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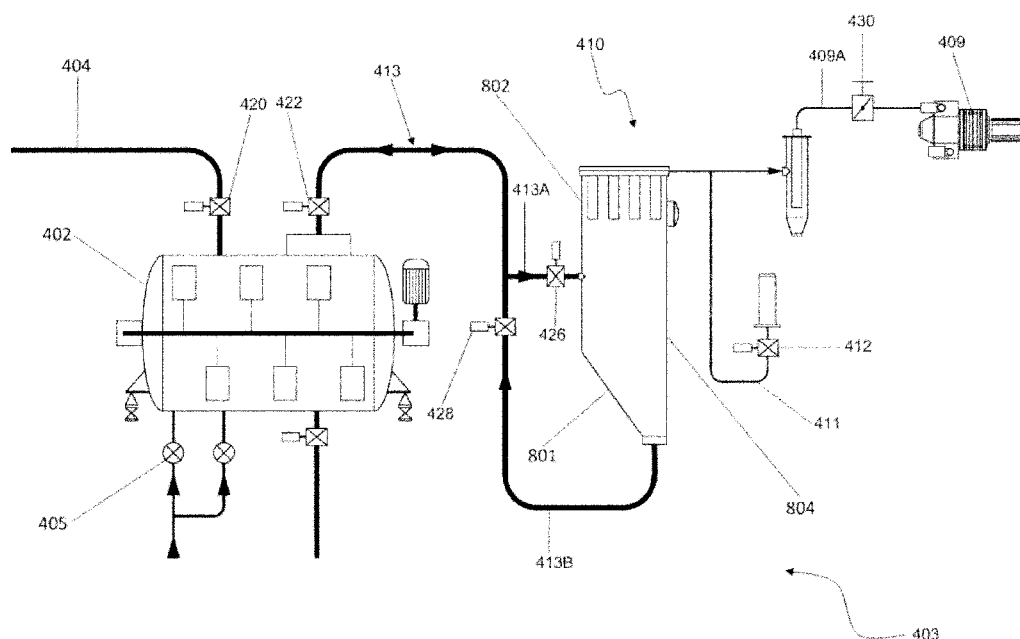
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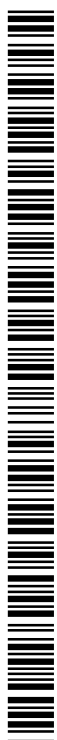
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(57) Abstract: Blending the constituent powders for the production of blended powders under unregulated environmental conditions may cause them to disintegrate at a particulate level, and/or may damage their agglomerate structure. Hence disclosed herein a blender in the production of product including a blend of powders, including a milk powder, wherein the blender includes a blending chamber, an agitator disposed within the blending chamber, and an inlet for introduction of powders into the blending chamber, characterised in that an environment-regulating means is associated with the blender via at least one interface point, for regulating the environment inside the blending chamber, wherein the environment-regulating means is configured to regulate the environment inside the blending chamber prior to blending of powders inside the blending chamber. In providing a blender configured to subject the constituent powders to environmental regulation prior to blending, the present invention may help to minimise disintegration or damage to the powders.

[Continued on next page]



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IMPROVED SYSTEM AND METHOD FOR THE PRODUCTION OF BLENDED POWDERS**TECHNICAL FIELD**

The present invention relates to a system and method for the production of blended powders with a milk powder base. Although not limited to this use, the invention has particular application for the production of infant formula.

BACKGROUND ART

Conventional methods of manufacturing infant formula consist of blending a number of constituent powders to produce a homogeneous mix before deoxidating prior to packaging. These powders may consist of the individual base ingredients, or of a number of these ingredients which have already been pre-formulated and spray-dried.

More complex methods involve combining a variety of different milk powders and derivatives. It is standard practice to add so-called “minor ingredients,” or “minors and macros,” at this stage (also in powder form), to complete the formulation.

There is typically no regulation of atmospheric conditions (notably, ambient oxygen levels) during the manufacturing process. The constituent powders progress through the process in a relatively exposed and unregulated ambient environment.

Atmospheric regulation only takes place towards the end of the process. Atmospheric regulation typically consists in removing air under vacuum and restoring atmospheric pressure with a mixture of carbon dioxide and nitrogen gases. The purpose of this is to achieve substantial “deoxidation”, such that the residual oxygen level is sufficiently low to be suitable to the preservation of the oxygen-sensitive powders.

Atmospheric regulation may commonly take place immediately prior to the canning stage. This is referred to in the art as “pre-gassing”, and forms part of what is known as “modified atmosphere packing systems” (MAPS).

A variation of MAPS involves what is known as “post-gassing”, wherein atmospheric regulation of the powder is effected after it is canned but prior to sealing of the can.

This is problematic as certain of the constituent powders are oxygen-sensitive; that is to say, exposure to oxygen (even for a relatively brief period of time) may be detrimental to the particulate properties of the powder. Thus a lengthy manufacturing process in exposed atmospheric conditions can lead to one or more of these constituent powders beginning to disintegrate at a particulate level.

This may be exacerbated by the blending stage of the manufacturing process. Blending involves mixing the constituent powders to form a homogenous mass. During this process the powder may be aerated (also referred to in the art as “fluidised”) in the ambient air environment within the blender chamber, adding to the oxygen exposure of the oxygen-sensitive powders. The dynamism of the blending process may further exacerbate the effects of this on the powders, potentially worsening their disintegration on a particulate level.

This exposure to ambient atmospheric conditions throughout the manufacturing process may mean that the final product is not at its optimum by the time it reaches the de-oxidation and packing stages.

Paradoxically, the de-oxidation stage itself can compound the problem of powder breakdown. The product may often be left sitting for considerable periods of time (typically 30 minutes or more) in exposed atmospheric conditions as it awaits transfer to an appropriate station to undergo one or more de-oxidation steps.

Another problem with conventional manufacturing methods is that the relative complexity of the process (i.e. the number of stages the powder must progress through) may mean that the production plant is physically relatively large. Thus the powder may have to travel a significant way (typically in the region of 30 to 40 metres) between the start and end of the process.

Powder of this kind is often delicate in nature; its agglomerate structure tends to be prone to breaking down on impact (which manifests as an increase in bulk density). The integrity of the agglomerate structure may be critical to the quality of the final product; especially with respect to its performance when dissolved (“wettability”) by the end consumer. Manufacturers of infant formula and similar powdered products are aware of the importance of preventing damage to the agglomerate structure of such powders.

It follows that the more stages are involved in the manufacturing process, the greater may be the risk and extent of damage to the powder as it is subjected to impact forces in transit. This may be especially an issue in the case of production plants which are arranged in a vertical, or “tower,” configuration, in which the powder is first transferred by vacuum transport to the top of the tower and then allowed to pass from one stage to the next under the force of gravity.

This problem may be further exacerbated by the fact that the powder mixture is typically stored in large “hoppers” while awaiting transfer to a successive stage of the process. A typical batch of infant formula may include at least several hundred kilograms of powder. Thus the fragile powder risks being damaged under its own weight as it sits piled up in the hopper, in addition to the effects of the drop or transit itself. Furthermore, the mass flow dynamics as the hopper is emptied may subject the powder to yet further forces, risking damage to its agglomerate structure as well as potentially resulting in dissimilar particle segregation.

Thus it will be appreciated that the various problems posed by conventional infant formula manufacturing processes are related to each other, and that measures designed to mitigate one issue may tend to exacerbate others.

In particular, the need to deoxidate the final product entails both additional apparatus (and hence additional transfer distance of the powder) and also adds to the duration of the manufacturing process, and hence the time the powder mixture spends exposed to unregulated atmospheric conditions while also often being subjected to its own weight in a storage hopper or the like.

Additionally, the large amount of apparatus required for conventional manufacturing processes may entail an environment that is inconvenient to clean and maintain, as well as requiring a relatively expansive premises and/or building to accommodate the required apparatus.

All references, including any patents or patent applications that may be cited in this specification are hereby incorporated by reference. No admission is made that any such reference constitutes prior art. The discussion of the references states what their authors assert, and the applicants reserve the right to challenge the accuracy and pertinency of the cited documents. It will be clearly understood that, although a number of prior art publications may be referred to herein, this reference does not constitute an admission that any of these documents form part of the common general knowledge in the art, in New Zealand or in any other country.

Unless the context clearly requires otherwise, throughout the description and the claims, the words “comprise”, “comprising”, and the like, are to be construed in an inclusive sense as opposed to an exclusive or exhaustive sense, that is to say, in the sense of “including, but not limited to”.

It is an object of the present invention to address the foregoing problems or at the very least to provide the public with a useful choice.

