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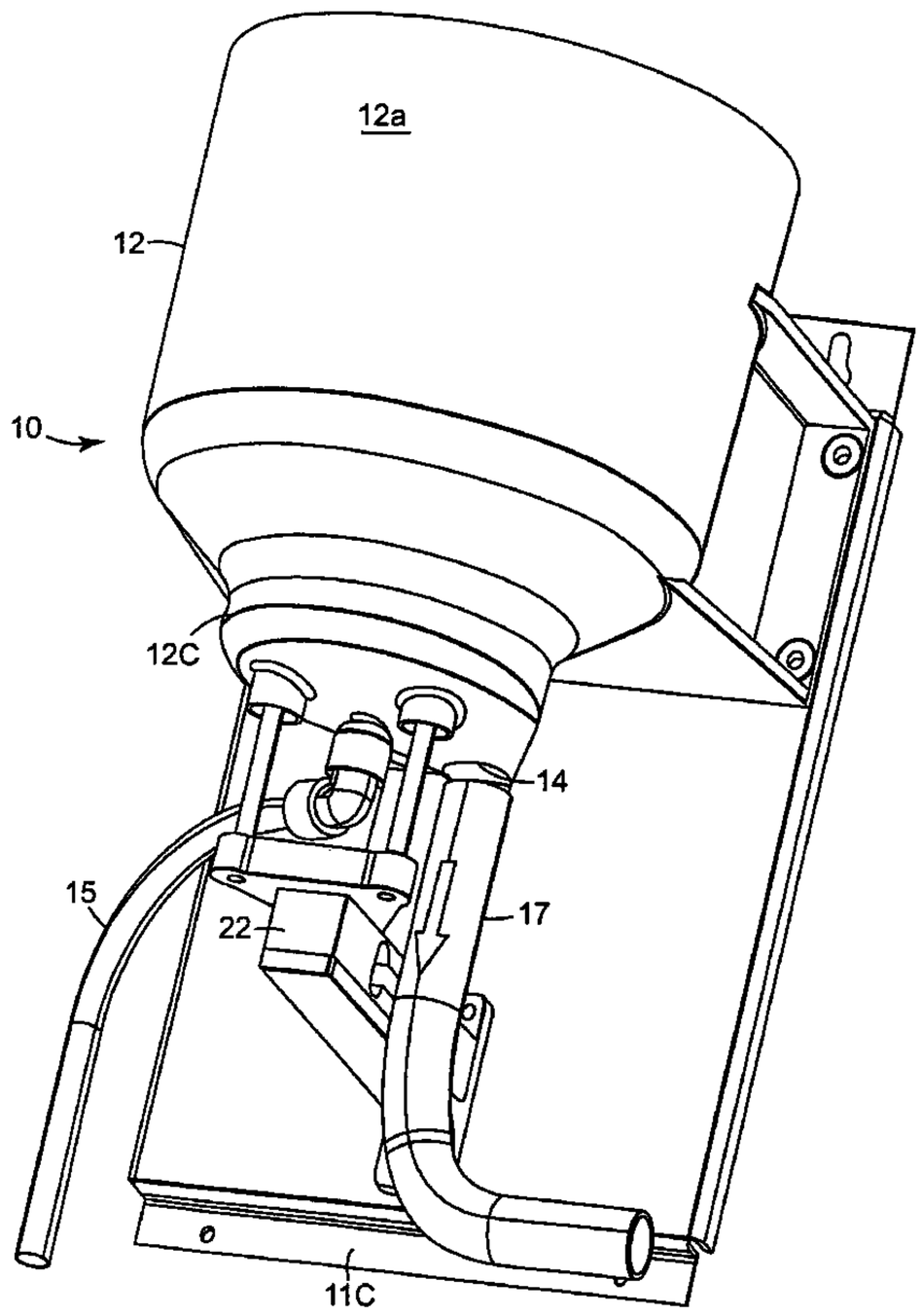
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Methods of dispensing an ingredient and measuring an amount of the ingredient dispensed, e.g., at a customer's location usually as the ingredient is used by the customer, in order to improve the dispensing process by adjusting future dispense cycles, accurately dispensing the ingredient, predicting an amount of ingredient to be dispensed.

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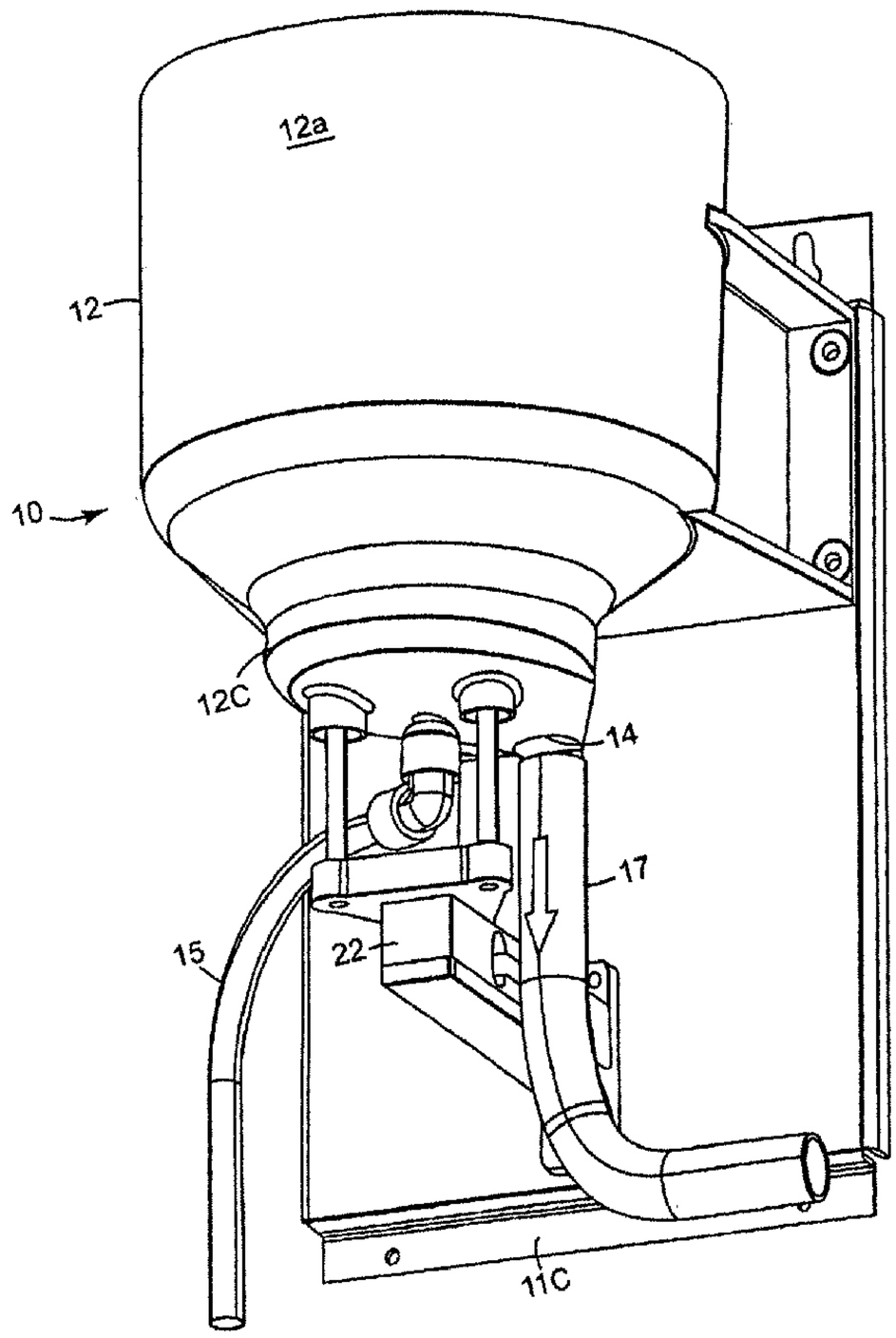
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(54) Title: METHODS OF DISPENSING AN INGREDIENT



(57) Abstract: Methods of dispensing an ingredient and measuring an amount of the ingredient dispensed, e.g., at a customer's location usually as the ingredient is used by the customer, in order to improve the dispensing process by adjusting future dispense cycles, accurately dispensing the ingredient, predicting an amount of ingredient to be dispensed.

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METHODS OF DISPENSING

Technical Field

[0001] This invention relates to methods of dispensing an ingredient and, more particularly, to methods of dispensing an ingredient in which the dispensed is controlled by a dispenser.

Background

[0002] Dispensing systems to dispense an ingredient for a commercial purpose have been widely used in many industries. For example, in the restaurant industry, warewashing systems are employed to rapidly wash large quantities of eating utensils, plates, pots, pans, glassware, etc. In another example in the hotel industry, linens, towels, clothing and the like are washed in commercial cleaning systems. Such systems commonly employ dispensers to dispense chemicals, such as detergents, to effectively perform the washing function.

[0003] Many types of dispensers and control systems for such dispensers have been utilized. Such dispensers, control systems and methods for controlling such dispensers have utilized a variety of techniques. As one example, such methods may dispense a predetermined amount of the ingredient into the cleaning apparatus for each cycle of the apparatus. Other systems and methods attempt to determine when the ingredient needs to be replenished in the cleaning apparatus by measuring a characteristic of the cleaning apparatus, e.g., measuring the conductivity of a use solution to determine when additional detergent needs to be added.

[0004] Many of these prior art dispensing methods fail to effectively manage the amount of ingredient dispensed.

Summary Of The Invention

[0005] Dispensing an ingredient, usually from a container (either in a dispenser or self-contained) in order to accurately measure an amount of an ingredient dispensed provides significant advantages.

[0006] In one example, accurately measuring an amount of an ingredient dispensed can be advantageously used in a dispenser to adjust a dispenser which otherwise dispenses the ingredient on another basis, e.g., on the basis of time.

[0007] In one embodiment, the present invention provides a method of dispensing a requested amount of an ingredient. The ingredient is dispensed based on a factor affecting a dispensed amount of the ingredient. The dispensed amount of the ingredient is determined. The factor is adjusted for a subsequent dispense cycle using a comparison between the requested amount and the dispensed amount.

[0008] In another embodiment, the present invention provides a method of dispensing a requested amount of an ingredient from a container. An initial weight of the ingredient in the container is measured. The ingredient is dispensed from the container for a predetermined period of time. A final weight of the ingredient in the container is measured. A dispensed amount of the ingredient dispensed during the predetermined period of time is determined by comparing the final weight with the initial weight. The predetermined period of time is adjusted for a subsequent dispense cycle using a comparison between the requested amount and the dispensed amount.

