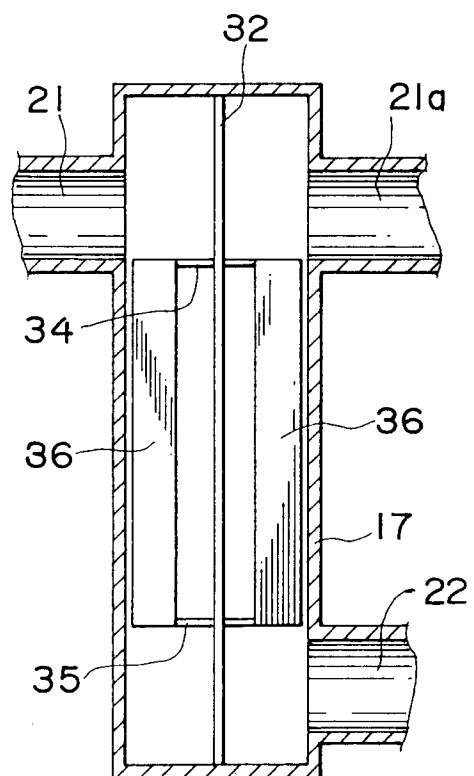


FIG. 7

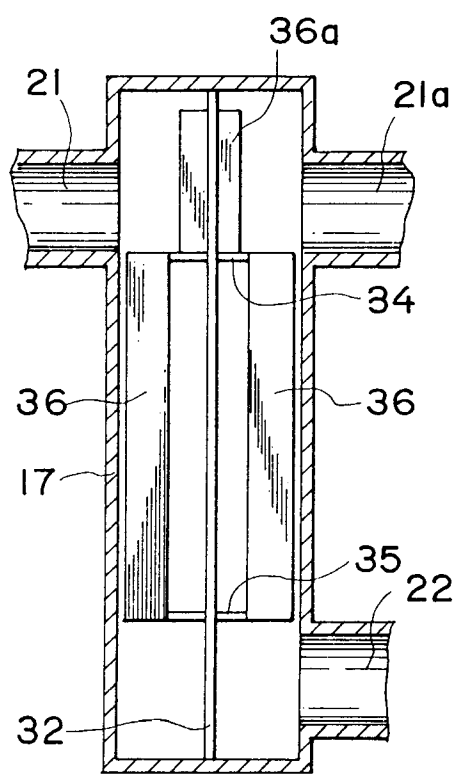


FIG. 8

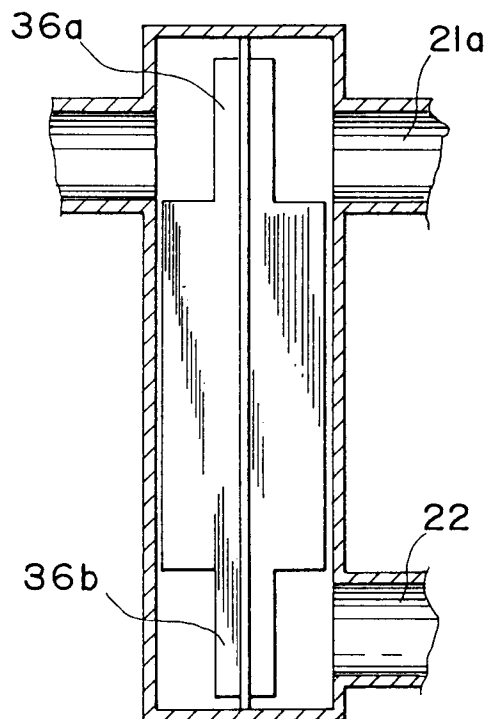


FIG. 9

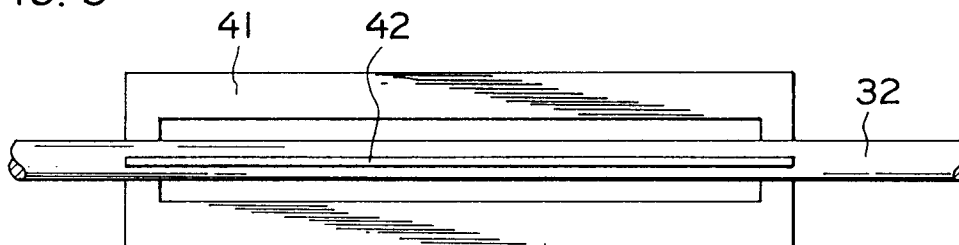


FIG. 10

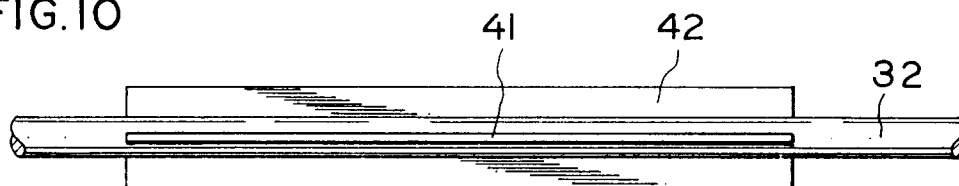


FIG. 11

