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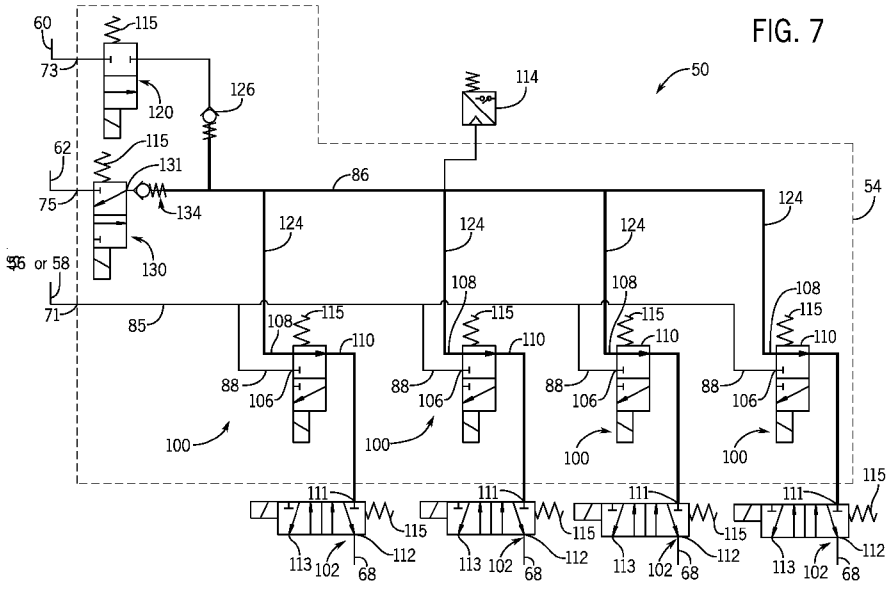
(54) Title: AUTOMATED TEAT DIP FLUID MANIFOLD

FIG. 7



(57) Abstract: A teat dip fluid manifold (50) and methods for distributing teat dip fluids, and including redundant valve sets (100, 102) and pressure monitoring (114) between valve pairs to determine valve condition.

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AUTOMATED TEAT DIP FLUID MANIFOLD

CROSS REFERENCE TO RELATED APPLICATION

This application claims the benefit of United States Provisional Application 62/581,526, filed November 3, 2017, and United States Provisional Application 62/581,514, filed November 3, 2017, the disclosures of which are incorporated by reference herein.

FIELD AND BACKGROUND OF THE INVENTION

The invention relates generally to dairy animal teat dip applicators, and more particularly to teat dip fluid manifolds that receive teat dip fluids, such as teat dips, water and air, from main supply lines and direct the teat dip fluids to individual teat dip applicators while protecting milk lines.

Dairy milking systems as they relate to the present invention include a cluster of teat cups, each of which is matched with a flexible teat cup liner that is attached to a teat of a dairy animal with a vacuum. Vacuum is applied in pulses between the shell and liner to facilitate movement of the flexible liner to milk the dairy animals. Milk flows from the dairy animal through each flexible liner and then through a milk tube to a milker unit collecting assembly, which collects milk from all of the animal's teats. This combination of elements is known as a milker unit and can be used to milk cows, sheep, goats and other dairy animals. Each milker unit is used to milk multiple animals so it must be sanitized, at least periodically, to prevent transmission of dirt and germs into the milk, and to help prevent transmission of diseases from animal to animal.

Milk from individual animals flows from each milker unit collecting assembly through milk tubes and into a milk line that receives milk from all of the milker units in the dairy. The milk is then chilled and stored in a milk tank. The milk lines and storage systems must not be contaminated with dirt, debris, chemicals, pathogens, or contaminated milk. In the event that milk being collected is from a sick dairy animal, or a monitoring system determines the milk

is unsellable, the milk would be diverted to a "bad milk" line or a "calf milk" line for feeding to calves.

Traditionally, dairy animal teats have been prepared for milking by cleaning the teats before milking using sanitizing teat dips, and protecting teats after milking by applying protective teat dips. These dips are broadly categorized as "pre-dips" and "post-dips." Before automated systems were used, the pre-dips and post-dips were applied by dairy operators manually, with cloth wipes or specialized teat dip applicators. The teat dips were effective in cleaning and protecting teats from infection, but as automated milking systems came into commercial use, automated teat dip applicators were developed to realize the full benefit of automated milking.

Various types of automated (robotic) milking systems have been developed with automated systems for applying teat dip, air, and rinsing fluids (referred to herein as "teat dip fluids") applied and rinsed from the system in a manner that protects milk lines, and the milk therein, from being contaminated. Protecting milk lines and milk is mandated in the United States Food and Drug Administration's Pasteurized Milk Ordinance ("PMO"), Item 14r., for example, as well as other regulatory agencies throughout the world.

To protect milk lines in the United States, they should be separated from potentially contaminating fluids using at least two automatically controlled valves or a double seat mixproof valve, with a drainable opening to the atmosphere between the valves or valve seats (PMO Item 14r). This arrangement is referred to as "block-bleed-block," and protects milk lines from contamination even when the valves or valve seats fail by draining fluid through the opening (bleed) rather than allowing it to pass through both valves or valve seats. Various embodiments of block-bleed-block valves and valve arrangements are known and operate effectively. See for example: U.S. Patent 8,342,125; U.S. Patent 9,510,556; and U.S. Patent 9,686,958.

Milk line protection systems can be complicated because pre-dipping and post-dipping require that teat dipping fluids be delivered in precise dosages and in a timely fashion to provide proper teat treatment, system cleaning, system timing, and milk line protection. Dosage valves for teat dips measure proper dosage quantities of teat dips and ensure that the doses are delivered under pressure and in proper sequence. Air can be used to "chase" the teat dip through the lines to overcome sluggishness due to friction in the lines and viscosity of the teat dip. Following teat dip application, the delivery system must be sufficiently cleaned and rinsed with water or other rinsing fluid, to sanitize equipment before subsequent milkings.

Further complicating teat dip delivery systems is the requirement that the teat dip, air, and rinsing fluids provided from main source lines must be accurately divided and delivered to each teat of the dairy animal. Typically, dividing dosages of teat dip fluids is performed through a teat dip fluid manifold that receives the fluids from one or more main supply lines and then divides the fluids into individual delivery lines. Given the short time durations in which teat dip must pass through the teat dip fluid manifold, providing adequate milk line protections can be challenging.

Further complicating teat dip fluid delivery systems is a desire to prevent cross-contamination of the various teat dip fluids. For example, water should not be allowed to contaminate teat dip before it is delivered to a teat because the dip can be diluted and possibly less effective. Conversely, teat dip should not be allowed to contaminate water and air lines, which could foul the system and require additional maintenance. Also, pre-dips should not be contaminated by post-dips, which could contain iodine or other antimicrobial composition that would then enter the milk lines during milking.

Thus, there is a need for a reliable teat dip fluid manifold that protects milk lines from contamination, and teat dip fluids from cross-contamination, while providing reliability and minimal maintenance.

SUMMARY OF THE INVENTION

An automated teat dip manifold in accordance with the present invention includes: an upstream fluid valve having a closed position and an open position; a galley in fluid communication with the upstream valve; a downstream valve in fluid communication with the galley, and the downstream valve has a closed position and an open position; and a pressure monitor in communication with the galley to sense galley pressure when the upstream valve is in the closed position and the downstream valve is in the closed position. The existence of galley pressure above a predetermined level is indicative of valve leakage and required maintenance. The galley may be formed in a housing, for example.

Further, the galley can be filled with air or rinsing fluids to test the pressure of these fluids by the pressure monitor. Failure to reach predetermined pressures could indicate that the source of these fluids is inadequate and in need of maintenance.

The upstream valve can be a two-position, three-way valve or a two-position, two-way valve. The upstream valve can define a vent when the upstream teat dip valve is in the closed position. This vent can be in fluid communication with other portions of the galley that can be monitored by the pressure monitor.

The upstream valve can define a vent when the upstream valve is in the closed position; and the automated teat dip fluid manifold further comprises: a check valve downstream from the vent to provide protection from cross contamination.

The automated teat dip fluid manifold can also include a pre-charge container disposed upstream from and in fluid communication with the upstream valve, and the pre-charge container defines a fluid compartment; and a pressure source to pressure feed fluid from the pre-charge container to the upstream valve and the downstream valve. The precharge vessel can be included in the galley to be monitored by the pressure monitor.

The automated teat dip fluid manifold can include a fluid drain to drain teat dip from a

precharge vessel, for example.

The galley can also define an air vent to release pressure that would otherwise inhibit flow of teat dip fluids through the manifold.

The automated teat dip fluid manifold can be dedicated to either pre-dip teat dip fluids or post-dip teat dip fluids. Other embodiments of a teat dip fluid manifold in accordance with the present invention can dispense both pre-dip teat dip fluids and post-dip teat dip fluids. In these embodiments, valves can be added to protect from cross contamination of pre-dip fluids and post-dip fluids.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a side view of a dairy animal milking unit incorporating automated teat dip fluid manifolds in accordance with the present invention;

Fig. 2 is a side view of the teat dip fluid manifolds of Fig. 1;

Fig. 3 is a perspective view of a teat dip fluid manifold in accordance with the present invention;

Fig. 4 is a front side view of the teat dip fluid manifold of Fig. 3;

Fig. 5 is a bottom side view of the teat dip fluid manifold of Fig. 3;

Fig. 6 is an end view of the teat dip fluid manifold of Fig. 3;

Fig. 7 is a schematic view of a first embodiment of a teat dip fluid manifold valve arrangement in accordance with the present invention;

Fig. 8 is a schematic view of a second embodiment of a teat dip fluid manifold valve arrangement in accordance with the present invention;

Fig. 9 is a schematic view of a third embodiment of a teat dip fluid manifold valve arrangement in accordance with the present invention;

Fig. 10 is a schematic view of a fourth embodiment of a teat dip fluid manifold valve arrangement in accordance with the present invention;

Fig. 11A through 11D are schematic views of a teat dip fluid manifold in accordance with the present invention, and each successive schematic illustrates a progression of valve positions for dispensing pre-dip teat dipping fluids;

Fig. 12A through 12D are schematic views of a teat dip fluid manifold in accordance with the present invention, and each successive schematic illustrates a progression of valve positions for dispensing post-dip teat dipping fluids;

Fig. 13A is a perspective view of a teat dip manifold in accordance with the present invention;

Fig. 13B is a front view of the teat dip manifold of Fig. 13A;

Fig. 13C is a right side view of the teat dip manifold of Fig. 13A;

Fig. 13D is a left side view of the teat dip manifold of Fig. 13A; and

Fig. 13E is a bottom side view of the teat dip manifold of Fig. 13A.

DETAILED DESCRIPTION OF THE INVENTION

Illustrated generally in Fig. 1 is an automated dairy animal milking stall unit 30 used in a dairy harvesting facility. The dairy animal milking stall unit 30 can be used in any type of dairy arrangement, including those with stationary or rotary milking stalls, and the present invention is not limited for use in the particular type of milking stall unit 30 depicted herein.

The automated dairy animal milking stall unit 30 includes: a frame 32 for mounting in or adjacent to a milking stall; a milker unit 34 mounted in the frame 32; milk lines 36 as part of the milker unit 34; milker arm controls 35 used to control movement of the milker unit 34 between a parked position (shown) and a milking position (not shown); and a teat dip fluid supply system 38. Further, the frame 32 carries a milking module 42 for determining whether to direct milk to a “good milk” path, a “bad milk” path, or a “calf milk” path, for example. Also included, is a dipping module controller 43 that is programmed to monitor and control teat dipping, rinsing, and backflushing. The milking module 42 and the dipping module 43 are in

communication with each other and coordinated by a programmable stall control 44, preferably concealed in an upper portion of the frame 32. It is preferred that all of the components described above be disposed in a single frame 32, but multiple frames or mounting systems can be used, so long as the teat dip fluid supply system 38 is in fluid communication with the milker unit 34 or at least a teat dip delivery unit for delivering pre-dip, post-dip, or both types of dip to a dairy animal's teats that will be milked using the milker unit 34.

The frame 32 can be open or enclosed or at least partially enclosed to protect the teat dip supply system 38, the milker unit control mechanism 42, and the programmable stall control 44 from the harsh dairy environment and from being damaged by dairy animals.

The milker unit 34 can be of any suitable design and preferably includes teat cups and liner combinations 46, each of which receives an animal teat for milking. Generally, milk travels from the liner through the milk lines 36 and downstream to suitable chilling and storage systems.

Preferably, the milker unit 34 also carries one or more hoses and teat dip delivery nozzles or openings to direct teat dip toward each animal teat. Also, preferably, the teat dip delivery nozzles or openings are formed in a teat cup liner, examples of such liners are disclosed in *Torgerson et al.,* U.S. Patent 8,991,335, but other types of dispensers and/or liners can be used with the present invention.

To receive teat dip fluids such as teat dip, air, and rinsing fluids from appropriate sources and delivering them to individual dairy animal teats, the present invention includes at least one teat dip fluid manifold 50, and the embodiment depicted in Figs. 1 and 2, includes a second teat dip fluid manifold 52. The first teat dip fluid manifold 50 delivers pre-dip fluids, and the second teat dip fluid manifold 52 delivers post-dip fluids. As described below, other embodiments of teat dip fluid manifolds can dispense both pre-dip fluids and post-dip fluids.

As used herein "teat dip fluids" can include teat dip for being applied before ("pre") or after ("post") milking, as well as, air to force teat dip through delivery lines, and rinsing fluids, such as water, for rinsing the teat dip fluid manifold, valves, delivery lines, and teat dip openings or nozzles. It is not necessary that all of these teat dip fluids be utilized in a single manifold 50, 52, but the present invention can be used to deliver one or more of these fluids effectively, efficiently, and reliably.