[0009] In another embodiment, the present invention provides a method of dispensing a requested amount of an ingredient from a container by eroding the ingredient with a diluent. An initial weight of the ingredient in the container is measured. The ingredient is dispensed from the container for a predetermined period of time. A time lag allows the diluent to drain from the ingredient. A final weight of the ingredient in the container is measured. A dispensed amount of the ingredient dispensed during the predetermined period of time is determined by comparing the final weight

with the initial weight. The dispensed weight is compared with the requested weight. The predetermined period of time for a subsequent dispense cycle is adjusted as a function of the comparing step.

[0010] In another embodiment, the present invention provides a method of dispensing a requested amount of an ingredient in each of a plurality of cycles. The ingredient in each of the plurality of cycles is dispensed based on a factor affecting a dispensed amount of the ingredient. The dispensed amount of the ingredient over the plurality of cycles is determined. The predetermined factor is adjusted for a subsequent dispense cycle using a comparison between the requested amount over the plurality of cycles and the dispensed amount.

[0011] In a preferred embodiment, the predetermined amount of time is adjusted downward if the dispensed amount exceeds the requested amount.

[0012] In a preferred embodiment, the predetermined amount of time is adjusted upward if the requested amount exceeds the dispensed amount.

[0013] In a preferred embodiment, the factor comprises a pumping speed of a pump used to dispense the ingredient.

[0014] In a preferred embodiment, the factor comprises an effectiveness of a grinder used to dispense the ingredient.

[0015] In a preferred embodiment, the factor comprises a speed of dispenser used to dispense a powdered ingredient.

[0016] In a preferred embodiment, the factor comprises a degree of flooding the ingredient.

[0017] In a preferred embodiment, the factor comprises a temperature at which the ingredient is dispensed.

[0018] In a preferred embodiment, the ingredient is dispensed by eroding the ingredient with a diluent.

[0019] In a preferred embodiment, the initial weight is compared with a known weight representative of an empty container and the container is replaced before dispensing if the comparison indicates that the container is empty.

[0020] In a preferred embodiment, the plurality of cycles is at least two.

[0021] In another example, accurately measuring the weight of an ingredient being dispensed, e.g., from a powdered or solid ingredient being eroded by a diluent, can be advantageously utilized in methods to control the erosion where the amount of the ingredient being dispensed his being partially masked by the weight of the diluent.

[0022] In another embodiment, the present invention provides a method of dispensing a requested amount of an ingredient from a container, i.e., eroding the ingredient with a diluent. The ingredient is weighed. The diluent is activated to erode the ingredient. A measured weight loss from a maximum weight of the ingredient is determined. The diluent is deactivated when the measured weight loss indicates that the requested amount will be dispensed.

[0023] In another embodiment, the present invention provides a method of dispensing a requested amount of an ingredient. The ingredient is weighed. A dispenser is activated to dispense the ingredient. A weight loss of the ingredient is determined at least in part by measuring a rate at which the ingredient is being dispensed. The dispenser is the activated when the weight loss indicates that the requested amount will be dispensed.

[0024] In a preferred embodiment, the ingredient is solid.

[0025] In a preferred embodiment, the diluent is sprayed on the ingredient.

[0026] In a preferred embodiment, the diluent is sprayed on the ingredient from below the ingredient.

[0027] In a preferred embodiment, a minimum weight is reached after activation and before the maximum weight.

[0028] In a preferred embodiment, the ingredient is powdered.

[0029] In a preferred embodiment, the deactivating step is accomplished when the measured weight equals the difference between the maximum weight and the requested amount minus an offset.

[0030] In a preferred embodiment, wherein the offset is based upon an amount of the ingredient dispensed between a time at which the activating step occurs and a time when the ingredient reaches the maximum weight.

[0031] In a preferred embodiment, the offset is empirically determined.

[0032] In a preferred embodiment, the offset is additionally based upon a trailing amount of the ingredient dispensed following the deactivating step.

[0033] In a preferred embodiment, the rate at which the ingredient is being dispensed is a function of measuring a slope of a dispensing curve.

[0034] In a preferred embodiment, the determining step comprises measuring a maximum of the ingredient and a rate at which the ingredient is being dispensed to interpolate a time when the requested amount of the ingredient will be dispensed.

[0035] In another example, accurately measuring the weight of an ingredient being dispensed can be advantageously used along with measurement of a factor indicative of the effectiveness of the ingredient in the apparatus. The ingredient dispensed is based on the factor in order to maintain the effectiveness of the ingredient in the apparatus.

[0036] In another embodiment, the present invention provides a method of dispensing an ingredient for use in an apparatus. The ingredient has an effectiveness in use in the apparatus in which the effectiveness is dependent upon a measurable factor. The factor is measured. An amount of the ingredient to be dispensed is predicted based at least in part on the factor. The amount of the ingredient is dispensed.

[0037] In another embodiment, the present invention provides a method of dispensing a concentrate into an apparatus having a sump containing a solution of the concentrate in a diluent in which any effectiveness of the concentrate declines in use. The effectiveness is dependent upon a measurable factor. The factor is measured. Whether an additional amount of the concentrate should be added to the sump in order to increase the effectiveness is determined. The additional amount of the concentrate is dispensed, if required.

[0038] In another embodiment, the present invention provides a method of dispensing a concentrate in each of a plurality of cycles into an apparatus having a sump containing a diluent in which any effectiveness of the

concentrate declines in use. The effectiveness is dependent upon a measurable factor. The factor is measured in each of the plurality of cycles. An amount of the concentrate is dispensed in each of the plurality of cycles based at least in part on the factor.

[0039] In a preferred embodiment, the ingredient is dispensed into a solution in the apparatus.

[0040] In a preferred embodiment, the factor is a function of the solution.

[0041] In a preferred embodiment, the factor is the pH of the solution.

[0042] In a preferred embodiment, the factor indicates too much of the concentrate in the sump.

[0043] In a preferred embodiment, the measuring step indicates that the sump has been refilled with fresh diluent and wherein the dispensing step dispenses a refill amount of the concentrate.

[0044] In a preferred embodiment, the amount of the concentrate dispensed is dependent upon a dispense time and wherein the dispense time is adjusted based at least in part on the measuring step.

Brief Description Of The Drawing

[0045] **Figure 1** is an illustration of a dispenser in which some or all of methods of the present invention may find usefulness;

[0046] **Figure 2** is a chart illustrating the weight of a dispensing ingredient of the dispenser of **Figure 1**;

[0047] **Figure 3** is a flow chart illustrating an embodiment of the invention in which an ingredient is dispensed by eroding the ingredient with a diluent;

[0048] **Figure 4** is a flow chart illustrating a first portion of a more detailed preferred embodiment of the method illustrated in **Figure 3**;

[0049] **Figure 5** is a flow chart illustrating a second portion of the method of **Figure 4**;

[0050] **Figure 6** is a flow chart illustrating an embodiment of the invention in which an ingredient is dispensed based on the result of a previous dispense cycle;

[0051] **Figure 7** is a flow chart illustrating a more detailed preferred embodiment of the method illustrated in **Figure 6**;

[0052] **Figure 8** is a flow chart illustrating a first portion of an embodiment of the invention in which an amount of an ingredient is dispensed based upon a predicted amount of the ingredient needed to maintain an effectiveness of the ingredient;

[0053] **Figure 9** is a flow chart illustrating a second portion of the method of **Figure 8**; and

[0054] **Figure 10** is a flow chart illustrating an alternative embodiment of the method illustrated in **Figure 8** and **Figure 9**.

Detailed Description

[0055] The methods of the present invention can be described, as an example, being used in conjunction with a mass based dispensing system such as a dispensing system described in U.S. patent no. 7,201,290 entitled "Method and Apparatus For Mass Based Dispensing," by Richard Mehus et al., issued April 10, 2007. The dispenser described in such patent is shown generally in **Figure 1**. Dispenser 10 includes a housing 12 that has an outer wall 12a having a cavity (not shown). Outer wall 12a has a larger diameter at the top so as to accommodate capsule (not shown). The capsule, in a preferred embodiment, contains a solid block of an ingredient to be dispensed. Inlet hose 15 allows a diluent to be sprayed into capsule and onto the block of ingredient to be dispensed effectively eroding a portion of the block of ingredient. Sump region 12c provides for a collection that region for a use solution of the eroded ingredient and the diluent. Hose 17 is connected to outlet 14 allowing the use solution to be

directed to a desired location. Load cell 22 measures that combined weight of capsule, the block of ingredient and any diluent contained in capsule.

[0056] Dispenser 10 operates by spraying a diluent through inlet host 15 into capsule and onto the block of ingredient. As the block of ingredient is eroded, a mixture of eroded ingredient and diluent is discharged from dispenser 10 through hose 17. Load cell 22 accurately measures the combined weight before the diluent is sprayed onto the block of ingredient, while the diluent is sprayed onto the block of ingredient and after the diluent is sprayed onto the block of ingredient.

[0057] **Figure 2** is a chart illustrating the effect of the spray of diluent onto the block of ingredient in the dispenser of **Figure 1**. The mantissa is time and the ordinate is weight in grams. Time 50 before the initiation of spray represents the starting combined weight, netted out at approximately zero (0) grams, for purposes of illustration. Spray is initiated at time 52 at which point two things begin to happen. First, pressure from the diluent sprayed on the underside of the block of ingredient relieves some of the combined weight from load cell 22. Second, the added weight from diluent accumulating in capsule tends to cause an increased combined weight. Thus, the combined weight on load cell 22 initially decreases until time 54 at which point the combined weight reaches an initial minimum of approximately minus four (-4) grams. Following time 54, the added weight of the diluent in capsule causes the combined weight to rather significantly increase. Over time, however, the added weight of the diluent in capsule tends to stabilize as the block of ingredient is eroded. As the block of ingredient is eroded, its weight decreases. Thus, at time 56 the combined weight reaches a maximum at approximately sixteen (16) grams. Following time 56 the block of ingredient continues to be eroded as the diluent continues to spray. Since the added weight of the diluent in capsule has stabilized, the combined weight continues to decrease during time 58 until the spray is discontinued. The spray of diluent is discontinued at time 60 causing a momentary weight gain for the combined weight as the upward pressure on the block of ingredient is discontinued. Following a

momentary weight gain cause by the lack of upward pressure on the block of ingredient by the spray of diluent, diluent continues to drain from capsule during time period 62 resulting in the near final weight at time 64 of approximately minus twenty-six (-26) grams.