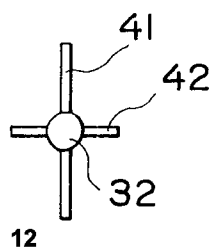


FIG. 12

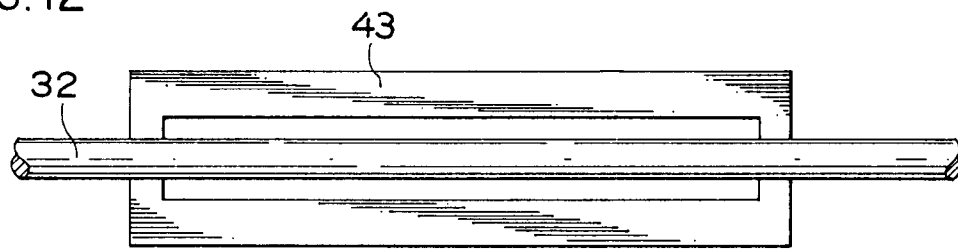


FIG. 13

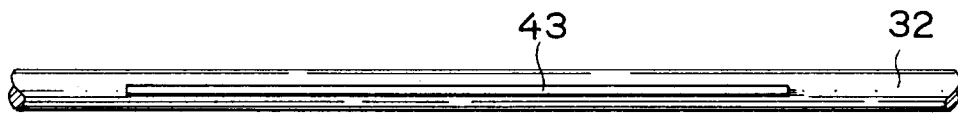


FIG. 14

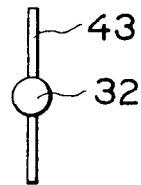


FIG. 15

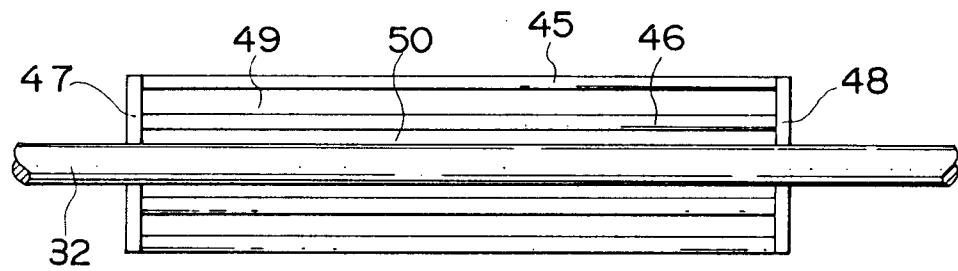


FIG. 16



FIG. 17