To simplify the following descriptions relating to Figs. 1 to 6, only the first teat dip fluid manifold 50 will be described in detail, as the second teat dip fluid manifold 52 can have substantially the same construction or any other construction in accordance with the present invention. The teat dip fluid manifold 50 includes a housing 54, a teat dip supply line 56, an air supply line 60, and a rinsing fluid supply line 62. Other fluids can also be supplied to the teat dip fluid manifold 50, if desired. Further, the teat dip supply inlet 56 could be divided into two teat dip inlets, so that one receives pre-dip and the other receives post-dip.

The teat dip fluids are then delivered to individual dairy animal teats through a number of delivery lines 68 (Fig. 7) that communicate from the teat dip fluid manifold 50 to a corresponding teat cup and liner combination 46.

The housing 54 preferably includes inlets 70 (Figs. 3, 4, 5), outlets 72 (Figs. 4 and 5), and control valves 76 (Figs. 3, 4, and 5, and described in more detail below). The housing inlets 70 and outlets 72 can be formed in the housing 54 using any appropriate method, and preferably include associated connectors or couplings 78 for connecting to supply lines 56, 58, 60, and 62, and delivery lines 68. Supply lines 56 and 58 can also serve as "pre-charge containers" for storing dip prior to being dispensed through the manifold 50.

The housing 54 is formed of any suitable material that can withstand the dairy environment as well as teat dips and rinsing fluids that pass through the housing 54. The housing 54 can be singular for containing most of the valve and seal components for use in

either pre-dipping or post-dipping operations as described below in relation to Fig. 10, for example, or the housing 54 can be separated into multiple housings 54 in fluid communication with one another using any suitable device such as tubes, hoses, conduits, for example, or in direct fluid communication with the individual conduits 88 (Fig. 7) in which teat dip fluids pass to the teat cup and liner combinations 46. Housing vents 79 can be provided for access to internal components during manufacturing, for example.

An electrical power source 80 is also provided for powering valves and actuators within the teat dip fluid manifold 50, and computer controls may also be directly wired to the valves or power source for controlling valve operation. Wireless controls and interfaces can also be used.

Main supplies for teat dip, air, and water are preferably disposed at a central source location for convenience in supplying a number of teat dip fluid manifolds 50. Alternatively, supplies can be disposed at various stations in the dairy harvesting facility or even at individual milking stalls. Teat dips, for example, can also be mixed on site or even as they are passing in the teat dip supply lines, 56, 58 with various ingredients, such as concentrates, water, or ingredients with short shelf lives.

Fig. 7 is a schematic illustration of a first embodiment of a teat dip fluid manifold 50 in accordance with the present invention. The teat dip supply line 56 (or 58 for a post-dip), the air supply line 60, and the rinsing fluid supply line 62 are illustrated in the upper left hand portion of the figure.

The teat dip supply line 56 connects to an inlet 71 protected by an optional mesh filter screen 71A (Fig. 6) and enters a main dip conduit 85, which is illustrated as a tube, but serves as a pre-charge container inside the housing 54, which includes branches of individual conduits 88 corresponding to each teat. Each individual conduit 88 preferably includes the same arrangement of valves, so only one set will be described. Teat dip fluid flow through each

individual conduit 88 is controlled by an upstream valve 100 and a downstream valve 102. The individual conduits 88 are part of the main dip conduit 85 and terminate at the downstream valve 102 in the illustrated example. The upstream valve 100 in this embodiment is preferably a 2 position-3 way valve. As seen in Fig. 7, each 2 position-3 way valve includes a first inlet 106, a second inlet 108, and an outlet 110. The first inlet 106 receives teat dip, and the second inlet 108 can receive other teat dip fluids such as air and rinsing fluids, as described in more detail below.

The quantity of teat dip supplied to the teat dip fluid manifold 50 can be determined at an upstream location via a suitable dosage valve or it can be provided at a suitable back pressure, so that the upstream valve 100 can be opened for a predetermined interval to provide a desired quantity of teat dip while the upstream valve 100 is open.

Each downstream valve 102 is preferably a safety valve to provide added protection for milk lines in the dairy, but other types of valves can be used as well. The example of a downstream valve 102 illustrated is a safety valve and includes an inlet 111, an outlet 112, and a vent 113 disposed between the inlet 111 and the outlet 113 to create a block-bleed-bock arrangement.

The upstream valve 100 and the downstream valve 102 provide redundancy in protecting the milk lines from contamination from teat dip fluids. To add further protection, a galley 86 is provided from an air check valve 126 and a rinse fluid check valve 134, into and including individual conduits 124 extending to the downstream valve 102. Included in this example of the galley 86, is the passage through the upstream valve 100 from the second inlet 108 to the outlet 110. The galley 86 is monitored for pressure by a pressure monitor 114, which in conjunction with a controller 43, monitors pressure in the galley 86 when the upstream valve 100 is closed to teat dip at inlet 106, and the downstream safety valve 102 is closed to all fluids, except at the vent 113.

The individual conduits 124 of the galley 86 extend through the upstream valve vent 108 down to the downstream valve 102. The positions of the upstream valve 100 and the downstream valve 102 are controlled by actuators 115 of any desired type including the solenoid valves illustrated in the figures. If the pressure rises or falls outside of a predetermined range, the pressure monitor 114 generates an appropriate signal that can send an alarm or other notice to a controller or a dairy operator indicating the abnormality. In such a case, the milking stall unit 30 can be taken out of service or the milk can be directed to a "bad milk" line, for example.

When the upstream valve 100 and the downstream valve 102 are both closed as described below, pressure inside the galley 86 can rise or fall if one of the valves is leaking. Even small or subtle leakage can be detected and indicate that valve maintenance is required. Of course, more catastrophic valve failures can be detected and the pressure monitor's 114 signal can send data to the controllers 43 and/or 44 to deactivate all or any portions of the teat dip delivery systems or even the automated dairy milking stall unit 30 itself. Preferably, the pressure monitor 114 senses pressures of about 15 psi, but any desirable pressure range can be selected.

The pressure monitor 114 is preferably a pressure switch that flips when it senses a certain pressure. Also preferably, the pressure switch is adjustable. Pressure sensors can also be used that monitor pressures at varying levels and rates.

This arrangement of a galley 86 and a pressure monitor 114 can monitor for valve leakage as described above, but it can also be used to check for unsatisfactory air or rinsing fluid supplies. This procedure preferably takes place when there is no milking operation occurring. The downstream valve 102 is closed and air or rinsing fluid are introduced into the galley 86 through their respective valves 120 or 130. If the air pressure or rinsing fluid pressure is insufficient to reach a pressure at which the pressure monitor 114 is set, then this is an

indication that supply pumps or anything affecting fluid pressures require attention. The failure of air or rinsing fluid pressure to meet predetermined standards can raise an alarm or even be used by the controller 44 to cease operations at that milking stall unit 30 or cause milk obtained at that stall unit 30 to be redirected to a "bad milk" line, for example.

The air supply line 60 connects to the housing 54 at a port 73, and only requires controlling with an air valve 120, which is preferably, a 2 position-2 way pneumatic valve that is in fluid communication with the individual air conduits 124, which each communicate with a corresponding upstream valve 100. To prevent cross-contamination of the air supply line 60 by other teat dipping fluids, an air check valve 126 is provided downstream from the air valve 120. Air (or any other suitable gas or gas mixture) provided to the teat dip fluid manifold 50 is preferably delivered immediately after a teat dip is sent from the teat dip fluid manifold 50. The air provides a back pressure to force ("chase") the teat dip through delivery lines to ensure delivery of a complete dose of teat dip, as well as a timely delivery of teat dip in the precisely-timed operation of an automated dairy-milking system. A port mesh filter 73A is preferably used to prevent debris from entering.

Next, a rinsing fluid, such as water, can be delivered through a port 75 (with a preferred mesh filter 75A) from the rinsing fluid supply line 62 through a rinsing fluid valve 130, which is preferably a 2 position-3 way hydraulic valve to provide a block-bleed-block arrangement between the rinsing fluid supply line 62 and the rest of the teat dip fluid manifold 50 using a vent 131. The rinsing fluid valve 130 preferably shares the individual air conduits 124 to delivery rinsing fluid through the rest of the teat dip fluid manifold 50 and the delivery lines 68. Nonetheless, separate individual rinsing fluid conduits could be used. Preferably, a rinsing fluid check valve 134 is provided downstream from the rinsing fluid valve 130 to prevent teat dip or air from cross-contaminating the rinsing fluid supply line 62.

In the embodiment of Fig. 7, when teat dipping is required, the controller 43 activates the upstream valve 100 inlet 106 to open and the downstream safety valves 102 to open to allow pressurized teat dip to flow from the teat dip supply 56, 58 through the conduits 88 and to the delivery lines 68. When a desired amount of teat dip has passed through the upstream valve 100, as determined by the period of time in which the upstream valve 100 is open for teat dip flow, the upstream valve 100 will be actuated to close to stop the teat dip supply 56, 58.

The upstream valve 100 inlet 108 will then be opened to the individual conduits 124 and the air valve 120 will be activated to open to supply pressurized air (or other gas) through each individual conduit 124, the upstream valves 100, the downstream valves 102 (which remain open from teat dip flow or are re-opened), and into the delivery lines 68 to "chase" the teat dip through the delivery lines 68 to the teats.

Once a desired amount of air is released, the air valve 120 closes, and the rinsing fluid valve 130 is activated to open to release rinsing fluid through the same path as the air traveled until a desired quantity of rinsing fluid has entered the system. Another activation of the air valve 120 could be used to "chase" the rinsing fluid through the system, if desired.

Once rinsing is complete, the rinsing fluid valve 130 and the air valve 120 are activated to be closed and the upstream valve 100 and the downstream safety valve 102 are activated to be closed. In this valve configuration, the teat dip fluid manifold 50 is in essentially a milking position because none of the teat dip fluids can reach the milk lines.

Further, in this milking position, the pressure monitor 114 monitors pressure levels in the galley 86 (heavy lines in Fig. 7), which includes individual conduits 124 and, as described above, generates data and/or warning signals if line pressure is outside of a desired or predetermined range, which might indicate that valve maintenance and/or replacement is necessary.

Figs. 13A through 13E illustrate a teat dip manifold substantially as illustrated in Figs. 3 through 7, except that many of the conduits are formed from tubes that are part of the housing 54. The teat dip fluid manifold 50 is depicted, (a second teat dip fluid manifold 52 would be substantially identical and can be used if separate manifolds were used for pre-and post-dips), including a housing 54 defining a teat dip inlet 71, an air inlet 73, a rinsing fluid inlet 75, which feed into the housing 54 conduits to a respective outlet 72, which in turn is connected to a delivery line 68.

Flow through the air inlet 73 is controlled by an air valve 120, and rinse fluid through the rinse fluid inlet 75 is controlled by a rinse fluid valve 130. Both air and rinse fluid flow through the galley 86 and the individual conduits 124 illustrated in Fig. 7, for example. Flow through each of the individual conduits 124 is controlled by an upstream valve 100 and a downstream valve 102.

A pressure monitor 114 is used to monitor pressure in the galley 86 and the individual conduits 124, and will send an appropriate signal to a controller, as described above, in the event pressure in the galley 86 is outside of a predetermined range. Such a signal would indicate the need for valve or system maintenance.

In this embodiment, the housing 54 can in the form of a frame and include a hanger feature 109 with hooks 111 for attaching to corresponding receivers in a mounting panel, such as seen in Figs. 1 and 2.

In another embodiment illustrated in Fig. 8, a single teat dip fluid manifold 250 receives both pre-dip and post-dip, as well as air and rinsing fluid. In this embodiment, pre-dip teat dip is provided through the teat dip supply line 56, through a pre-dip valve 200, which is preferably a 2 position-2 way valve, but other valves could be used. Downstream from the pre-dip valve 200, is a pre-dip check valve 202 to prevent the pre-dip teat dip supply line 56 from being

cross-contaminated by post-dip teat dip, rinsing fluids, and air. Pressurized teat dip is sufficient to open the check valve 202.

The pre-dip teat dip supply line 56 is in fluid communication with the galley 86 (bold lines) before splitting into the individual conduits 124. Each individual conduit 124 is provided with a pre-charging vessel 208 to provide a premeasured dose of teat dip immediately upstream of a set of teat dip fluid manifold valves described below. This arrangement provides an immediate and accurately measured dose of teat dip or other teat dip fluid for delivery to a dairy animal teat or for rinsing the teat dip fluid manifold 250 and the delivery lines 68. Preferably, the pre-charging vessel 208 is sized to receive and store a pressurized volume of between four and eight milliliters (ml) of teat dip fluid, but other volumes or masses can be measured or metered to provide a desired quantity of teat dip.

Downstream from the pre-charging vessel 208 is a drain valve 214 and a downstream valve 216. The drain valve 214 is preferably a 2-position-2 way valve with a drain 218, so that teat dip can be drained from the related pre-charging vessel 208 in the event it is not needed for any reason. For example, all of the charging vessels 208 must be changed simultaneously. If one of the teats is re-dipped for some reason and only one vessel 208 is emptied for that re-dipping, then the other vessels 208 must be emptied through the drain valves 214. Although slightly wasteful, it provides a reliable means for re-dipping one or more teats, if necessary.

Each downstream safety valve 216 is preferably a suitable safety valve providing a block-bleed-block arrangement or a "block-monitor-block" arrangement as disclosed in patent application serial number 62/581,514 entitled "Automated Milking System Safety Valve Arrangement," filed on November 3, 2017, and naming inventors Matthew J. Stuessel, Wolfgang Schulze-Wilmert, and Thomas Orban, which is incorporated herein by reference.

A post-dip dip supply 58 is controlled by a post-dip valve 226 arranged in series with the air supply line 60 and the rinsing fluid supply line 62. Preferably, the post-dip valve is a 2-

position-3 way valve for receiving post-dip, as well as, air and rinsing fluid through a separate valve inlet 228. Of course, other valve configurations can be used.

The air supply line 60 is controlled by an air valve 230, and the rinsing fluid supply line 62 is controlled by a rinsing fluid valve 232, each of which is preferably a 2-position-2 way valve. An air check valve 236 is provided downstream from the air valve 230 to prevent cross-contamination by teat dip and rinsing fluid.

