PATENT SPECIFICATION

(11) S85895

(21) Application No. S2010/0606

(22) Date of Filing of Application: 22/09/2010

(30) Priority Data::
(31) S2009/0726 (32) 22/09/2009 (33) Ireland (IE)

(45) Specification Published: 23 November 2011

(51) Int. Cl. (2011)
A01J 5/00

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(54) Title: A milk diverting valve assembly

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"A MILK DIVERTING VALVE ASSEMBLY"

INTRODUCTION

The present invention relates to a milk diverting valve assembly. In particular it relates to milk diverting valve assembly comprising a milk inlet in fluid communication with a milk inflow chamber; a first milk outlet in fluid communication with a first milk outflow chamber; a second milk outlet in fluid communication with a second milk outflow chamber; a first valve to control fluid flow between the milk inflow chamber and the first milk outflow chamber; and a second valve to control fluid flow between the milk inflow chamber and the second milk outflow chamber. Such diverting valve assemblies are known for use in milking parlours.

In milking parlours, the milking system collects milk from many cows and that milk is stored centrally in a bulk tank for subsequent further processing into dairy products for human consumption. It is therefore very important that only safe, healthy milk reaches the bulk tank and that milk that is not suitable for human consumption is directed elsewhere. Milk may be deemed unsuitable for a variety of reasons. A first example of a source of contaminated milk would be from a cow suffering from mastitis; a second example would be milk from a cow recently treated for infection using antibiotics. Other examples of contaminated milk, such as bloody milk, are also known.

It is therefore necessary to provide a manner in which contaminated milk can be diverted away from the milk of the healthy cows so as not to contaminate it. It is known to provide milk diverter valves in the milking system of the milking parlour, however the known valves are prone to failure and can lead to flow issues within the milking apparatus.

Milking systems for milking parlours comprise a plurality of teatcups that are attachable to a cow's teats and have suitable connections thereto to apply a pulsed vacuum to the teatcup and so extract the milk from the teat. In this way, the milk inflow chamber of a milk diverting valve assembly will be subject to a vacuum. This vacuum can adversely affect the operation of the valves controlling fluid flow between the milk inflow chamber and the milk outflow chambers. For example, valves can end up in positions where they

are neither fully open nor fully closed, giving rise to inaccurately diverted milk, and the potential for contaminated milk reaching the bulk tank.

It is an object therefore of the present invention to provide a milk diverting valve assembly that overcomes at least some of the above-mentioned problems.

STATEMENTS OF INVENTION

According to the invention there is provided a milk diverting valve assembly comprising a milk inlet in fluid communication with a milk inflow chamber; a first milk outlet in fluid communication with a first milk outflow chamber; and a second milk outlet in fluid communication with a second milk outflow chamber characterised in that the milk diverting valve assembly further comprises a first valve to control fluid flow between the milk inflow chamber and the first milk outflow chamber; and a second valve to control fluid flow between the milk inflow chamber and the second milk outflow chamber, wherein at least one of the valves each comprise a double diaphragm valve having an actuator diaphragm connected to a flow-control diaphragm, the actuator diaphragm having a larger area than the flow-control diaphragm.

In this way, the double diaphragm valve provides very effective, efficient and accurate operation of the milk diverting valve assembly. The use of the actuator diaphragm having a larger area than the flow-control diaphragm allows a larger force to be applied indirectly to the fluid-flow diaphragm, through the actuator diaphragm. This allows for greater control of the diaphragm, so that the double diaphragm valve can be fully closed or fully opened as required.

In an alternative embodiment of the invention there is provided a milk diverting valve assembly further comprising a cap covering each actuator diaphragm, the caps being adapted to be connected to an actuating apparatus. This provides for a convenient method of forming an airtight enclosure surrounding the actuator diaphragm so that a vacuum or partial vacuum may be applied thereto, thereby opening the double diaphragm valve.

In one embodiment of the invention there is provided a milk diverting valve assembly in which the actuating apparatus comprises a vacuum source. This is a particularly convenient manner of providing a force suitable for actuating the double-diaphragm valve.

In another embodiment of the invention there is provided a milk diverting valve assembly in which the actuator diaphragm is concentric with the flow-control diaphragm. This is a particularly convenient and efficient construction of the double diaphragm valve.

In a further embodiment of the invention there is provided a milk diverting valve assembly in which the actuator diaphragm is connected to the flow-control diaphragm along their central axis. This is a particularly convenient and efficient construction of the double diaphragm valve.

In another embodiment of the invention there is provided a milk diverting valve assembly further comprising a water inlet. In this way, water may be flushed through the milk diverting valve assembly so as to wash out any contaminated milk prior to using the milk diverting valve assembly with good milk. Preferably, the water inlet will be adapted to deal with pressurised water for more effective cleaning.

In a further embodiment of the invention there is provided a milk diverting valve assembly in which the water inlet is in fluid communication with the milk inflow chamber. In this way, the milk inflow chamber and those parts in fluid communication therewith, such as the milk inlet, milk pipeline and the milking attachments for the cows, can be washed out by the water supplied to the water inlet.

In an alternative embodiment of the invention there is provided a milk diverting valve assembly further comprising an air inlet. In this way, air may be supplied to the milk diverting valve assembly to dry it out after milking, or after the milk diverting valve assembly has been washed. Preferably, the air inlet is adapted to receive compressed air, which will dry the assembly and connected pieces more efficiently.

In one embodiment of the invention there is provided a milk diverting valve assembly in which the air inlet is in fluid communication with the milk inflow chamber. In this way, the

milk inflow chamber and those parts in fluid communication therewith, such as the milk inlet, milk pipeline and the milking attachments for the cows, can be reached by the air and so dried.

In another embodiment of the invention there is provided a milk diverting valve assembly in which the milk inlet is connected to a milk meter. In this way, milk from the cow passes through the milk meter before being directed to its destination by the milk diverting valve assembly. This allows the total milk production of the cow to be measured, and not just the level of production of good milk.

In a further embodiment of the invention there is provided a milk diverting valve assembly further comprising a drain outlet. This is useful when washing the milk diverting valve assembly after use. Preferably, the drain outlet is fitted with a valve that is opened when it is desired to drain out any remaining washing water from the milk diverting valve assembly. Additionally, the drain outlet is particularly useful when the milk diverting valve assembly is connected to a milk meter at the milk inlet of the milk diverting valve assembly, as this allows the milk meter to be washed and successfully drained via the milk diverting valve assembly. There is no need for the milk meter to be disconnected from the milk diverting valve assembly. The drain outlet allows the washing water to be drained from the milk diverting valve assembly without operating the double diaphragm valves to open a fluid path.

In an alternative embodiment of the invention there is provided a milk diverting valve assembly in which the milk inflow chamber comprises a milk detecting apparatus. In this way the presence of milk within the milk inflow chamber can be monitored and provide information as to the when the cow has been milk successfully.