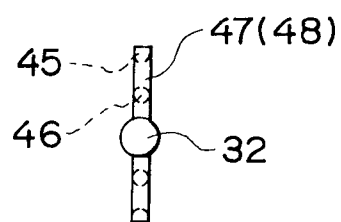


FIG.18

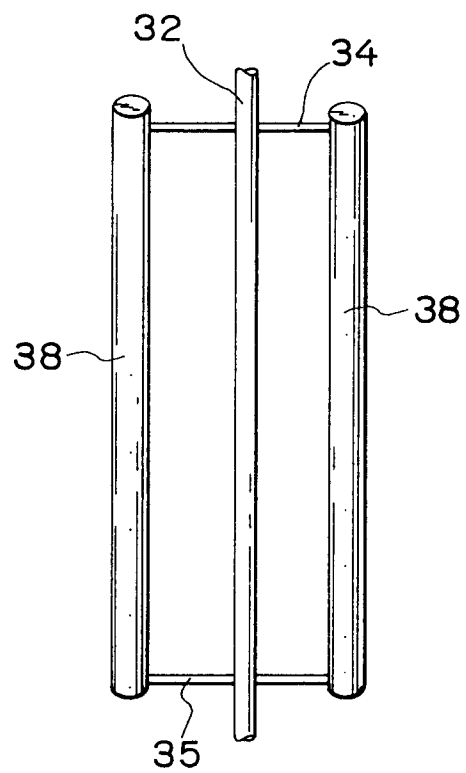


FIG.19

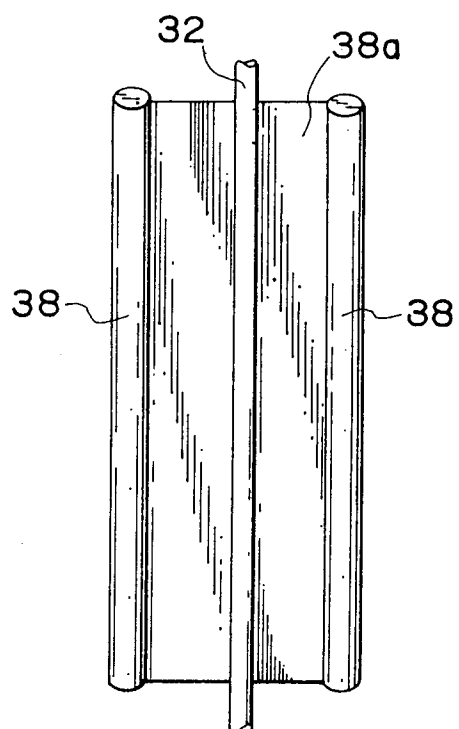


FIG.20

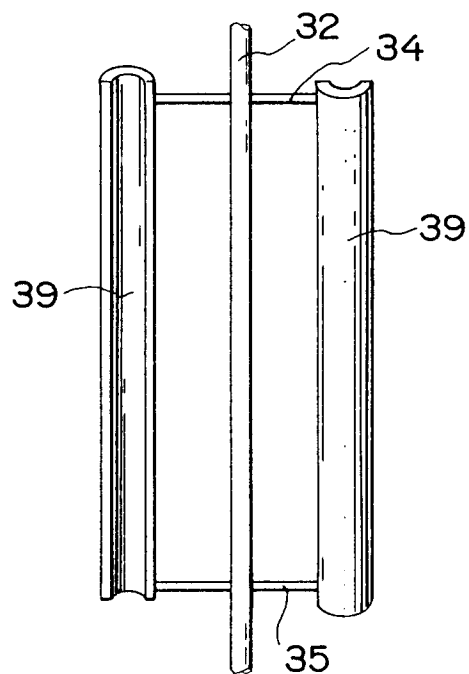


FIG.21

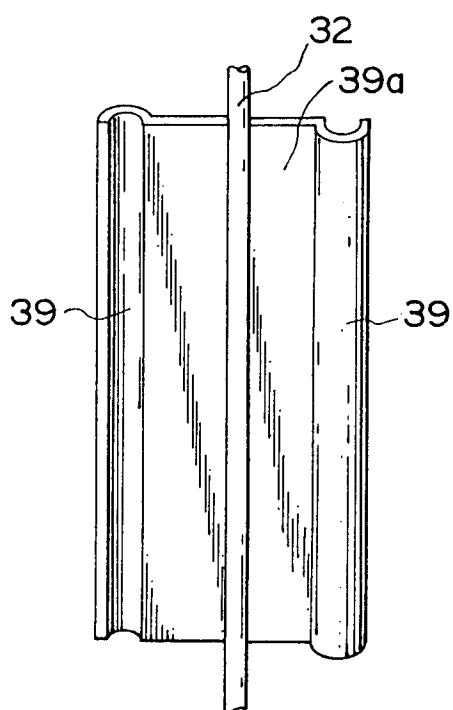


FIG. 22