To further isolate the post-dipping teat dip supply line 58 in the teat dip fluid manifold 50, a safety valve 240 is disposed downstream from the post-dip valve 226. This safety valve 240 can be any desired configuration, including a block-bleed-block or a block-monitor-block, as mentioned above.

Finally, the schematic Fig. 8 illustrates a vent valve 244 in the upper right portion that includes an air vent 246 for releasing pressure from the galley 86 while other fluids are entering. Venting the galley 86 lowers galley pressure to enable easier ingress of teat dip fluids into the manifold 50, 52. The galley 86 can be simply vented to atmosphere, or a vacuum could be applied to evacuate the galley 86 and even draw in teat dipping fluids, if desired.

As seen in Fig. 8, air and rinsing fluid are supplied in series to the post-dip valve 226 and pass through the post-dip valve 226 when that valve is activated to open to the water and air line 235. This arrangement is efficient in terms of operation and space conservation.

Generally, when a milking operation is taking place, all of the valves are in closed positions, and an air pressure monitor 114 senses pressure in the galley 86, including the portions between the pre-charging vessel 208 and the downstream valve 216 for the purposes described above.

Before the milking operation, the pre-dip valve 200 is activated and pre-dip passes through the check valve 202 and the galley 86, and then is divided into each of the individual conduits 124 of the galley 86 to charge the pre-charging vessels 208. When pre-dip is desired,

the downstream valve 216 opens and back pressure and air from the air valve 230 urge the pre-dip to pass through the delivery lines 68 to a teat cup and liner combination 46. Should all or a portion of the pre-dip fail to reach the teat cup and liner combination 46, the dip valves 200 or 226 can be activated to refill all of the pre-charging vessels 208, and only the teat or teats that did not receive dip can be re-dipped. Afterward, the pre-charging vessels 208 having unused teat dip therein can be dumped through a corresponding drain valve 214, so that all of the charging vessels 208 can receive the next teat dip fluid.

Subsequent to the pre-dip being passed through the manifold 250, an air "chase" passes through the air valve 230, the air check valve 236, the air line 235, the post-dip valve 226, the safety valve 240, the galley 86, and the rest of the path described above for the pre-dip.

Rinsing fluid can then be used, if desired, so that the rinsing fluid valve 232 will be activated to open and allow pressurized rinsing fluid to follow the same path as the "chase" air traveled, as described above.

Before milking is completed, post-dip can be released through an activated post-dip valve 226 and the valve 240, through the galley 86 and into the pre-charge vessels 208. This part of the process preferably can take place during milking or immediately following milking, but before the teat cup and liner combination 46 is detached from the dairy animal.

After milking and before detachment, the downstream safety valve 216 is activated to open and permit the post-dip to flow toward the teat cup and liner combination 46. Chase air and optional rinsing fluid can follow, as described above. Again, if post-dip fails to complete the delivery path, another dose can be provided, as described above in relation to the pre-dip teat dip.

A third embodiment is illustrated in Fig. 9, is similar to the second embodiment of Fig. 8, because it includes a manifold 350 with a similar arrangement of a pre-dip valve 300, and a pre-dip check valve 302.

One benefit of this embodiment is that the pre-charging vessel 308 can be refilled if for some reason it fails to fill completely, or the teat dip is delivered at a time when a teat is not located in a corresponding teat cup and liner combination 46. This refiling capability is less wasteful of teat dip compared to the Fig. 9 embodiment, but requires more valves. The ability to refill individual (versus all) charging vessels 308 results from the use of an upstream valve 314, and a second upstream valve 320 having an air vent 346, which vents the pre-charging vessel 308 and related lines to allow the pre-charging vessel 308 to be re-charged and applied to an animal teat: This process can be performed manually or automatically based on other sensors or observation made downstream from the manifold 350.

Downstream from the pre-charging vessel 308, is a downstream valve 316, which is preferably a safety valve such as a 2 position-5 way valve or a block-monitor-block valve.

In addition, as described above in relation to the second embodiment of Fig. 8, is a post-dip valve 326, an air valve 330, an air check valve 336, a rinsing fluid valve 332, and a safety valve 340, which all operate as described above.

The Fig. 9 embodiment wastes less teat dip, but requires more valves and results in the galley 86 not extending all the way to the downstream valves 316.

In Fig. 10, a fourth embodiment is depicted, which is similar to the Fig. 7 embodiment, except that the teat dip fluid manifold 450 includes elements for dispensing both pre-dip teat dip fluids and post-dip teat dip fluids through a single housing 54. A pre-dipping portion 396 and a post-dipping portion 398 are provided, and they are both in communication with a single air supply line 60 and a single rinsing fluid supply line 62.

The pre-dipping portion 396 and the post-dipping portion 398 each include a galley 486 with individual conduits 488. In each individual conduit 488 there is an upstream valve 400 and a downstream valve 402. The upstream valves 400 are preferably 2 position- 3 way valves for receiving teat dip through one inlet, and air and rinsing fluid through another inlet.

The other features of the first embodiment (Fig. 7) are also present, including: a pre-dip supply line 56; a post-dip supply line 58; an air supply line 60; a rinsing fluid supply line 62; an air valve 420; an air check valve 426; a rinsing fluid valve 430; and a rinsing fluid check valve 434. In addition, a pre-dip/post-dip selection valve 477 is provided to direct air and rinsing fluid to the pre-dip portion 396, when pre-dipping or to the post-dip portion 398, when post-dipping. A simple 2 position-2 way valve can be used for the selection valve 477. Again, actuators and valve position sensors are used in relation to any or all of the valves described above.

The individual conduits 488 of the pre-dip portion 396 are protected from cross-contamination from the post-dip portion 398, by a check valve 440 and the opposite is true because of the check valve 444. Other types of protective valves could be used as well to prevent cross contamination.

In this embodiment, a pressure sensor 414 is in fluid communication with each galley 486 to detect abnormal pressures in each galley 486, which could indicate leakage in any of the various valves, as described above.

Figs. 11A to 11D illustrate a progression of valve positions that dispense pre-dip teat dipping fluids through a manifold 50, in accordance with the present invention. In Fig. 11A, the "good milk state", the upstream valves are closed and the downstream valves 102 (not illustrated in these figures) are also closed. The air valve 120 and rinsing fluid valve 130 are also closed. The galley 86, including the individual conduits 124 is monitored by the pressure monitor 114 for leaks. The individual conduits 124 are in communication with the rest of the galley 86 because the second inlet 108 and the outlet 110 in the upstream valve 100 are open to one another. (see: Fig. 7, for example.)

Fig. 11B illustrates the next step, "pre-cleaning," taking place by releasing rinsing fluid into the manifold 50. In this configuration, the rinsing fluid vent 131 is closed and the rinsing

fluid valve 130 is opened to permit rinsing fluid to pass through the rinsing fluid check valve 134 and into the galley 86, including the conduits 124. The pressure monitor 114 can be used to check adequacy of the rinsing fluid supply, if desired.

Fig. 11C illustrates the next step, "pre-dipping," during which the air valve 120 and the rinsing fluid valve 130 are closed. Pre-dip is provided through the pre-dip line 85, and in the illustrated example, only the first upstream valve 100 and its corresponding downstream valve 102 are opened, and only an associated teat will receive pre-dip. This can occur while the other teats are being connected to the milking unit 34. Therefore, the other upstream valves 100 remain closed until the other teats are attached.

Fig. 11D illustrates the "dip chase" step in which the upstream valves 100 are closed, but air and then rinsing fluid are allowed via the air valve 120 and the rinsing fluid valve 130, respectively, to enter the galley 86 and pass through the upstream valve inlet 108 to 110 and through the downstream valves (again, not illustrated in this figure) and through the remaining flow path.

Figs. 12A to 12D illustrate a progression of valve positions that dispense post-dip teat dipping fluids through a manifold 50, in accordance with the present invention. In Fig. 12A, the "good milk state", the upstream valves are closed and the downstream valves 102 (not illustrated in these figures) are also closed. The air valve 120 and rinsing fluid valve 130 are also closed. The galley 86, including the individual conduits 124 is monitored by the pressure monitor 114 for leaks. The individual conduits 124 are in communication with the rest of the galley 86 because the second inlet 108 and the outlet 110 in the upstream valve 100 are open to one another.

Fig. 12B illustrates the next step, "post-dipping," during which the air valve 120 and the rinsing fluid valve 130 are closed. Post-dip is provided through the post-dip line 85, and in

the illustrated example, only the upstream valve 100 and its corresponding downstream valve 102 are opened, and only an associated teat will receive post-dip.

Fig. 12C illustrates the "dip chase" step in which the upstream valves 100 are closed, but air and then rinsing fluid are allowed via the air valve 120 and the rinsing fluid valve 130, respectively, to enter the galley 86 and pass through the upstream valve inlet 108 to 110 and through the downstream valves (again, not illustrated in this figure) and through the remaining flow path.

Fig. 12D illustrates the next step, "backflushing," taking place by releasing rinsing fluid into the manifold 50. In this configuration, the rinsing fluid vent 131 is closed and the rinsing fluid valve 130 is opened to permit rinsing fluid to pass through the rinsing fluid check valve 134 and into the galley 86, including the conduits 124. The pressure monitor 114 can be used to check adequacy of the rinsing fluid supply, if desired.

The foregoing detailed description of drawings is provided for clearness of understanding only, and no unnecessary limitations therefrom should be read into the following claims. For example, valve types can be replaced with other valve types, or mixed rather than using a single valve type in the manifold. The valves also need not all be located in the same housing or in any housing because they can be mounted in any desirable way. The manifolds can also be mounted at any suitable location in the dairy or dairy unit to facilitate efficiency and access for maintenance.

CLAIMS

1. An automated teat dip manifold comprising:

an upstream valve having a closed position and an open position;

a teat dip fluid galley in fluid communication with the upstream valve;

a downstream valve in fluid communication with the galley, and the downstream valve has a closed position and an open position; and

a pressure monitor in communication with the galley to sense conduit pressure when the upstream valve is in the closed position and the downstream valve is in the closed position.

2. The automated teat dip manifold of claim 1, wherein the upstream valve is a two-position, three-way valve.

3. The automated teat dip manifold of claim 1, wherein the upstream valve is a two-position, two-way valve.

4. The automated teat dip manifold of claim 1, wherein the upstream valve defines a vent when the upstream teat dip valve is in the closed position.

5. The automated teat dip manifold of claim 1, wherein the upstream valve defines a vent when the upstream teat dip valve is in the closed position; and

the automated teat dip manifold further comprises:

a block valve downstream from the vent.

6. The automated teat dip manifold of claim 1, wherein the upstream valve defines a vent when the upstream valve is in the closed position; and

the automated teat dip manifold further comprises:

a check valve in fluid communication with the vent.

7. The automated teat dip manifold of claim 1, and further comprising:

a pre-charge container disposed upstream from and in fluid communication with the upstream valve, and the pre-charge container defines a fluid compartment.

8. The automated teat dip manifold of claim 1, and further comprising:

a fluid drain in communication with the teat dip fluid galley.

9. The automated teat dip manifold of claim 1, wherein the teat dip fluid galley defines an air vent.

10. The automated teat dip manifold of claim 1, and further comprising:

a second upstream valve in fluid communication with the upstream valve.

11. The automated teat dip manifold of claim 1, and further comprising:

a second upstream valve in communication with the teat dip fluid galley, and not in fluid communication with the upstream valve.