[0058] The difference between the starting weight at time 50 of approximately zero (0) grams and the ending weight of approximately minus twenty-six (-26) grams, once the diluent has drained from capsule, of twenty-six (26) grams represents the amount of ingredient dispensed. However, note that the difference between the maximum weight of approximately sixteen (16) grams and the weight at time 60 of approximately minus nine (-9) grams when spray is discontinued is only twenty-five (25) grams. This is because ingredient was eroded from the block of ingredient during time 66, between time 52 when spray is begun and time 56 when the maximum is measured, and also during time 62 as diluent drains from capsule.

[0059] This process can be more readily understood with reference to the flow chart of **Figure 3**. A requested amount of the ingredient requested is set (block 110). Load cell 22 weighs the ingredient (block 112). A valve is turned on (block 114) at time 52 initiating the spray of diluent against the block of ingredient. Optionally, the process waits (block 116) for a minimum weight at time 54 to be reached. The process waits (block 118) for diluent being added by spray to accumulate in capsule and increase the combined weight. Note that if the step represented by block 116 is omitted, it is still proper to wait for weight gain in block 118. Alternatively, if the step represented by block 116 is not omitted then it is no longer necessary to wait for weight gain and the step represented by block 118. Alternatively, the steps represented by both blocks 116 and 118 could be omitted in the process could continue directly to block 120. In block 120, the method searches for a maximum combined weight at time 56 and, once found, records that peak weight (block 122). Again optionally, the process waits for weight loss (block 124). Load cell 22 measures (block 126) the amount of weight lost from the maximum or peak weight recorded.

Optionally, the process adjusts for an offset (block 128) which is explained below. The process determines (block 130) whether the measured weight lost is equal to an amount which will result in a dispensed amount of ingredient which equals the requested amount. When such a determination is made, the valve is turned off (block 132) discontinuing the spray of diluent against the block of ingredient. The process stops (block 134) until the process is repeated by again setting a requested amount (block 110).

[0060] Since some ingredient will be eroded from the block of ingredient during time 66 (between time 52 when spray is initiated and time 56 when weight loss begins to be recorded) and during time 62 (while remaining diluent drains from capsule), the amount of weight lost from capsule during time 58 does not necessarily equal the total weight of the ingredient eroded and, hence, dispensed. However, an amount of the ingredient which is additionally dispensed during time 66 and time 62 can be calculated and/or estimated by a variety of means. For example, this amount can be determined empirically from previous dispensed cycles. Alternatively, the slope of curve 48 during all or a portion of time 58 may be determined and an original maximum 68 may be determined by regression to account for an amount of the ingredient eroded during time 66. The amount of additional ingredient eroded during times 66 and 62 can be accounted for in the method in block 128 by adjusting the time 60 at which the spray of the diluent is discontinued. For example, if it is determined that the additional amount of the ingredient dispensed during time periods 66 and 62 is equal to approximately one (1) gram, then time 60 can be adjusted to turn off the spray of diluent when the measured weight loss is equal to the requested amount of ingredient minus one (1)gram.

[0061] **Figure 4** is a flow chart illustrating a more detailed process. The process starts at block 150 waiting for a dispense request. A determination is made at block 152 whether or not a dispensed request has occurred. The starting weight is logged, the requested amount is determined and the diluent spray valve is turned on (block 154). The initial

weight loss is evaluated (block 156). If the weight loss is excessive (block 158) a fault is recorded (block 160). The weight gain is evaluated (block 162) to determine if a peak weight has been reached (block 164).

[0062] If a peak weight has been reached, the peak weight is recorded (block 166) and a branch is made to compute an offset value (block 168). Dispensing continues (block 170) and the offset (from offset value in block 172) is subtracted (block 174) from the requested amount. If the requested amount is greater (block 176) than the amount remaining, a determination is made (block 178) whether the capsule is empty. If the capsule is empty, the spray valve is turned off (block 180) and an alarm is sounded (block 182). If the capsule is not empty or if the requested amount is still greater than the amount remaining, the current weight is subtracted from the previous weight and added to the startup offset (block 184). If the startup offset plus the previous weight equals the requested amount (block 186), the spray valve is turned off (block 188), the process waits (block 190) and updates the offset buffer (block 192) before returning to the wait for dispense request at block 150. However, if (in block 186) the startup offset plus the previous weight is not equal to the requested amount, and the process returns to block 184 and the current weight is again subtracted from the previous weight and added to the startup offset (block 184).

[0063] **Figure 5** is a flow chart illustrating the offset value calculation from the flow chart illustrated in **Figure 4**. From the offset value in **Figure 4** (block 194), the process determines whether this is the capsule's first dispense cycle (block 196). If it is, the process uses a predetermined new capsule startup value (block 198) before updating the FIFO buffer with the new offset amount (block 200) and returning (block 202) to the offset value in **Figure 4**. If however (at block 196) it is not the capsule's first dispense cycle, the process determines (block 204) if it is the capsule's second dispense cycle. If it is, an average (block 206) between the predetermined new capsule startup value and an empirical result from the first dispense cycle is sent to the FIFO buffer (block 200) and the process returns to **Figure 4** (block 202). If however (at block 204) it is not the capsule's

second dispense cycle, the process determines (block 208) if it is the capsule's third dispense cycle. If it is, an average (block 210) of a new capsule startup value and empirical result from the first and second dispense cycles is sent to the FIFO buffer (block 200) and the process returns to **Figure 4** (block 202). If however (at block 208) it is not the capsule's third dispense cycle, then an average (block 212) of the empirical result from the capsule's last three dispensed cycles are used as an offset and sent to the FIFO buffer (block 200) and the process returns to **Figure 4** (block 202).

[0064] An alternative embodiment of a method of the present invention is illustrated in the flow chart of **Figure 6** which can be utilized, for example, in a dispenser which dispense as an ingredient for a predetermined period of time in each of a plurality of cycles. A desired weight of an amount of the ingredient to be dispensed is determined (block 220). The initial weight is measured (block 222). A determination is made (block 224) on whether the initial weight is greater than the weight of an empty capsule. If the initial weight is not greater than the weight of an empty capsule, the capsule may be changed (block 226) and the process again measures the initial weight (at block 222). If however the initial weight is greater than the empty weight, the ingredient is dispensed (block 228) for the predetermined period of time. Following dispensing, the amount of dispensed ingredient is determined (block 230). If the amount actually dispensed should disagree with the desired amount to be dispensed, the period of time for the next dispense period (block 228) is appropriately adjusted (block 232). The initial weight is then set to be equal to the final weight (block 234) to properly enable the next dispense cycle.

[0065] **Figure 7** is a flow chart illustrating a more detailed method of **Figure 6**. Again, the weight to be dispensed is set (block 220) and the initial weight is measured (block 222). Similarly, a determination (block 224) is made on whether the capsule is empty and whether the capsule should be changed (block 226). Also similarly, the ingredient is dispensed for a predetermined period of time (block 228). Following dispensing, the

process waits (block 236) for any remaining diluent to drain from the capsule. The final weight is measured (block 238) and the dispensed weight is determined (block 240). The weight dispensed is compared (block 242) to the set weight and the predetermined period of time to dispense for the next cycle is adjusted (block 232) appropriately. As an example, if the amount dispensed is greater than the set amount, then the period of time to dispense would be adjusted downward. However, if the amount dispensed is less than the set amount, then the period of time to dispense would be adjusted upward. And, of course, if the amount dispensed equals the set amount no adjustment need be made. The initial weight is then set to be equal to the final weight (block 234) to properly enable the next dispense cycle.

[0066] An alternative embodiment of a method of the present invention is illustrated in the flow chart of **Figure 8** and **Figure 9** which can be utilized in any of the dispensers described or other dispensers. The process first waits for a dispense request (block 250) using the determination block 252 based on whether a cycle signal has been received. Once a cycle signal is received, the process measures a factor which, at least in part, is indicative of the effectiveness of the ingredient being dispensed into the machine in which the ingredient is utilized. In one example in a machine in which the ingredient is dispensed into a use solution in a sump, a measurement of the pH of the use solution is indicative of an amount of detergent (for example, an alkaline detergent) contained in the use solution. Thus, by measuring a factor such as pH, a dispenser can predict an amount of ingredient, in this case detergent, which should be dispensed into the machine. It is recognized and understood that the pH of a use solution is just an example of one of many factors which may be indicative of the effectiveness of the ingredient being dispensed. For example with warewashing machines, other examples could include temperature, turpidity, conductivity, water pressure, or another factor not related to the use solution per se such as a degree of soiling of the dishes or the length of time since the last cycle.

[0067] In **Figure 9**, the pH is measured (block 254) and a determination (block 256) on whether the measured pH is greater than an upper limit is made. If the pH is greater than the upper limit, the machine already has too much detergent, the present dispense cycle is skipped and the process returns to block 250 to wait for the next dispense request. If, however, the measured pH is not greater than the upper limit, a determination (block 258) is made on whether the pH is lower than a lower limit. If not, then the detergent amount is with in a normal range and the process dispenses (block 260) a regular amount of detergent for the current dispense cycle. If however, the measured pH is lower than a lower limit, then a determination is made (block 262) on whether the pH is so low that it is below a fresh water limit which would indicate that the machine's sump has been drained and refilled with fresh water. If it is, a larger, refill amount of detergent is dispensed (block 264). If it is not, the amount of detergent is below the normal range but not so low as to require a refill amount dispense amount. In this case, the regular dispense amount is increased (block 266) to account for the low amount of detergent. Following blocks 260, 264 and 266, the process returns to **Figure 8** and dispenses (block 268) the requested amount of detergent.

[0068] **Figure 10** is a flow chart illustrating generally how the predictive process of **Figure 9** can be integrated in a dispensing method previously illustrated in **Figure 3**. Instead of setting the amount of ingredient to be dispensed (as is done in **Figure 3**), the process waits for a dispense request (block 250) and determines (block 252) whether a dispense cycle has been requested. If a dispense cycle has been requested, the amount of the ingredient which needs to be dispensed is predicted (block 270) using the techniques illustrated in **Figure 9**. Essentially having substituted the predictive process of **Figure 9** for the manual setting of **Figure 3**, the process of **Figure 10** continues essentially identical to the process illustrated in **Figure 3** beginning with block 112 without optional steps represented by blocks 124 and 128.

[0069] While the methods of this invention have been described throughout this description is dispensing an ingredient useful or utilized in an apparatus in the cleaning industry, for example a warewashing machine, it is to be recognized and understood that the methods of the present invention have usefulness in other applications as well.