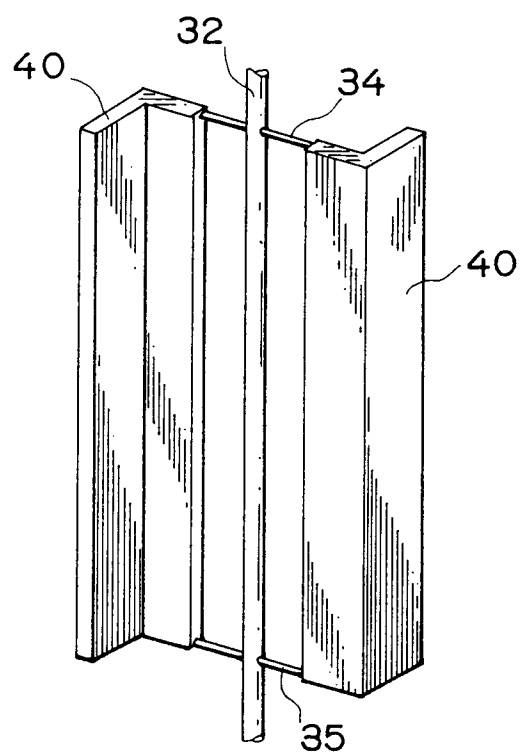


FIG. 23

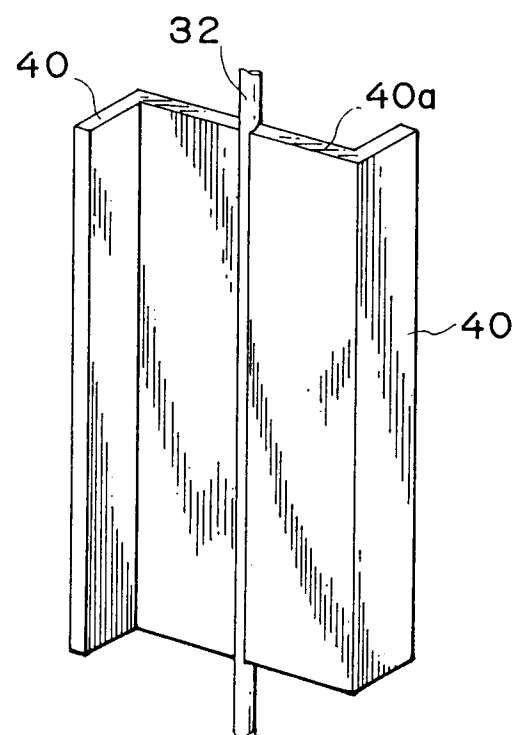


FIG. 24

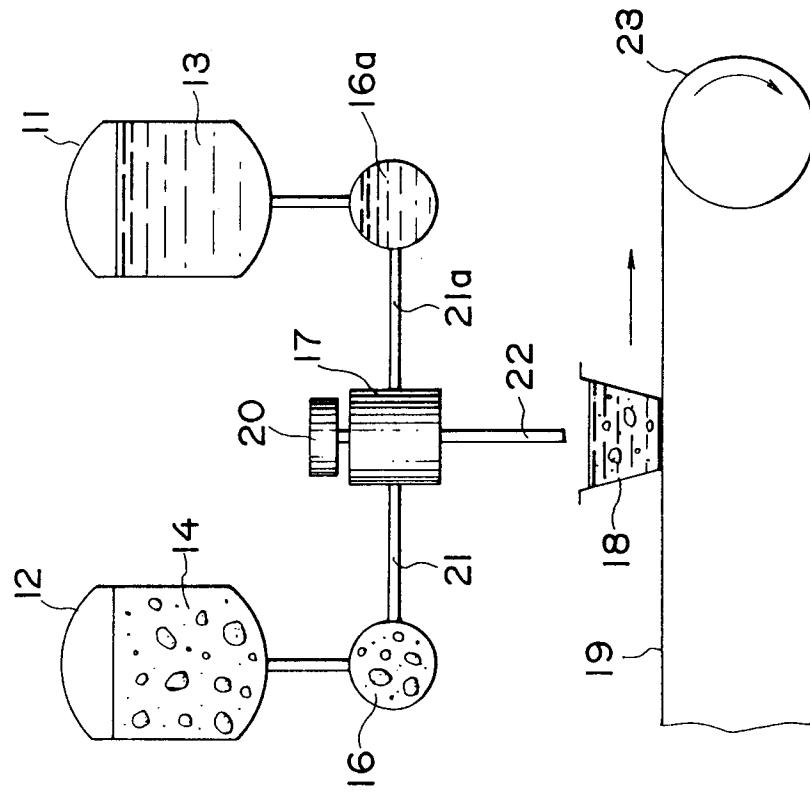


FIG. 25

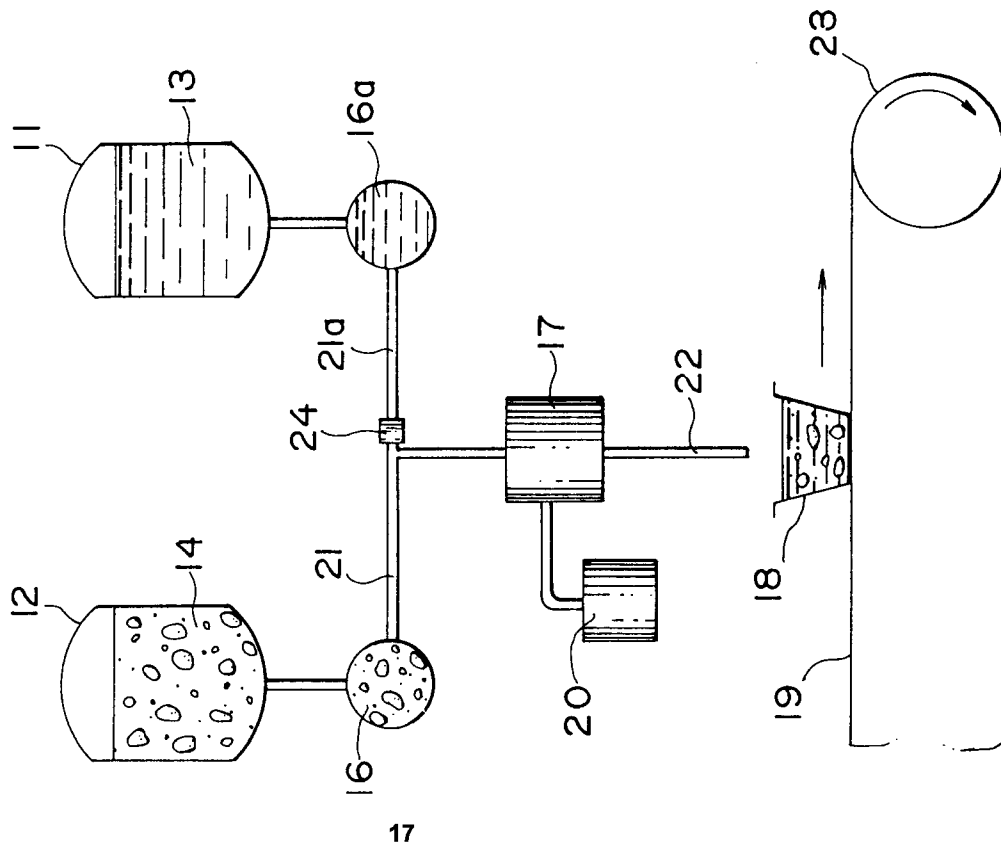


FIG. 26

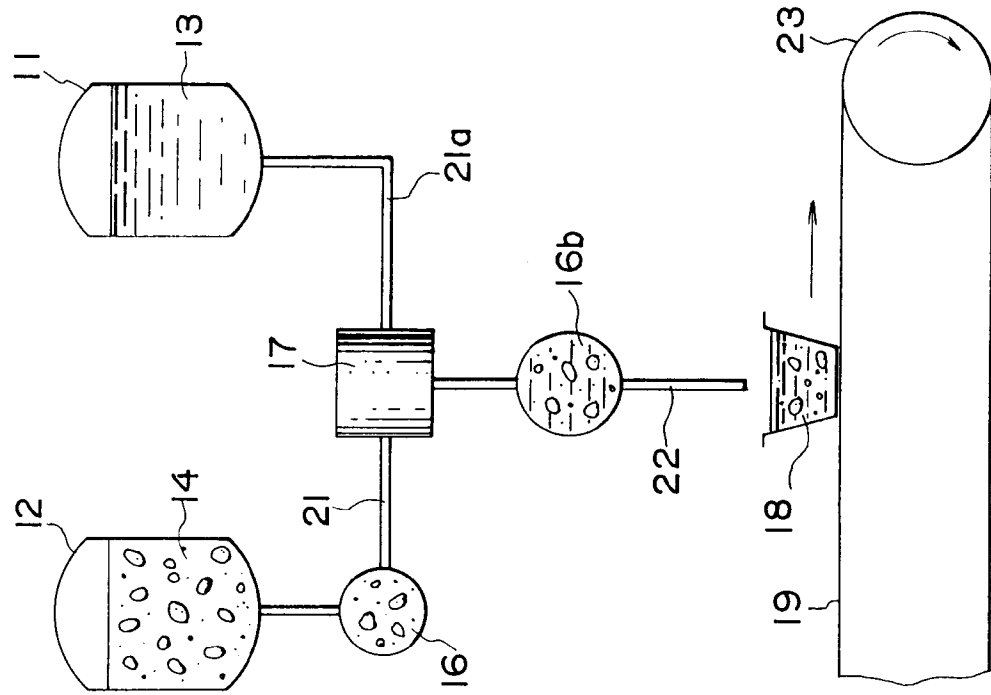


FIG. 27