12. The automated teat dip manifold of claim 1, wherein the pressure monitor is a pressure switch.

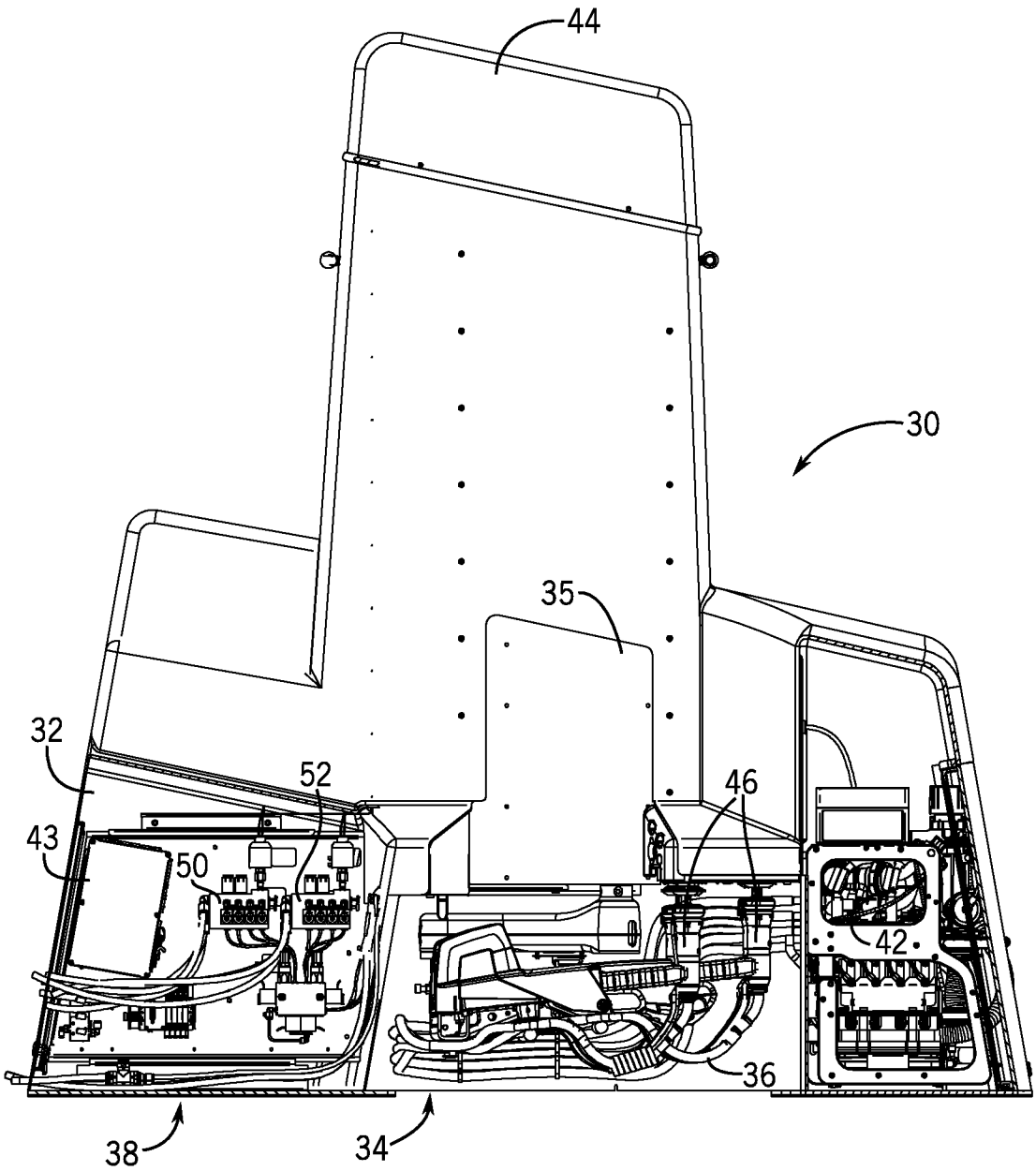


FIG. 1

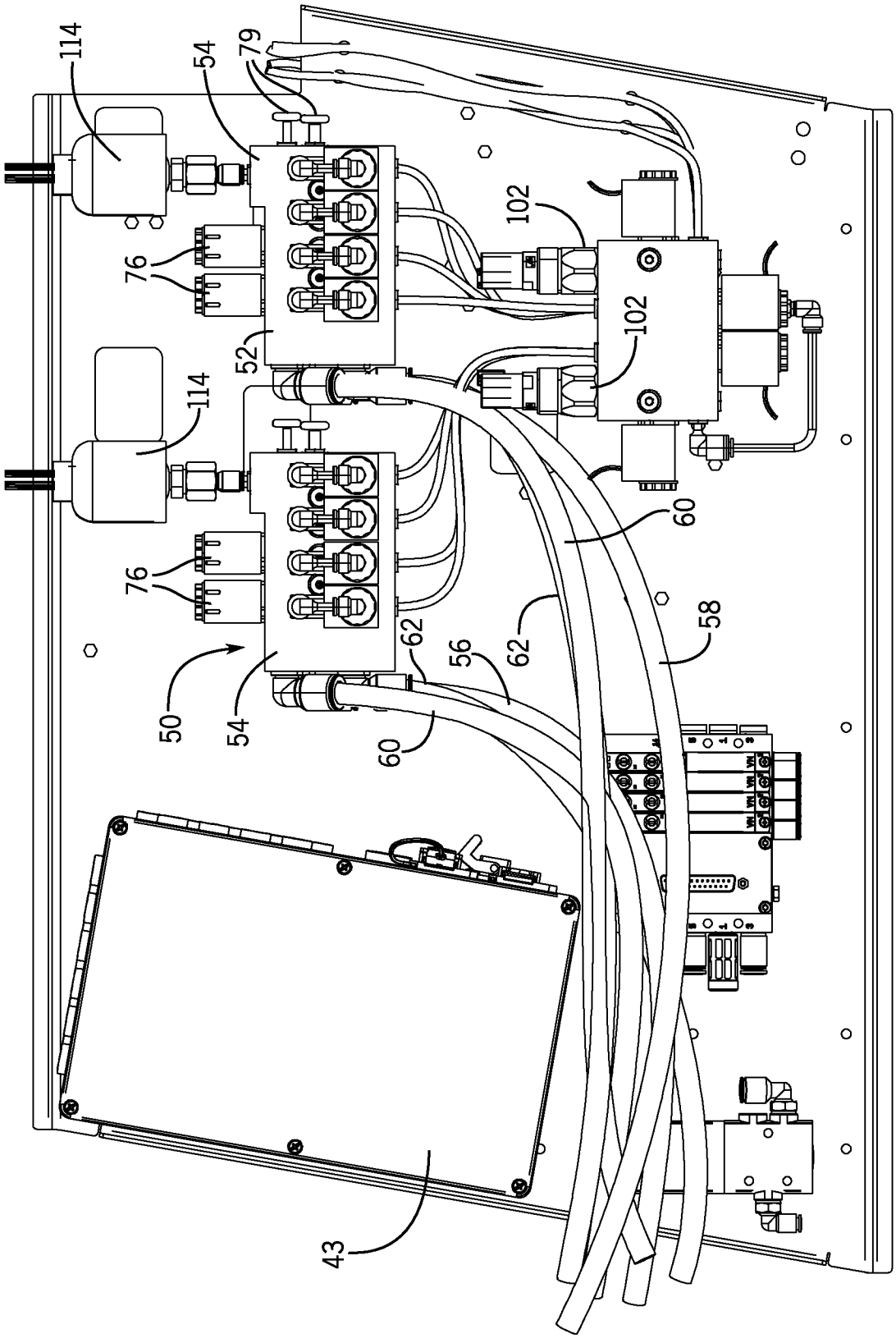
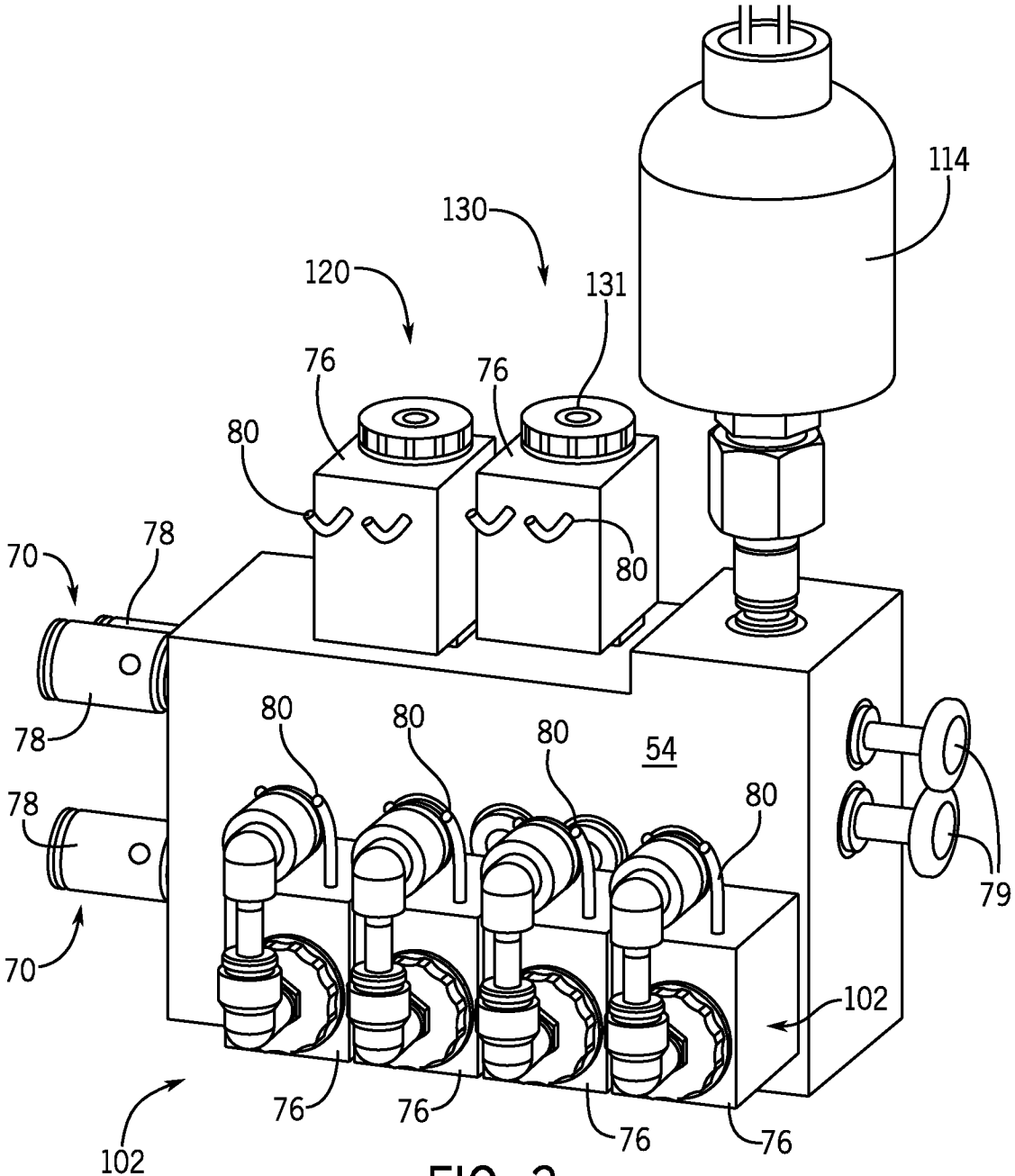


FIG. 2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130
120
131
76
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102
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102

FIG. 3

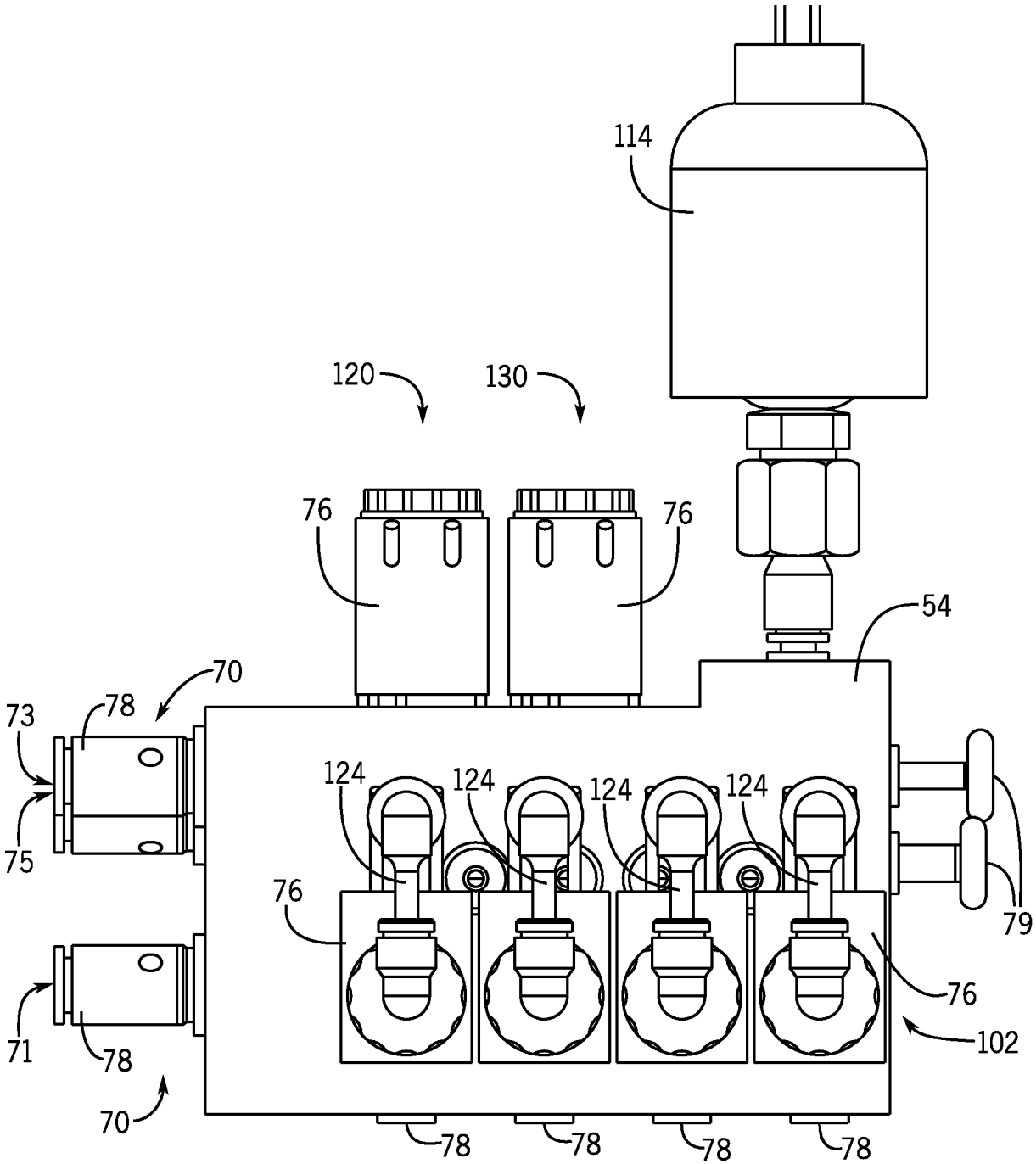
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FIG. 4