DISCLOSURE OF THE INVENTION

According to one aspect of the present invention, there is provided a blender for use in the production of product including a blend of powders, wherein at least one of the powders is a milk powder, wherein the blender includes:

a blending chamber;

an agitator disposed within the blending chamber; and

an inlet for introduction of powders into the blending chamber

characterised in that

an environment-regulating means is associated with the blender via at least one interface point, for regulating the environment inside the blending chamber, wherein the environment-regulating means is configured to regulate the environment inside the blending chamber prior to blending of powders inside the blending chamber.

According to another aspect of the present invention, there is provided a system for the production of product including a blend of powders, wherein at least one of the powders is a milk powder, wherein the system includes:

a blender, wherein the blender includes:

a blending chamber;

an agitator disposed within the blending chamber; and

an inlet for introduction of powders into the blending chamber;

environment-regulating means associated with the blender via at least one interface point, for regulating the environment inside the blending chamber

characterised in that

the environment-regulating means is configured to regulate the environment inside the blending chamber prior to blending of powders inside the blending chamber.

According to yet another aspect of the present invention, there is provided a method for the production of product including a blend of powders, wherein at least one of the powders is a milk powder, using the system substantially as described above, wherein the method includes the steps of:

- a) introducing powders to be blended into a blending chamber of a blender;
- b) regulating the environment inside the blending chamber; and then
- c) blending the powders inside the blending chamber.

According to yet another aspect of the present invention, there is provided an apparatus for use in the introduction of powders into a blending chamber of a blender, wherein the apparatus includes:

a filter associated with the blender, wherein the filter includes:

- a main compartment;
- an extraction pipe;
- a plurality of filter surfaces disposed within the main compartment;
- a gas feed pipe connected to the main compartment; and
- a feedback pipe.

According to yet another aspect of the present invention, there is provided a blender for use in the production of product including a blend of powders, wherein the blender includes:

a blending chamber;

an agitator disposed within the blending chamber; and

an inlet for powders to be introduced into the blending chamber via a supply line

characterised in that

a filter is associated with the blender, the filter including a main compartment; an extraction pipe; a plurality of filter surfaces disposed within the main compartment; a gas feed pipe; and a feedback pipe.

The present invention provides a system and method for manufacturing product including a blend of powders. In some embodiments of the invention, at least one of the powders is a milk powder. The invention is intended in particular for use in a processing facility for the manufacture of such product.

In exemplary embodiments of the invention, the product includes infant formula but this is not meant to be limiting. Other products may also be produced using the present invention, such as protein powder mixes for use in preparing sports supplement drinks.

The system and method disclosed in the present invention allows several of the steps in the manufacturing and blending process to be undertaken *in situ* inside the blender, rather than the powders being transferred to separate apparatus for each step, as may be the case in conventional manufacturing methods.

Specifically, both the environment-regulation step, as well as blending itself, can be performed inside the blender; and following blending, the final product can proceed directly to the packaging

stage, without the need for any further vacuum or degassing steps. Furthermore, optional additional steps (such as a pre-blending step, discussed below) can also be performed inside the blender. Thus the powder may only need to be transferred once, as opposed to three or four times. Furthermore, use of the blender for multiple steps in this way may significantly reduce the amount of apparatus required for the manufacturing process.

In its broadest form, according to one aspect of the invention the system includes a blender and environment-regulating means associated with the blender.

Throughout the present specification, the term “blender” should be understood to mean an apparatus designed to effect the blending, mixing, or agitation of at least one powder.

The blender should be understood to include a blending chamber with an internally-mounted agitator for effecting the blending of powders. Throughout the remainder of the specification, reference to the inside of the blender should be understood to mean the blending chamber.

The blender also includes an inlet for the introduction of powders into the blending chamber. In preferred embodiments, powders are introduced into the blending chamber via a supply line. Accordingly, reference will be made throughout the remainder of the present specification to a supply line. However, this is not intended to be limiting. Preferably, the blender also includes an outlet via which the product may exit the blending chamber for further processing or packaging.

It will be understood that the blender should be of a kind that is capable of withstanding substantially vacuum conditions (as will be understood by one skilled in the art) and thus the blending chamber is appropriately configured to this. Furthermore, the inlet and/or outlet may be provided with appropriate valves and/or sealing surfaces in order to maintain the desired environment in the blending chamber.

The blender may be of any make and model configured to effect the blending, mixing or agitation of powders, as long as it is able, or is modified to be able, to withstand substantially vacuum conditions. A person skilled in the art will readily envisage apparatus suitable for this purpose.

The inventors have found that the present invention works particularly well with a suitably modified 3500-litre Chem-Plant PHLAUER™ blender. However, this is not intended to be limiting and persons skilled in the art will appreciate that other blenders may readily be employed for use in the present system if appropriately configured or modified.

It will likewise be understood that the system may include just one blender, or a plurality of blenders. In embodiments including a plurality of blenders, the number and configuration of other components of the system may need to be adapted appropriately. The skilled person will readily appreciate appropriate means of achieving this.

For instance, in an exemplary embodiment the system includes two blenders, each having associated therewith an environment-regulating means. In this embodiment, a single supply line is configured to introduce powders into both blenders via inlets in the respective blenders. However, this is not intended to be limiting, and the skilled person will readily appreciate suitable variations on this configuration; as well as other suitable configurations.

Throughout the present specification, the term “environment-regulating means” should be understood to mean a means for regulating the atmospheric environment inside the blender such that the environment established inside the blender is substantially inert with respect to the powders to be blended therein.

In preferred embodiments, the environment-regulating means may regulate the environment inside the blender in a preconfigured manner, such as by being automated. However, this is not intended to be limiting.

In exemplary embodiments of the invention, some or all of the powders to be blended are oxygen-sensitive (such as constituents of infant formula). Accordingly, the environment established inside the blender may be a “deoxidated” environment. A “deoxidated” environment should be understood to mean one which is substantially devoid of oxygen, such that the residual oxygen level is suitable for the preservation of the oxygen-sensitive powders, i.e. wherein the powders do not disintegrate at a particulate level. However, this is not intended to be limiting.

It will be understood that the atmospheric environment inside the blender is regulated by, firstly, establishing substantially a vacuum inside the blender (the “vacuum step”); and, secondly, introducing one or more gases into the blender; such as until standard atmospheric pressure is substantially restored.

In preferred embodiments, the environment regulating means includes a vacuum pump, as that term will be understood to one skilled in the art. In use, the vacuum pump operates to establish substantially a vacuum inside the blender at the vacuum step.

In preferred embodiments, the environment-regulating means also includes or provides for a compressed gas supply, a pressure-regulating valve and an automated supply valve operatively connected to the compressed gas supply. These may be communicative, wirelessly or otherwise, with a pressure transmitter to control the environment within the blender as required.

In preferred embodiments, the vacuum pump may be separate from the other components of the environment-regulating means. However, this is not intended to be limiting.

In particularly preferred embodiments, a “deep vacuum” is established inside the blender at the vacuum step (such as in the region of -95 kPa relative to standard atmospheric pressure at sea level). This is close to the lowest pressure that can be achieved in practical terms; and may result in the environment inside the blender being deoxidated to the greatest extent possible. For example,

residual oxygen levels following the establishment of a “deep vacuum” may be less than 3 per cent. In particularly preferred embodiments, the residual oxygen levels are less than 1 per cent.

However, this is not intended to be limiting; and higher pressures at the vacuum step (such as in the region of -60 kPa) may still be functionally effective. Alternatively, or additionally, a higher residual oxygen level may be permitted at this step, and mitigated by means of further gassing steps following blending.

It will be understood that the one or more gases introduced into the blender following the vacuum step are gases which are substantially inert with respect to the powders to be blended; by which is meant that the powders are substantially non-reactive with, and/or non-sensitive to, the one or more gases.

In an exemplary embodiment, wherein the powders to be blended are constituents of infant formula, the one or more gases introduced into the blender may include nitrogen gas, carbon dioxide gas, or a mixture thereof. An environment is thereby established inside the blender which is substantially devoid of oxygen, to which some or all of the powders may be sensitive, and in which pressure has been restored via a gas or gases which are substantially inert with respect to the powders.

Regulating the environment inside the blender prior to blending means that, during subsequent blending, the powders are not forced into contact with pockets of gas to which they are sensitive or reactive. This may significantly mitigate the breaking down of the powders in the course of blending.

Furthermore, it may eliminate the need for the powders to undergo further vacuum and degassing steps following blending as the product may already be in a substantially inert environment that mitigates its deterioration. Accordingly, this may allow the product to proceed from the blender directly to packaging.