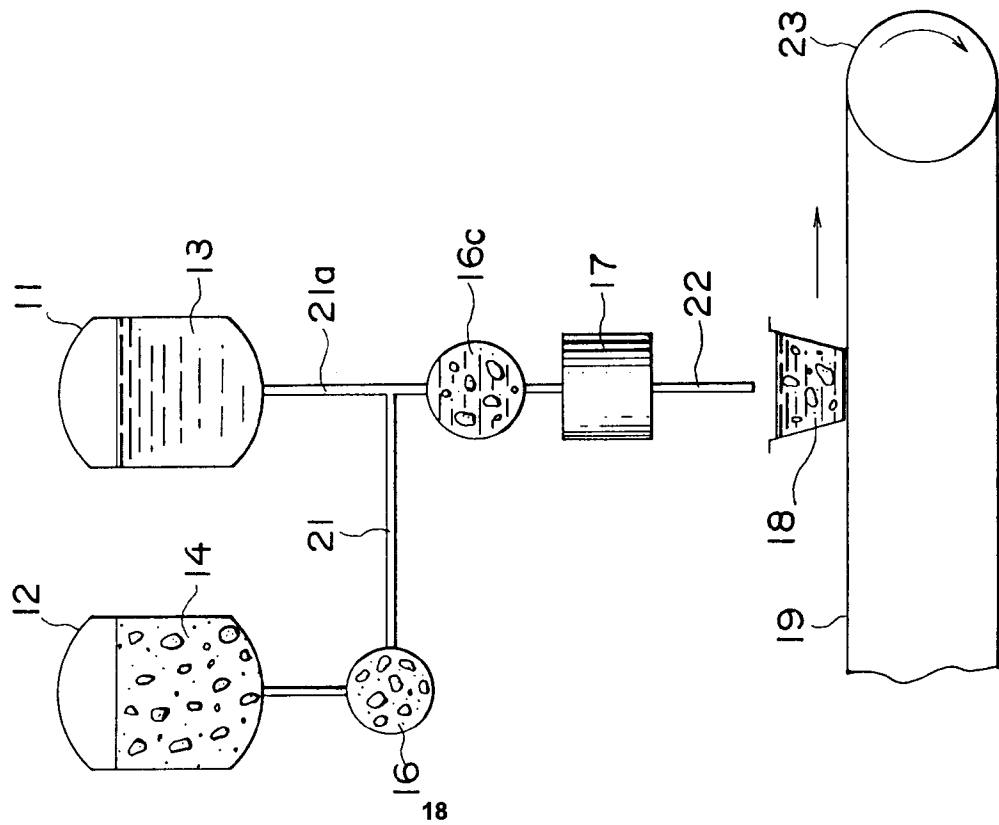


FIG. 28

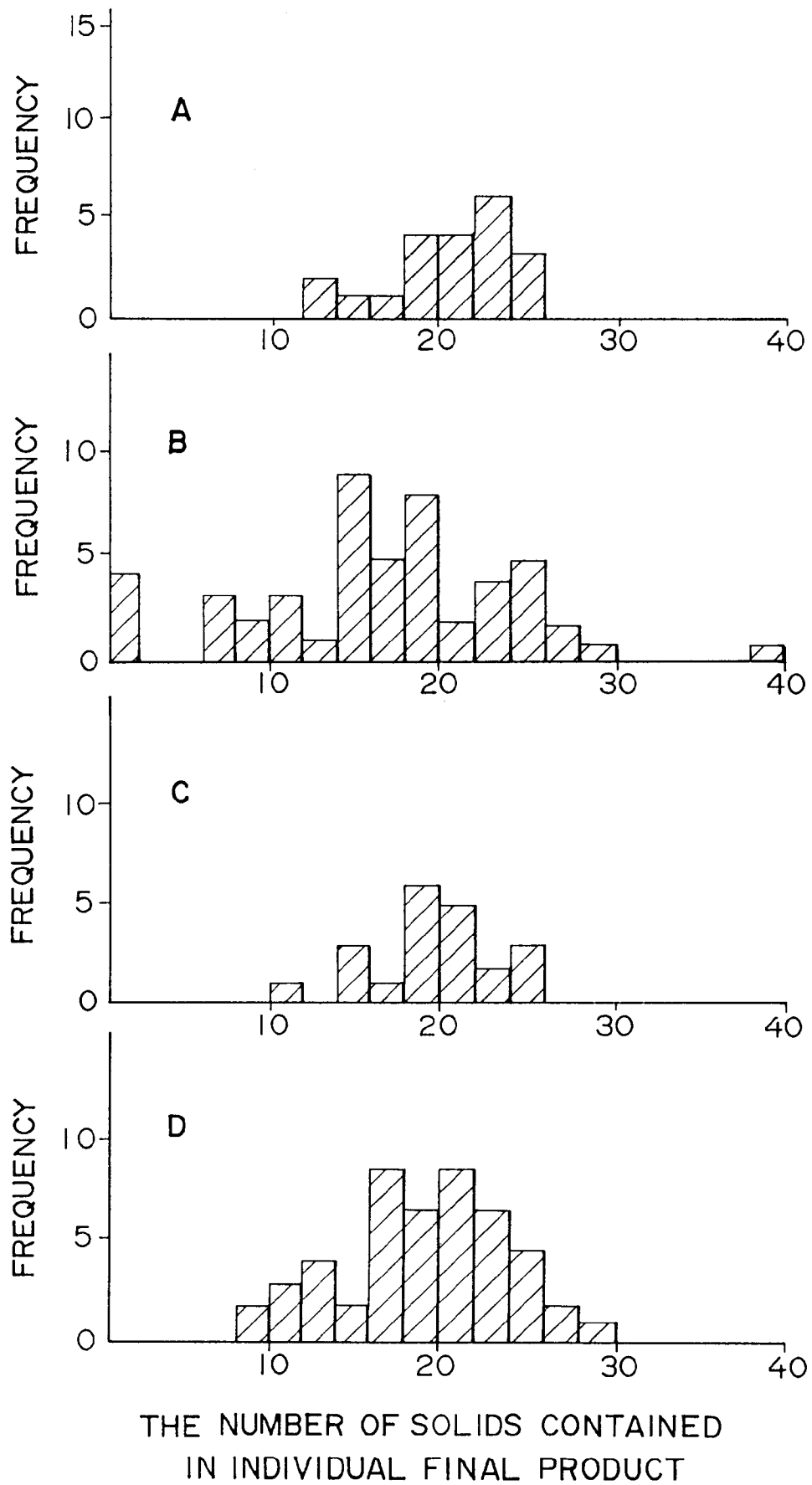


FIG. 29

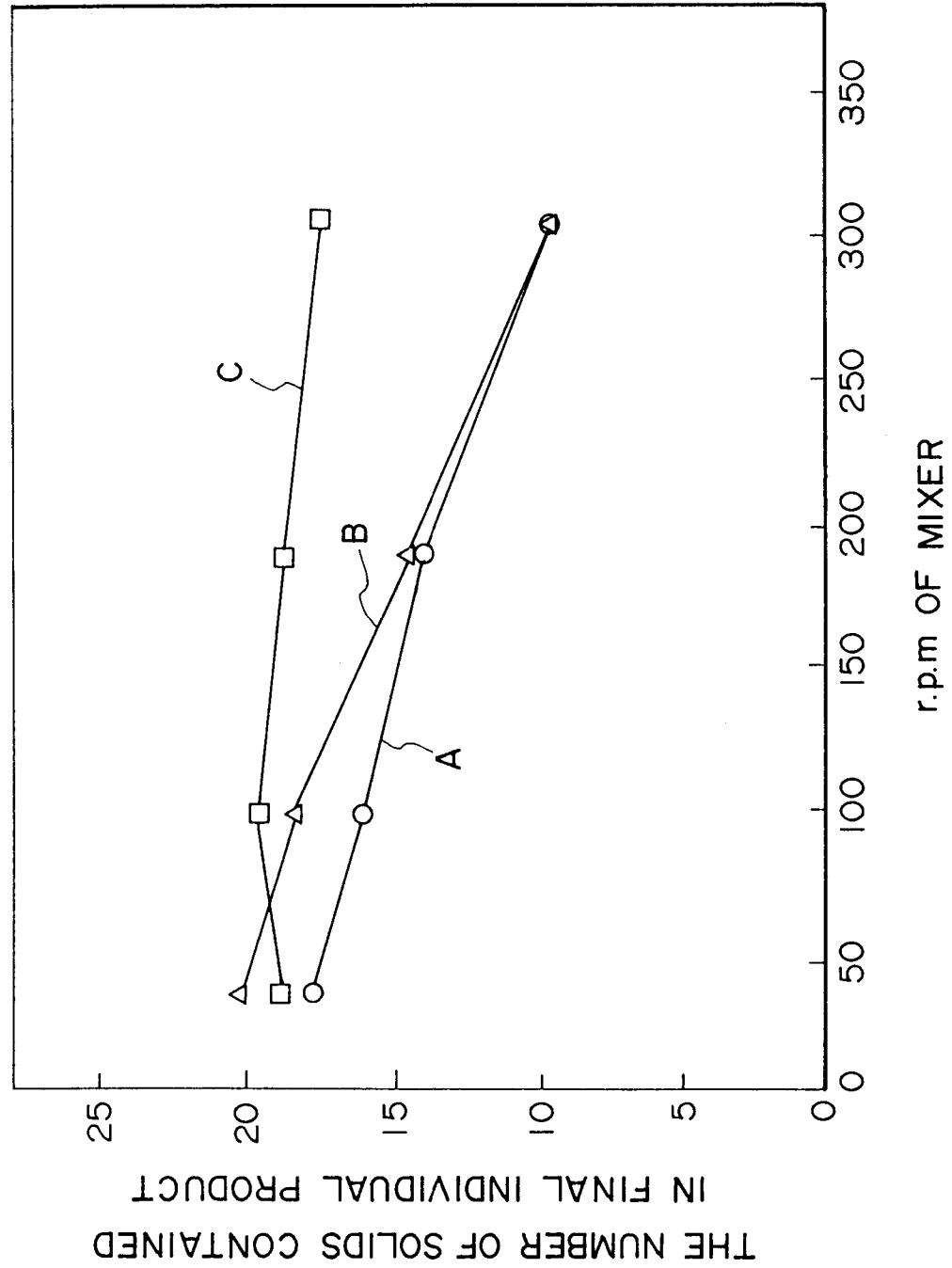
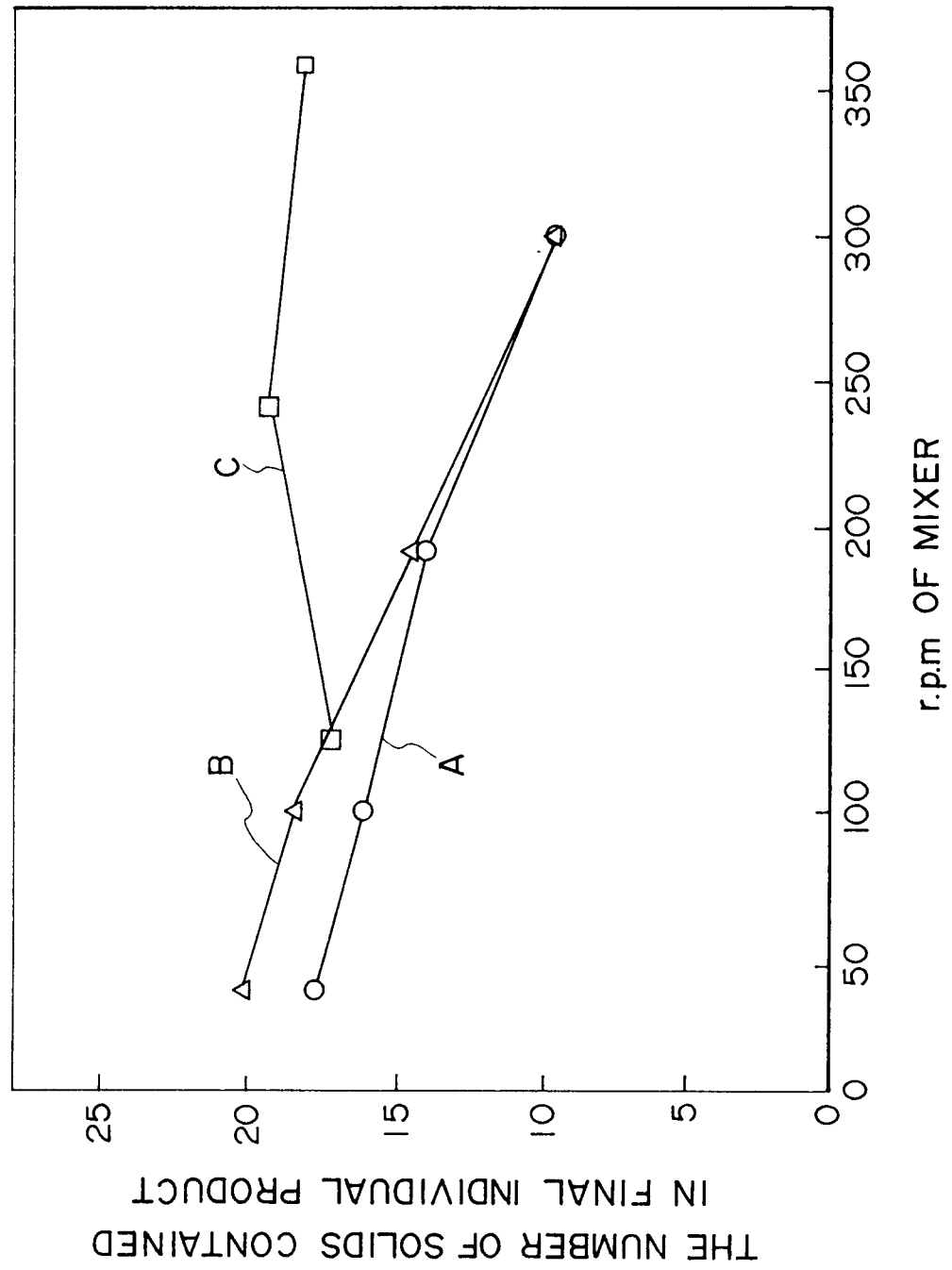


FIG. 30





European Patent
Office

EUROPEAN SEARCH REPORT

Application Number

EP 93 30 5410

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	US-A-3 434 804 (R B WINN) * figures 1-4,7,14 * * column 3, line 15 - line 17 * * column 3, line 53 - line 64 * * column 4, line 22 - line 35 * * column 5, line 31 - line 42 * * column 6, line 52 - line 57 * ---	1-6	B01F15/00 B01F7/16
A	US-A-4 522 502 (C L BRAZELTON) * column 4, line 35 - column 6, line 54; figure 6 * ---	1-4,6,7	
A	EP-A-0 119 447 (W HACHENEY) * the whole document * ---	1-5,8	
A	US-A-4 893 943 (J L MCKELVEY) * figure 1 * ---		
P,A	WO-A-9 305 873 (HENKEL) * the whole document * -----	1,4,5	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			B01F B29B
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 21 OCTOBER 1993	Examiner PHILPOTT G.R.
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