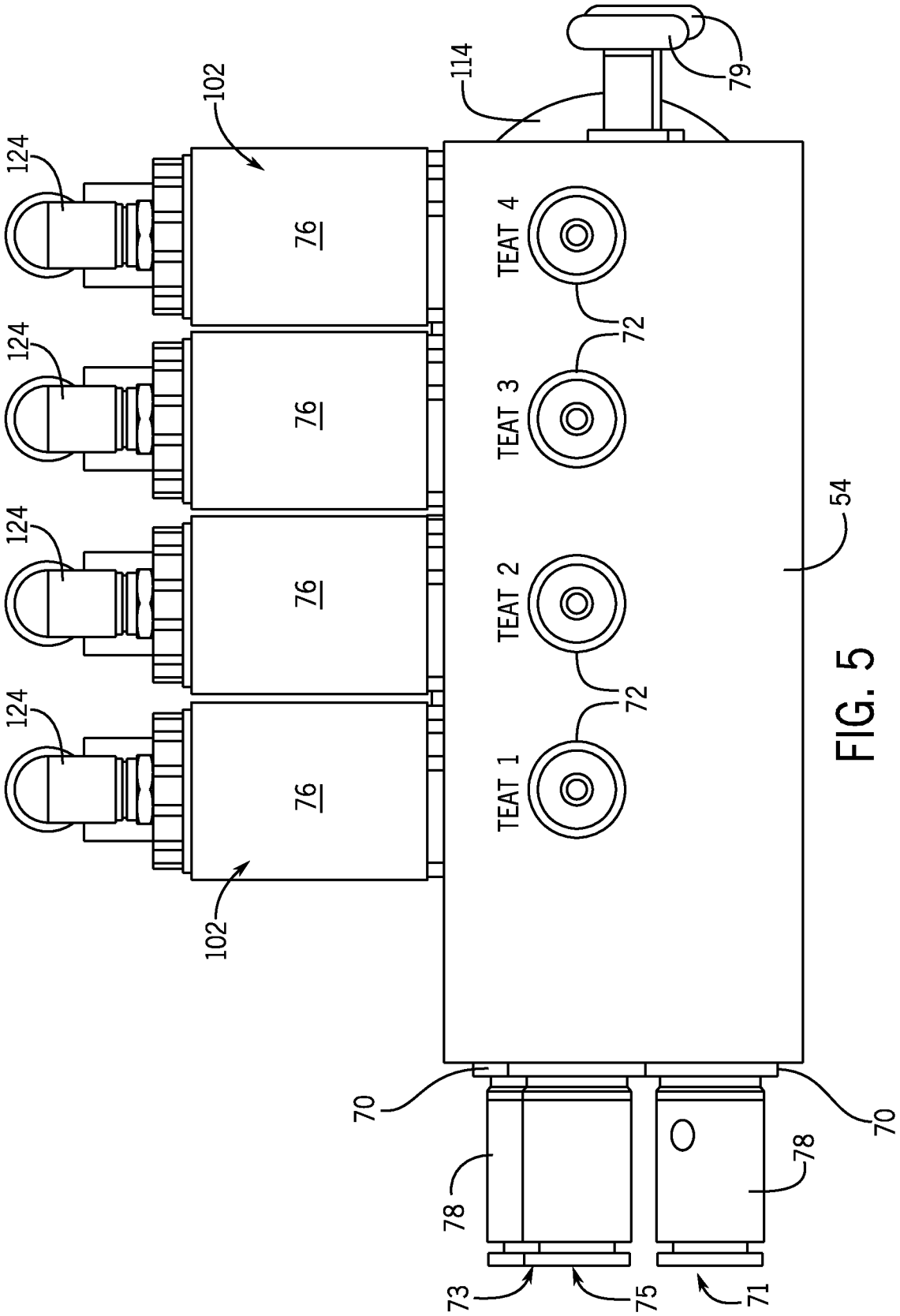
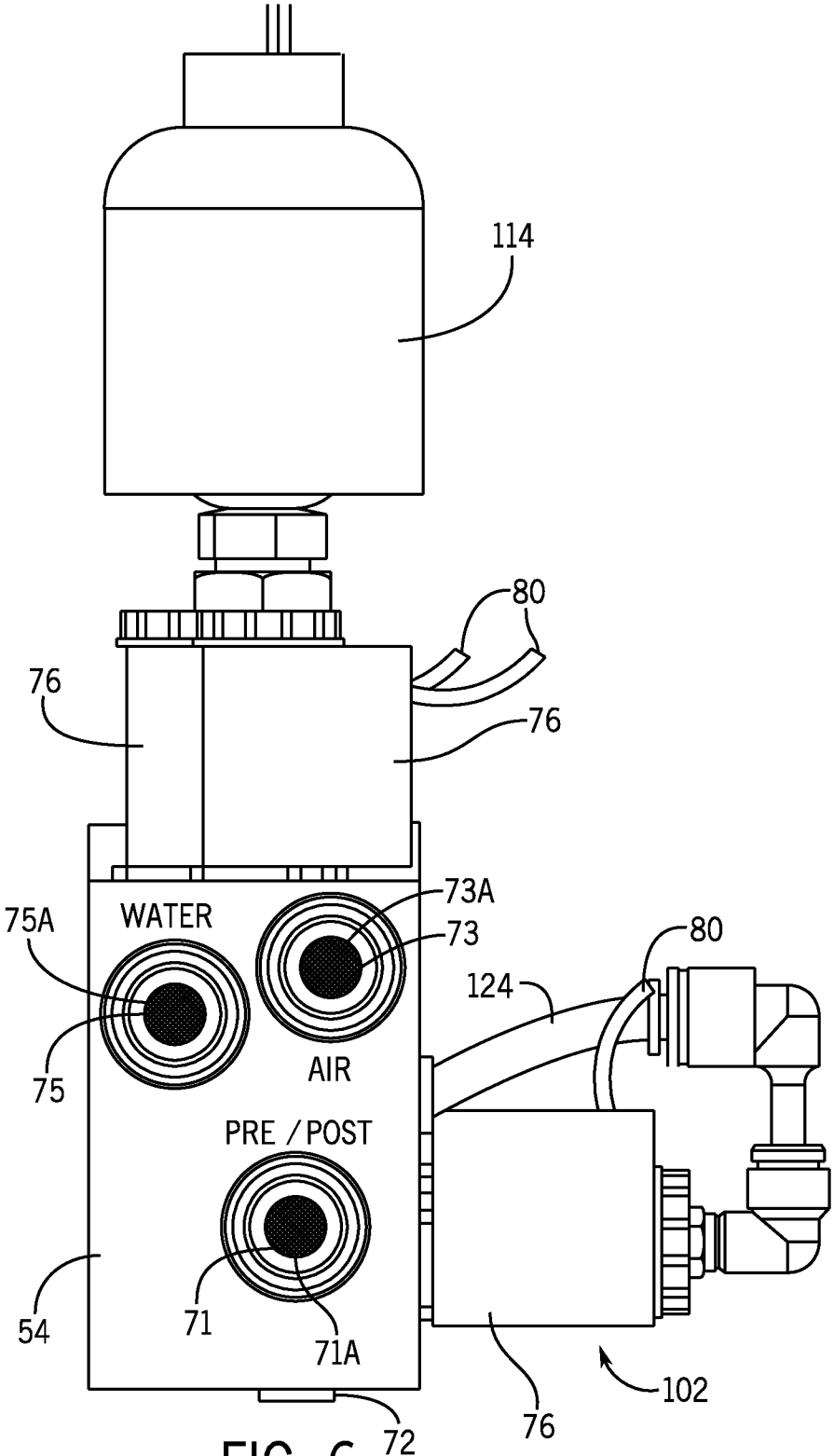


FIG. 5


114
80
76
76
WATER
75A
73A
73
80
124
75
AIR
PRE / POST
71
71A
54
102
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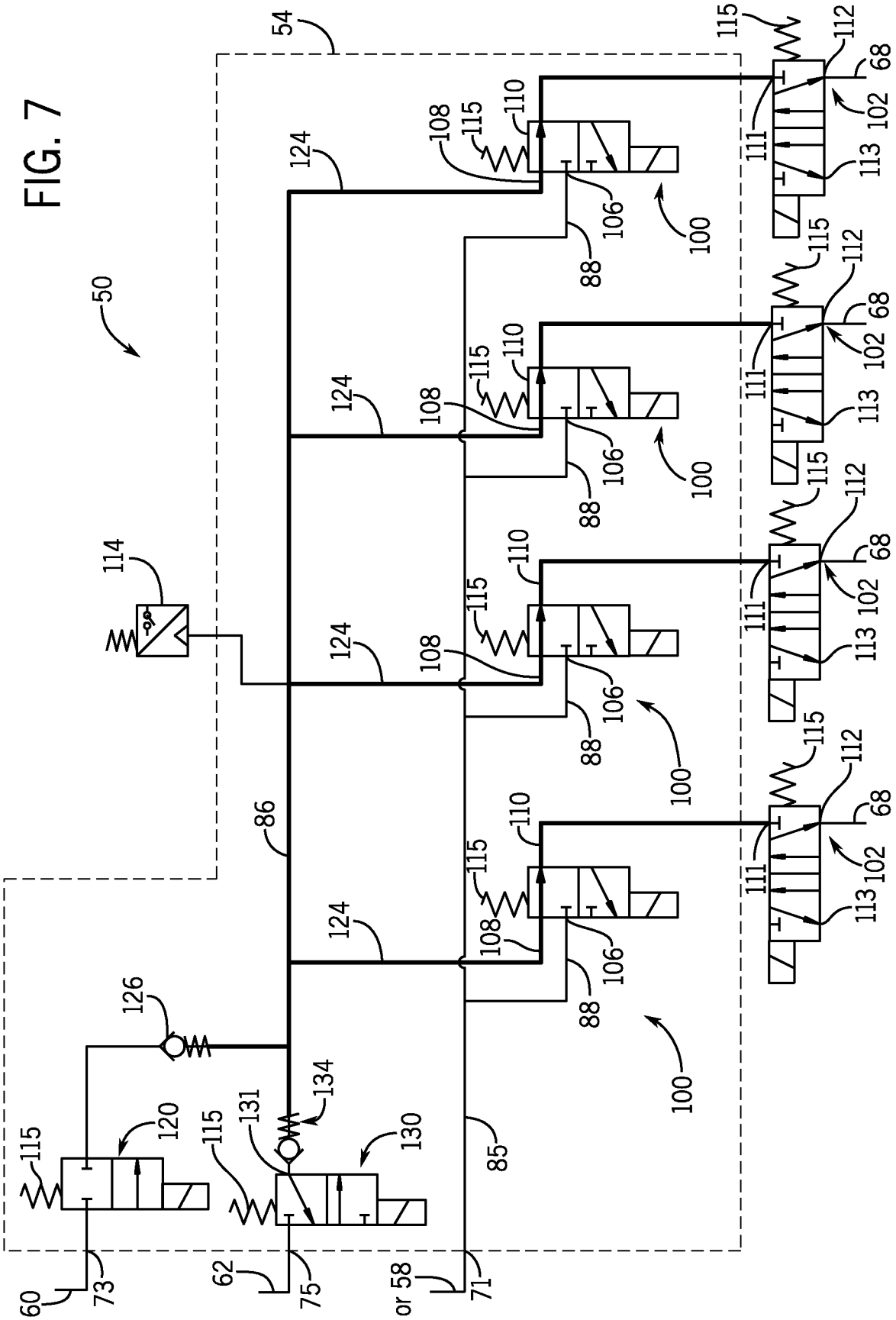
72

FIG. 6

FIG. 7


50
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62
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or 58
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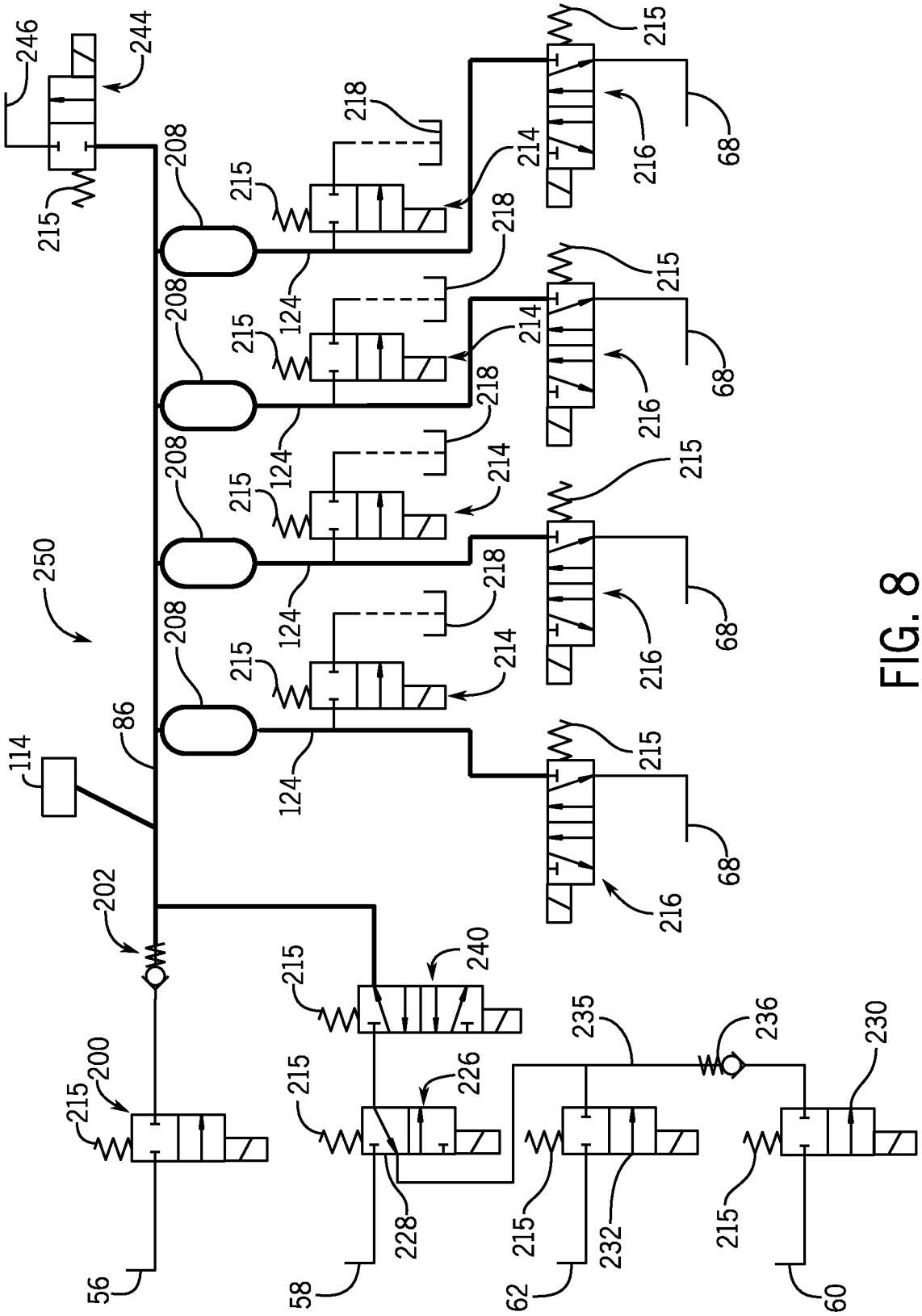
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208
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114
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226
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FIG. 8