In one embodiment of the invention there is provided a milk diverting valve assembly in which the milk detecting apparatus is connected to an automatic cluster removal system. In this way, the lack of milk in the milk inflow chamber, indicating that the cow has finished milking, can be used to trigger the release of the cluster of teatcups from the cow's udder.

In a further embodiment of the invention there is provided a milk diverting valve assembly in which the milk diverting valve assembly is connected to a control unit. In this way, the operation of the milk diverting valve assembly can be controlled as necessary by the milk parlour operator.

According to the invention there is provided a cattle milking system comprising the milk diverting valve assembly as claimed in any preceding claim. Such a cattle milking system would allow for the efficient and accurate separation of contaminated milk from good milk.

DETAILED DESCRIPTION OF THE INVENTION

The invention will now be more clearly understood from the following description of an embodiment thereof given by way of example only with reference to the accompanying drawings in which:-

Fig. 1 is an exploded perspective view of a milk diverting valve assembly according to the invention;

Fig. 2(a) is perspective view of the milk diverting valve assembly shown in Fig. 1;

Fig. 2(b) is a section view of the milk diverting valve assembly shown in Fig. 1, the section taken along a vertical plane bisecting the milk diverting valve;

Figs. 3(a), (b) and (c) are perspective, side and section (along the line A-A in Fig. 3(b)) views of the double diaphragm valve used in the milk diverting valve assembly of the invention;

Figs. 4(a), (b) and (c) are perspective, top and section (along the line B-B in Fig. 3(b)) views respectively of a cap used in the milk diverting valve assembly of the invention;

Fig. 5 is an exploded perspective view of an alternative embodiment of milk diverting valve assembly according to the invention;

Figs. 6(a) and (b) are perspective and top views respectively of the milk diverting valve assembly shown in Fig. 5;

Figs. 7(a) and (b) are section (along the line C-C in Fig. 7(b)) and top views respectively of the milk diverting valve assembly shown in Fig. 5;

Fig. 8 is an exploded perspective view of the milk diverting valve assembly shown in Fig. 5 in combination with a milk meter assembly;

Figs. 9(a) and (b) are front and rear perspective views of the milk diverting valve assembly shown in Fig. 5 in combination with a milk meter assembly;

Figs. 10(a) and (b) are front and section (along the line D-D in Fig. 10(a)) views of a further embodiment of milk diverting valve assembly according to the invention in combination with the milk meter assembly;

Figs. 11(a) and (b) are side and section (along the line E-E in Fig. 11(a)) views of the milk diverting valve assembly and milk meter assembly shown in Fig 10.

Fig. 12 is a diagrammatic representation of the diverting valve assembly shown in Fig. 1, where the valve is closed; and

Fig. 13 is a diagrammatic representation of the diverting valve assembly shown in Fig. 1, where the valve is open.

Referring to the drawings, and initially to Figs. 1 and 2 thereof, there is shown milk diverting valve assembly indicated generally by the reference numeral 100, comprising a central unit 102 formed by a substantially cylindrical outer body 104, each end of which is fitted with a collar 106 which tapers outwardly therefrom. Each collar 106 terminates in a non-tapering cylindrical section 108. A milk inflow chamber 110, comprising a substantially cylindrical body is mounted within the outer body 104, and located

substantially co-axially therewith. The outer body 104 is the same length at the milk inflow chamber 110 such that each end of the outer body 104 is in line with an end of the milk inflow chamber 110. A milk inlet 112 is connected to the milk inflow chamber 110 and is in fluid communication therewith, such that the combination of the milk inflow chamber 110 and milk inlet 112 form a T-shaped unit. The space between the milk inflow chamber 110 and the outer body 104 forms the milk outflow chambers, the first milk outflow chamber 113a and the second milk outflow chamber 113b to which a first milk outlet 114 and a second milk outlet 115 are connected and with which they are fluid communication. The first milk outflow chamber 113a is not in fluid communication with the second milk outflow chamber 113b as they are divided by the milk inlet 112 and other structural elements of the main body 104. The central body further comprises a water inlet 117 and an air inlet 118. A pair of probes 119, forming a milk detecting apparatus, are located in the main body 104, extending into the milk inflow chamber 110. The probes 119 are connected to a control and communication wiring loom 121.

Further to the outer body 104, the milk diverting valve assembly 100 comprises a pair of diaphragm washers 120, each comprising a frusto-conical ring. The diaphragm washers 120 are adapted to engage the sides of a double diaphragm valve 122 and secure an air-tight and liquid-tight seal around the sides of the double diaphragm valve 122. The double diaphragm valve 122 comprises a substantially circular flow-control diaphragm 124 connected to a concentric, substantially circular actuator diaphragm 126. The flow-control diaphragm 124 is smaller in diameter than the actuator diaphragm 126. The flow-control diaphragm 124 and actuator diaphragm 126 have a connecting portion 127 therebetween.

The milk diverting valve assembly 100 further comprises a pair of caps 128 to fit over the double diaphragm valve 122. Each cap 128 comprises a nozzle 130 for connection to a vacuum source.

Referring now to Figs. 3(a), (b) and (c), in which like parts have been given the same reference numerals as before, there is shown the double diaphragm valve 122 comprising flow-control diaphragm 124 and actuator diaphragm 126 connected together by the connecting portion 127. Each diaphragm 124, 126 comprises a diaphragm face 140, located centrally within the diaphragm, the diaphragm face of the flow-control

diaphragm 124 being smaller than that of the actuator diaphragm 126. The connecting portion 127 extends between the diaphragm faces 140 of both diaphragms and consequently tapers inwardly from the actuator diaphragm 126 to the flow-control diaphragm 124.The connecting portion 127 is therefore substantially frusto-conical in shape with its larger non-curved side forming the diaphragm face 140 for the actuator diaphragm 126, and its smaller non-curved side forming the diaphragm face 140 of the flow-control diaphragm 124. Each diaphragm face 140 is surrounded by a border 142 and is connected thereto by a flexible membrane 144. While the double diaphragm 122 is not actuated, the flexible membrane 144 will form a channel between the diaphragm face 140 and the border 142. However when the double diaphragm 122 is actuated, the diaphragm faces 140 will move to the left (relative to the orientation shown in Figs. 3(b) and (c)) and the border 142 will not move, such that the flexible membranes will no longer form a channel, but will extend directly between the edge of the diaphragm faces and the edge of the border 142.

