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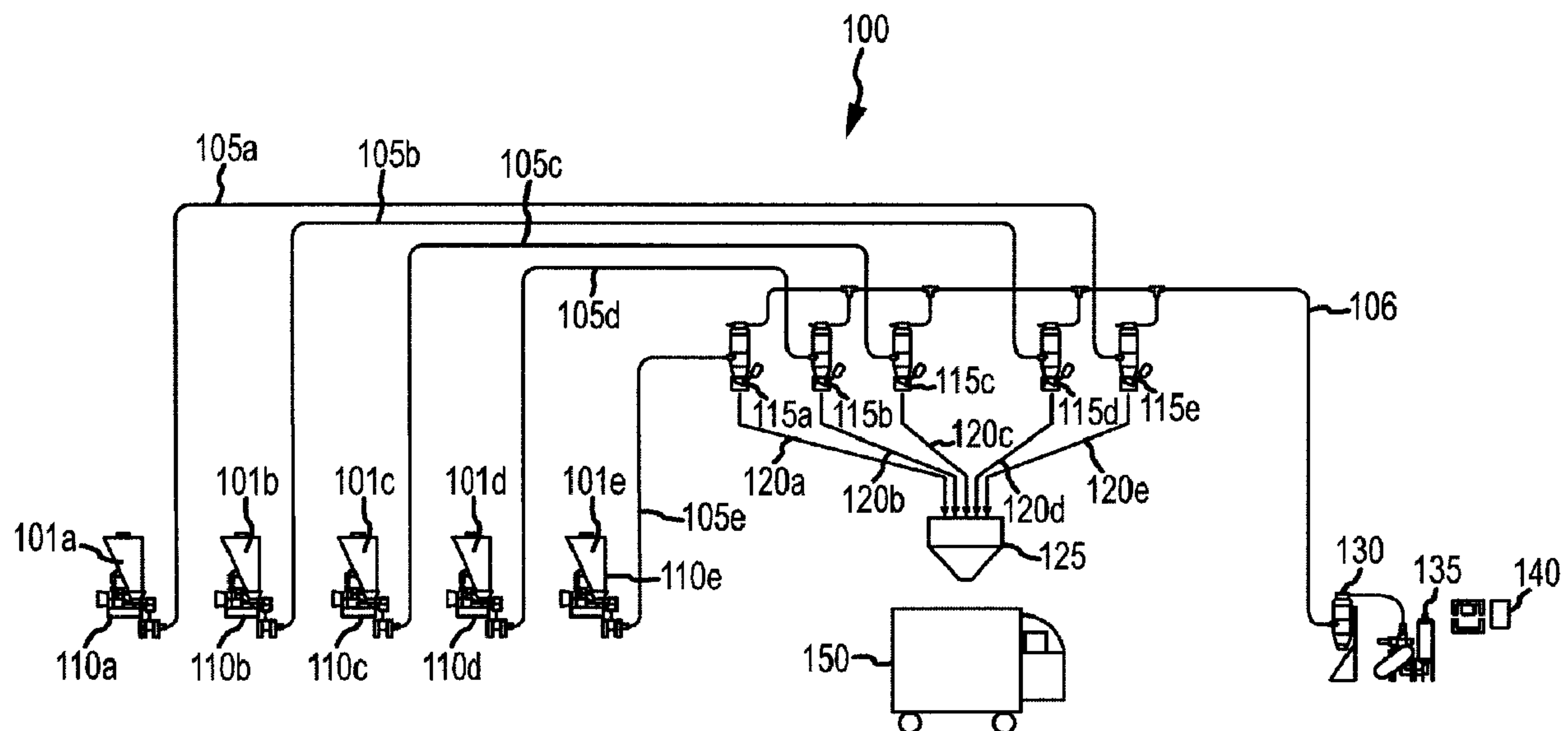
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(54) Titre : SYSTÈME ET PROCÉDE PNEUMATIQUES DE DISTRIBUTION D'INGRÉDIENTS D'ALIMENTS

(54) Title: PNEUMATIC FEED INGREDIENT DELIVERY SYSTEM AND METHOD



(57) Abrégé/Abstract:

A system and method provides for delivering dry feed ingredients through delivery lines using vacuum propelling techniques, and to mix the dry feed ingredients, without use of liquids such as water. By avoiding use of a liquid during dispensing and transporting to a mixing vessel, lower infrastructure costs can be achieved while also avoiding problems such as freezing related to systems that carry liquids. A method is also provided for delivering feed ingredients to achieve optimal mixing between ingredients to prevent ingredient damage by over-mixing, and undesirable separation of ingredients. Another method is provided for delivering feed ingredients to prevent cross contamination between ingredients in a batch or between ingredients in separate batches. A cleaning ingredient is used to clean selected lines to prevent the contamination, such as corn or grain, therefore also avoiding use of a liquid.



ABSTRACT

A system and method provides for delivering dry feed ingredients through delivery lines using vacuum propelling techniques, and to mix the dry feed ingredients, without use of liquids such as water. By avoiding
5 use of a liquid during dispensing and transporting to a mixing vessel, lower infrastructure costs can be achieved while also avoiding problems such as freezing related to systems that carry liquids. A method is also provided for delivering feed ingredients to achieve optimal mixing between ingredients to prevent ingredient damage by over-mixing, and undesirable separation of ingredients. Another method is provided for delivering feed ingredients to prevent cross contamination between ingredients in a batch or between
10 ingredients in separate batches. A cleaning ingredient is used to clean selected lines to prevent the contamination, such as corn or grain, therefore also avoiding use of a liquid.

PNEUMATIC FEED INGREDIENT DELIVERY SYSTEM AND METHOD ✓

BACKGROUND OF THE INVENTION

5 The invention is directed generally to a system and method for improved conveyance to and mixing of feed additives with feed rations and, more specifically, to a system and method for improved conveyance and mixing of feed additives with feed rations while in solid form, without the need for a water or liquid conveyance component.

BACKGROUND OF THE INVENTION

10 Conveying of feed ingredients for accurate mixing and or delivery to a distribution point for livestock commonly includes the use of liquids such as water. When feed ingredients are combined to make a feed mixture, a liquid such as water is typically the conveyance medium as well as the medium for mixing the ingredients.