It will be understood that the environment-regulating means is associated with the blender via at least one interface point (such as in the style of an inlet), via which air is extracted from the blender at the vacuum step and a gas or gases are subsequently introduced into the blender. In preferred embodiments, there are a plurality of interface points.

In a particularly preferred embodiment, the vacuum pump of the environment-regulating means is associated with the blender via a separate interface point from the remaining components of the environment-regulating means. However, the invention could also be configured to function with a sole interface point although this may compromise the time required to establish a vacuum inside the blender, and/or to introduce a gas or gases into the blender.

Preferably, each of the interface points is fitted with appropriate filter/diffusion material to encourage the uniform dispersion of gas or gases entering the blender. This may help to ensure that the powders become properly infused with the gas or gases.

Throughout the present specification, reference to “introducing” powders into the blender should be understood to mean transferring or transporting the powders into the blender via the supply line; in particular, into the blending chamber of the blender via the inlet.

Preferably, the total required quantities of powders to be blended are prepared and stored at an external location pending transfer to the blender. The skilled person will appreciate that the powders to be blended may remain segregated from one another while at the external location.

In a particularly preferred embodiment of the present invention, the total required quantity of base milk powder is prepared and stored on the one hand; and on the other hand, the total required quantity of additive powder, being a mixture of minor and macro ingredients and flush powder, is prepared and stored, and preferably also pre-sifted.

In an exemplary embodiment of the invention, 1300 kg of base milk powder, and at least 200 kg of additive powder (such as essential elements or the like), are prepared and stored at the external location. However, this is given by way of example only and is not intended to be limiting. The amount of powders used will depend on the size of the blenders, whether there is more than one blender operable at any one time, the overall size of the processing plant in which the system of the present invention is to be used, and other factors which will be readily appreciated by one skilled in the art.

In preferred embodiments, powders are transferred to the blender by creating vacuum suction in the supply line connecting the external location to the blender (this may entail also creating vacuum suction inside the blender itself). The inventors have found that vacuum suction is a convenient and effective means of transferring industrial quantities of powders into the blender. This may be effected using the environment-regulating means associated with the blender. However, this is not intended to be limiting. The person skilled in the art will envisage alternative methods of transferring the powders to the blender.

In preferred embodiments, powders are introduced into the blender in a preconfigured sequence wherein intermediate steps are performed on particular ingredients.

In a preferred embodiment, a “pre-blending” step is effected as part of introducing powders into the blender. This step consists of introducing additive powder into the blender, further introducing a small quantity of the base milk powder, and then blending these powders for 60 seconds under either regulated or unregulated atmospheric conditions. The remainder of the base milk powder is then added in, and the process continues as described above.

In a particularly preferred embodiment, powders are vacuum-transferred to the blender at the pre-blending step. A vacuum is established inside the blender. When the inlet of the blender is opened, the vacuum in the blender causes a relatively powerful “suction” effect which may transfer the

additive powder and the small quantity of base milk powder to the blender with a high degree of efficiency, and in a manner that results in little or no carry-over powder. In an especially preferred embodiment, the volume of the blender is greater than the total volume of powders used at the pre-blending step. This may mean that the “suction” effect is especially effective at transferring the powders to the blender for pre-blending.

In preferred embodiments of the invention, the method is effected using at least two blenders. This is advantageous as it may be conducive to the continuous production of product by minimising or eliminating “turn-around time” between successive batches of powders to be blended.

In developing the present invention, the inventors configured two blenders to be connected to the external location by a single set of supply lines, according to the configuration described above. Once introduction of the powders into the first blender was complete, introduction of powders into the second blender could commence while environment-regulation and blending (as well as subsequent stages of the process, such as packing/canning of the product) were in progress in the first blender. That is, the process could be ‘staggered’, resulting in superior production efficiency.

According to another aspect of the invention, there is provided an apparatus configured for use in the introduction of powders into a blender, the apparatus including a filter associated with the blender.

It will be understood that the blender may be substantially as described above. However, this is not intended to be limiting and the skilled person will appreciate that the apparatus may also have application with other types and/or configurations of blender.

The filter is configured to capture “carry-over” powder; that is to say, powder that has not properly separated out. This should be understood to mean ‘fine’ powder that has been retained in the air stream during introduction into the blender and hence has not successfully settled in the blender.

Powder that has not properly separated out may compromise its ability to achieve a homogenous mix with other constituent powders during blending. In preferred embodiments, the blender may include weighing paraphernalia such as scales, or “load cells”, configured to monitor the mass of powder that has settled in the blending chamber and hence determine whether carry-over powder has successfully been captured.

The filter may include a housing or similar structure to contain its various components which shall now be discussed.

The filter should be understood include a main compartment in which are disposed a plurality of filter surfaces. In exemplary embodiments, the filter surfaces are pleated. This increases the available surface area although it should be appreciated that this is not meant to be limiting.

The filter should be understood to include an extraction pipe. The extraction pipe may be connected to the blender (in particular, to the blending chamber). Alternatively, or additionally, the extraction pipe may be connected to the supply line, such as at a position proximate the inlet of the blender. In use, this allows carry-over powder to be extracted from the blender and/or the supply line via the extraction pipe, and drawn into the main compartment.

In a preferred embodiment, the filter may include more than one extraction pipe. For instance, the filter may include an extraction pipe connected to the blending chamber, and another extraction pipe connected to the supply line. However, this is not intended to be limiting.

The filter should further be understood to include a gas feed pipe connected to the main compartment proximate the pleated filter surfaces.

In preferred embodiments, the filter may also include a collection compartment located on the opposite side of the pleated filter surfaces from the gas feed pipe.

Finally, the filter should be understood to include a feedback pipe connected to the filter (and preferably, the collection compartment of the filter). The feedback pipe may connect the filter to the blender. Alternatively, the feedback pipe may connect the filter to, for example, the external location where the powders are stored pending transfer to the blender. In some embodiments, the extraction pipe and the feedback pipe may be provided by the same component. However, this is not intended to be limiting.

The filter extracts carry-over powder from the blender and/or the supply line via the extraction pipe and captures it on the pleated filter surfaces. The carry-over powder is subsequently blown off the filter surfaces by a high-velocity stream of air directed over the filter surfaces via the gas feed pipe using a “back pulse” system (as will be understood by one skilled in the art) and settles in the collection compartment. It is then conveyed from the collection compartment via the feedback pipe using vacuum suction. Depending on the configuration of a given embodiment, the feedback pipe may deliver the carry-over powder to the blender, or alternatively to the external powder storage location.

In a particularly preferred embodiment, wherein the filter is used in conjunction with a blender having an environment-regulating means, the vacuum pump of the environment-regulating means may be configured to effect the operation of the filter in the manner described above. A vacuum may be established in the main compartment, after which the main compartment may be allowed to return to standard atmospheric pressure. This may create a suction effect whereby carry-over powder is drawn into the main compartment via the extraction pipe. A vacuum may then be created in the blender, and the blender subsequently allowed to return to standard atmospheric pressure, resulting in a suction effect that draws the powder from the collection compartment into the blender via the feedback pipe.

In this embodiment, the system may be configured such that the filter is located between the blender and the vacuum pump of the environment-regulating means. The vacuum pump may thereby effect the operation of the filter in the above manner.

In a particularly preferred embodiment, the extraction/feedback pipe of the filter may also serve as the interface point between the vacuum pump of the environment-regulating means and the blender.

Furthermore, the system may be configured to selectively establish an "open path" through the filter, such that the vacuum pump of the environment-regulating means may create a vacuum inside the blender, both at the filter step and for the purposes of environmental regulation inside the blender prior to blending, as discussed further above. The skilled person will readily envisage ways in which the system can be configured to selectively establish an "open path". For instance, selective connection of the vacuum pump to the filter and/or the blender may be achieved using appropriately configured valve(s).

However, this is not intended to be limiting.

The inclusion of an apparatus including a filter as herein described may be advantageous. It may ensure that powder which is transferred from the external location is ultimately introduced into the blender with a high degree of efficiency and is properly separated out.

Furthermore, the fact that the filter is associated with though distinct from the blender, as opposed to being located inside it, may mean that the interior surfaces of the blender can be relatively smooth. Hence the interior of the blender may be devoid of sharp geometry where powder could accumulate in a manner that could compromise its uniform blending. In embodiments wherein the blender also includes an environment-regulating means, the smooth interior surfaces of the blender

may also enhance the relatively uniform and complete infusion of the powders with inert gas upon introduction of same into the blender.

It will be appreciated that the apparatus may be used in conjunction with the method described above. In preferred embodiments, the method is effected using two blenders, as discussed above. In a particularly preferred embodiment of the method, a filter is associated with at least one of the blenders and is configured to extract carry-over powder (in the manner discussed above) after introduction of powders into the first blender but before introduction of powders into the second blender. The filter of the apparatus thereby effectively “flushes” the supply line to help ensure it is substantially devoid of carry-over powder prior to introduction of powder into the second blender.