[0070] A description of alternatives methods of dispensing related to the present invention are described in U.S. patent application publication no. US 2004-0230339 A1, entitled "Methods of Managing Based on Measurements of Actual Use of Product," by Bryan Maser et al, published November 18, 2004.

[0071] The present invention has applicability in many areas in addition to those already discussed. The following is a list of at least some of the areas in which the invention may be used. In the area of pest elimination dispensing equipment, a load cell could be utilized to measure a pre-set amount of ready-to-use insecticide which would enable the user to document proof of delivery for regulatory compliance, while ensuring a consistent dose was used for each application. Use in the vehicle cleaning market could encompass the use of a chemical measurement device for a vehicle care product dispenser. The product could be in a solid, liquid or gel form. Delivery would be by conventional means such as a recirculating system for solid products or pump systems for liquids or gels. The load cell would measure precise weight changes in the product being delivered from a concentrate to create a ready-to-use solution or an intermediate solution that can be diluted at a user's convenience. The prior art procedures require chemical or volumemetric measurements by operators of product usage to ensure reproducible product delivery. As each product type varies greatly in chemical components for vehicle cleaning products, different chemical tests need to be developed and validated for each new product. Batch to batch variations in solid dissolution rates require very stringent quality control measures and greatly restrict new product development of solid systems. Large variations in product use temperature due to seasonal

temperature variations in the vehicle cleaning market have negative effects on liquid product viscosities. Water pressure variations within vehicle cleaning sites result in wide changes in product delivery as many dilution systems are based on siphon technology. These variations often result in unacceptable differences in product delivery. All of the variations require human intervention to adjust the chemical delivery system. The use of the load cell technology would permit reproducible delivery of product regardless of chemical composition. This presents the possibilities of greater flexibility and product formulation. Concerns about variation in solid product solubility differences or liquid viscosity changes with temperature would be eliminated as only weight changes are measured. Simplicity of the dispenser design would also result as the same dispenser technology could be used for many product chemistries since chemical measurement systems do not need to be taken into account for each product.

[0072] Still another area where the present invention could be utilized is in the janitorial and health care areas. The janitorial business would be able to utilize the technology of the present invention for accurately dispensing two component chemistries as well as cross linking chemistries for floor care. For health care, the present invention would be able to be utilized for proof of delivery for sanitizers and disinfectants. There is also the need to deliver very accurate amounts of chemistry for instrument care and hard surface cleaning. The technology would be available for both liquid and solid products. The present invention is also applicable for Housekeeping. The invention is able to be utilized as a platform for accurate solid, liquid or concentrate proportioning when it is used in conjunction with a device that can quantify an amount of water passing through a pipe. For example, if a known volume of water is used, and the load cell could detect the amount of concentrate dispensed, a proportion would be known. So in an accurate dispenser of this kind, the user would set a proportion. While water is filling up the use vessel, the concentrate is dispensed. Dispensing the concentrate occurs until the proportion is

satisfied. If a known amount of water is passed through a pipe in a fixed time, the dispenser could dispense the concentrate to satisfy the proportion. For example, if 100 milliliters of water is passed through the dispenser, a known amount of concentrate would be needed to satisfy the set proportion. The known amount of concentrate could be dispensed and stopped, when the load cell is satisfied.

[0073] The present invention is also applicable for laundry systems. Present laundry systems service two machines at a relatively high cost. The system is both complex and costly. The load cell technology of the present invention would reduce both the cost and complexity of a current laundry dispenser. Further, the current laundry system for liquid also has significant drawbacks in that there is no empty drum alarm and no way to compensate for the reduced output of the peristaltic pump dispensing. Load cell technology of the present invention would allow for accurate dispensing of the peristaltic pump over time, providing a signal of when to change the squeeze tube, and allow and empty warning device. These would be significant improvements over the prior art. The foregoing is not an exhaustive list but are just further examples of the applicability of the present invention.

[0074] Various modifications and alterations of this invention will be apparent to those skilled in the art without departing from the scope and spirit of this invention. It should be understood that this invention is not limited to the illustrative embodiments set forth above.

What is claimed is:

1. A method of dispensing a requested amount of an ingredient, comprising the steps of:

dispensing said ingredient based on a factor affecting a dispensed amount of said ingredient;

determining said dispensed amount of said ingredient; and

adjusting said factor for a subsequent dispense cycle using a comparison between said requested amount and said dispensed amount.

2. A method as in claim 1 wherein said factor comprises a predetermined amount of time.

3. A method as in claim 2 wherein said predetermined amount of time is adjusted downward if said dispensed amount exceeds said requested amount.

4. A method as in claim 3 wherein said predetermined amount of time is adjusted upward if said requested amount exceeds said dispensed amount.

5. A method as in claim 1 wherein said factor comprises a pumping speed of a pump used to dispense said ingredient.

6. A method as in claim 1 wherein said factor comprises a speed of dispenser used to dispense a powdered ingredient.

7. A method as in claim 1 wherein said factor comprises a degree of flooding said ingredient.

8. A method as in claim 1 wherein said factor comprises a temperature at which said ingredient is dispensed.

9. A method as in claim 1 wherein said ingredient is dispensed by eroding said ingredient with a diluent.

10. A method of dispensing a requested amount of an ingredient from a container, comprising the steps of:

measuring an initial weight of said ingredient in said container;

dispensing said ingredient from said container for a predetermined period of time;

measuring a final weight of said ingredient in said container;

determining a dispensed amount of said ingredient dispensed during said predetermined period of time by comparing said final weight with said initial weight; and

adjusting said predetermined period of time for a subsequent dispense cycle using a comparison between said requested amount and said dispensed amount.

11. A method as in claim 10 wherein said predetermined amount of time is adjusted downward if said dispensed amount exceeds said requested amount.

12. A method as in claim 11 wherein said predetermined amount of time is adjusted upward if said requested amount exceeds said dispensed amount.

13. A method as in claim 10 wherein said ingredient is dispensed by eroding said ingredient with a diluent.

14. A method of dispensing a requested amount of an ingredient from a container by eroding said ingredient with a diluent, comprising the steps of:

measuring an initial weight of said ingredient in said container;

dispensing said ingredient from said container for a predetermined period of time;

waiting for a lag time to allow said diluent to drain from said ingredient;

measuring a final weight of said ingredient in said container;

determining a dispensed amount of said ingredient dispensed during said predetermined period of time by comparing said final weight with said initial weight;

comparing said dispensed weight with said requested weight; and

adjusting said predetermined period of time for a subsequent dispense cycle as a function of said comparing step.

15. A method as in claim 14 wherein said predetermined amount of time is adjusted downward if said dispensed amount exceeds said requested amount.

16. A method as in claim 15 wherein said predetermined amount of time is adjusted upward if said requested amount exceeds said dispensed amount.

17. A method as in claim 14 which further comprises the steps of:

comparing said initial weight with a known weight representative of an empty container; and

replacing said container before said dispensing step if a result of said comparing step indicates that said container is empty.

18. A method of dispensing a requested amount of an ingredient in each of a plurality of cycles, comprising the steps of:

dispensing said ingredient in each of said plurality of cycles based on a factor affecting a dispensed amount of said ingredient;

determining said dispensed amount of said ingredient over said plurality of cycles; and

adjusting said predetermined factor for a subsequent dispense cycle using a comparison between said requested amount over said plurality of cycles and said dispensed amount.

19. A method as in claim 18 wherein said factor comprises a predetermined amount of time.

20. A method as in claim 19 wherein said predetermined amount of time is adjusted downward if said dispensed amount exceeds said requested amount.

21. A method as in claim 20 wherein said predetermined amount of time is adjusted upward if said requested amount exceeds said dispensed amount.