15 Systems that employ liquids for conveyance to a mixing and/or distribution point, such as a hopper or feed truck, require components such as pumps and valves suitable for liquids that add to the cost and complexity of the system. Additionally, a potable source of liquid can be difficult to obtain in isolated areas. Liquid conveying systems are prone to environmental effects such as freezing of conveying lines and rusting of equipment components. Liquids as compared to solids are heavier requiring liquid conveying equipment components to be leak-proof and more robust.

20 If a liquid based mixing and/or delivery system of feed ingredients can be eliminated, the overall costs of a system should decrease. Eliminating liquids from a mixing stage of feed ingredients also requires one less major component (e.g., water) to be conveyed thus further simplifying the system.

SUMMARY OF THE INVENTION

25 The invention addresses the above short-comings and provides for transporting and mixing of dry feed ingredients without use of liquids, thereby reducing system costs, and overall simplifying a conveying system.

30 In one aspect, a system for mixing feed products is provided that includes a plurality of feed ingredient sources interconnected to a plurality of receiving vessels, the plurality of feed ingredient sources configured to dispense respective dry feed ingredients stored therein, interconnection lines to deliver dispensed dry feed ingredients to the plurality of receiving vessels from the plurality of feed ingredient sources, a vacuum source coupled to the plurality of feed ingredient sources and the plurality of receiving vessels, and a controller to control measured dispensing of the dry feed ingredients and to control the vacuum source, wherein the plurality of receiving vessels receives the respective dispensed dry feed ingredients from

the plurality of feed ingredient sources that are delivered by vacuum propulsion for mixing, without a liquid component.

In another aspect, a method of mixing feed products includes connecting a plurality of feed ingredient sources to a plurality of receiving vessels, the plurality of feed ingredient sources configured to
5 dispense respective dry feed ingredients therein, interconnecting delivery lines to deliver dispensed dry feed ingredients to the plurality of receiving vessels from the plurality of feed ingredient sources, coupling a vacuum source to the plurality of feed ingredient sources and to the plurality of receiving vessels, and controlling dispensing of the dry feed ingredients and controlling the vacuum source, wherein the plurality of receiving vessels receives the respective dispensed dry feed ingredients from the plurality of feed ingredient
10 sources delivered by vacuum propulsion for mixing, without a liquid component.

In another aspect, the system and method for mixing feed products includes a delivery sequence of feed ingredients that allows for different optimal mixing times among different ingredients as opposed to a simultaneous delivery of all feed ingredients within a single mixing time. More specifically, the method includes a sequential delivery of selected feed ingredients to the receiving vessels in which the time at which
15 the delivery occurs is based on an optimal mixing time for each particular ingredient. Some ingredients may require more or less mixing times, and the sequential controlled delivery of the feed ingredients from each feed ingredient sources to the receiving vessels therefore also enhances the optimal mixed characteristics of the designated feed product. Some feed ingredients, such as flaked corn, are relatively fragile. Prolonged or excessive mixing causes the flaked corn to break up, and these corn fines can easily settle out of the mixed
20 feed product upon delivery to feed bunks or other feed locations. These fines will collect at the bottom of feeding containers, and may otherwise not be a feed component that the animals will readily consume because of its very small size and unusual texture. Therefore, the nutritional value of the feed product is diminished if the fines are not consumed by the animals.

In another aspect of the invention, the system and method for mixing feed products includes a
25 controlled release of feed ingredients from the feed ingredient sources to comply with use restrictions for a particular group of feed products. Some feed ingredients, such as medications, have use restrictions with other feed additives. When the feed ingredients are dispensed through a common line, the line may require cleaning to prevent cross contamination with subsequent batches of different feed products. According to another aspect of the invention, one or more feed ingredients that are part of a feed batch being produced
30 that have no restrictions, such as corn, could be used to clean the line as opposed to the use of a liquid. The one or more restricted feed ingredients of a particular feed batch would be dispensed first. After the restricted feed ingredient(s) have cleared the dispensing line(s), the non-restricted feed ingredient is dispensed to clean out the line for the next batch of feed to be conveyed. Therefore, the sequence of delivery of feed ingredients for a particular batch would be controlled in terms of when each are allowed to be

dispensed from the feed ingredient sources in order to achieve the required cleaning of the lines to prevent cross-contamination for a subsequent batch.

In yet another aspect of the invention, an automatic cross-contamination check can be completed by the controller. If a restricted feed ingredient or additive has been introduced through a line, the controller would not allow delivery of other feed additives or ingredients until the line has been cleaned. For example, the element within each ingredient supply that controls dispensing (e.g. a valve or auger), would be disabled by the controller to prevent the ingredients from entering their respective conveying lines. As mentioned above, cleaning can be achieved by delivery of non-restricted products, such as corn. Logic within the controller automatically conducts a check to confirm that each delivery line has received a "cleaning" ingredient, such as corn prior to delivery of the next ingredient in the same batch and between different batches. This logic can be, for example, a software application in which a user enters information regarding each of the ingredients for each batch of feed to be prepared. Known cross contamination combinations of ingredients are set forth in one or more algorithms or logic expressions. If the ingredient data entered results in a contamination issue for ingredients within a particular batch, or between different batches to be conveyed within the same conveying lines, the software would produce a user output warning of the contamination problem. The output could be, for example, a screen display, a report, or some other tangible output that would convey the potential contamination issue to a user. Further, the controller could generate a temporary interlock to prevent ingredients from being dispensed into conveying lines until a solution was completed to address the warning. Solutions could include reconfiguring the location and/order of dispensing of ingredients to ensure a "cleaning" ingredient, such as corn or grain, was a final conveyed ingredient. This cleaning ingredient would achieve the necessary cleaning prior to delivery within the same line of a conflicting ingredient that otherwise could result in a contamination problem.

Further features and advantages of the invention will become apparent from the following detailed description, taken in conjunction with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are included to provide a further understanding of the invention, are incorporated in and constitute a part of this specification, illustrate embodiments of the invention, and together with the detailed description, serve to explain the principles of the invention. No attempt is made to show structural details of the invention in more detail than may be necessary for a fundamental understanding of the invention and the various ways in which it may be practiced. In the drawings:

Figure 1 is a schematic diagram of a first embodiment and method for mixing solid feed ingredients to produce a feed mixture, configured according to principles of the invention;

Figure 2 is a schematic diagram of another embodiment of a system and method for mixing solid feed ingredients to produce a feed mixture, configured according to principles of the invention;

Figure 3 is a schematic diagram of yet another embodiment for mixing solid feed ingredients to produce a feed mixture, configured according to principles of the invention.