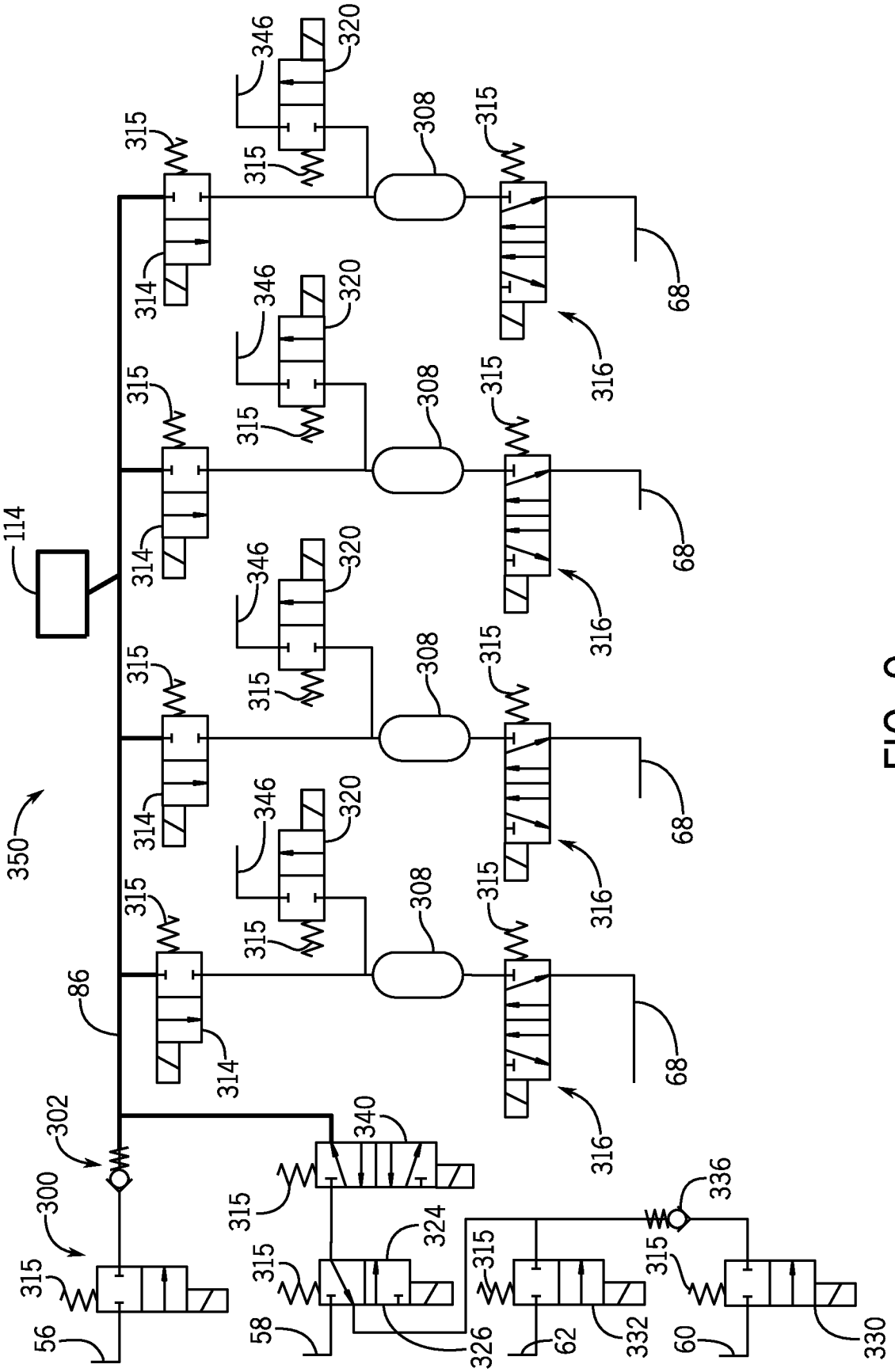
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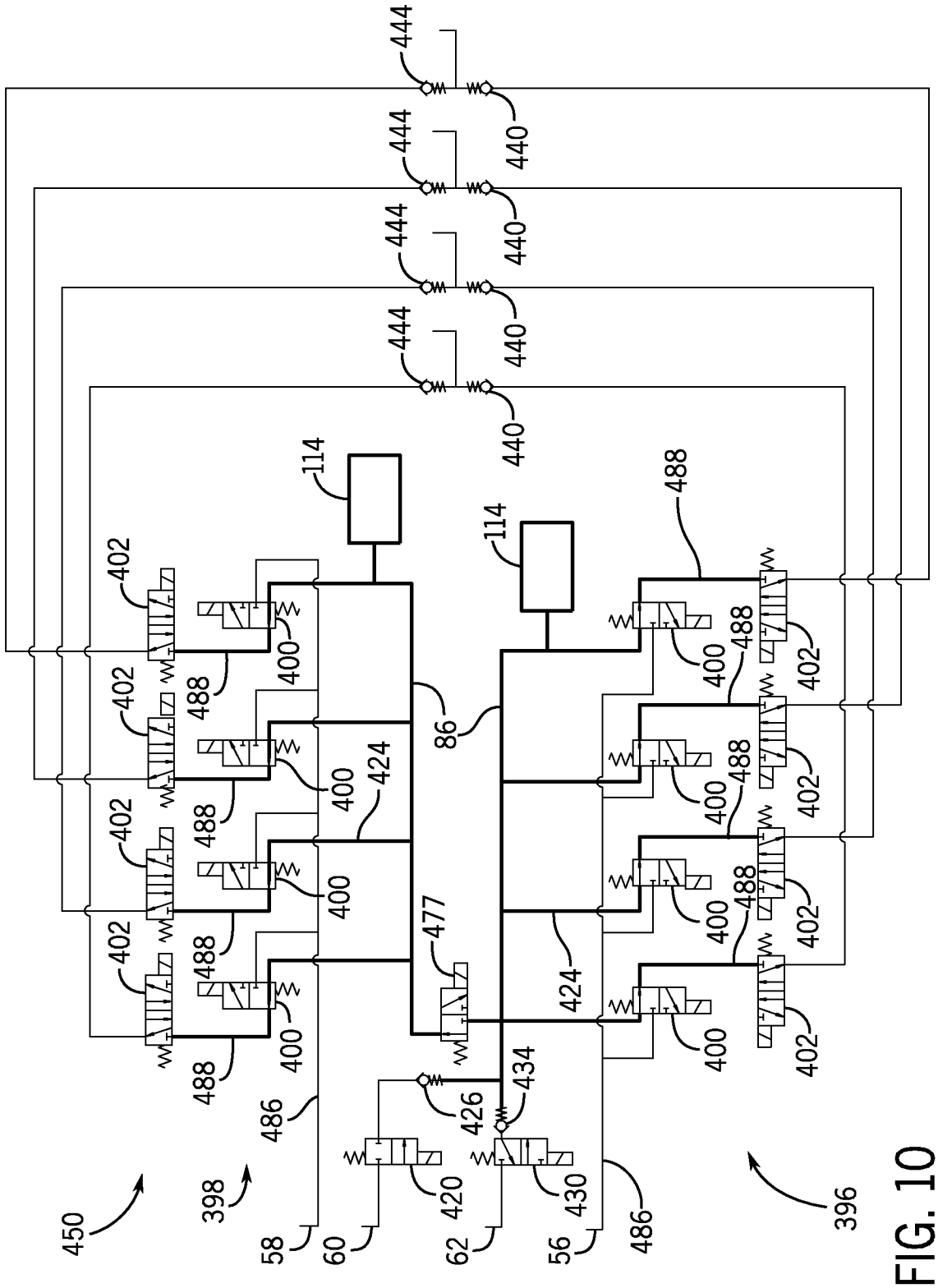
FIG. 9


444
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426
420
430
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450
396