The invention has a number of advantages over conventional systems and techniques for producing blended powders with a milk powder base, including:

- Reduction of exposure to atmospheric oxygen during the manufacturing process of the blended powder through regulating the atmospheric environment for at least a part of the process (including, importantly, the blending step), and hence potentially substantial reduction of powder breakdown due to contact with oxygen;
- Reduction of the distance the powder must travel during the manufacturing process, and hence potentially substantial reduction of damage to/disintegration of the powder on a particle level as a result of impact/forces it is subjected to during manufacture;
- Reduction of the amount of equipment required for the manufacturing process, and hence reduction of operating/maintenance costs as well as of workplace hazards for employees;
- Relatedly, reduction of the size of the manufacturing plant (such as the height of the tower), entailing lesser building costs.

At the very least, the present invention provides the public with a useful choice.

BRIEF DESCRIPTION OF FIGURES

Figure 1 is a flow chart showing the essential steps of conventional methods of manufacturing milk powder;

Figure 2 is a flow chart showing one exemplary embodiment of the method disclosed by the present invention;

Figure 3 is a schematic view showing a conventional blending system used in the manufacture of blended milk powder;

Figure 4 is a schematic view showing one exemplary embodiment of the blending system of the present invention for use in the manufacture of blended milk powder;

Figure 5 is a schematic view showing one exemplary embodiment of the blender of the present invention;

Figure 6 is a schematic view showing an end elevation of the blender of Figure 5;

Figure 7 is a schematic view showing a plan elevation of the blender of Figure 5; and

Figure 8 is a schematic view showing one exemplary embodiment of the filter apparatus of the present invention.

DETAILED DESCRIPTION OF FIGURES

Figure 1 is a flow chart showing the essential steps involved in conventional methods (generally indicated by arrow 100) of manufacturing milk powder.

Powders to be blended are firstly introduced into the system at a bag tip stage (101). They are then vacuum-transferred to a blender (102) for blending. The resulting product is then transferred into a blender hopper (103), where it sits while awaiting transfer to a sifter stage (104).

Following this, the product is transferred to a pregasser (105), where atmospheric regulation takes place to ensure the product is in an inert environment pending packing or canning. Finally, the product is transferred to a can filling station (106).

Thus the powders are transferred into the blender (102) for the blending step, then transferred again for the pregassing step (105). This adds to both the distance travelled by the powders (and hence the damaging forces they are subjected to in transit) and the time spent waiting to be transferred to a successive step. During this delay period the oxygen-sensitive powders sit in unregulated atmospheric conditions, and in large industrial hoppers which can also expose the powders to being damaged under their own weight.

Moreover, the blending step (102) itself takes place in unregulated atmospheric conditions, which forces pockets of air into the oxygen-sensitive powders, and furthermore, causes the powders to collide with these air pockets in a vigorous way that exacerbates their deterioration.

Turning now to Figure 2, this is a flow chart showing the steps involved in an exemplary embodiment of the method (generally indicated by arrow 200) of the present invention.

Firstly, powders to be blended are deposited at an external location (201a). They are then introduced into the system at a bag-tip point (201) and are vacuum-transferred into a blender (202).

The environment inside the blender is then regulated (203a), after which the powders are blended (203b) inside the blender under regulated environmental conditions. The product is then transferred from the blender to a sifter (204), and subsequently to a can filling station, all still under regulated environmental conditions.

Figure 3 is a schematic showing the common features involved in a conventional system (generally indicated by arrow 300) for the manufacture of milk powder. The powders to be blended are introduced into the system at a bag-tip point (301). The powder is then vacuum-transferred via a supply line (304) to the blender (302) where blending takes place under unregulated atmospheric conditions. The product is then placed in a hopper (302a) while awaiting transfer to a sifter (306). Finally, it progresses to the pregasser (307) where the environment is regulated by introduction of inert gases (305) into the pregasser. Finally, the product proceeds to a can-filling station (308).

Figure 4 is a schematic of a preferred embodiment of the disclosed system (generally indicated by arrow 400). The system comprises a number of valves, discussed below. In their default position, the valves are closed.

The powders to be blended are introduced into the system at a bag-tip point (401). Although not shown, the base milk powder is deposited separately from an additive mixture (comprising a mixture of minor- and macro- ingredients and flush powder).

In the embodiment of Figure 4, a pre-blending step is performed. A combination of the base powder and the additive mixture is introduced into the system (400) at a bag-tip point (401) and transferred via a supply line (404) to a first blender (402). Transferring of the powders is achieved by creating a vacuum in the first blender using the vacuum pump (409) of the environment-regulating means (generally indicated by arrow 410), the vacuum pump being connected to the system via a vacuum line (409A).

Valves 420 and 422 on the blender, as well as 426, and 430 associated with the vacuum pump (409) of the environment-regulating means (410), are open and the vacuum pump establishes a vacuum in the first blender (402) and supply line (404). Valve 422 is then closed and a valve (401A) associated with the bag-tip point (401) is opened. This creates a suction effect in the supply line (404) as

atmospheric pressure is restored in the first blender (402), causing the additive mixture and base milk powder to be transferred to the first blender.

The powders are then pre-blended under ordinary atmospheric conditions for a relatively short period of time.

The remainder of the base milk powder is subsequently introduced into the first blender (402) by means of vacuum transfer, for the purposes of which valves 420, 422, 426 and 430 are again open.

In the embodiment of Figure 4, a filter apparatus (403) having an extraction / feedback pipe (413, 413A, 413B) extracts carry-over powder from the system and delivers it back to the first blender (402) after the transfer is complete. This ensures that substantially the total amount of powder introduced into the system is delivered to, and properly settles in, the blender. The blender may be configured with load cells (not shown) to monitor whether this has occurred.

To extract carry-over powder and deliver it back to the blender, valve 420 is closed, while valves 422, 426 and 430 are open to form an open path through the extraction pipe (413, 413A) to the vacuum pump (409). The vacuum pump operates to establish a pressure of (in this embodiment) $> -10\text{kPa}$ relative to standard atmospheric pressure. This causes a suction effect that extracts carry-over powder from the blender (402) and causes it to settle on the filter surfaces (not shown in Figure 4) of the filter.

Valves 426 and 430 are then closed, isolating the filter apparatus (403) while it is still under low pressure. Closing valve 426 also means that low pressure is retained in the blender (402), since valves 420 and 426 to either side of the blender are now closed.

A valve (412) associated with the external environment via a gas feed pipe (411) is then opened, restoring the filter apparatus (403) to standard atmospheric pressure. Due to the abrupt restoration of pressure in the filter apparatus, a high-velocity stream of air is directed onto the filter surfaces via

the gas feed pipe, causing the carry-over powder to be blown off the filter surfaces and settle in the collection compartment (not labelled in Figure 4) at the bottom of the filter.

Valve 428 is then opened, to establish an open path through the feedback pipe (413, 413B) to the blender (402). Opening valve 428 has the effect of abruptly restoring the blender to standard atmospheric pressure. This creates a suction effect that transfers the carry-over powder back to the blender.

The vacuum pump (409) forms part of the environment-regulating means (410) of the system (400) according to this embodiment, and is configured to effect operation of the filter apparatus (403) as described above, as well as to regulate the environment in the blender (402) itself.

After carry-over powder has been transferred to the first blender (402), an open path is established between the first blender and the vacuum pump (409) by opening valves 422, 426 and 430. The vacuum pump operates to establish a deep vacuum (such as in the region of -95kPa relative to standard atmospheric pressure at sea level) inside the first blender for a prescribed soak time.

Pressure in the first blender (402) is then restored by introducing a combination of nitrogen gas and carbon dioxide gas into the first blender through multiple fluidising points (not shown), using the compressed gas supply and other components (generally indicated by 405) of the environment-regulating means (410). Once pressure has been restored, the powders are blended in this regulated atmospheric environment for a prescribed time.

The powder is then discharged from the first blender (402) through a sifter (406); and is transferred to a buffer hopper (407) to await transfer to a can-filling station (408); all the while being maintained in environmentally-regulated conditions.

In this embodiment, after transfer of carry-over powder to the first blender (402) has been completed, the above process begins in respect of a second blender (not shown), the second

blender (not shown) likewise having environment-regulating means (not shown) associated therewith and also being associated with the filter apparatus (403). Accordingly, the production process may be “staggered” by utilising two blenders, such that the process begins in the second blender once the supply line (404) is free following introduction of powders into the first blender (402).