5 Figure 4 is a flow diagram of another method of the invention; and

Figure 5 is another flow diagram of yet another method of the invention.

DETAILED DESCRIPTION OF THE INVENTION

Unless defined otherwise, all technical and scientific terms used herein have the same meanings as commonly understood by one of ordinary skill in the art to which the invention pertains. The embodiments of the invention and the various features and advantageous details thereof are explained more fully with reference to the non-limiting embodiments and examples that are described and/or illustrated in the accompanying drawings and detailed in the following description. It should be noted that the features illustrated in the drawings are not necessarily drawn to scale and features of one embodiment may be employed with other embodiments as the skilled artisan would recognize, even if not explicitly stated herein. The examples used herein are intended merely to facilitate an understanding of ways in which the invention may be practiced and to further enable those of skill in the art to practice the embodiments of the invention. Accordingly, the examples and embodiments herein should not be construed as limiting the scope of the invention, which is defined solely by the appended claims and applicable law.

20 Moreover, it is noted that like reference numerals reference similar parts throughout the several views of the drawings.

Mixing of feed for animals such cattle, horse, pigs, chickens, sheep, dogs, and the like, may be accomplished by way of accurately mixing solid ingredients without use of liquid components such as water. By mixing feed in solid form, as opposed to using a liquid medium for the mixing, infrastructure for transporting ingredients and accomplishing the mixing is less costly at least in part due to a difference in valves, couplings, and transport mechanisms. Also, avoiding the need to have a source of water allows the system to be easily transported to isolated areas. Moreover, environmental problems such as freezing can be alleviated. By delaying the use of liquids until actually needed (if at all), system components for transporting and accurately mixing feed additives in a batch of feed can be achieved with more efficiently and less costly.

30 Figure 1 is a block diagram of a first embodiment of a system for mixing solid feed ingredients to produce a feed mixture, configured according to principles of the invention, generally denoted by reference numeral 100. System 100 illustrates five separate delivery lines 105a-105e each for transporting a dry feed ingredient 101a-101e from a respective originating ingredient sources 110a-110e. The ingredient sources are containers or bins with a means to dispense the ingredients, such as a valve or screw auger. Usually, there is a different dry feed ingredient in each respective originating ingredient source 110a-110e, but this is not a

requirement. It is conceivable that two or more originating ingredient sources 110a-110e may be stocked with a same ingredient if volumes or batch ratios require such a situation. In one aspect, the originating ingredient sources 110a-110e may have premeasured amounts of each feed ingredient awaiting transport or, alternatively, may be configured to dispense an ingredient based on a measured weight change, described
 5 more fully below. The delivery lines 105a-105e may be constructed of suitable material such as low cost polyvinyl chloride (PVC) pipe, although other materials may be employed as appropriate.

The delivery lines 105a-105e are connected to receiving vessels 115a-115e, and configured to receive the feed ingredients from the respective originating ingredient source 110a-110e in anticipation of mixing the feed ingredients for producing a designated feed batch. The receiving vessels 115a- 115e may be constructed
 10 to perform as a vortex chamber, wherein the received ingredients are drawn into the receiving vessel by vacuum. The receiving vessels may be configured to generate a swirling effect of the respective ingredient at the receiving vessel. This swirling effect at the receiving vessels 115a-115e may provide mixing action when more than one ingredient is being received at a particular receiving vessel 115a-115e. Alternatively, the receiving vessels may be conventional mixers that mix the ingredients by one or more mixing blades. The
 15 feed ingredients may be conveyed from each of the respective ingredient sources to the corresponding receiving vessels by a vacuum created by a vacuum source 135 interconnected by vacuum line 106 and tank 130. A programmable controller 140, including a motor starter control, is electrically connected to various dispensing elements such as valves or augers at the originating ingredient sources 110a-110e, receiving vessels 115a-115e and hopper 125 to control vacuum application at proper sequencing times. The
 20 programmable controller 140 may also be configured to oversee the correct formulation of ingredients from the specific originating ingredient sources and to manage mixing of correct weights of specific ingredients, according to predefined formulations for a particular batch of feed.

Hopper delivery lines 120a-120e are configured to deliver each ingredient (or, in some instances mixed ingredients) to a destination 150 such as a feed delivery truck, although the destination 150 may be
 25 any desired location (e.g., a feed bagging stage) or other physical structure. Typically, if the destination is a truck or tanker, then liquid such as water may be applied at this stage of delivery, if necessary, to create a solid-liquid mixture, for distribution according to customer desires or specific requirements of the feed batch. However, the mixing of the solid feed ingredients has already occurred without use of a liquid for transport or intermediary mixing.

The ingredient sources 110a-110e may be configured to deliver measurable amounts of an ingredient through the opening of a gate valve by a solenoid, activation of a screw auger, or the like. The amount to be dispensed may be measured by use of a load cell at each originating ingredient source 110a-110e to detect a
 30 change in weight of an ingredient as the ingredient is conveyed through delivery lines 105a-105e. Alternatively, or in addition thereto, each receiving vessel 115a-115e may be configured with a load cell to
 35 detect a weight change at each respective receiving vessel 115a-115e. Alternatively, an intermediate weigh

station (not shown) between the sources 110a-110e and delivery lines 115a-115e may include a load cell to measure ingredient amounts. The timed operation of the above-mentioned gate valve or auger may also be utilized with or without the above-noted load cells confirm or to otherwise further control the determination of ingredient amounts delivered. Although load cells are described above, other measuring devices are contemplated. The detected weight changes (from originating ingredient source 110a-110e and/or each receiving vessel 115a-115e) and/or timed operation of the gate valve or auger may be controlled by the programmable controller 140 so that activation/deactivation of these dispensing elements and/or vacuum may be initiated to start/stop delivery of an ingredient. In some embodiments the receiving vessels 110a-110e may be configured to close a dispensing valve automatically when a vacuum is applied to the receiving vessels 110a-110e. The dispensing valve may close upon a vacuum being applied by vacuum source 135, while the vortex is created in the respective receiving vessels 115a-115e, and therefore permits suction on the delivery lines 105a-105e, while also agitating and/or mixing, of received ingredients in the vortex created within the receiving vessels 115a-115e. Once the vacuum is removed at the receiving vessels 115a-115e, the bottom valve may open due to lack of vacuum to hold the bottom valve in a closed position, and the ingredient(s) within the respective receiving vessel may drop by gravity into the hopper 125.