FIG. 10

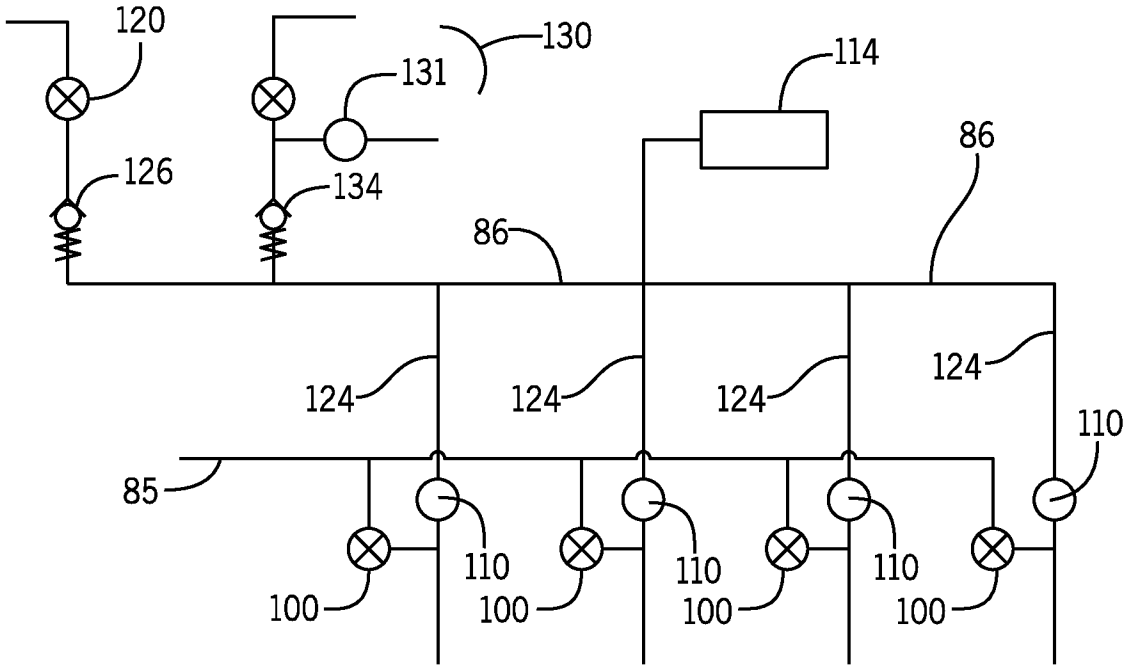

FIG. 11A

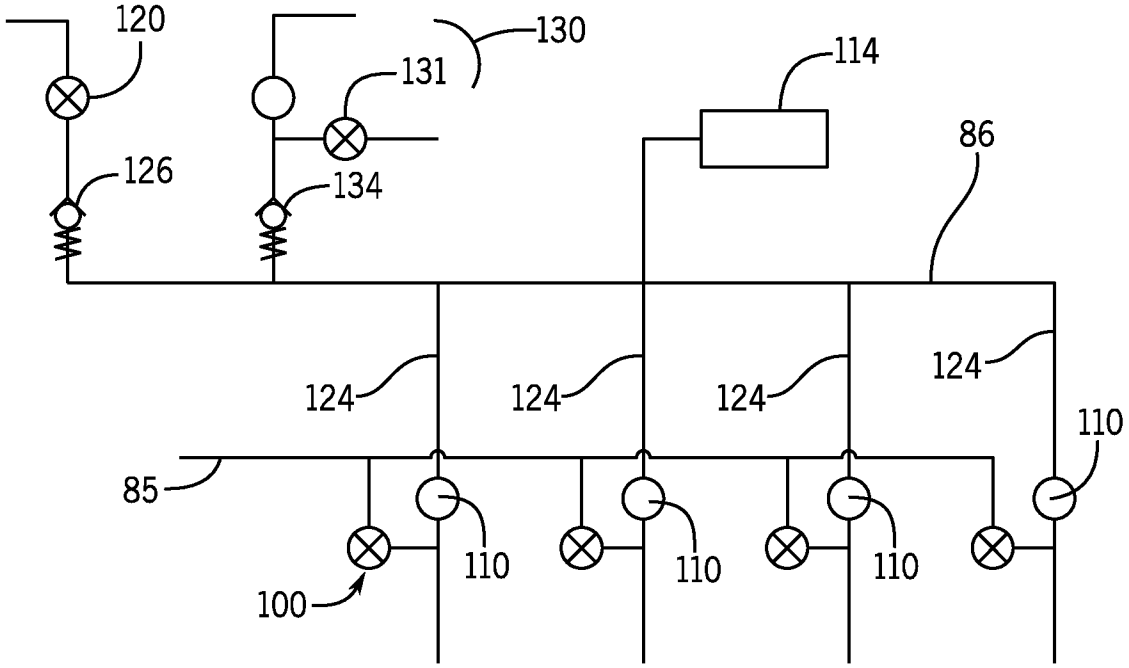

FIG. 11B

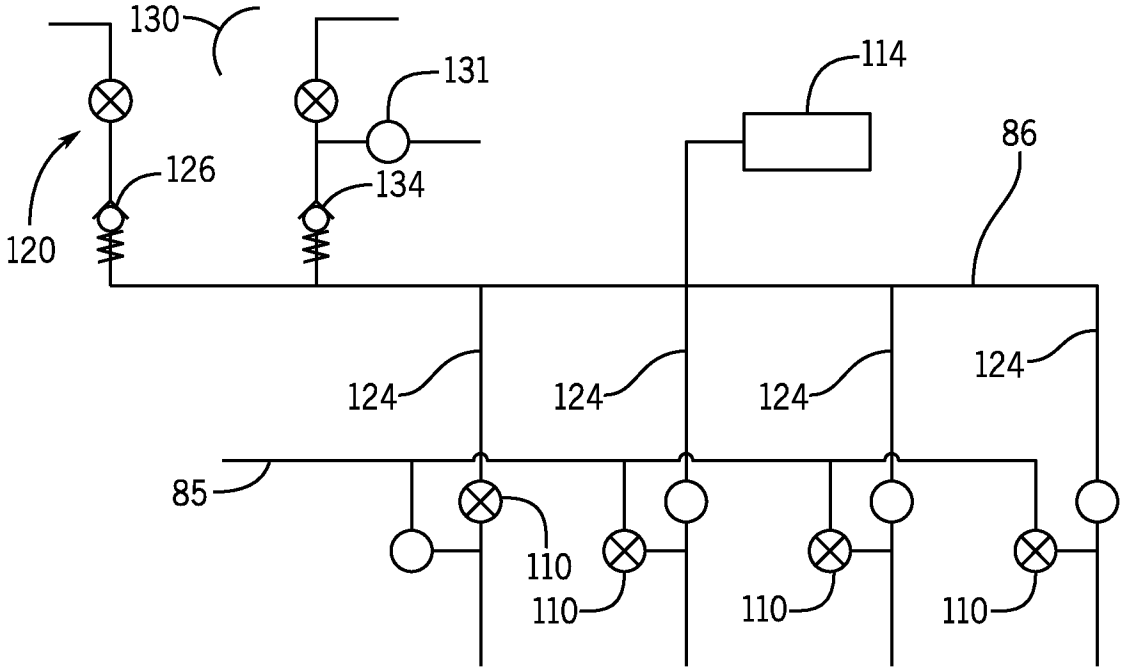

FIG. 11C

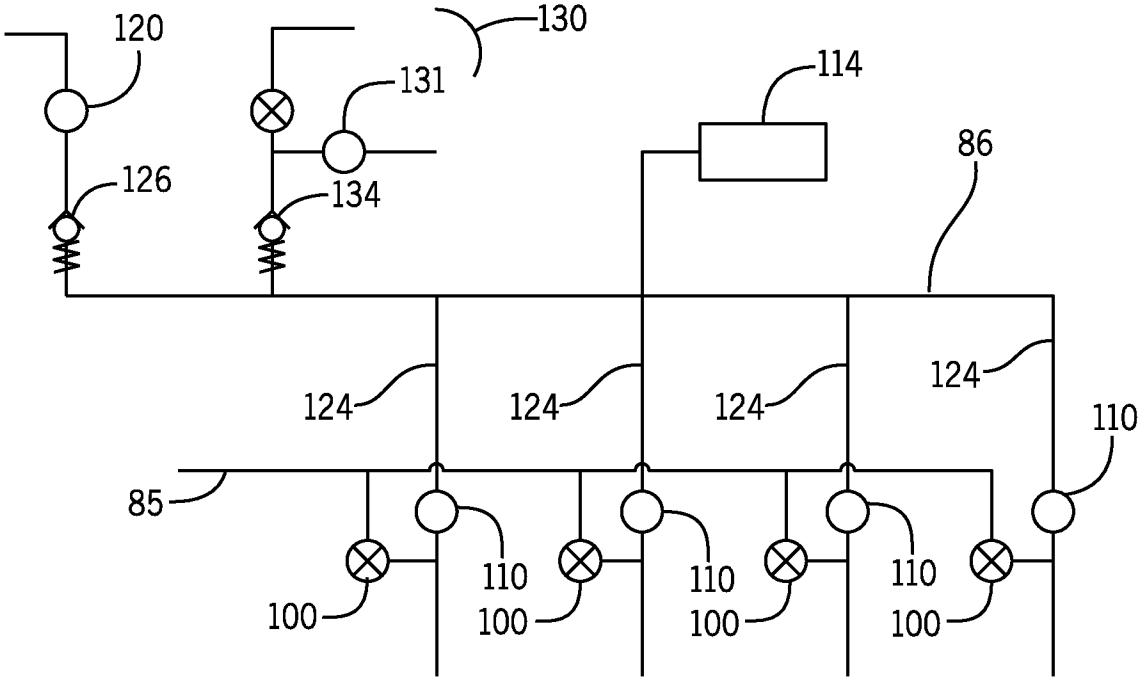

FIG. 11D

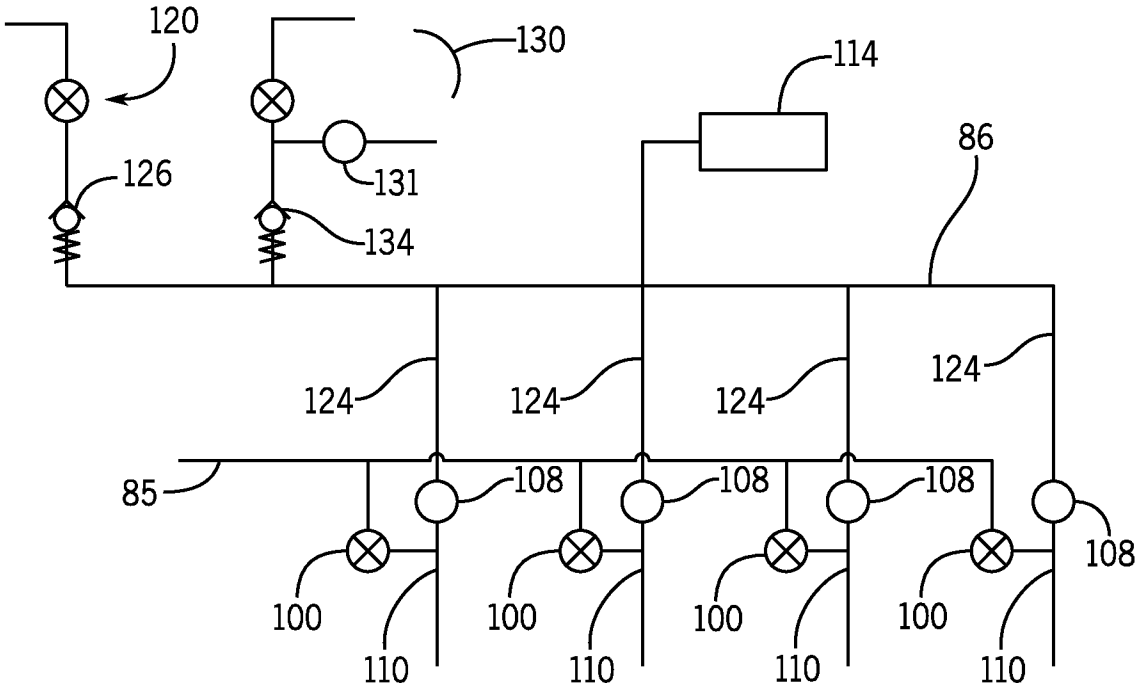

FIG. 12A

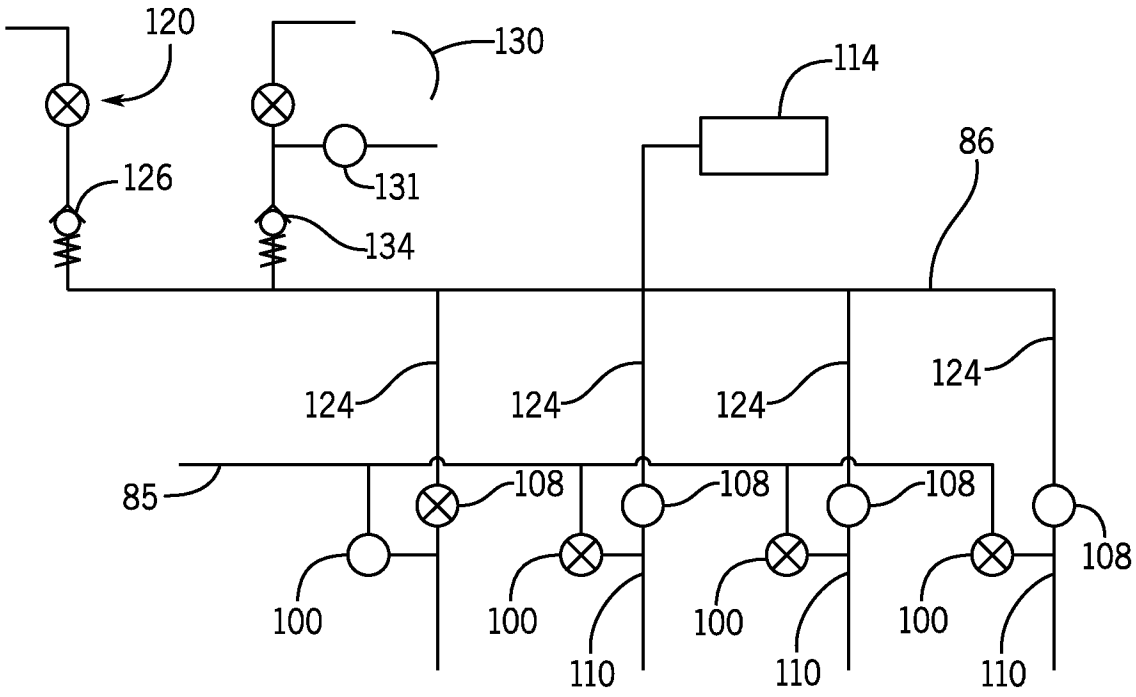

FIG. 12B

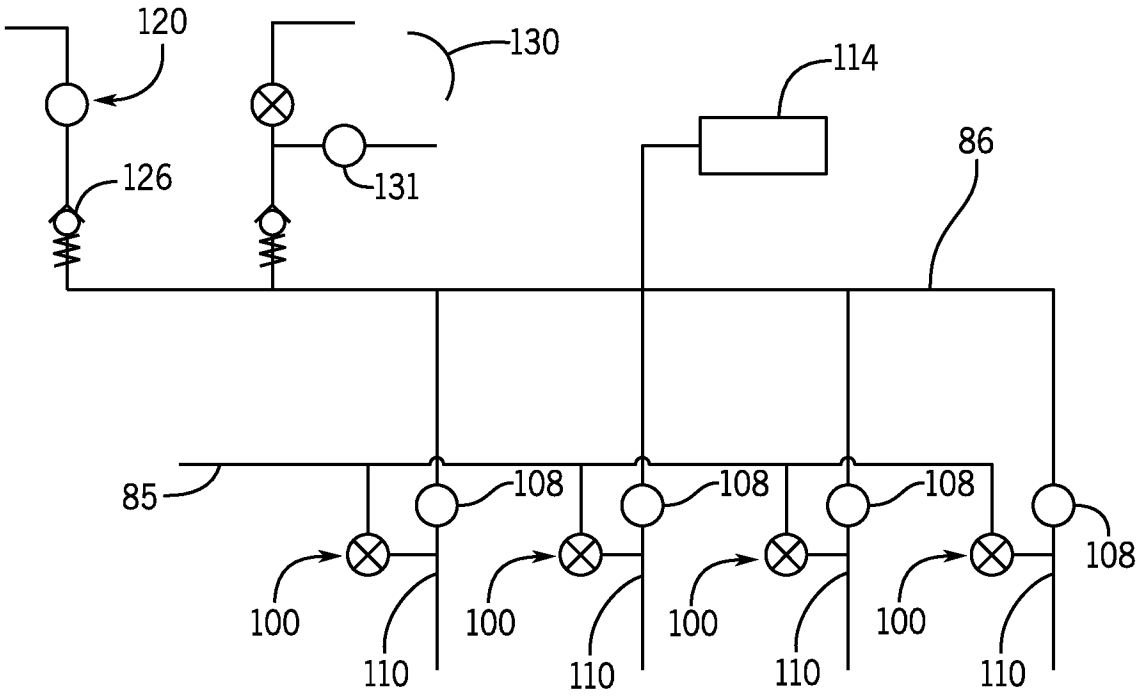

FIG. 12C

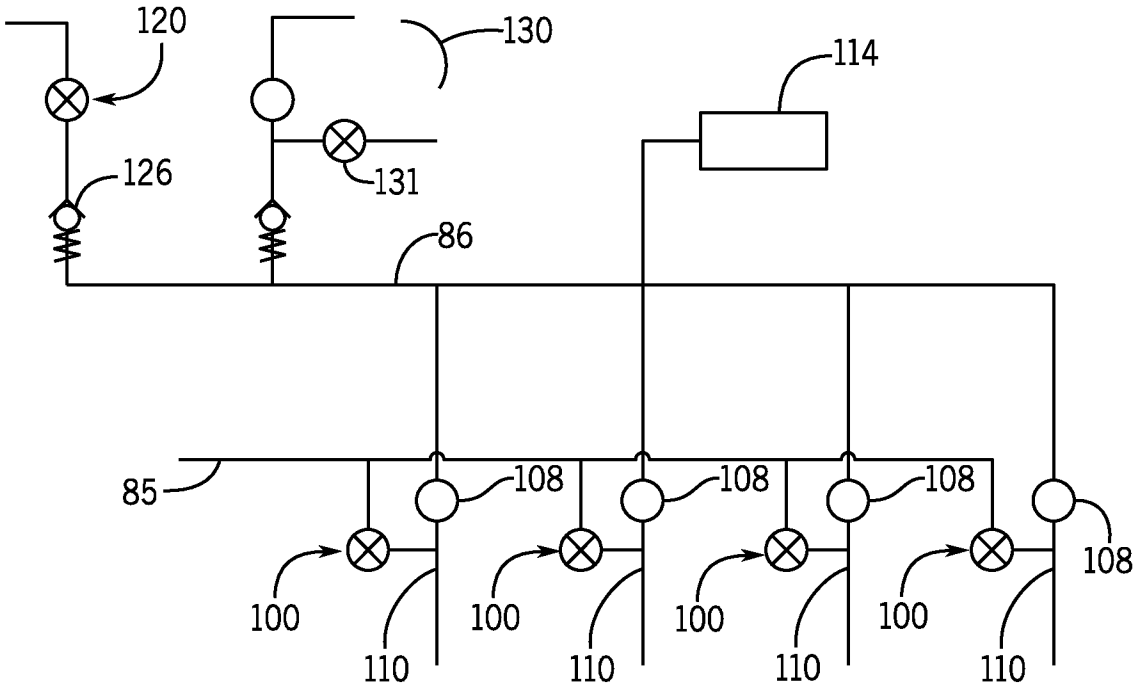

FIG. 12D

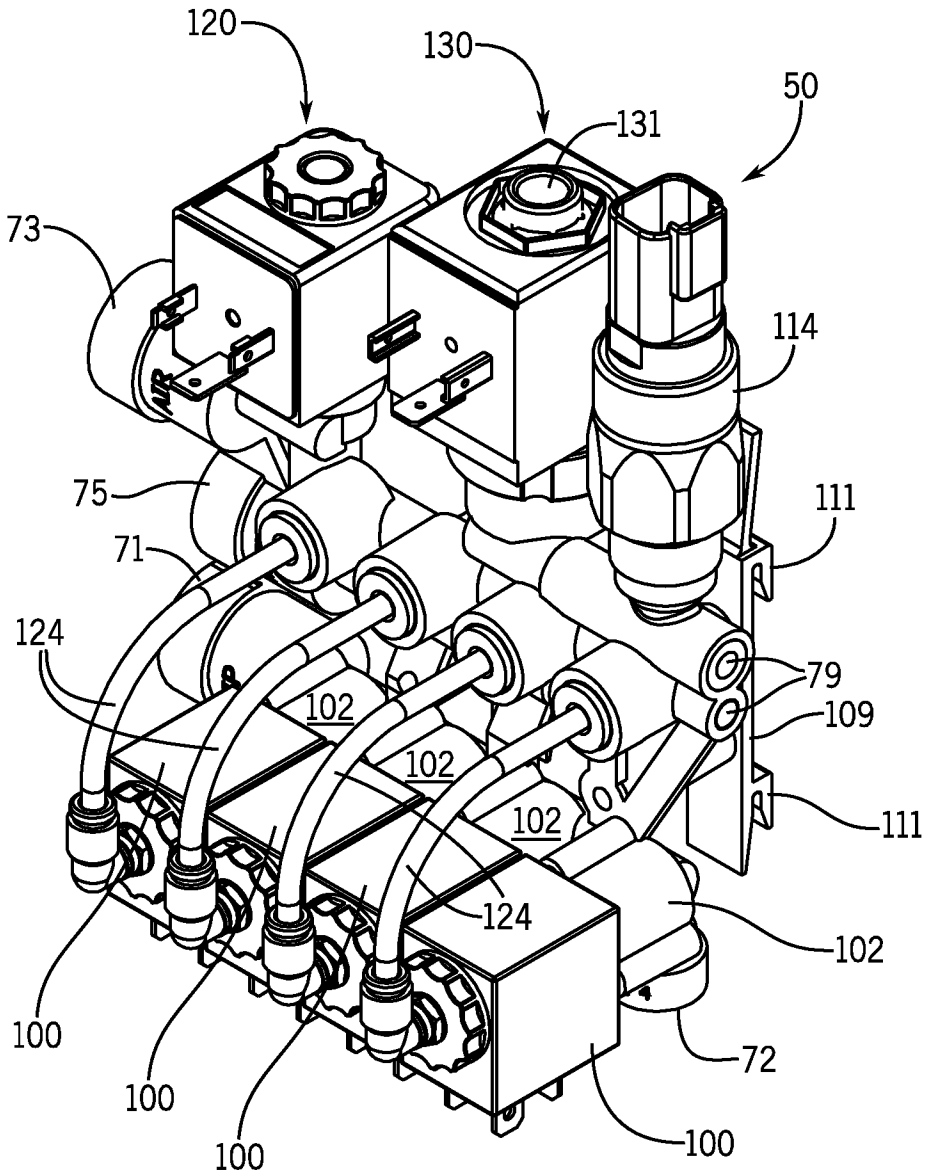
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FIG. 13A

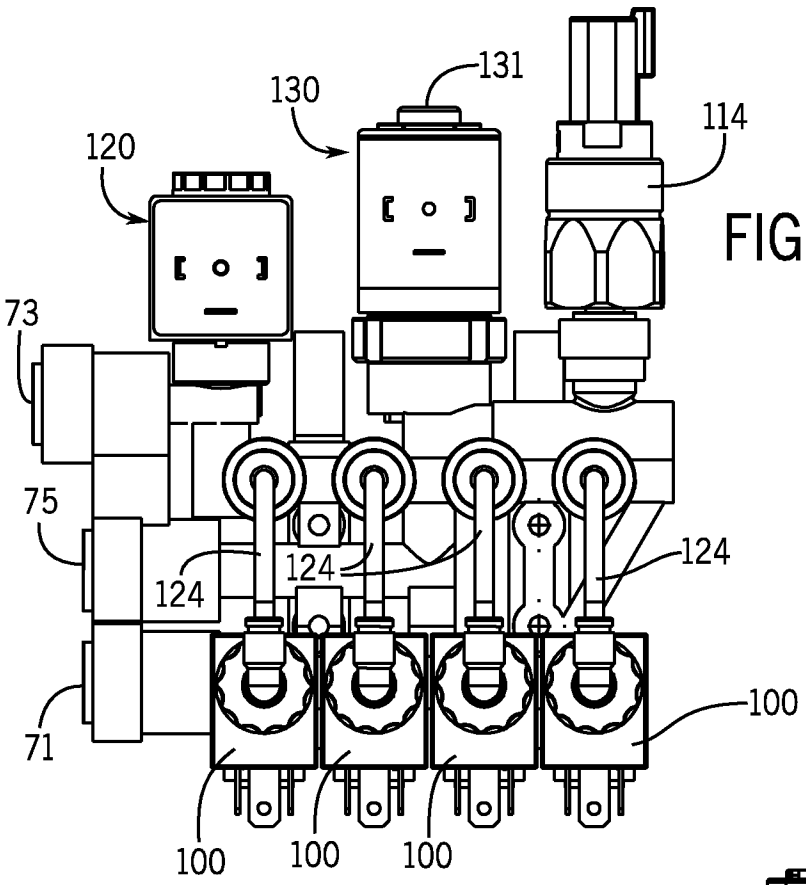

FIG. 13B

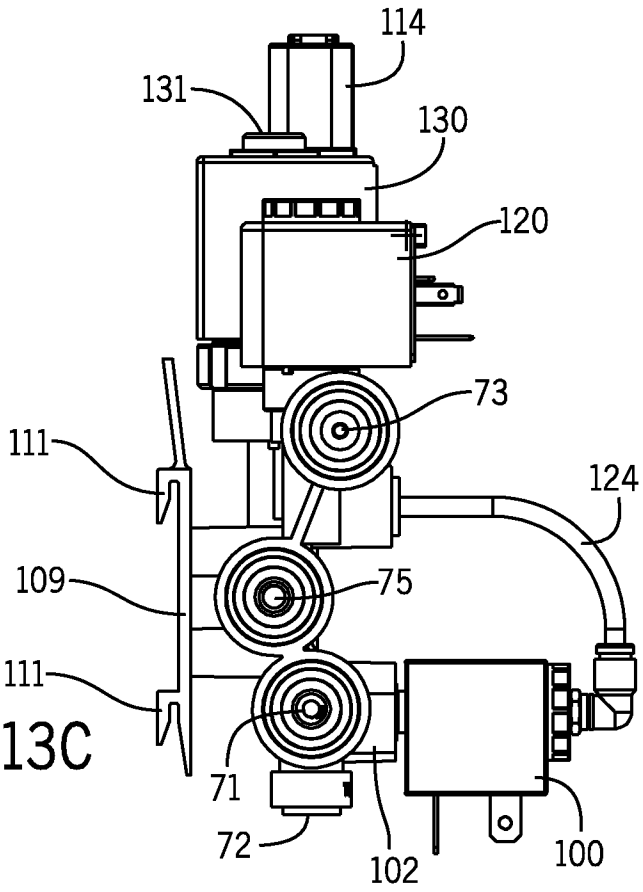

FIG. 13C

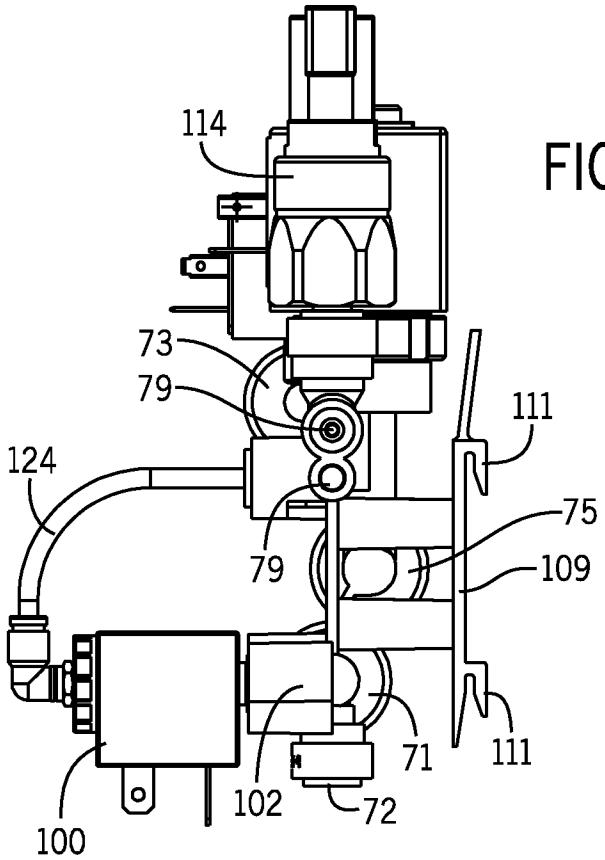

FIG. 13D

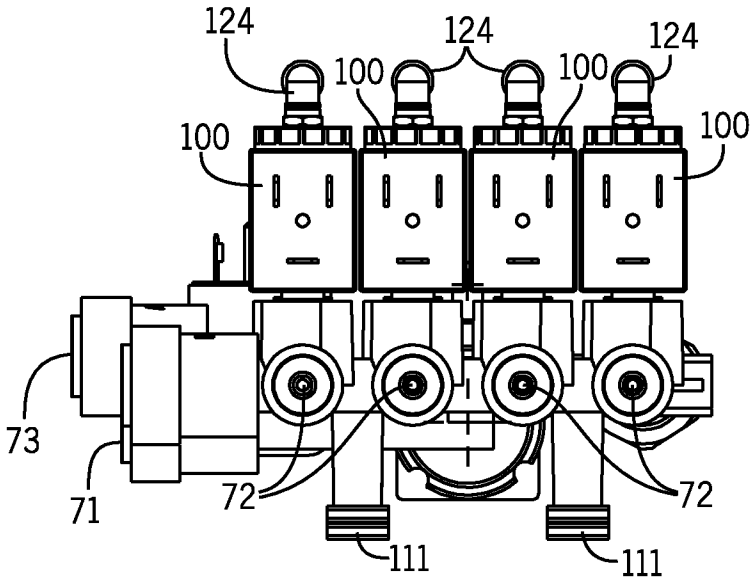

FIG. 13E

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2018/058897

A. CLASSIFICATION OF SUBJECT MATTER
INV. A01J7/04
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A01J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 9 686 958 B2 (GEA FARM TECH INC [US]) 27 June 2017 (2017-06-27) cited in the application column 15 - column 18; figure 3B -----	1-12
X	US 8 342 125 B2 (K.L. TORGERSON) 1 January 2013 (2013-01-01) cited in the application column 8 - column 27; figures 9A-16D -----	1-12

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
15 February 2019	25/02/2019

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Moeremans, Benoit

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2018/058897

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☒ Claims Nos.: 1-12(partially)
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

see FURTHER INFORMATION sheet PCT/ISA/210

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box II.2

Claims Nos.: 1-12(partially)

An invitation to provide informal clarification has been sent to the applicant on 25-01-2019:
"The word "galley" is used in the claims and throughout the whole application. However, in the context of manifolds and teat dip distribution, said word does not seem to have any correct meaning.
The applicant is invited to explain the meaning of the word "galley", and support the explanation with copies of dictionaries/text books/...".

The applicant replied to said invitation on 07-02-2019, the main arguments being the following:
"The galley is adequately recited in the claims, described in the specification, and illustrated in the drawings as including or being one or more conduits or passages in the teat dip manifold. The inventors have chosen the word "galley" to describe a portion of the manifold in which pressure is monitored to determine whether there are leaks or other pressure losses between an upstream valve and a downstream valve... Figs. 7 through 10 illustrate the galley 86 as a bold line for further emphasis, which depicts a conduit communicating with a number of other branching conduits.