Turning to Figures 5 to 7, these are schematic views of a blender (generally indicated by arrow 500) according to one exemplary embodiment of the present invention. It will be seen that the blender includes a blending chamber (501) with an agitator (502) having blades (502a) disposed in the blending chamber.

The blender (500) also includes an inlet (503) via which powders are introduced into the blending chamber (501) via a supply line (not shown); as well as an outlet (510) via which the powders are extracted from the blending chamber following blending. The inlet and outlet are provided with appropriate sealing means in order that the environment inside the blending chamber may be regulated.

The blender is associated with a filter (not shown) which in this embodiment includes a pipe (504) that acts both as the extraction pipe and the feedback pipe, allowing carry-over powder to be extracted into the filter (not shown) and subsequently delivered back to the blending chamber (501). In other embodiments not illustrated in Figure 5, a separate extraction pipe may be associated with the supply line for extracting carry-over powder from the supply line.

The blending chamber (501) is associated with an environment-regulating means that includes a vacuum pump (not shown). In this embodiment, the vacuum pump (not shown) of the environment-regulating means functions both to establish a vacuum inside the blending chamber and to effect operation of the filter (not shown). For the former purpose, an “open path” is established through the filter (not shown), such that the pipe (504) functions as the interface point between the blending

chamber and the vacuum pump (not shown), allowing the vacuum pump (not shown) to establish a vacuum in the blending chamber. This is achieved using appropriately-configured valves, as discussed above.

After powders have been introduced into the blending chamber (501), the vacuum pump (not shown) first establishes a vacuum in the blending chamber through the pipe (504). A mixture of nitrogen and carbon dioxide gases is then introduced into the blending chamber from a compressed supply (506) via a fluidiser pipe (507) via a plurality of interface points (508), to restore atmospheric pressure inside the blending chamber. The interface points are fitted with filter/diffusion material (not shown) to encourage the uniform dispersion of the inert gas on entering the blending chamber.

Turning now to Figure 8, this is a detailed schematic of an off-board filter apparatus (generally indicated by arrow 403) according to one exemplary embodiment of the present invention, shown connected to the blender (402) and vacuum pump (409). The off-board filter apparatus includes a main compartment (801) in which are located a plurality of pleated filter panels (802). At least one extraction/feedback pipe (413, 413A, 413B) connects the main compartment to the blender. A gas feed pipe (411) having a valve (412) is connected to the main compartment proximate the pleated filter panels. A collection chamber (804) is located on the opposite side of the pleated filter panels from the gas feed pipe.

By configuring the valves of the system as described above with reference to Figure 4, the carry-over powder is conveyed to the main compartment (801) via the extraction pipe (413, 413A), and settles on the pleated filter panels (802). It is then blown off the panels by a high-velocity stream of air channelled through the gas feed pipe (411), and settles in the collection chamber (804) before being conveyed to the blender (402) via the feedback pipe (413, 413B).

Reference to any prior art in this specification is not, and should not be taken as, an acknowledgement or any form of suggestion that that prior art forms part of the common general knowledge in the field of endeavour in any country in the world.

The invention may also be said broadly to consist in the parts, elements and features referred to or indicated in the specification of the application, individually or collectively, in any or all combinations of two or more of said parts, elements or features.

Where in the foregoing description reference has been made to integers or components having known equivalents thereof, those integers are herein incorporated as if individually set forth.

It should be noted that various changes and modifications to the presently preferred embodiments described herein will be apparent to those skilled in the art. Such changes and modifications may be made without departing from the spirit and scope of the invention and without diminishing its attendant advantages. It is therefore intended that such changes and modifications be included within the present invention.

The invention may also be said broadly to consist in the parts, elements and features referred to or indicated in the specification of the application, individually or collectively, in any or all combinations of two or more of said parts, elements or features.

Aspects of the present invention have been described by way of example only and it should be appreciated that modifications and additions may be made thereto without departing from the scope thereof.

WHAT WE CLAIM IS:

1. A method for the production of a milk product from a blend of powders, the method including the use of a blender which includes:

a blending chamber;

an agitator disposed within the blending chamber;

an inlet for introduction of powders into the blending chamber;

an outlet for product exiting the blending chamber; and

a filter associated with the blender, wherein the filter includes a main compartment, an extraction pipe, a plurality of filter surfaces disposed within the main compartment, a gas feed pipe connected to the main compartment, and a feedback pipe;

and wherein

an environment-regulating means is associated with the blender via at least one interface point for regulating the environment inside the blending chamber, wherein the environment-regulating means is configured to selectively establish substantially a deoxidated environment inside the blending chamber prior to blending of powders inside the blending chamber, the method including the steps of:

- a) selectively establishing substantially a deoxidated environment inside the blending chamber of the blender;
- b) introducing the powders, wherein one of the powders is a milk powder, to be blended into the blending chamber;
- c) regulating the environment inside the blending chamber; and then
- d) blending the powders inside the blending chamber.

2. The method of claim 1, wherein the method includes a preliminary step, prior to step a), of;
 - i) preparing and storing the powders to be blended at an external location; and/or
 - ii) pre-sifting at least one of the powders to be blended; and/or
 - iii) introducing a predetermined quantity of the powders to be blended into the blending chamber and blending the predetermined quantity of powders inside the blending chamber under unregulated environmental conditions, wherein the predetermined quantity of the powders is smaller than a total quantity of the powders to be blended.
3. The method of either claim 1 or claim 2, wherein the powders are introduced into the blending chamber by means of vacuum suction.
4. The method of any of claims 1 to 4, wherein step a) includes:
 - 1) establishing substantially a vacuum condition inside the blending chamber via the at least one interface point, wherein establishing substantially a vacuum condition includes establishing a pressure inside the blending chamber of substantially:
 - i) -60kPa relative to standard atmospheric pressure at sea level, via the at least one interface point; or
 - ii) -95kPa relative to standard atmospheric pressure at sea level, via the at least one interface point;and/or
 - 2) introducing at least one gas into the blending chamber via the at least one interface point after substantially a vacuum condition has been established inside the blending chamber, wherein the at least one gas is substantially inert with respect to the powders to be blended, wherein the at least one gas includes nitrogen gas, carbon dioxide gas, or both.

5. The method of claim 4, wherein the at least one gas is introduced into the blending chamber via the at least one interface point until standard atmospheric pressure is substantially restored inside the blending chamber.
6. The method of any one of claims 1 to 5, wherein there is an additional step of directing a stream of gas from the gas feed pipe at the plurality of filter surfaces to blow off any powder thereupon.
7. The method of claim 6, wherein the blown off powder is conveyed back to the blender via the feedback pipe using vacuum suction .
8. The method of any one of claims 1 to 7, wherein the milk product is infant formula.
9. A blender when used in the method of producing a milk product from a blend of powders as claimed in claim 1, wherein the blender includes:

a blending chamber;

an agitator disposed within the blending chamber;

an inlet for introduction of powders into the blending chamber;

an outlet for product exiting the blending chamber; and

a filter associated with the blender, wherein the filter includes a main compartment, an extraction pipe, a plurality of filter surfaces disposed within the main compartment, a gas feed pipe connected to the main compartment, and a feedback pipe;

and wherein

an environment-regulating means is associated with the blender via at least one interface point for regulating the environment inside the blending chamber, wherein the environment-regulating means is configured to selectively establish substantially a deoxidated environment inside the blending chamber prior to blending of powders inside the blending chamber.

10. The blender of claim 9, wherein the environment-regulating means includes one or more of:

a compressed gas supply; and/or

a pressure-regulating valve; and/or

a supply valve operatively connected to the compressed gas supply; and/or

a pressure transmitter.

11. The blender of claim 10, wherein the compressed gas supply includes at least one gas that is substantially inert with respect to the powders to be blended.
12. The blender of claim 11, wherein the compressed gas supply includes nitrogen gas, carbon dioxide gas, or both.
13. The blender of any one of claims 9 to 12, wherein the plurality of filter surfaces are substantially pleated.
14. The blender of any one of claims 9 to 13, wherein the gas feed pipe is connected to the main compartment proximate the plurality of filter surfaces.
15. The blender of claim 14, wherein the gas feed pipe is configured to direct a stream of gas at the plurality of filter surfaces.
16. The blender of any one of claims 9 to 15, wherein the filter includes a collection compartment.
17. The blender of claim 16, wherein the collection compartment is disposed at a substantially opposite side of the main compartment from the gas feed pipe.
18. The blender of any one of claims 9 to 17, wherein the filter includes a housing.