Figure 2 is a block diagram of another embodiment of a system for mixing solid feed ingredients to produce a feed mixture configured according to principles of the invention, generally denoted by reference numeral 200. This embodiment is similar to the embodiment of Fig. 1 except the number of delivery lines 105a-105b has been reduced as shown. In this embodiment 200, a plurality of originating ingredient sources 110b-110e are coupled to a common delivery line 105b to the same receiving vessel 115b, while a separate originating ingredient source is coupled to a separate receiving vessel 115a. This configuration may provide for situations that require a segregated delivery line for an ingredient (or ingredients) that require special consideration. For example, it may be that the ingredients 201b-201e are rather commonly used for a multitude of feeds (i.e., common base ingredients), with variations in feed product being one ingredient for example (e.g., ingredient 201a held within ingredient source 110a). So, when changing to mix a batch for a different feed product, only the ingredient that must be changed is the ingredient held in the source 110a. This may also require cleaning of the delivery line 105a and receiving vessel 115a of residue, before mixing a different feed product. Moreover, this configuration of Fig. 2 may be more suitable if the amount of ingredients is measurable at each originating sources 110a-110e, or at least 110b-110e. As discussed, cleaning however is carried out without the use of liquid.

Figure 3 is a block diagram of another embodiment of a system for mixing solid feed ingredients to produce a feed mixture, configured according to principles of the invention, generally denoted by reference numeral 300. Ingredient source 310a is configured to be connected to receiving vessel 315a, and is the only ingredient source that is conveyed through line 305a. Originating ingredient source 310b-310e may be configured to be coupled to a common receiving vessel 315b.

This aspect permits an ingredient 310a to be segregated from the other ingredients. That is, delivery line 305a is used solely for ingredient 310a. But, the other originating sources 310b-310e are configured to be individually selectable to charge receiving vessel 315b. For example, originating source 310b having ingredient 301b may be selected for certain product mixes, while not being selected for other product mixtures. Likewise, originating sources 310c-310e may be selectable individually, but having a common receiving vessel 315b through the respective conveying lines 305b-305e.

The dynamic selection of ingredients is controlled by controller 140 that decides which originating sources 310b-310e are selected based on what product is to be ultimately mixed. The mixing is accomplished at the common receiving vessel 315b for the subset of ingredients selected by the controller 140 from the originating sources 310b-310e. Moreover, the controller 140 may selectively start and stop delivery of a particular ingredient 310a-310e by engaging or disengaging the dispensing valves or augers at each respective originating source(s) 310a-310e (or alternatively, valves or other dispensing elements located at the receiving vessel 315a and 315b). This use of valves/augers permits ingredients at one originating source of smaller overall contribution to the product mix to be stopped sooner, while other ingredients of higher contribution ratios of the product to be delivered for a longer period of time, or until a specific amount of weight has been delivered. Each originating source 310a-310e may be selectively controlled by time, or by weight measured.

Referring to Figure 4, in another embodiment of the invention, a method is shown for mixing feed products in which a controlled delivery sequence of different feed ingredients is achieved that enables optimal mixing times for different ingredients as opposed to a simultaneous delivery of all feed ingredients within a single mixing time. Some ingredients may require that the ingredients not be over-mixed to prevent degradation of the product, yet may also require minimum mixing times to ensure the ingredients are adequately mixed to disperse all of the ingredients uniformly in the batch. For example, in the case of micro-ingredients, that is vitamins, medications, or other ingredients that constitute a small overall percentage of the weight of the feed batch, it is important that these ingredients be fully mixed within the particular batch to ensure proper distribution throughout the feed batch. For ingredients such as corn, it is also important that these ingredients not be over-mixed which could result in excessive breakage, and could cause these corn fines to easily settle out of the mixed feed product as mentioned. Further, over-mixing can change the overall texture of the feed, which also may result in rejection by the animals.

Referring specifically to Figure 4, block 400 in the method is to first determine the feed ingredients for the particular batch or product that is to be delivered to animals. At block 402, a determination is made of the optimal mixing times for each of the ingredients, to include any constraints in terms of preventing over-mixing or under-mixing of ingredients. More specifically, the controller may include software or logic with rules or guidelines as to what are the optimal mixing times, and based on data entered regarding the particular ingredients for the batch being prepared, a user would select the particular protocol for mixing as

conveyed to the user on a user interface such as a computer screen. Referring to block 404, optimal mixing times have been established and the controller then controls the discharge or dispensing of the ingredients from the respective ingredient sources to the receiving vessels. For example, for the ingredient sources that dispense through a valve or through a dispense auger, the controller controls activation of the valve/augers at the appropriate times taking into consideration the dispense rate of each of the particular ingredient sources, the time in which it takes for a particular amount of material to be transported through its corresponding transport line to the receiving vessel, and any other factors that may affect delivery. Thus, the delivery of the ingredients is conducted in a pre designated sequence taking into consideration the particular attributes of the ingredients to include optimal mixing times. At block 406, the delivery and mixing of the ingredients is completed. For those ingredients which are first released from their respective ingredient sources, they will undergo a greater mixing time, while those ingredients that are released at later times during the delivery sequence would undergo less mixing assuming the time it takes to deliver the ingredients to their respective receiving vessels is the same. Accordingly, ingredients are sequentially received in the respective receiving vessels for the appropriate mixing as prescribed by optimal mixing times as set forth by the controller 140. At block 408, the mixed batch of product is delivered to the hopper 125, such as by the gravimetric flow into the hopper 125, and then to the final delivery point such as a vehicle positioned to receive the batch from the hopper.

Referring to Figure 5, in yet another embodiment of the present invention, the method of the invention includes a controlled release of feed ingredients from feed ingredient sources to comply with use restrictions for a group of feed ingredients within a single batch, or between different batches of different groups of feed products. Some micro ingredients such as medications must be cleaned out to prevent cross contamination of subsequent feed products that do not require the medication. As mentioned, one solution according to an aspect of the invention is to use bulk material such as corn or grain to clean the line as opposed to the use of a liquid. The one or more restricted feed ingredients of a particular feed batch would be dispensed first. After the respective feed ingredients have cleared the dispensing line(s), the non-restricted feed ingredient(s) would then be dispensed that would then clean the line(s) adequately therefore enabling the transport of the next material through the line.