Referring now to Figs. 4(a), (b) and (c), in which like parts have been given the same reference numerals as before, there is shown the cap 128 which fits over the ends of the milk diverting valve assembly 100. The cap 128 is substantially circular and has a centrally located nozzle 130. The cap 128 comprises an outer lip 132 that, in use, sits outside the cylindrical portion 108 of the collar 106 at the end of the outer body 104 of the milk diverting valve assembly 100. The cap 128 further comprises an inner lip 134 that, in use, sits against the border 142 of the actuator diaphragm 126 in the double diaphragm 122. When affixed to the end of the milk diverting valve assembly 100, the cap 128 forms an air-tight seal around the collar 106 and diaphragm 122.

Referring now to Figs. 5 to 7, in which like parts have been given the same reference numerals, there is shown an alternative embodiment of the milk diverting valve assembly according to the invention, indicated generally by the reference numeral 200. This embodiment 200 is adapted to be connected to a milk meter unit (not shown). The milk diverting valve assembly 200 comprises a central unit 202 formed by a substantially cylindrical outer body 204, wherein the milk inlet 212 is located at the top of the body 204. Adjacent the milk inlet 212, a bracket 208 is fitted to allow connection of the milk meter (not shown). The bracket 208, comprising two discrete portions 208a, 208b

disposed around the milk inlet 212, forms the female side of a bayonet mounting for engagement with the milk meter (not shown).

Referring now to Figs. 12 and 13, in which like parts have been given the same reference numerals as before and direction of fluid flow is shown by the heavy arrows, there is shown a diagrammatic representation of the milk diverting valve assembly 100 of the invention. In Fig. 12, both double diaphragm valves 122 are closed such that the flow-control diaphragm 124 seats at the ends of the milk inflow chamber 110 and outer body 104 such that the milk inflow chamber 110 and milk outflow chambers 113 are closed off. In this figure, milk will not flow through the milk diverting valve assembly 100. In Fig. 13, the double diaphragm valve 122 on the left has been opened by the application of a vacuum to the actuator diaphragm 126. This causes the actuator diaphragm to move outwards, which in turn causes the flow-control diaphragm 124 move outwards and thus to unseat, thereby providing a path for fluid flow from the milk inflow chamber 110 to the first milk outflow chamber 113a.

In use, a vacuum is applied to the first milk outlet 114 and second milk outlet 115. This causes a vacuum to be created in the first milk outflow chamber 113a and the second milk outflow chamber 113b. The vacuum in the outflow chambers 113a, 113b pulls the flow-control diaphragms 124 inwards such that the flow-control diaphragm 124 will be pulled against the ends of the cylinders forming the milk inflow chamber 110 and the outer body 104. The flow-control diaphragm 124 will seat in the cylindrical portion 108 of the collar 106 at the end of the outer body 104, thus sealing off the milk inflow chamber 110 and preventing any fluid flow from the milk inflow chamber 110. In the absence of any further vacuum forces being applied to the caps 128, both flow-control diaphragms will be seated in the collars 106 and therefore there will be no fluid flow through the milk diverting valve assembly 100. If a vacuum force is applied to one of the double diaphragm valves 122 through the appropriate nozzle 130, then the vacuum will cause the actuator diaphragm 126 to move towards the cap 128. When the actuator diaphragm 126 moves outwardly, it caused the flow-control diaphragm 124 to also move outwardly, thus unseating itself and opening a path for fluid flow from the milk inflow chamber 110 to one of the milk outflow chambers 113a, 113b. The same vacuum source (not shown) will be used throughout the milking system. Therefore the vacuum applied to each milk outlet 114, 115 and that applied to the double diaphragm valves 122 will be derived from

the same source, and will therefore be of substantially similar magnitudes. As such, the vacuum force acting on the actuator diaphragm 126 will be larger than that acting on the flow-control diaphragm 124, due to the larger area of the actuator diaphragm 126 that is presented to the vacuum, that that of the flow-control diaphragm that is presented to the vacuum. In this way, the double diaphragm 122 valve will operate correctly when a vacuum is applied thereto.

The milk detecting apparatus 119 forms part of an automatic cluster removal system (not shown), wherein the probes detect the presence of milk within the milk inflow chamber 110. When the probes 119 are no longer detecting milk in the milk inflow chamber 110, a signal is sent along the control and communication wiring loom 121 to trigger release of the cluster of teatcups (not shown) for the cow in question, as the absence of milk in the milk inflow chamber indicates that the cow has been successfully milked.

Referring now to Figs. 8 and 9, in which like parts have been given the same reference numerals as before, there is shown a diverting valve assembly 200 connected to a milk meter 700. The combination of the milk meter 700 with the milk diverting valve assembly 200 in this way allows the milk production of a cow to be accurately recorded, as the total production will be recorded, and not just the good quality milk production. The quantity of milk produced is first measured in the milk meter 700, before the milk is directed either to the bulk tank (not shown) for further processing, or discarded if contaminated.

The milk meter 700 comprises meter milk inlet 702 and a meter milk outlet 704, adapted to connected the milk inlet 212 on the top of the milk diverting valve assembly 100. The milk meter 700 further comprises a lower chamber 706, an upper chamber 708 and a valve cylinder 710. The lower chamber comprises the milk outlet 704 and the valve cylinder 710 comprises a base section 711 dimensioned to close off the lower chamber 706 from the upper chamber 708 when the valve cylinder 710 is seated at an upper rim 707 of the lower chamber 708. The upper chamber 708 is fitted with three fluid probes, indicated generally by the reference numeral 712, an upper probe, a middle probe and a lower probe, which protrude horizontally into the milk meter 700.The probes 712 are connected to a wiring loom 714 for communication and control. The milk inlet 704 is located in a top chamber 716 which is fitted to the top of the upper chamber. The milk

meter 700 further comprises a control valve assembly 718 having a double diaphragm valve 720 of the same design as the double diaphragm valve 122 used in the milk diverting valve assembly 100, 200. The control valve assembly 718 is connected to the valve cylinder 710. The milk meter 700 comprises a lid 722 covering the cap 724 of the control valve assembly 718, and associated controls including a solenoid 728 for operation of the valve and wiring loom 730 for control and communication. A clamp 726 is used to affix the milk meter and diverting valve assembly to a horizontal or vertical bar (not shown). The clamp 726 is located adjacent the probes 712.

In use, milk flows in through the milk meter milk inlet 702 into the upper chamber 708. When the three fluid probes 712 detect that the milk has reached a certain height within the upper chamber, the control valve is triggered. This causes a vacuum to be applied to the double diaphragm valve 720 which causes the valve cylinder 710 to lift and allow milk to flow out of upper chamber 708 into the lower chamber 706 and thereby exit the milk meter 700 through the milk meter the milk outlet 704. In practice, the control valve will operate at a reasonably high frequency while in use.

Referring now to Figs. 10 and 11, in which like parts have been given the same reference numerals as before, there is shown the milk meter 700 connected to a further embodiment of the milk diverting valve assembly of the invention, indicated generally by the reference numeral 300 connected to a milk meter 700. This embodiment of the milk diverting valve assembly 300 differs from the previous embodiment in that it comprises a drain outlet 302. The drain outlet is used when the diverting valve and meter have been washed using water injected through the water inlet 117. The drain outlet is used to drain any remaining water from the milk diverting valve assembly 300 and milk meter 700.