The claims also recite a galley for teat dip fluids extending between an upstream valve and a downstream valve, and in communication with a pressure monitor. Beyond these descriptions, drawings, and claim recitations, Applicant respectfully submits that no further explanation is necessary before the Search Authority can perform an adequate search. Nonetheless, would yield comparable results because these terms describe elements through which teat dip may flow and may also be sealed at upstream and downstream ends by valves so that pressure between the valves can be monitored, as recited in the present claims.
Respectfully,
Applicant is aware of no requirement in the U.S., European Patent Office, or any other patent jurisdiction requiring further definitions from dictionaries or text books when the application itself provides a clearly defined and depicted claim element. This is particularly true when the requirement may narrow the scope of the claim term simply for the purpose of a search. Nonetheless, Applicant informally provides the above citations and explanations to assist the International Searching Authority' to carry out a meaningful search, and without prejudice to Applicant".

However, it is still the opinion of the International Searching Authority that in the context of manifolds and teat dip distribution, the word "galley"does not seem to have any correct meaning. The applicant has not provided any basis in a dictionary or text book for using such a term. The use of the word "galley" in the present application is de facto a mistake.
According to the PCT Guideline 8.01

(under Rule 91.1 (a) and (b) PCT), an obvious mistake could be rectified at the request of the applicant, provided:
(i) that something else was intended than what appears in the document concerned --> this is the case ; and
(ii) that nothing else could have been intended than the proposed rectification ---> this is NOT the case : the applicant provided various suggestions: " conduit", "chamber", "passage", "manifold", or similar terms "; however, said terms are not technical synonyms: for example, a chamber is not a conduit and vice versa.

The present search has been conducted by interpreting the word "galley" as "conduit". However, as argued here-above, it is expected that a requested for such a rectification according to the PCT Guideline 8.01 cannot be admitted.

The applicant's attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure. If the application proceeds into the regional phase before the EPO, the applicant is reminded that a search may be carried out during examination before the EPO (see EPO Guidelines C-IV, 7.2), should the problems which led to the Article 17(2) declaration be overcome.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2018/058897

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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