Referring to Figure 5, at block 500, the feed ingredients are determined/confirmed for the particular batch. At block 502, the particular rules are selected and applied regarding use restrictions for the ingredients. That is, like the method for Figure 4, the controller may include software or logic with rules or guidelines as to what constitutes use restrictions to prevent cross-contamination of feed batches. Based on data entered regarding the particular ingredients for the batch being prepared, a user would select the particular protocol for delivery of the ingredients in the conveying lines, as provided to the user such as a user interface screen. At block 504 a determination and confirmation is made of the base products such as grain or corn that will be used to adequately clean the conveying line(s) in lieu of a liquid rinse through the

conveying line(s). At block 506, the delivery sequence is commenced for the particular batch being prepared. At block 508, the delivery and mixing of the ingredients is completed taking into consideration the prescribed delivery sequence in which cleaning ingredients are the last to be conveyed in order to achieve the desired cleaning action. At block 510, a confirmation is made of the cleaning products being fully conveyed
5 through the conveying lines. For example, the software of the controller could run a system check in which reported weights of cleaning materials delivered would be confirmed by the various load cells used in the system. If there was a failure of a delivery of a cleaning ingredient (e.g. caused by a conveying line blockage), then a perceptible user warning would be generated by the controller to advise the user that there was not only a failure to complete the batch as prescribed, but also a potential failure to adequately clean the
10 line. This dual warning would therefore prevent a user from remedying the failed delivery by simply adding additional ingredients to the hopper as opposed to completing delivery through the blocked line to complete cleaning.

The system and method herein may be used to mix different ingredients to form various different animal feed products. For example, the ingredients may include but are not limited to any one or more of: a
15 grain, a grass, a vitamin, a hormone, an enzyme, a filler, an organic supplement, a medication, a seed, and a mineral supplement.

While the invention has been described in terms of exemplary embodiments, those skilled in the art will recognize that the invention can be practiced with modifications in the spirit and scope of the appended claims. These examples given above are merely illustrative and are not meant to be an exhaustive list of all
20 possible designs, embodiments, applications or modifications of the invention.

What is claimed is:

1. A system for mixing feed ingredients, comprising:

a plurality of feed ingredient sources interconnected to a plurality of receiving vessels, the plurality of feed ingredient sources configured to dispense respective dry feed ingredients therein;

interconnection lines to deliver dispensed dry feed ingredients to the plurality of receiving vessels from the plurality of feed ingredient sources;

a vacuum source coupled to the plurality of feed ingredient sources and the plurality of receiving vessels;

a controller to control measured dispensing of the dry feed ingredients to prevent cross contamination between feed ingredients of one or more batches, and to control the vacuum source;

wherein the plurality of receiving vessels receives the respective dispensed dry feed ingredients from the plurality of feed ingredient sources delivered by vacuum propulsion for mixing, without a liquid component; and

further wherein the controller has an automatic check that each interconnection line has received a cleaning ingredient prior to delivery of a next ingredient in a same batch and between batches.

2. The system of claim 1, wherein the plurality of feed ingredient sources are connected to a respective one of the plurality of receiving vessels.

3. The system of claim 1, wherein a first subset of the plurality of feed ingredient sources are connected to a first common one of the plurality of receiving vessels.

4. The system of claim 3, wherein a second subset of the plurality of feed ingredient sources are connected to a second common one of the plurality of receiving vessels.

5. The system of claim 1, wherein the plurality of receiving vessels have at least one valve to control vacuum application.

6. The system of claim 1, wherein the plurality of receiving vessels have at least one valve to retain one or more dry feed ingredients while being mixed therein by vortex action.

7. The system of claim 6, wherein the at least one valve releases based on lack of vacuum pressure to

release the mixed dry feed ingredients.

8. The system of claim 1, wherein the controller controls dispensing of the dry feed ingredients by at least one of a time period and a measured weight.

9. The system of claim 1, wherein at least one feed ingredient source is segregated from other of the plurality of feed ingredient sources by a separate interconnection line.

10. The system of claim 1, wherein the plurality of receiving vessels have a measuring device for measuring received dry feed ingredients.

11. The system of claim 1, further comprising a hopper to receive mixed dry feed ingredients from the plurality of receiving vessels.

12. A method of mixing feed ingredients, the steps comprising:

connecting a plurality of feed ingredient sources to a plurality of receiving vessels, the plurality of feed ingredient sources configured to dispense respective dry feed ingredients therein;

interconnecting delivery lines to deliver dispensed dry feed ingredients to the plurality of receiving vessels from the plurality of ingredient sources;

coupling a vacuum source to the plurality of feed ingredient sources and to the plurality of receiving vessels; and

controlling dispensing of the dry feed ingredients to prevent cross contaminations between feed ingredients of one or more batches and controlling the vacuum source, wherein the plurality of receiving vessels receives the respective dispensed dry feed ingredients from the plurality of feed ingredient sources delivered by vacuum propulsion for mixing, without a liquid component; and

automatically checking, by the controller, that each interconnection line has received a cleaning ingredient prior to delivery of a next ingredient in a same batch and between batches.

13. A method of mixing feed ingredients for achieving pre-designated mixing times, said method comprising:

providing a feed ingredient delivery system including a plurality of feed ingredient sources, a plurality of receiving vessels and a plurality of delivery lines interconnecting the feed ingredient sources to the receiving vessels, a vacuum source applied to at least one of the plurality of feed ingredient sources and the plurality of receiving vessels, and a controller for controlling operation of the system to include control of dispensing elements used at the ingredient sources for dispensing ingredients;

determining feed ingredients for a batch of feed ingredients being prepared for consumption by animals;

entering the feed ingredient information in the controller;

determining by the controller optimal mixing times for each of the ingredients, including any constraints corresponding to over-mixing or under-mixing of ingredients;

controlling the dispensing of the ingredients by the controller from respective ingredient sources to respective receiving vessels; and

wherein delivery of the ingredients is conducted in a pre-designated sequence taking into consideration attributes of the ingredients to include said optimal mixing times, and wherein the ingredients are delivered by vacuum without a liquid component.