It will be understood that the milk meter illustrated herein is an example and other sorts of milk meters may be appropriately connected to the milk diverting valve assembly of the assembly and provide the same advantages as discussed herein. Furthermore, it will be understood that the method of interconnection between the milk diverting valve assembly and milk meter is not limited to a bayonet mount, and the person skilled in the art will aware of a wide range of suitable alternatives.

It will be understood by the person skilled in the art that one or more milk diverting valve assemblies of the invention may be incorporated into a cattle milking system to ensure that contaminated milk from the herd is kept separate from the good milk. Furthermore, the implementation of a control system to control, either manually or automatically, the operation of the milk diverting valve assembly, or each of an array thereof, will be apparent to the person skilled in the art.

Throughout the specification, the term "milk outflow chamber" has been used to refer to an area from which milk exits the milk diverting valve assembly through a milk outlet. It will be understood by the person skilled in the art, that the term is not limited to a specific chamber but may also refer to a pipe or other conduit used to convey the milk. Furthermore, in certain embodiments, the milk outflow chamber may also be the milk inflow chamber.

It will be understood by the person skilled in the art that the term vacuum may refer to a partial vacuum.

In the specification the terms 'comprise', 'comprises', 'comprised' and 'comprising' or any variation thereof and the terms 'include', 'includes', 'included' or 'including' or any variation thereof are considered to be totally interchangeable and they should all be afforded the widest possible interpretation.

The invention is not limited to the embodiment herein described, but may be varied in both construction and detail within the terms of the claims.

CLAIMS

1. A milk diverting valve assembly (100, 200, 300) comprising a milk inlet (112, 212) in fluid communication with a milk inflow chamber (110); a first milk outlet (114) in fluid communication with a first milk outflow chamber (113a); a second milk outlet (115) in fluid communication with a second milk outflow chamber (113b); a first valve to control fluid flow between the milk inflow chamber (110) and the first milk outflow chamber (113a); and a second valve to control fluid flow between the milk inflow chamber (110) and the second milk outflow chamber (113b)

   characterised in that

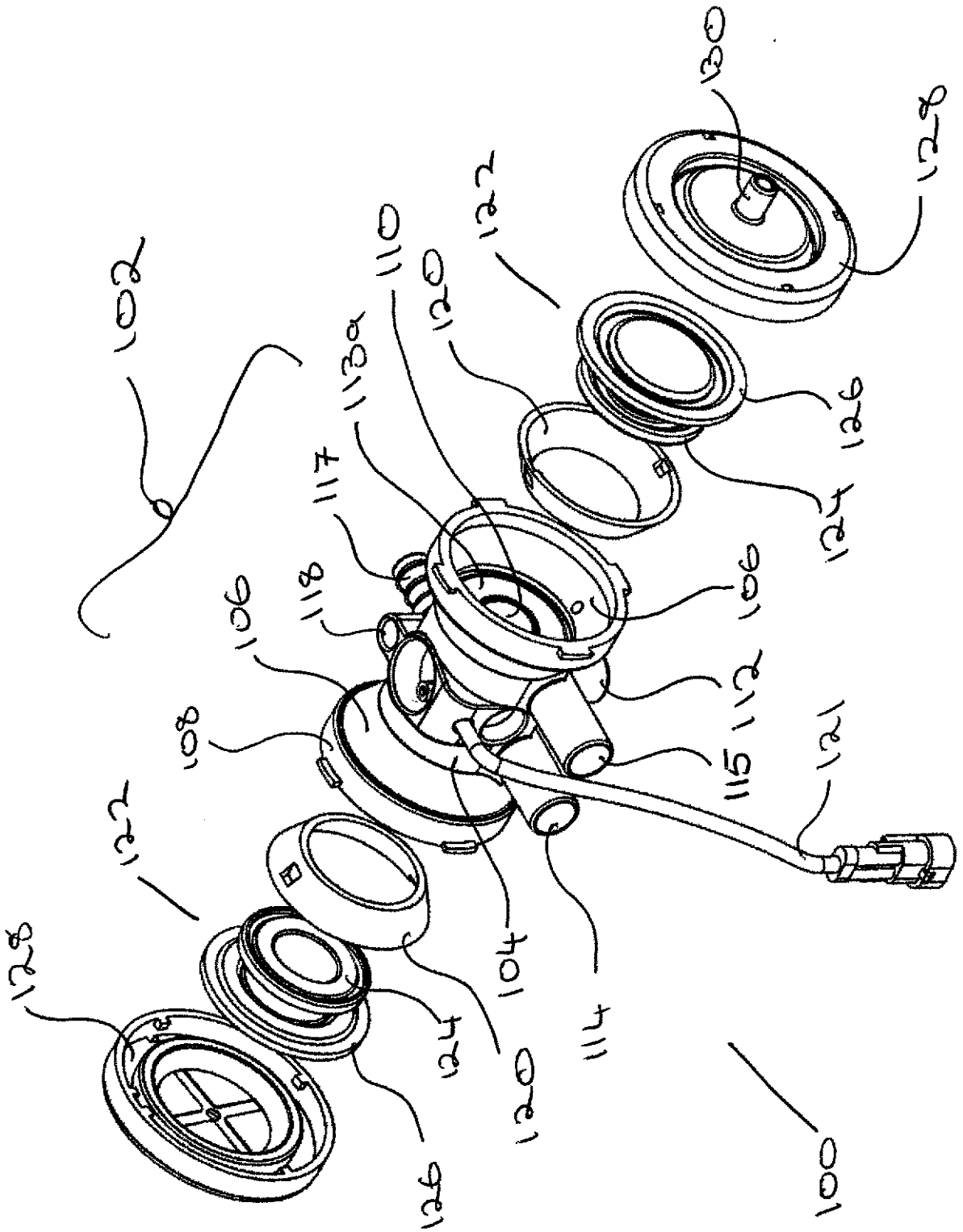
   at least one of the valves comprises a double diaphragm valve (122) having an actuator diaphragm (126) connected to a flow-control diaphragm (124), the actuator diaphragm (126) having a larger area than the flow-control diaphragm (124).

2. A milk diverting valve assembly (100, 200, 300) as claimed in claim 1 further comprising a cap (128) covering each actuator diaphragm (126), the caps (128) being adapted to be connected to a vacuum source.

3. A milk diverting valve assembly (100, 200, 300) as claimed in any preceding claim in which the actuator diaphragm (126) is concentric with the flow-control diaphragm (124) and the actuator diaphragm (126) is connected to the flow-control diaphragm (124) along their central axis.