22. A method as in claim 18 wherein said plurality of cycles is at least two.

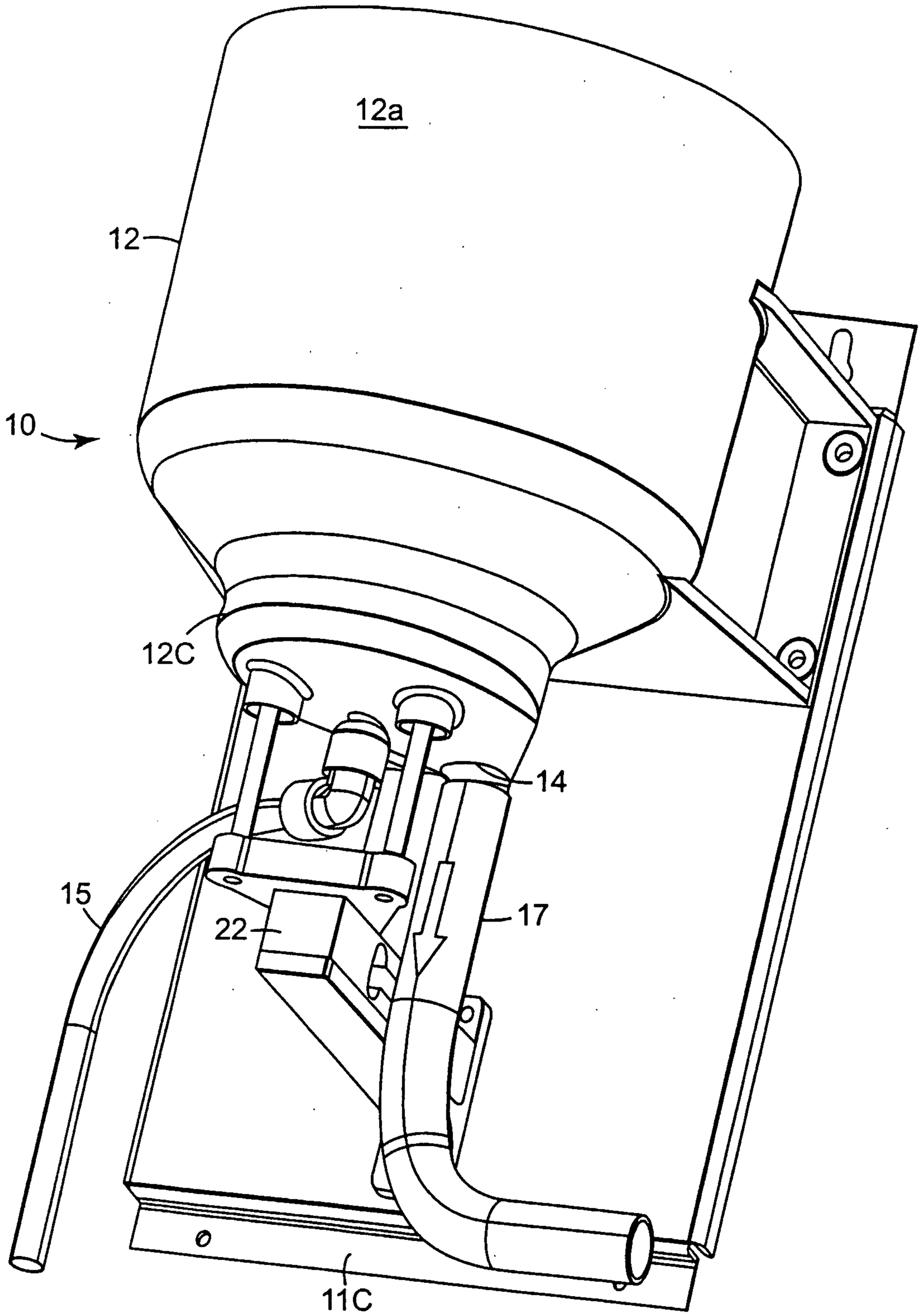


Fig. 1

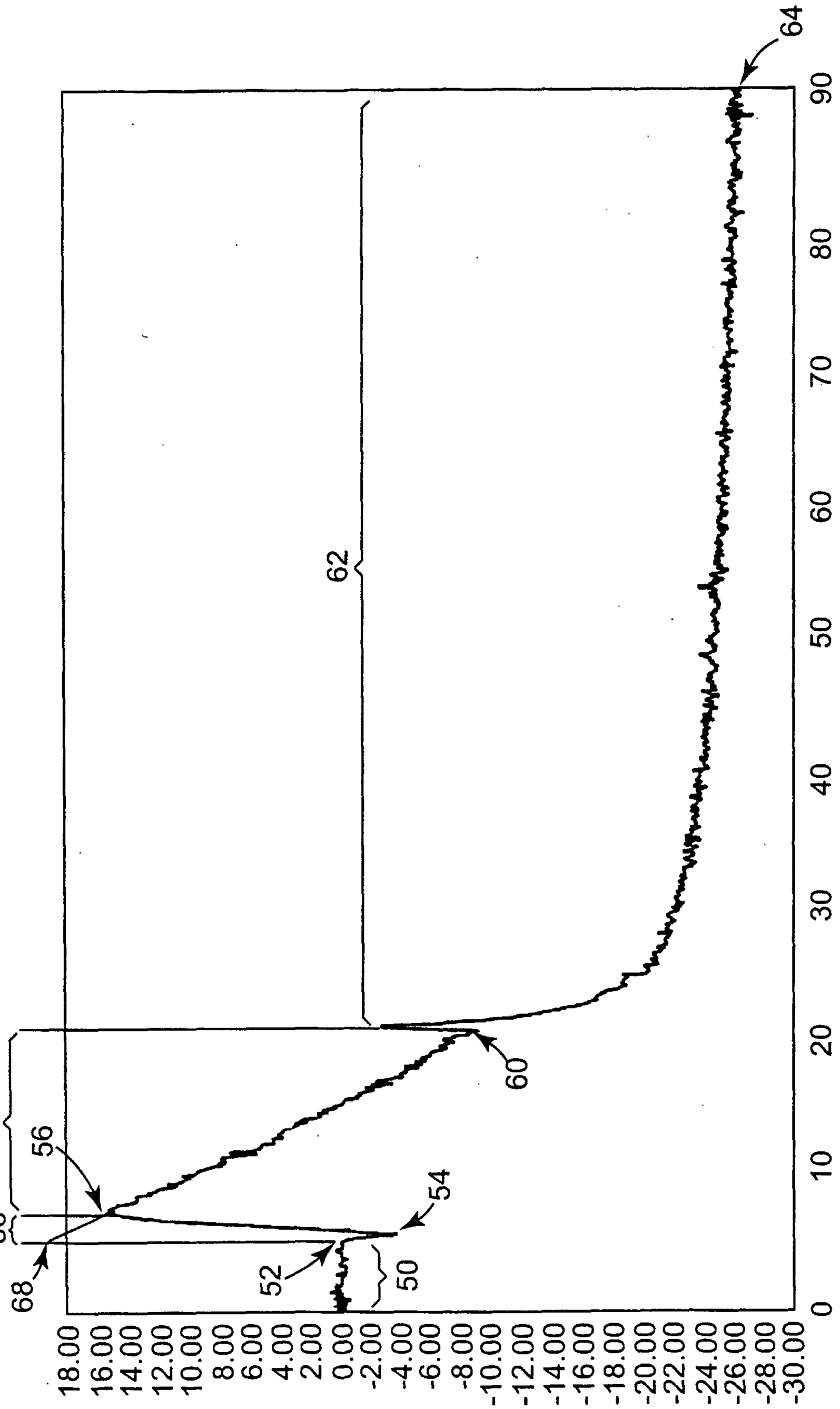

64
90
80
70
60
50
40
30
20
10
0
Time (seconds)
62
58
56
66
68
52
54
50
60
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
-2.00
-4.00
-6.00
-8.00
-10.00
-12.00
-14.00
-16.00
-18.00
-20.00
-22.00
-24.00
-26.00
-28.00
-30.00
Weight Loss (grams), Spray Pressure (psi)

Fig. 2

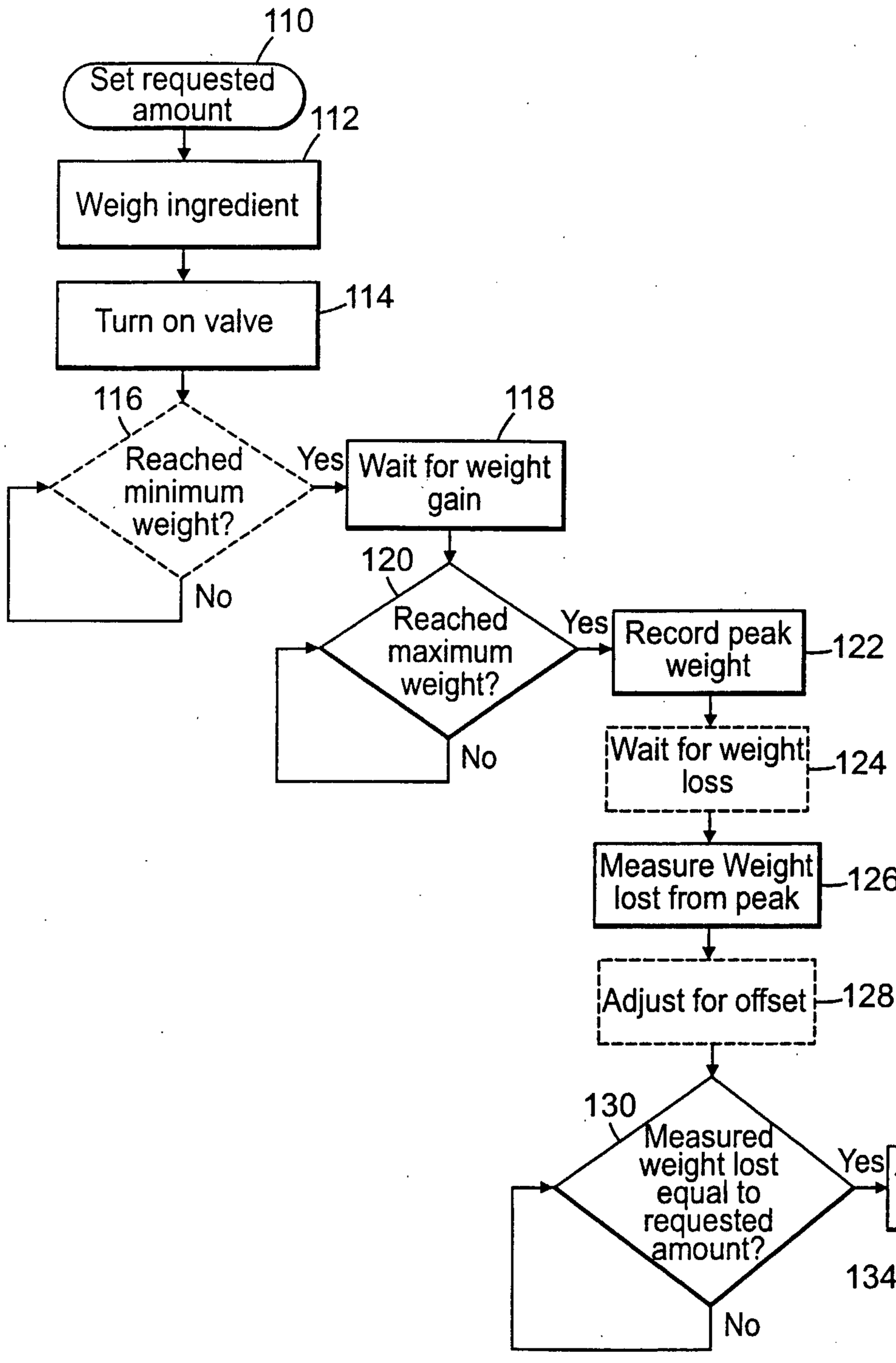

110
Set requested amount
112
Weigh ingredient
114
Turn on valve
116
Reached minimum weight?
Yes
No
118
Wait for weight gain
120
Reached maximum weight?
Yes
No
Record peak weight
122
Wait for weight loss
124
Measure Weight lost from peak
126
Adjust for offset
128
130
Measured weight lost equal to requested amount?
Yes
No
132
Turn off valve
134
Stop