14. A method, as claimed in claim 13: wherein the delivery of the ingredients is conducted in the pre-designated sequence resulting in ingredients being delivered to respective receiving vessels at different times and further wherein the ingredients undergo different mixing times.

15. A method mixing feed ingredients to prevent cross-contamination of the ingredients within a particular batch of ingredients or between different batches of ingredients, said method comprising:

providing a feed ingredient delivery system including a plurality of feed ingredient sources, a plurality of receiving vessels and a plurality of delivery lines interconnecting the plurality of feed ingredient sources to the receiving vessels, a vacuum source applied to at least one of the plurality of feed ingredient sources and the plurality of receiving vessels, and a controller for controlling operation of the system to include control of dispensed elements used at the ingredient sources for dispensing ingredients;

determining feed ingredients for a batch of feed ingredients being prepared for consumption by animals;

entering the feed ingredient information in the controller;

determining by the controller cross-contamination constraints for each of the ingredients;

controlling the dispensing of the ingredients by the controller from respective ingredient sources to respective receiving vessels to prevent cross contamination including an automatic check by the controller that each delivery line has received a cleaning ingredient prior to delivery of a next ingredient in a same batch and between batches; and

wherein delivery of the ingredients is conducted in a pre-designated sequence taking into consideration attributes of the ingredients to include said optimal mixing times, and wherein the ingredients are delivered by vacuum without a liquid component.

16. A method, as claimed in claim 15, wherein: controlling the dispensing of the ingredients occurs for ingredients within a particular batch.

17. A method, as claimed in claim 15, wherein: controlling the dispensing of the ingredients occurs for ingredients between different batches.

18. A method, as claimed in claim 15, wherein: controlling the dispensing of the ingredients further includes delivering the cleaning ingredient through selected lines in which cross contamination could occur as determined by the controller.

19. A method, as claimed in claim 18, wherein: said cleaning ingredient includes at least one of corn or grain.

20. A method, as claimed in claim 15, wherein: said method further includes generating a warning to a user that an ingredient delivery has failed, and therefore a possibility of cross contamination, wherein said warning includes an electronic message sent to the user comprising at least one of an audible alarm, a visual alarm on a computer user interface, or a written report.