FIGURE 1

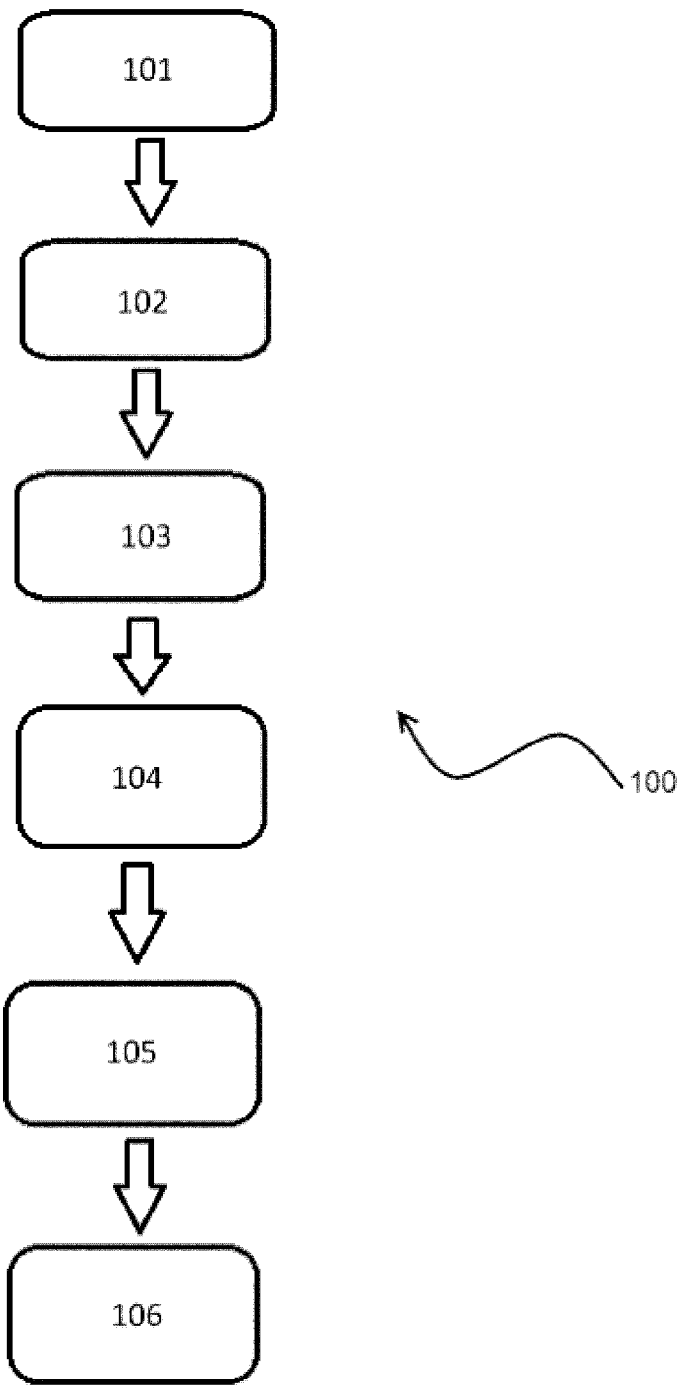


FIGURE 2

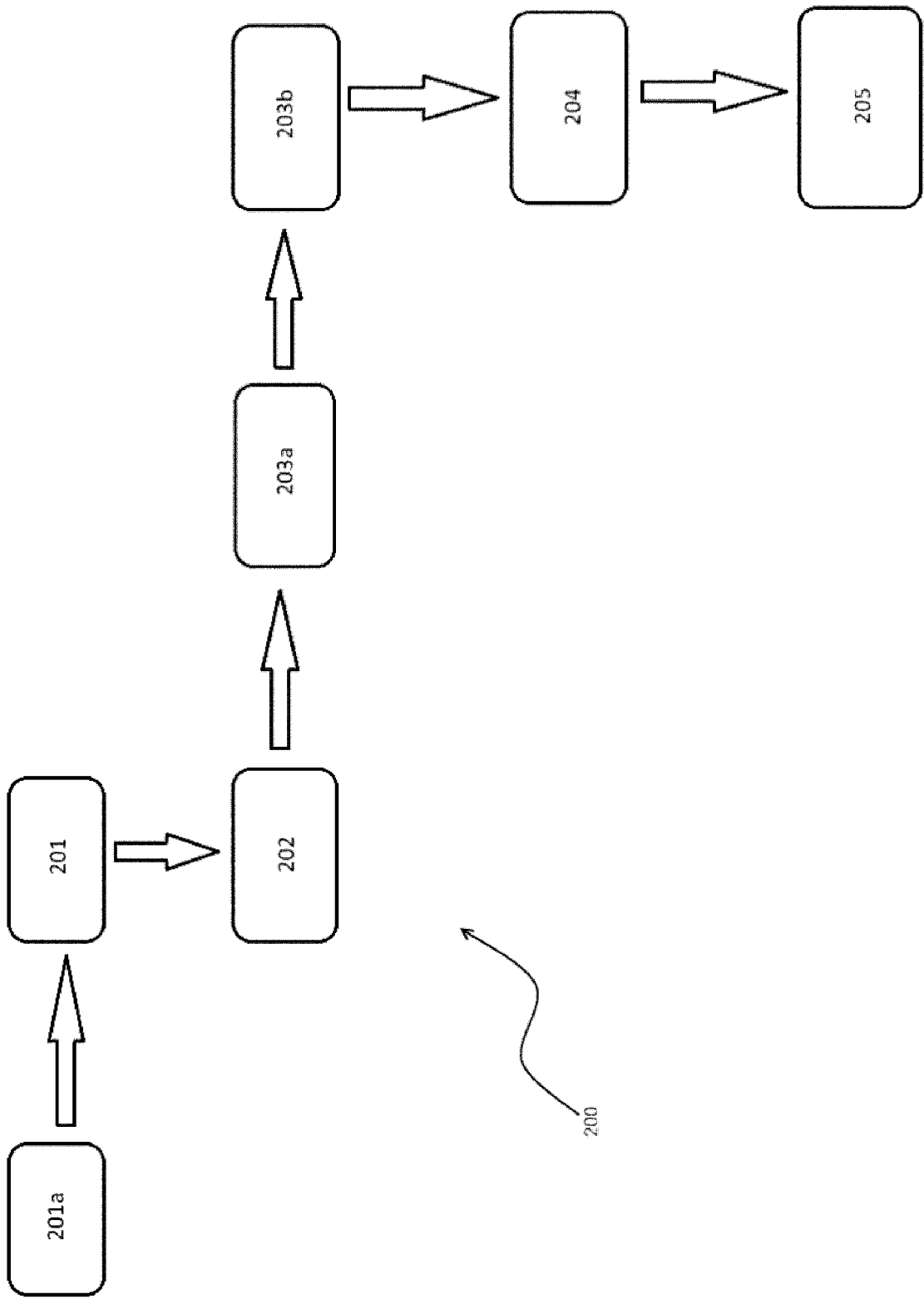


FIGURE 3