Fig. 3

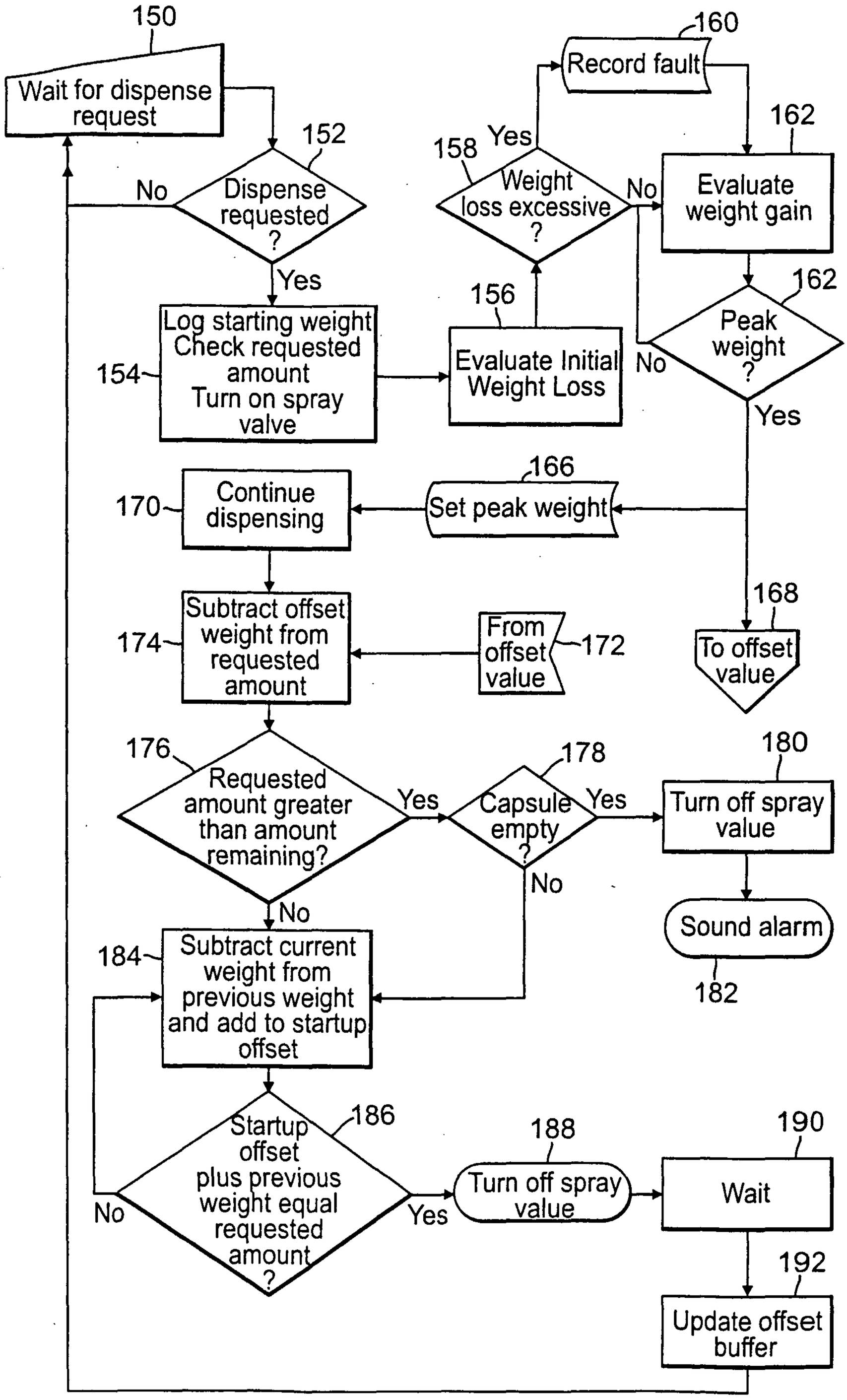

150
Wait for dispense request
152
Dispense requested ?
No
Yes
154
Log starting weight
Check requested amount
Turn on spray valve
156
Evaluate Initial Weight Loss
158
Weight loss excessive ?
Yes
No
160
Record fault
162
Evaluate weight gain
162
Peak weight ?
No
Yes
166
Set peak weight
168
To offset value
170
Continue dispensing
172
From offset value
174
Subtract offset weight from requested amount
176
Requested amount greater than amount remaining?
Yes
No
178
Capsule empty ?
Yes
No
180
Turn off spray value
Sound alarm
182
184
Subtract current weight from previous weight and add to startup offset
186
Startup offset plus previous weight equal requested amount ?
No
Yes
188
Turn off spray value
190
Wait
192
Update offset buffer

Fig. 4

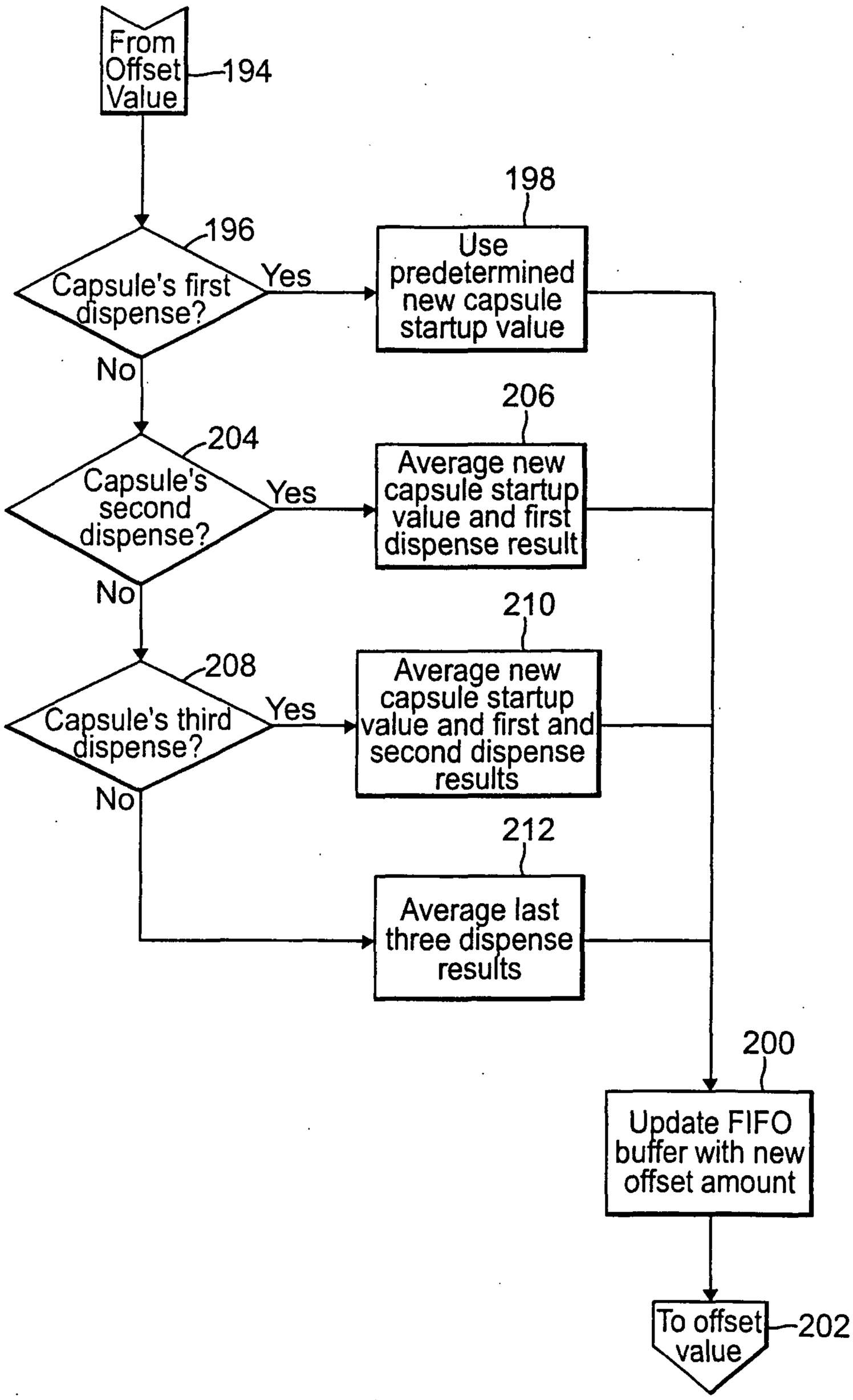

From Offset Value
194
196
Capsule's first dispense?
Yes
No
198
Use predetermined new capsule startup value
204
Capsule's second dispense?
Yes
No
206
Average new capsule startup value and first dispense result
208
Capsule's third dispense?
Yes
No
210
Average new capsule startup value and first and second dispense results
212
Average last three dispense results
200
Update FIFO buffer with new offset amount
To offset value
202

Fig. 5

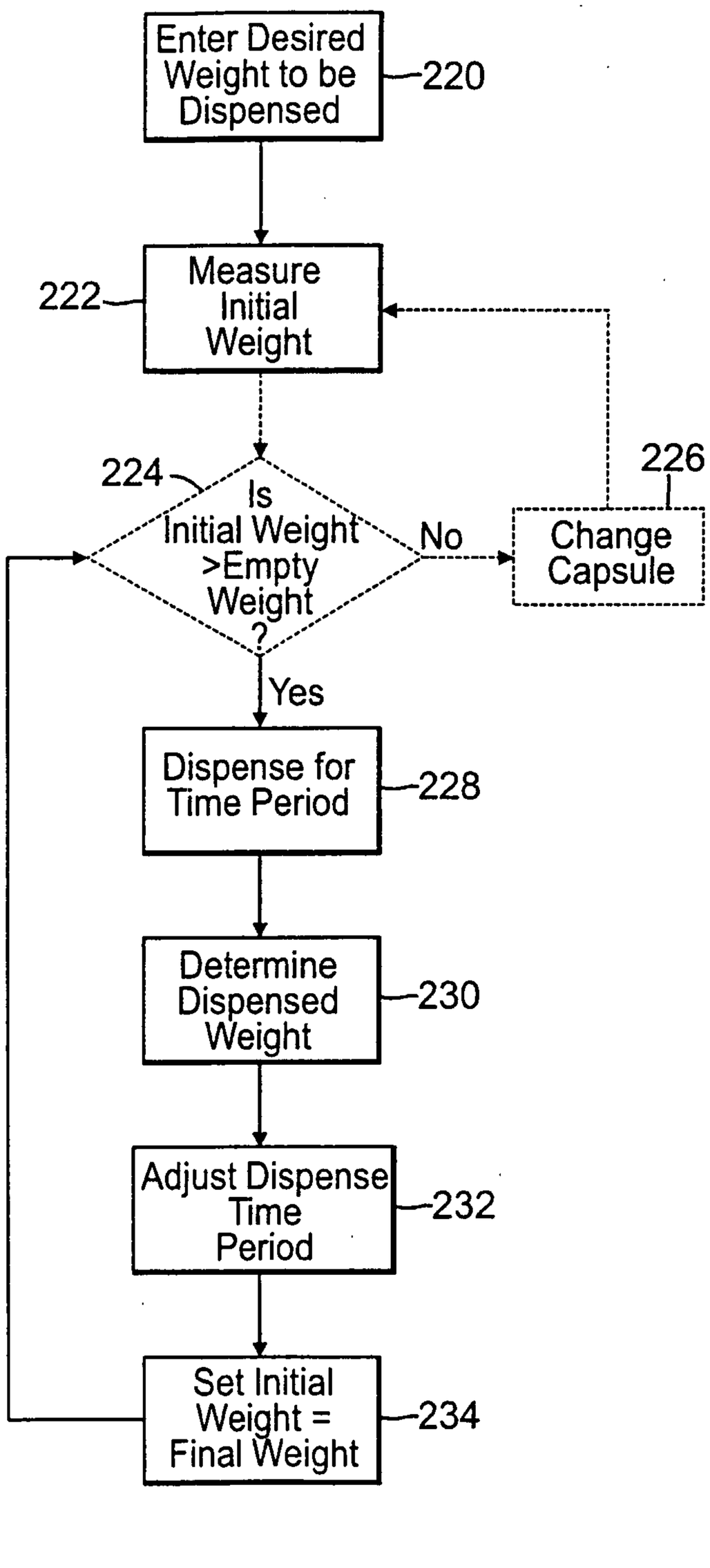

Enter Desired Weight to be Dispensed
220
Measure Initial Weight
222
224
Is Initial Weight >Empty Weight ?
No
Change Capsule
226
Yes
Dispense for Time Period
228
Determine Dispensed Weight
230
Adjust Dispense Time Period
232
Set Initial Weight = Final Weight
234