4. A milk diverting valve assembly (100, 200, 300) as claimed in any preceding claim in which the milk inlet (112, 212) is connected to a milk meter (700).

5. A cattle milking system comprising the milk diverting valve assembly (100, 200, 300) as claimed in any preceding claim.


130
128
122
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120
102
126
117
113a
118
106
108
112
115
121
104
114
100
124

Fig. 1

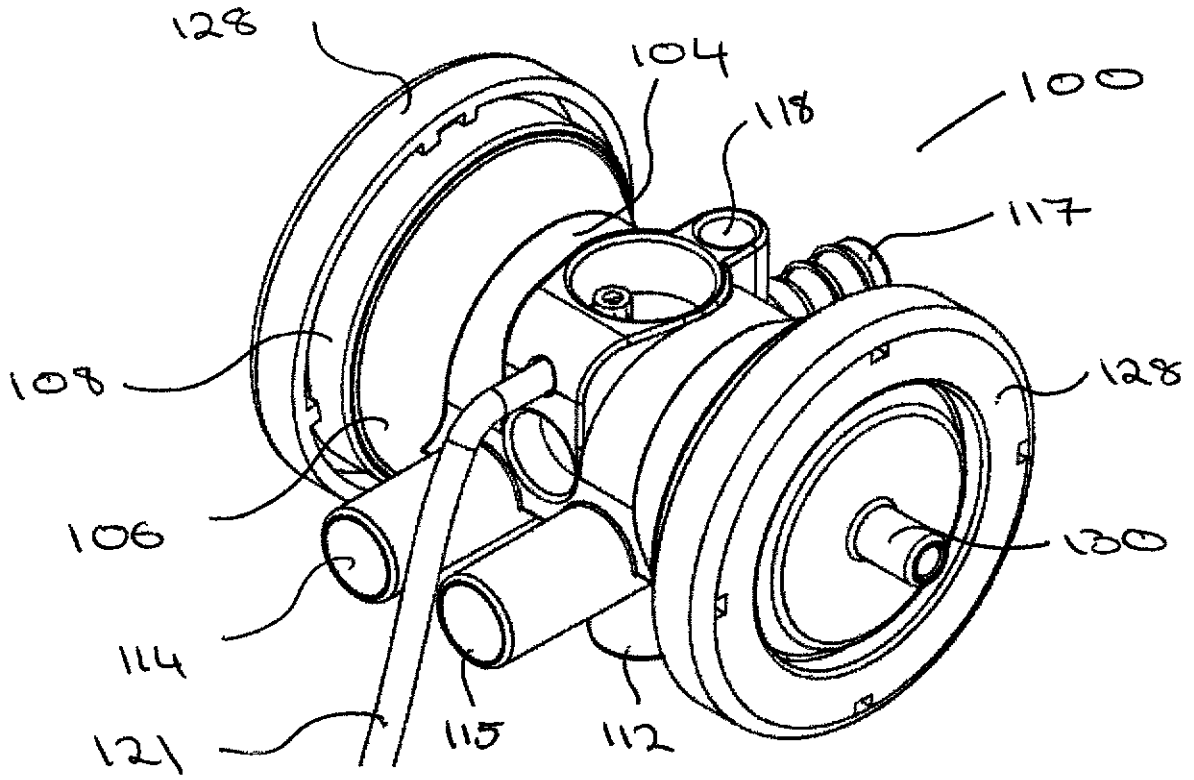
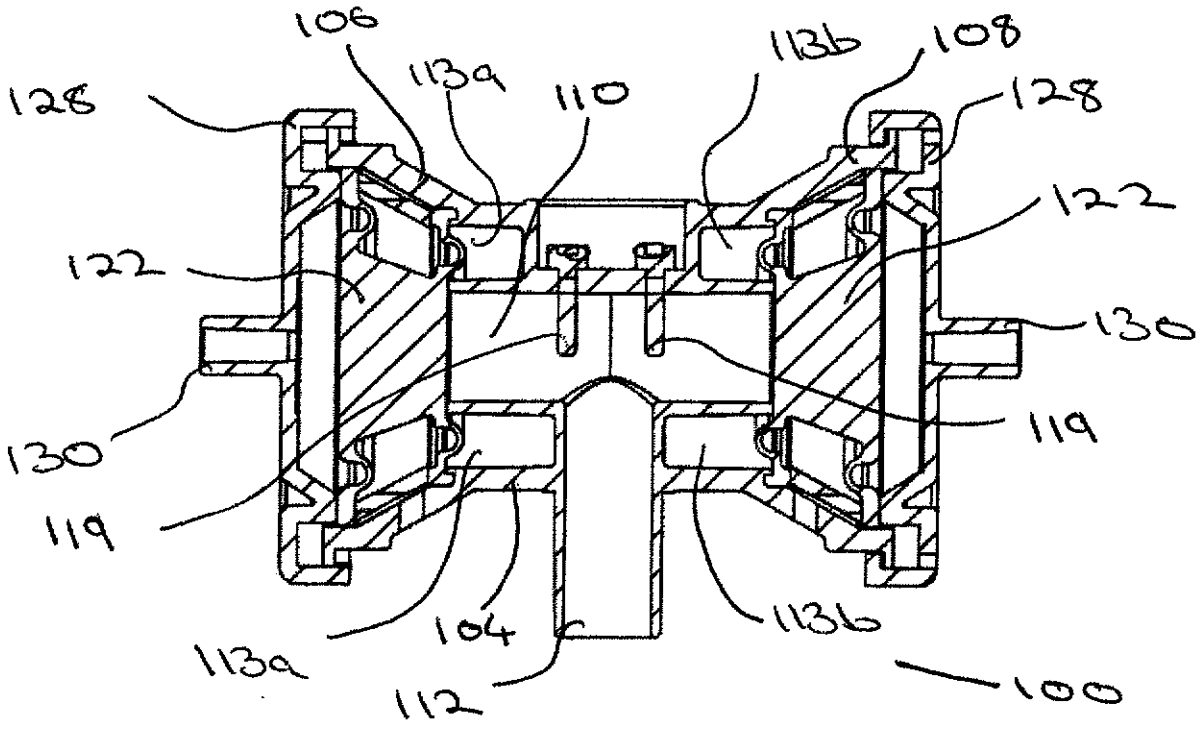

128
104
100
118
117
108
128
106
130
114
121
115
112

Fig. 2(a)