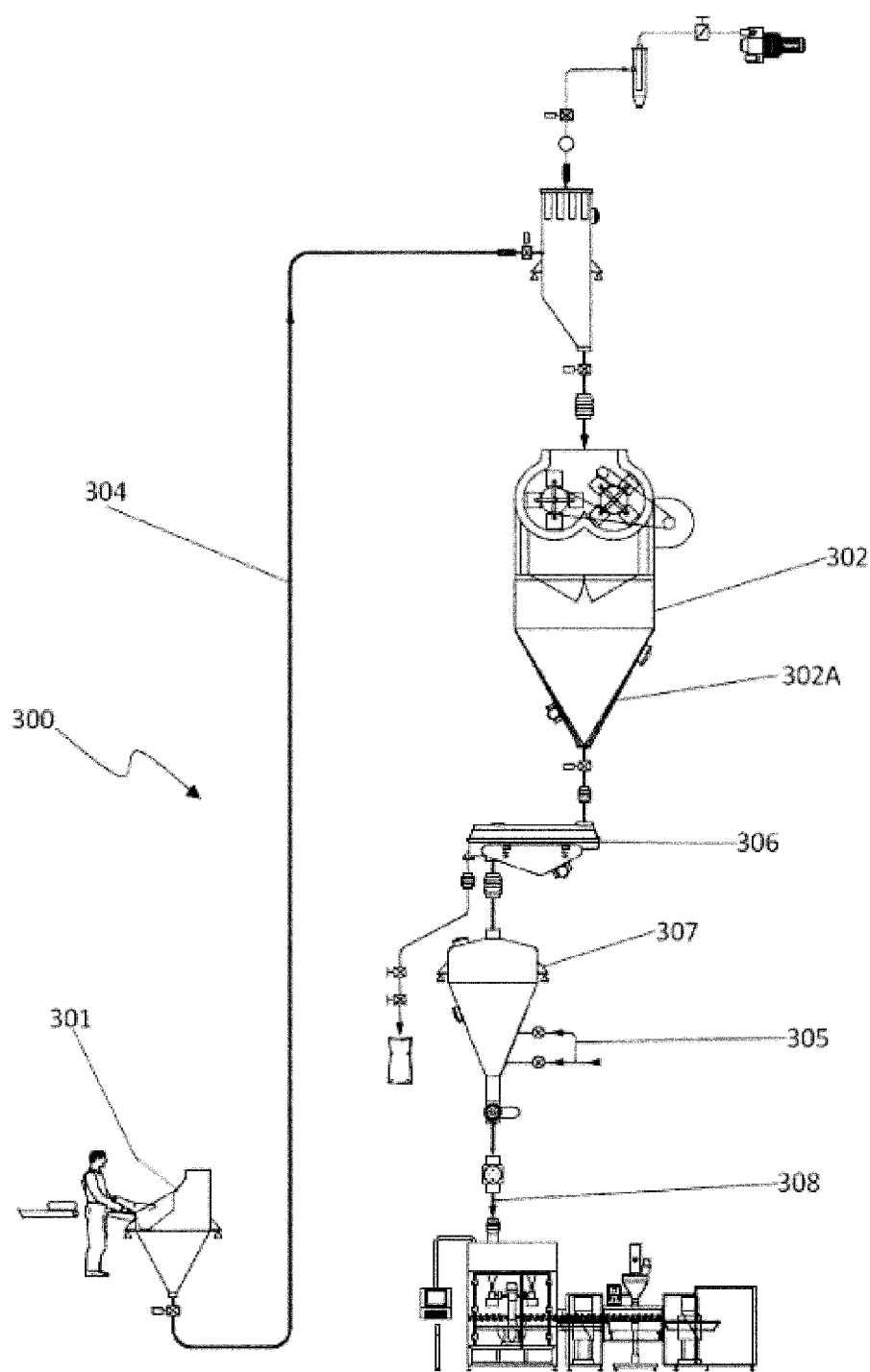


FIGURE 4

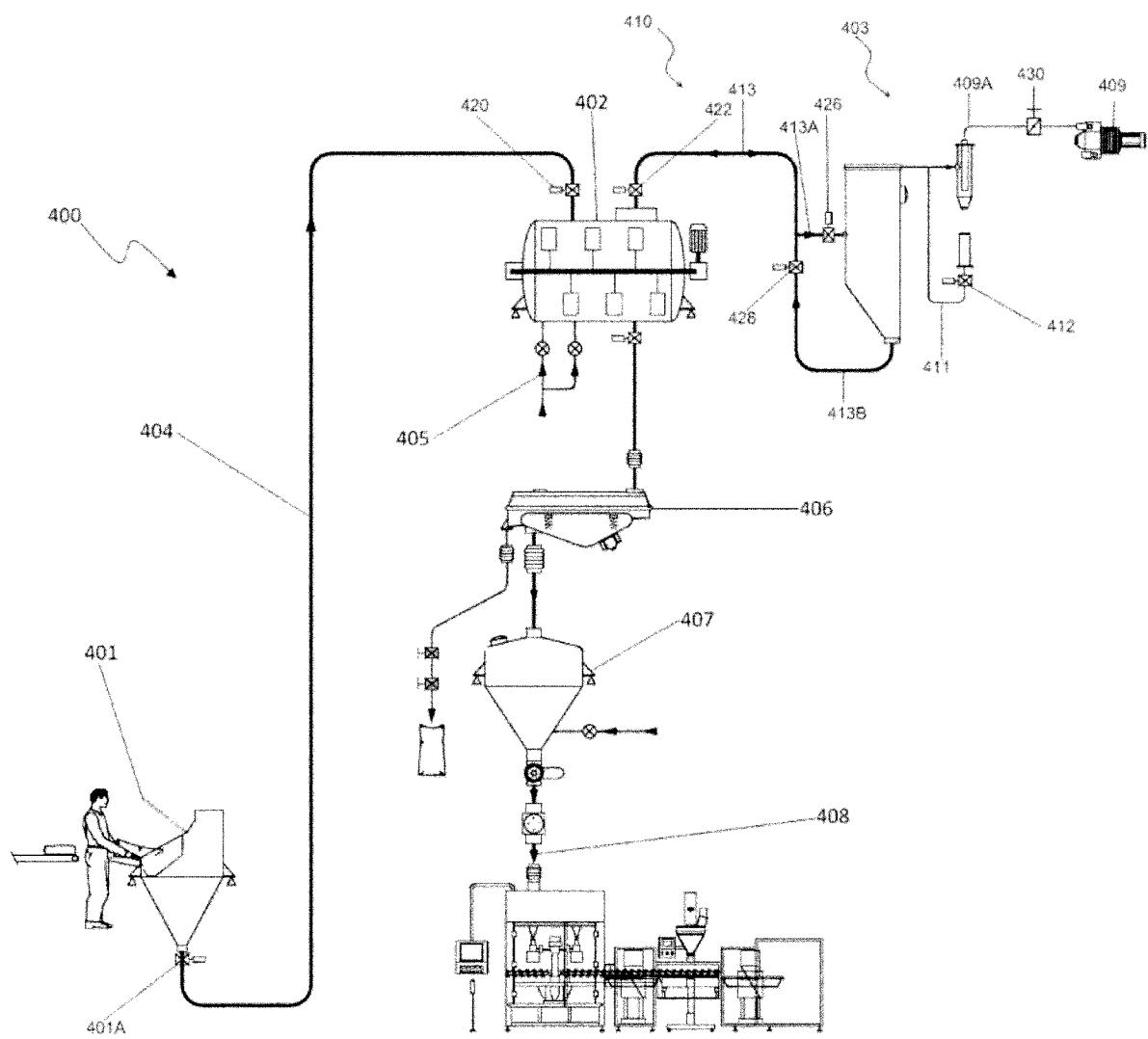


FIGURE 5

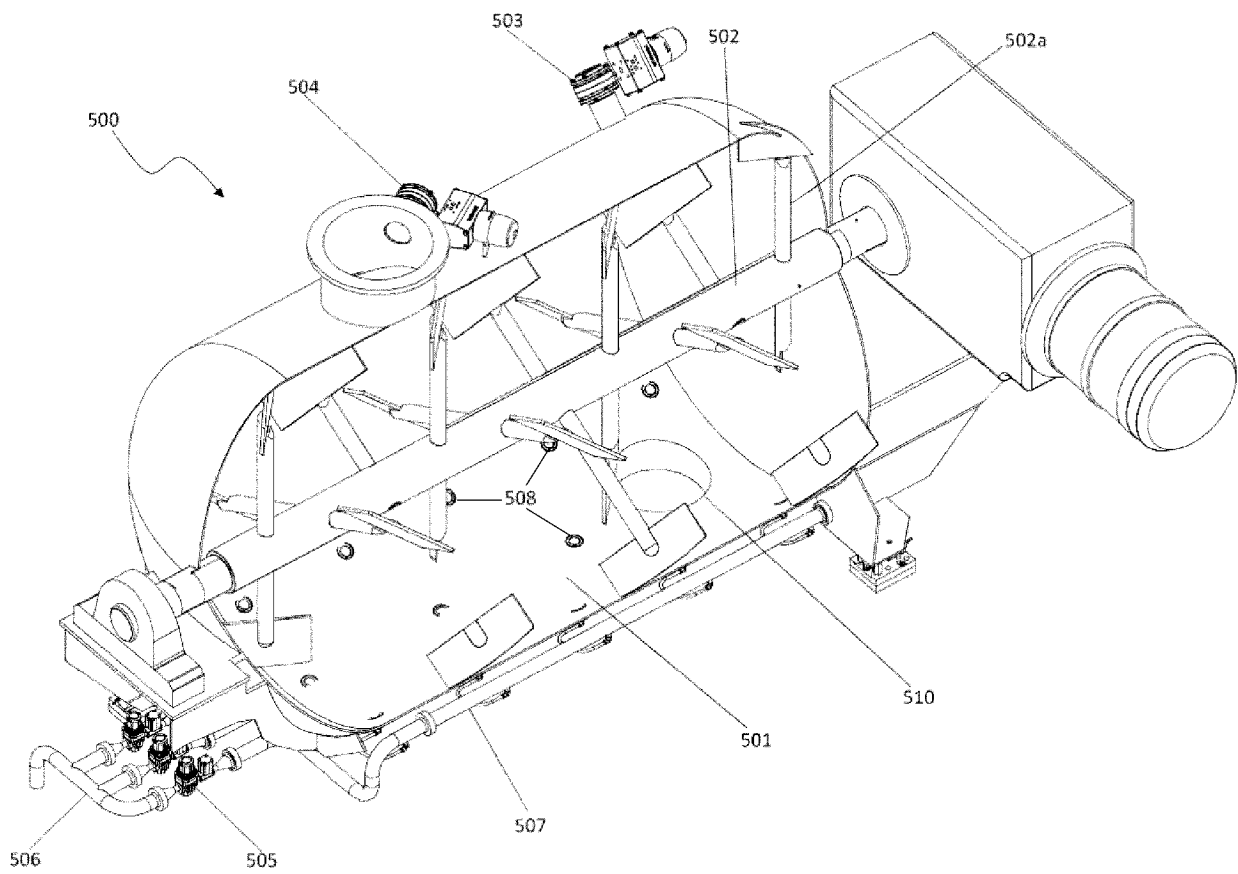