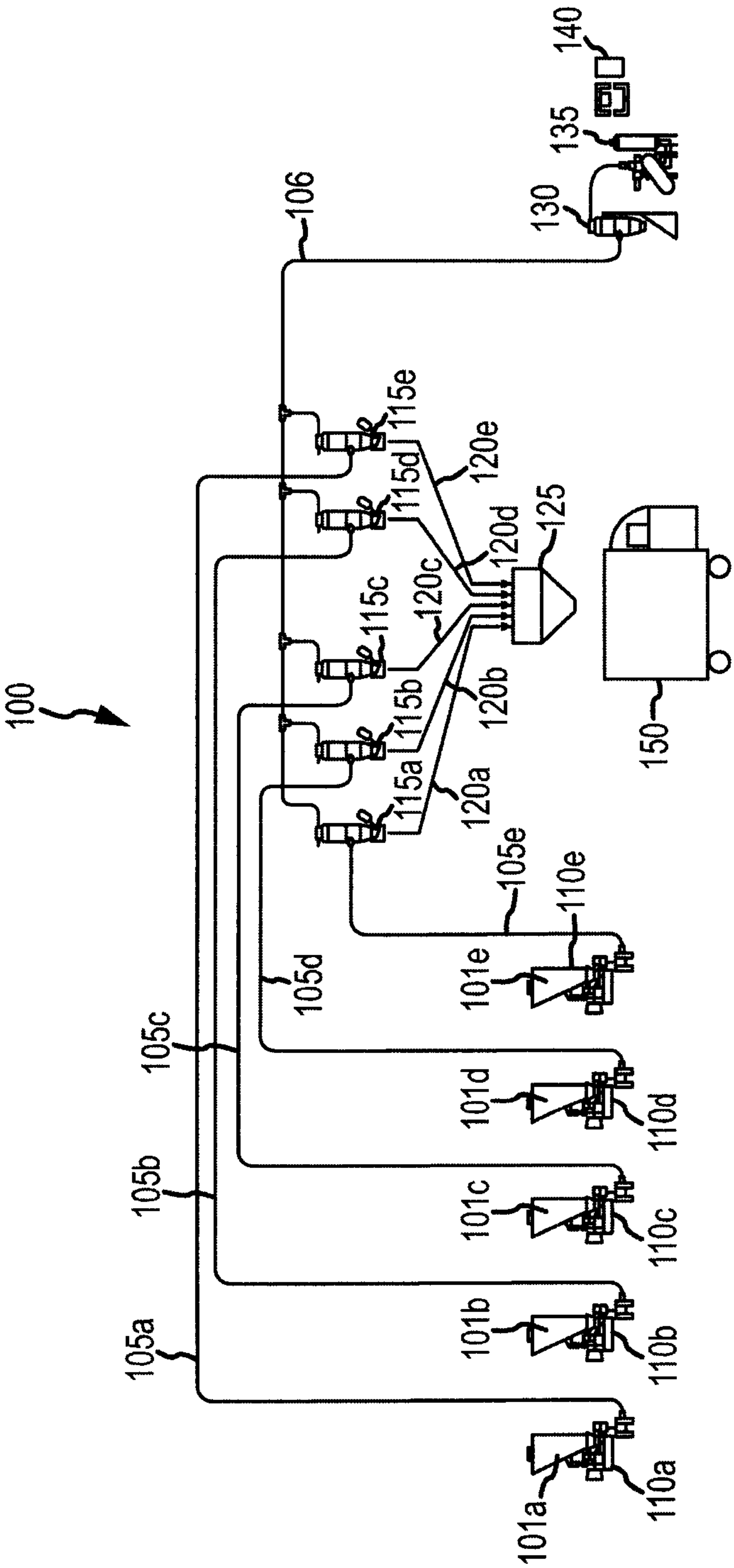


FIG.1

2/4

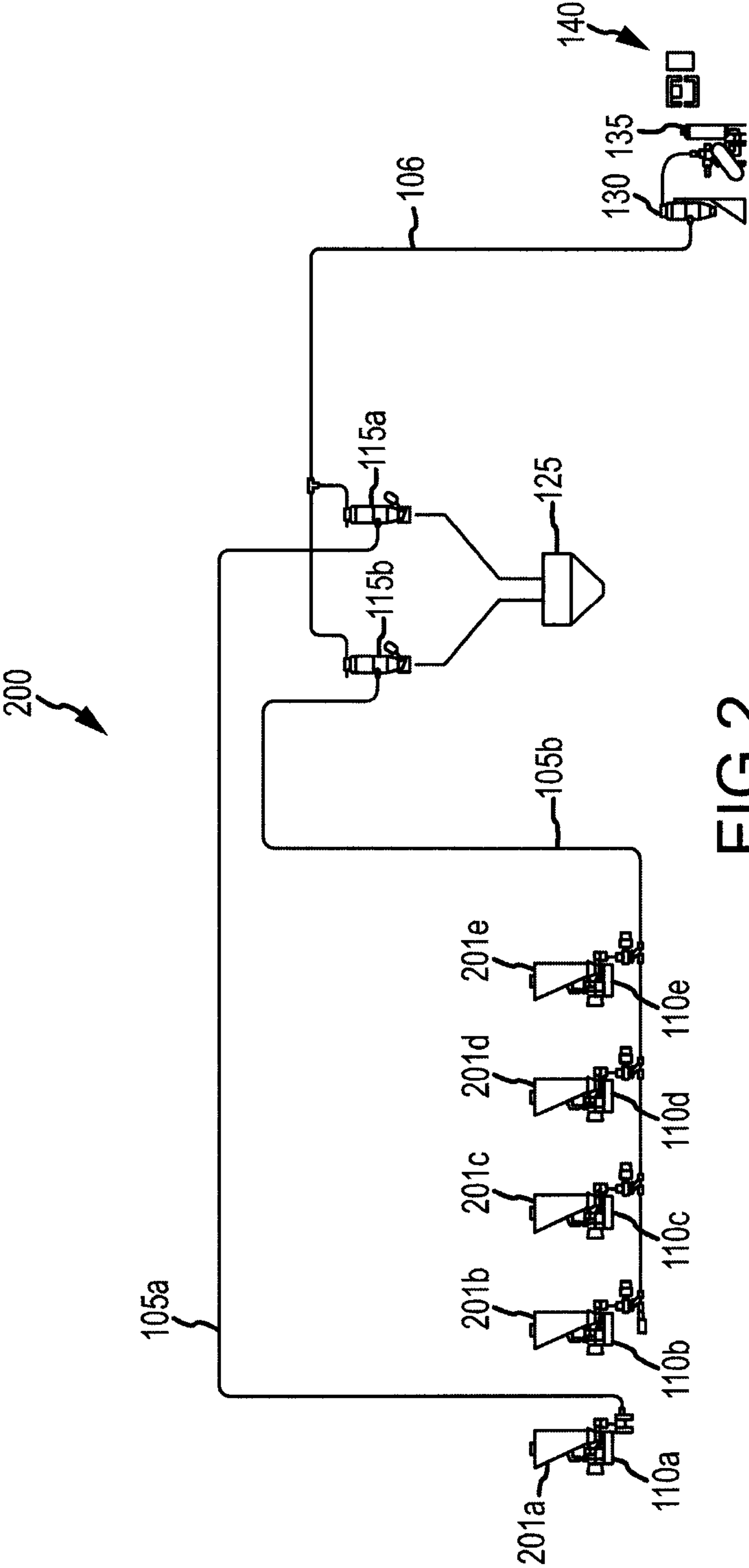


FIG.2

3/4