106
113b
110
113b
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128
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122
122
130
130
119
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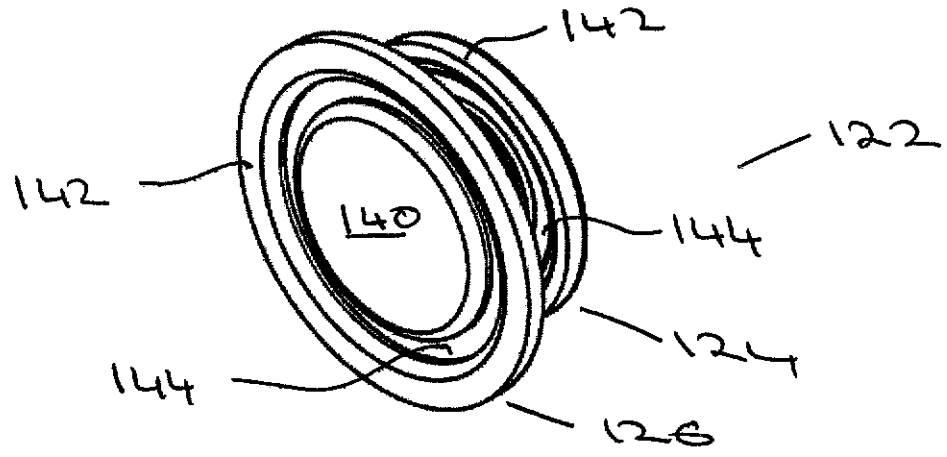
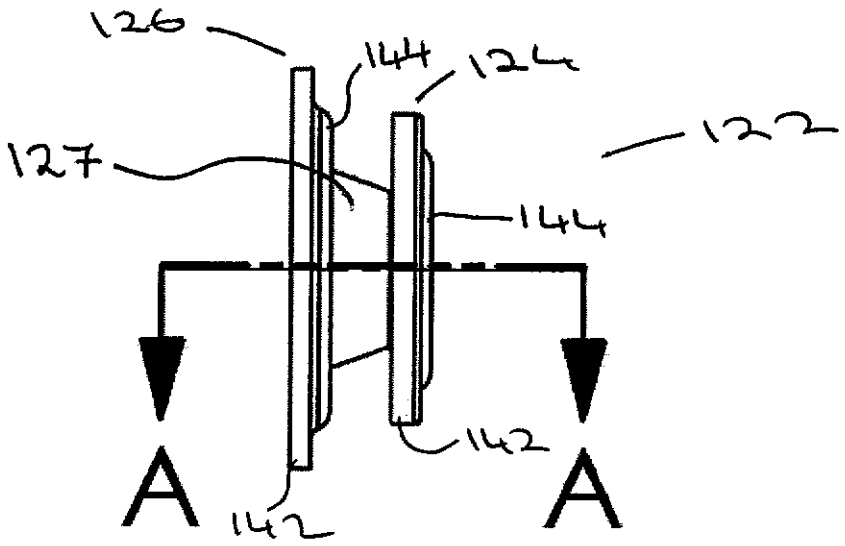
104
113b
112
113b
100

Fig. 2(b)



(a)



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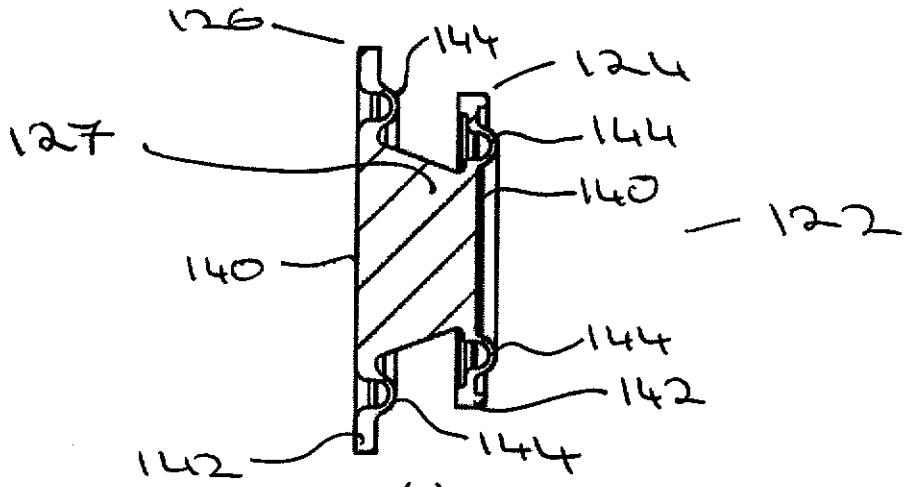
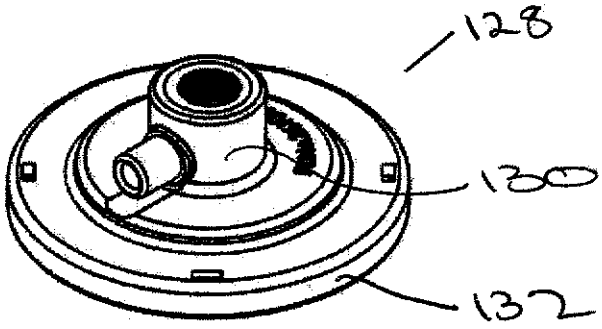
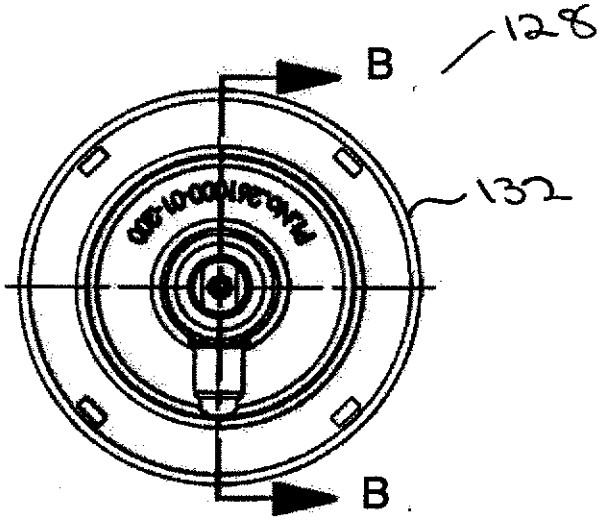


(c)

Fig. 3



(a)



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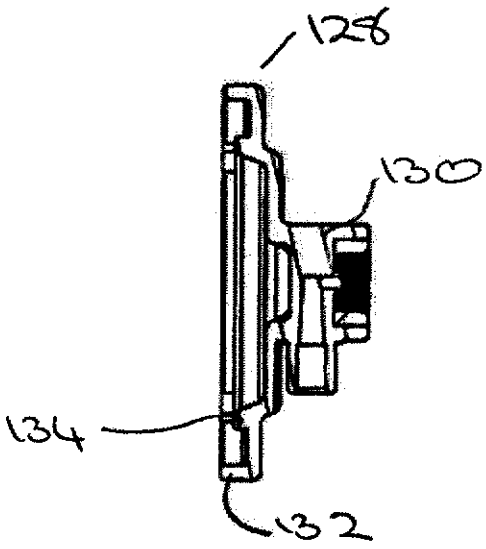