FIGURE 6

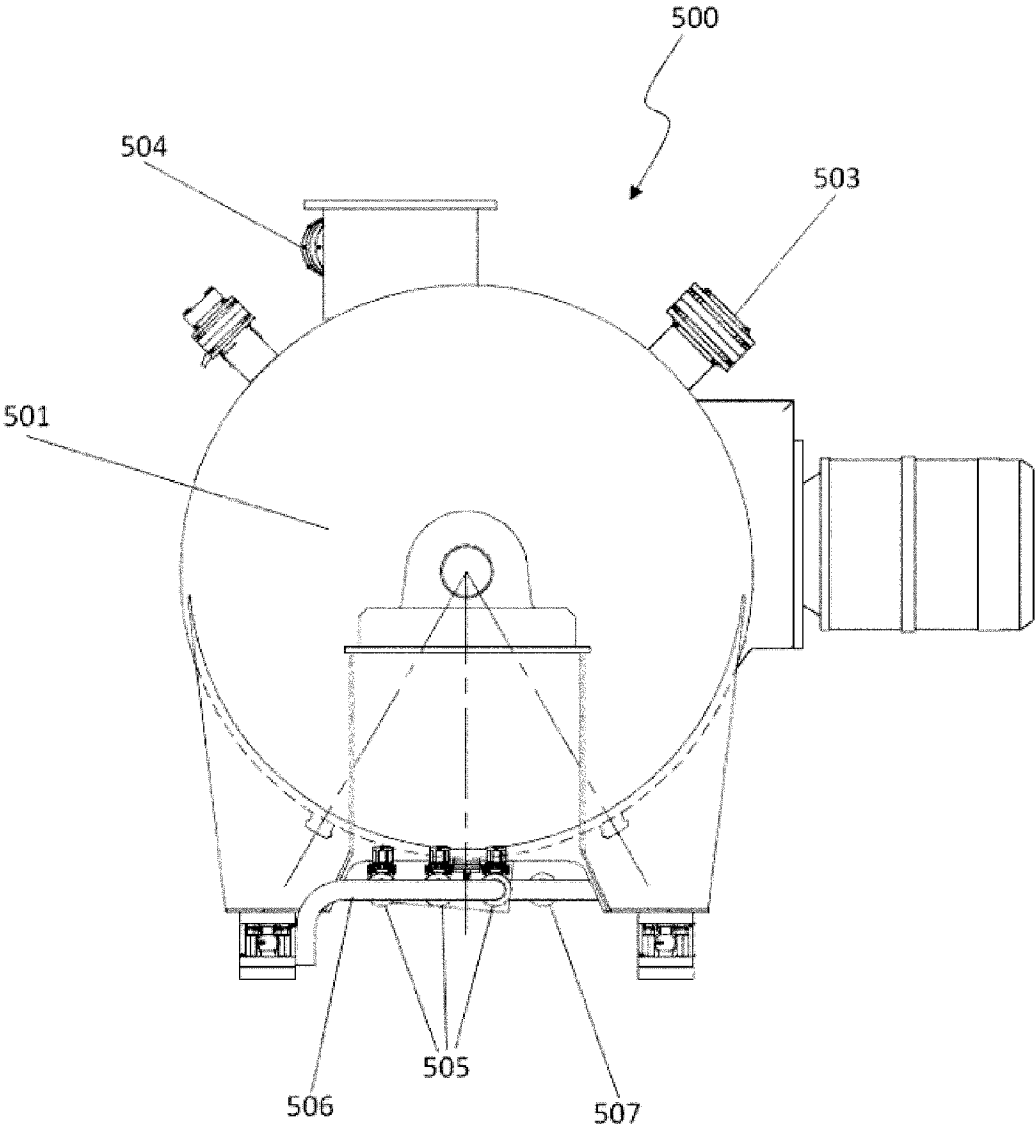


FIGURE 7

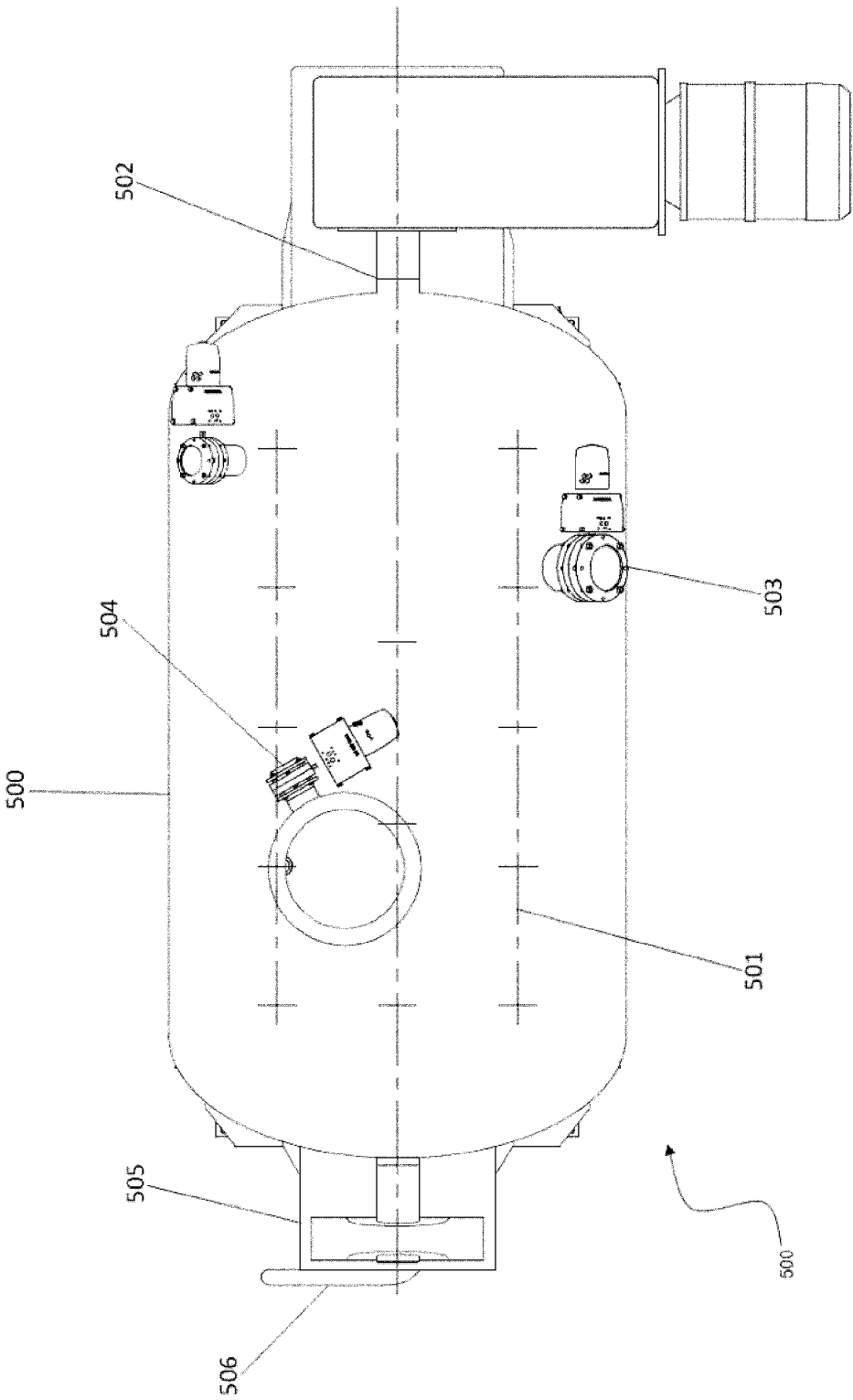


FIGURE 8