Fig. 6

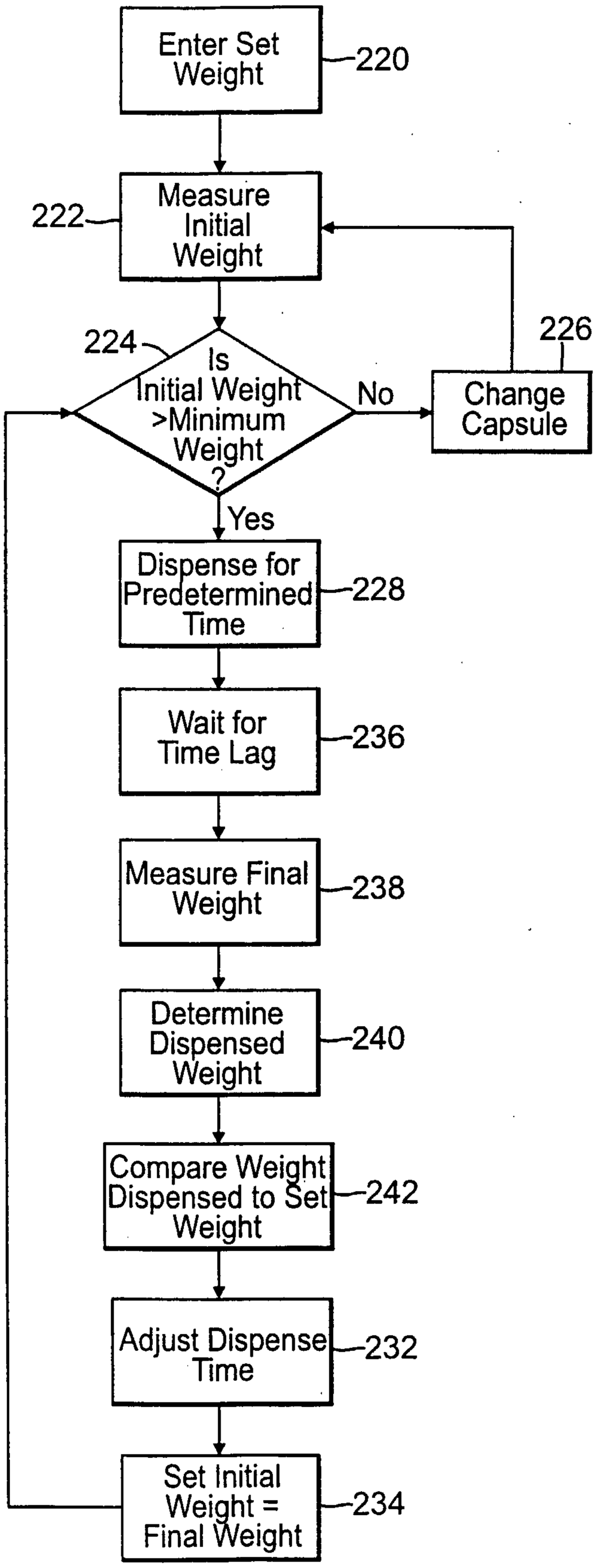

Enter Set Weight
220
Measure Initial Weight
222
224
Is Initial Weight >Minimum Weight ?
No
Change Capsule
226
Yes
Dispense for Predetermined Time
228
Wait for Time Lag
236
Measure Final Weight
238
Determine Dispensed Weight
240
Compare Weight Dispensed to Set Weight
242
Adjust Dispense Time
232
Set Initial Weight = Final Weight
234