(c)

Fig. 4

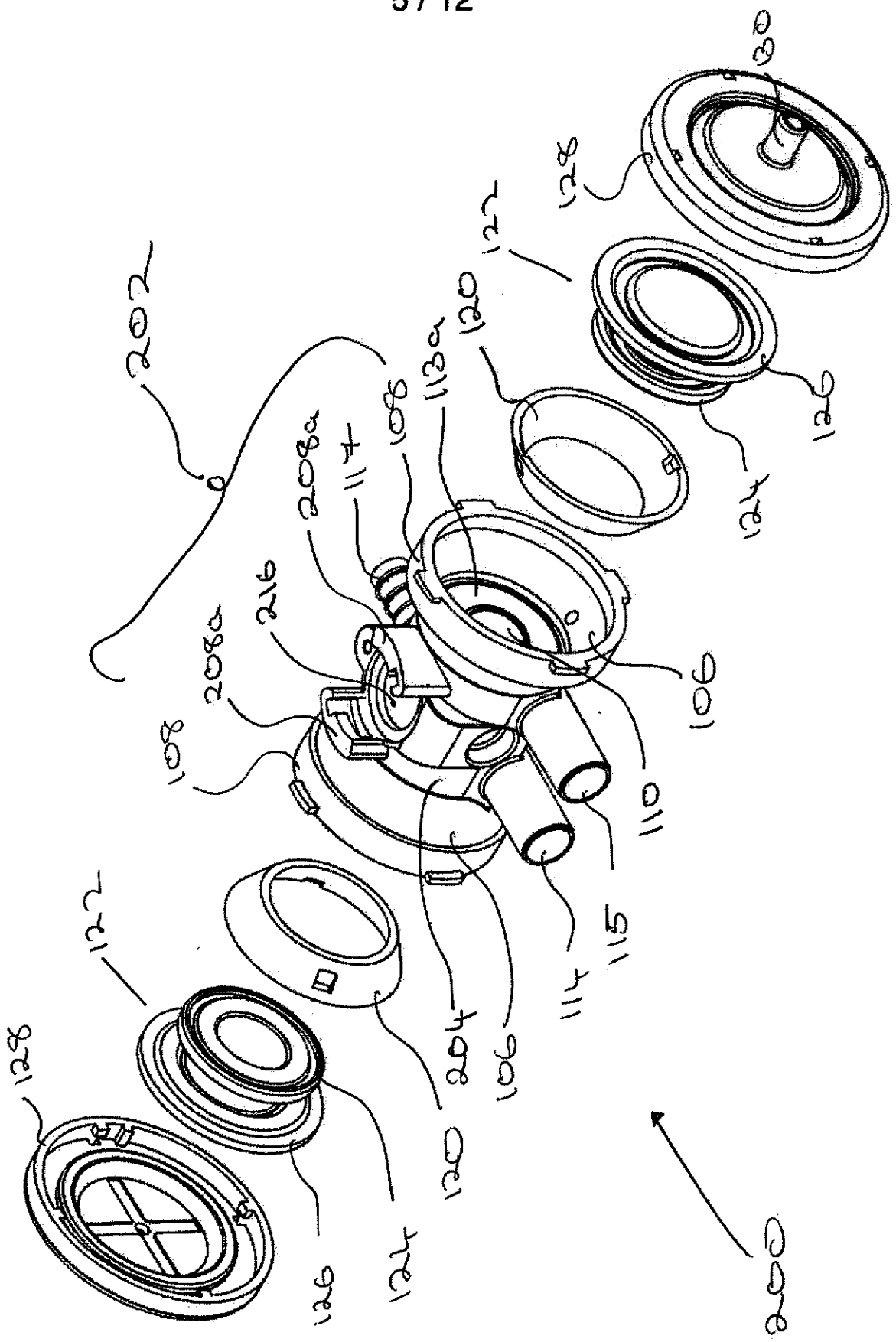
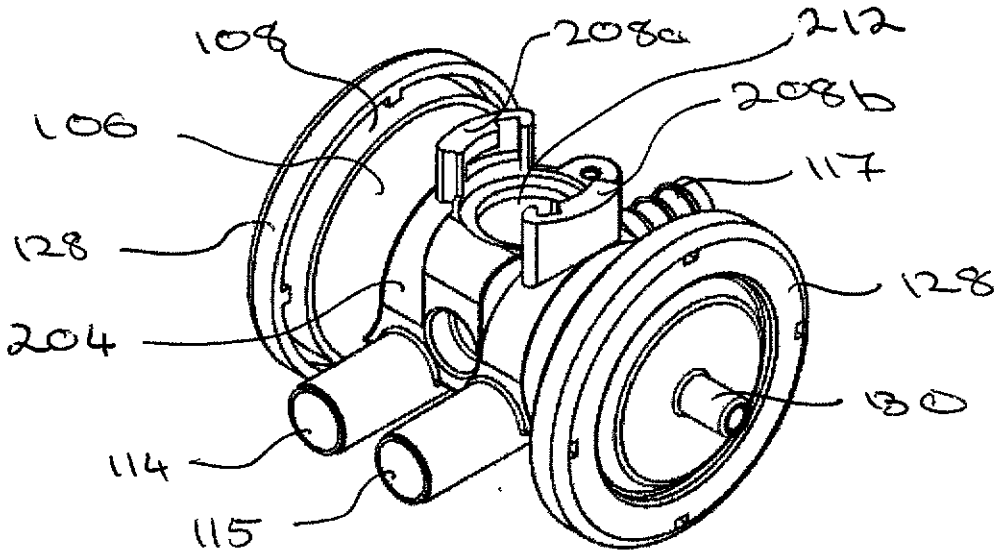

202
208a
114
108
113a
120
122
128
130
216
208a
108
106
110
112
115
204
106
120
122
126
124
128
200