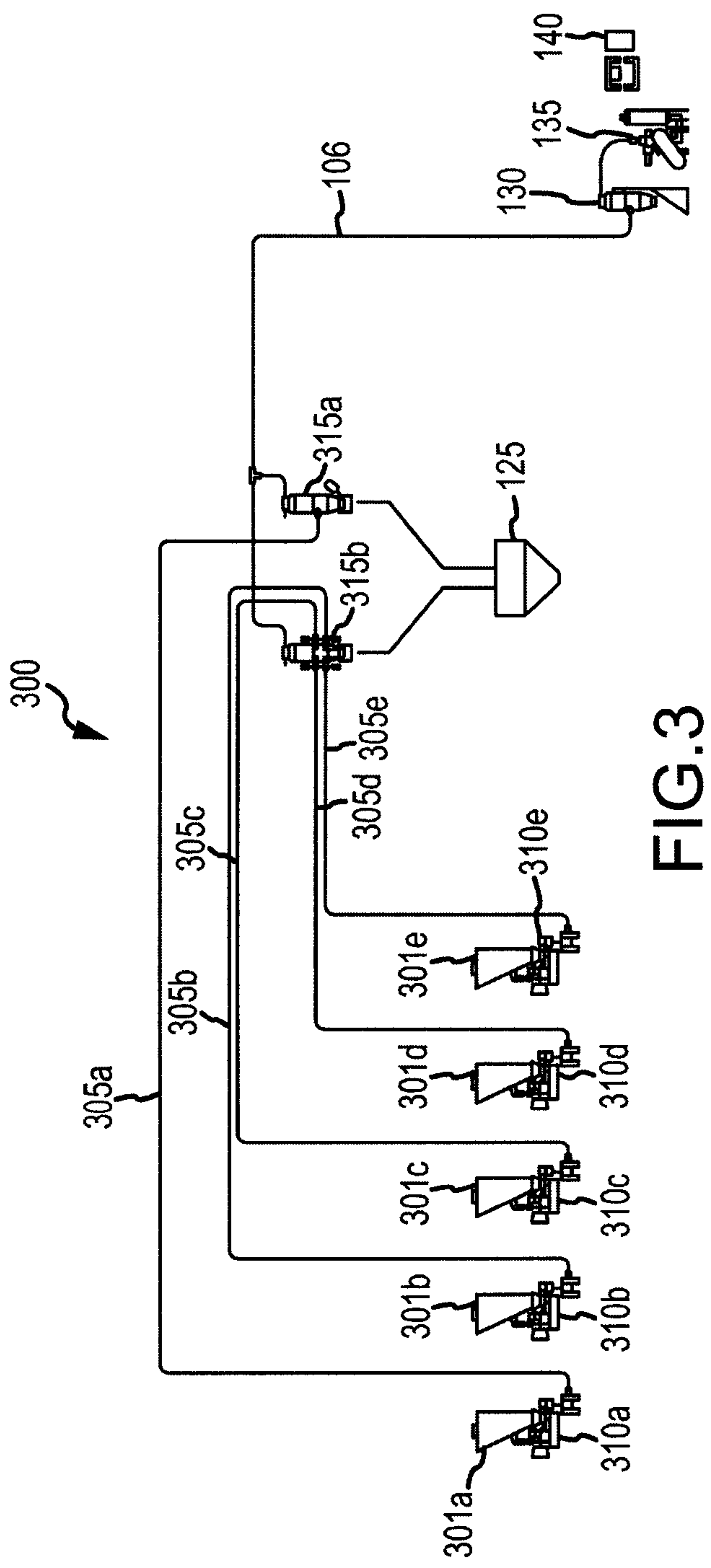


FIG.3

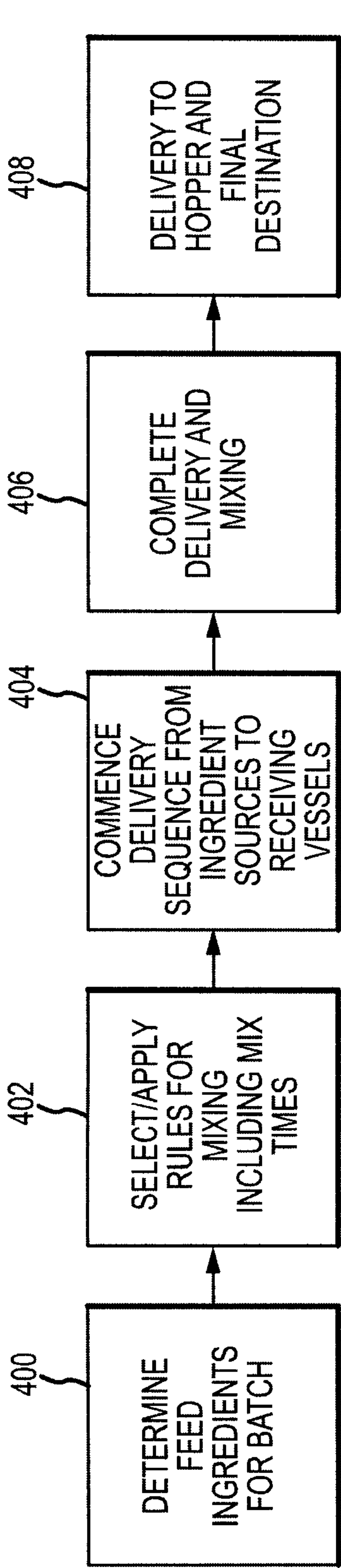


FIG.4

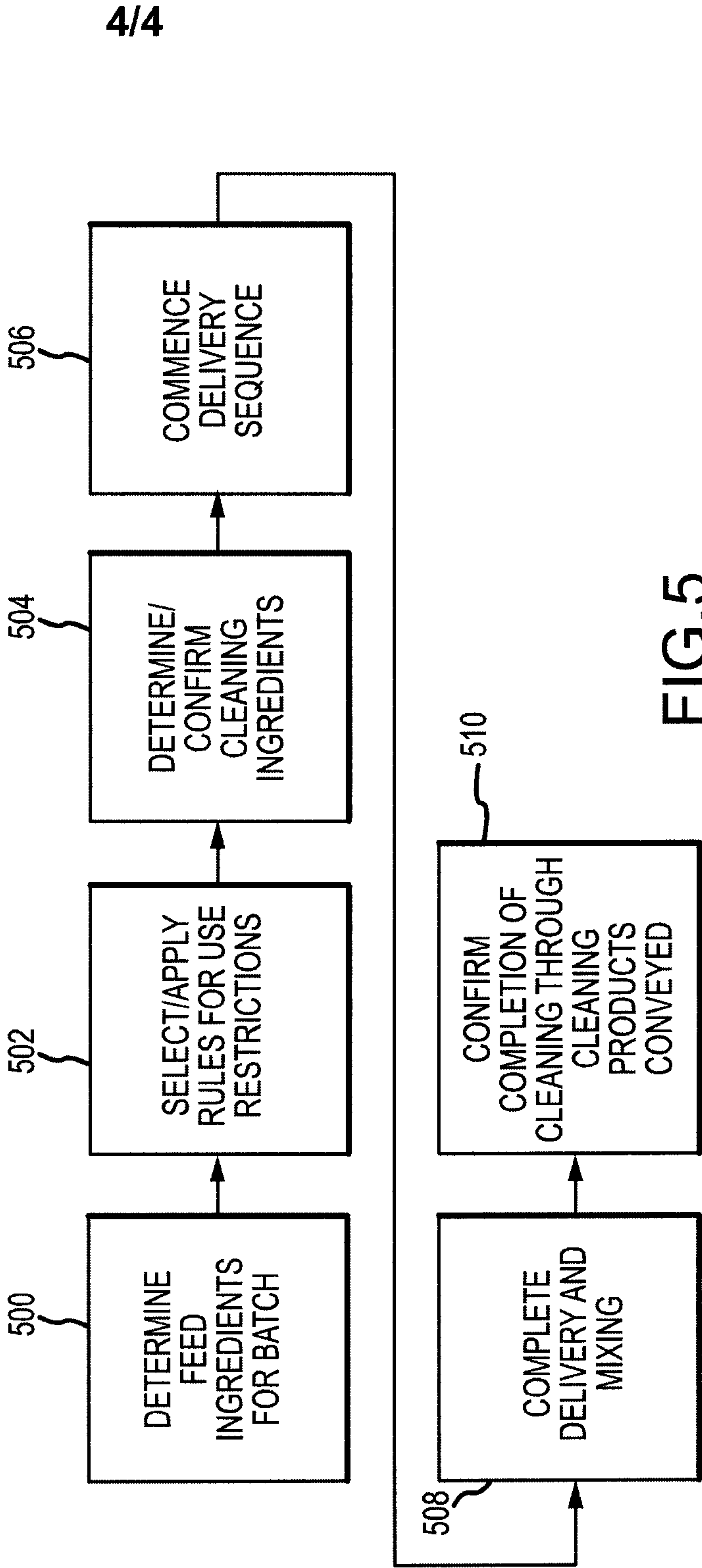


FIG.5