Fig. 7

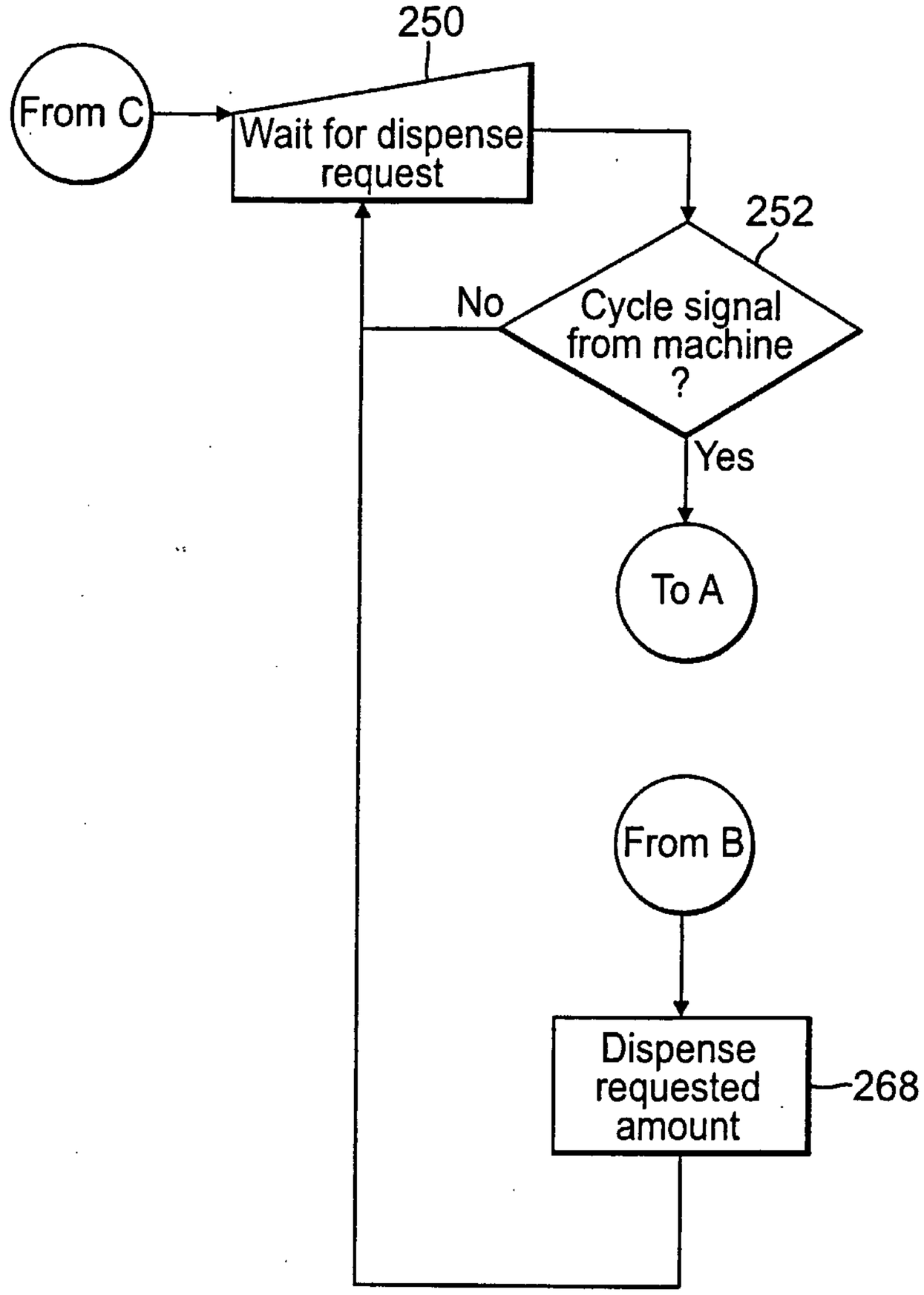

250
From C
Wait for dispense request
252
No
Cycle signal from machine ?
Yes
To A
From B
Dispense requested amount
268

Fig. 8

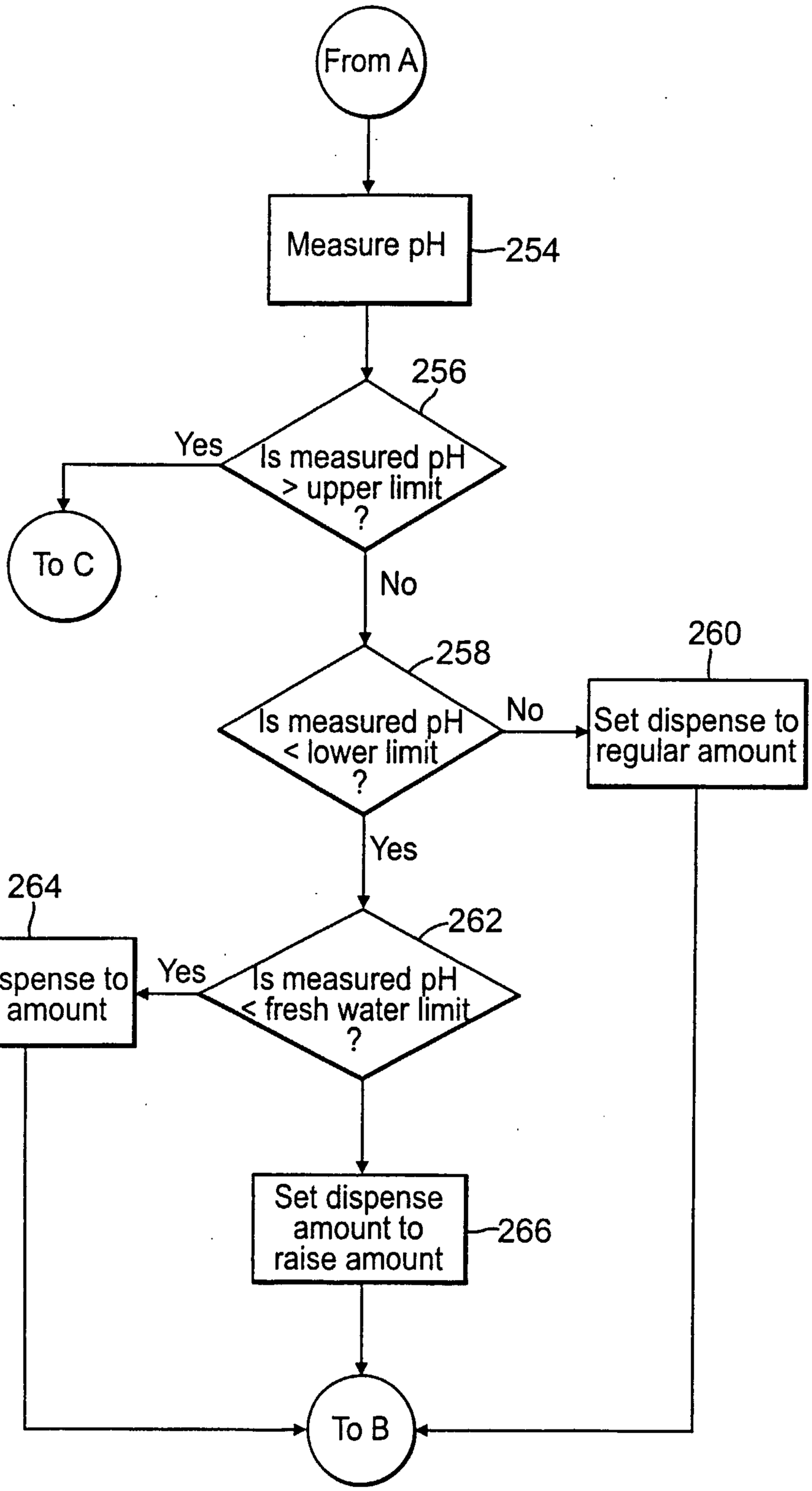

From A
Measure pH
254
256
Is measured pH > upper limit ?
Yes
To C
No
258
Is measured pH < lower limit ?
No
260
Set dispense to regular amount
Yes
262
Is measured pH < fresh water limit ?
Yes
264
Set dispense to refill amount
Set dispense amount to raise amount
266
To B

Fig. 9

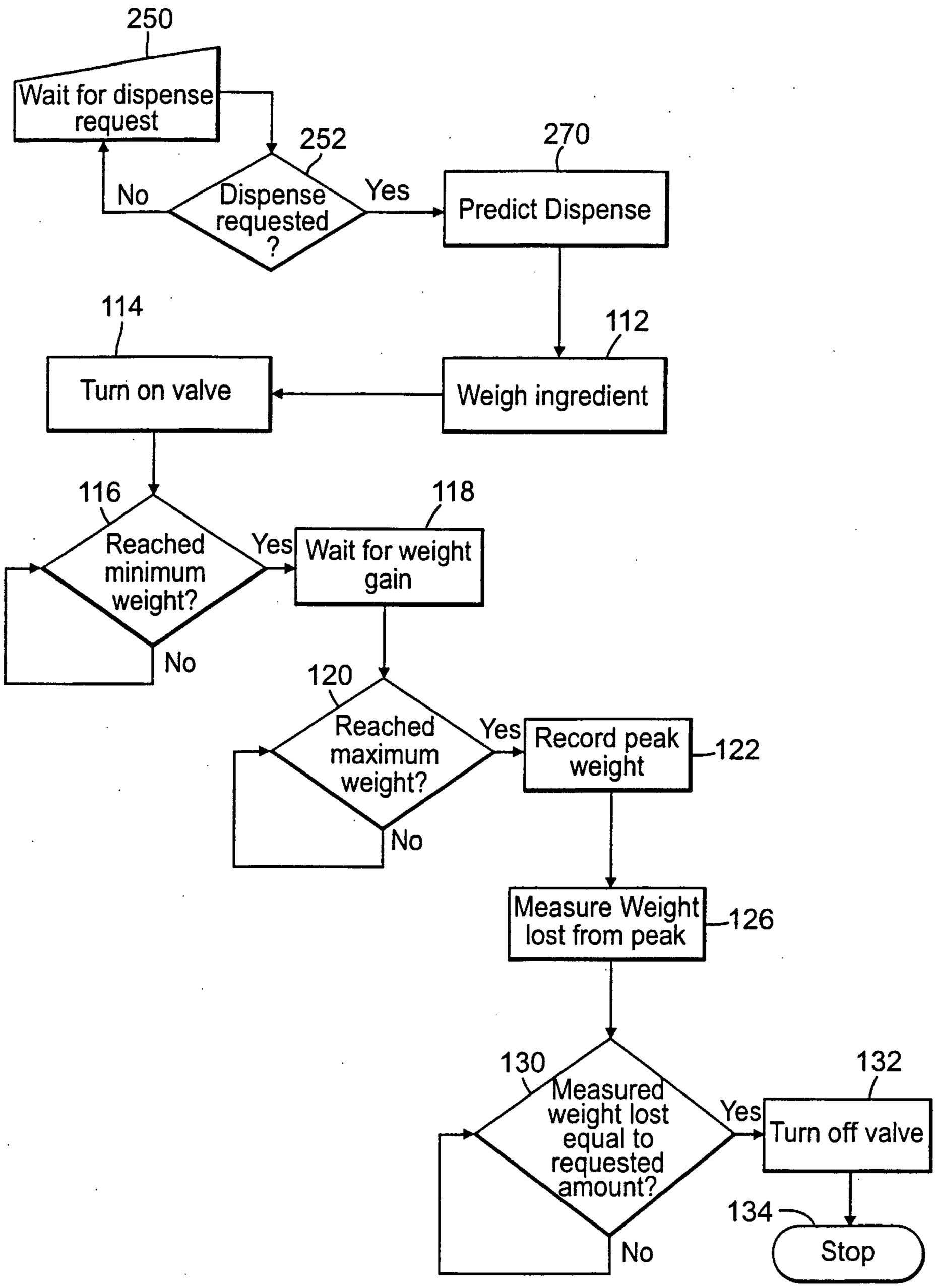
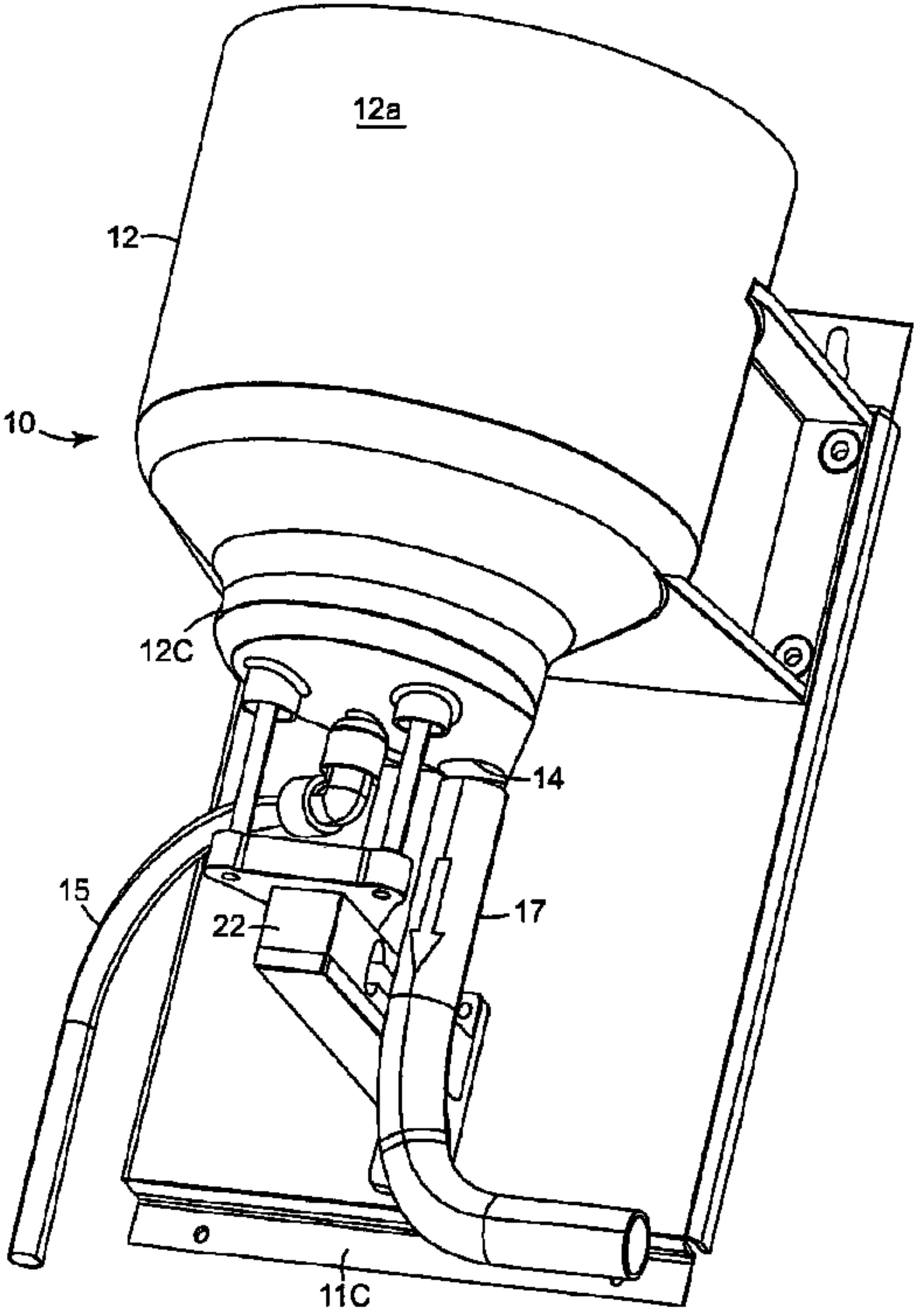

250
Wait for dispense request
252
Dispense requested ?
No
Yes
270
Predict Dispense
114
Turn on valve
112
Weigh ingredient
116
Reached minimum weight?
Yes
No
118
Wait for weight gain
120
Reached maximum weight?
Yes
No
Record peak weight
122
Measure Weight lost from peak
126
130
Measured weight lost equal to requested amount?
Yes
No
132
Turn off valve
134
Stop

Fig. 10


12a
12
10
12C
14
15
22
17
11C