Fig. 5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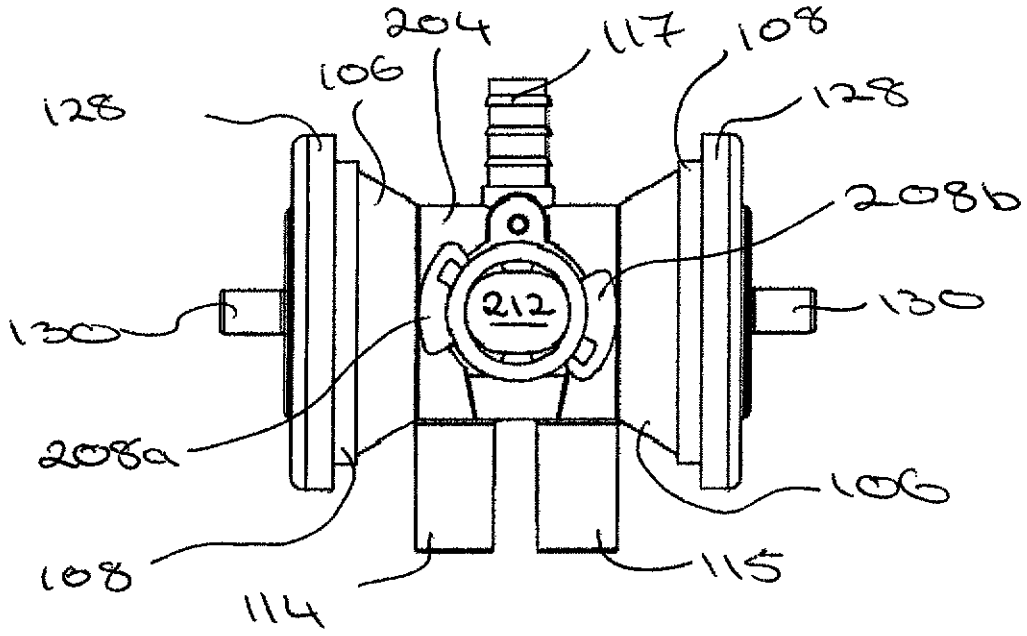
114
115

(a)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208b
212
130
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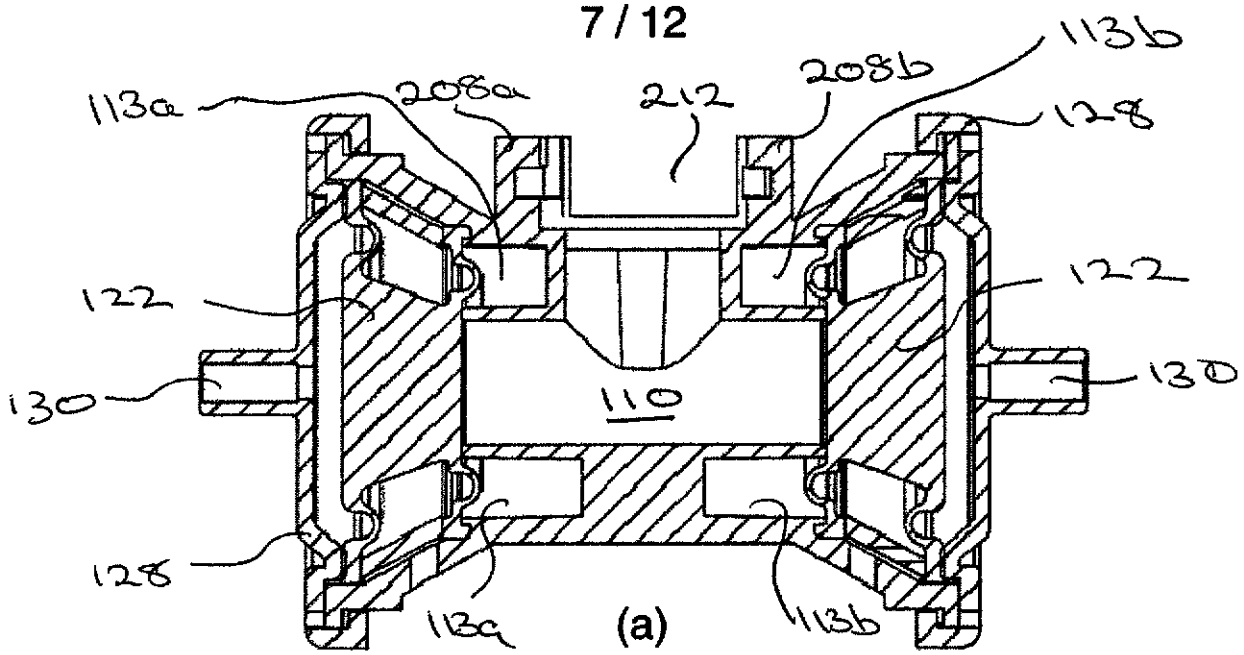
208a
106
108
114
115

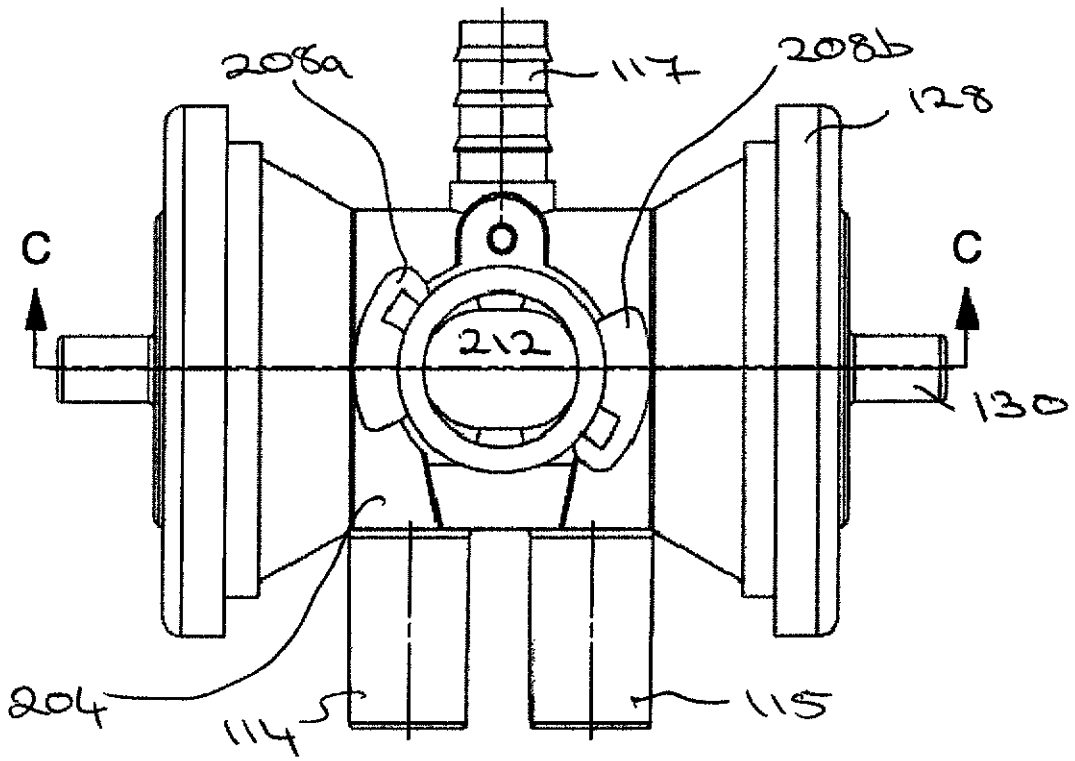
(b)

Fig. 6



(a)

SECTION C - C



(b)

Fig. 7

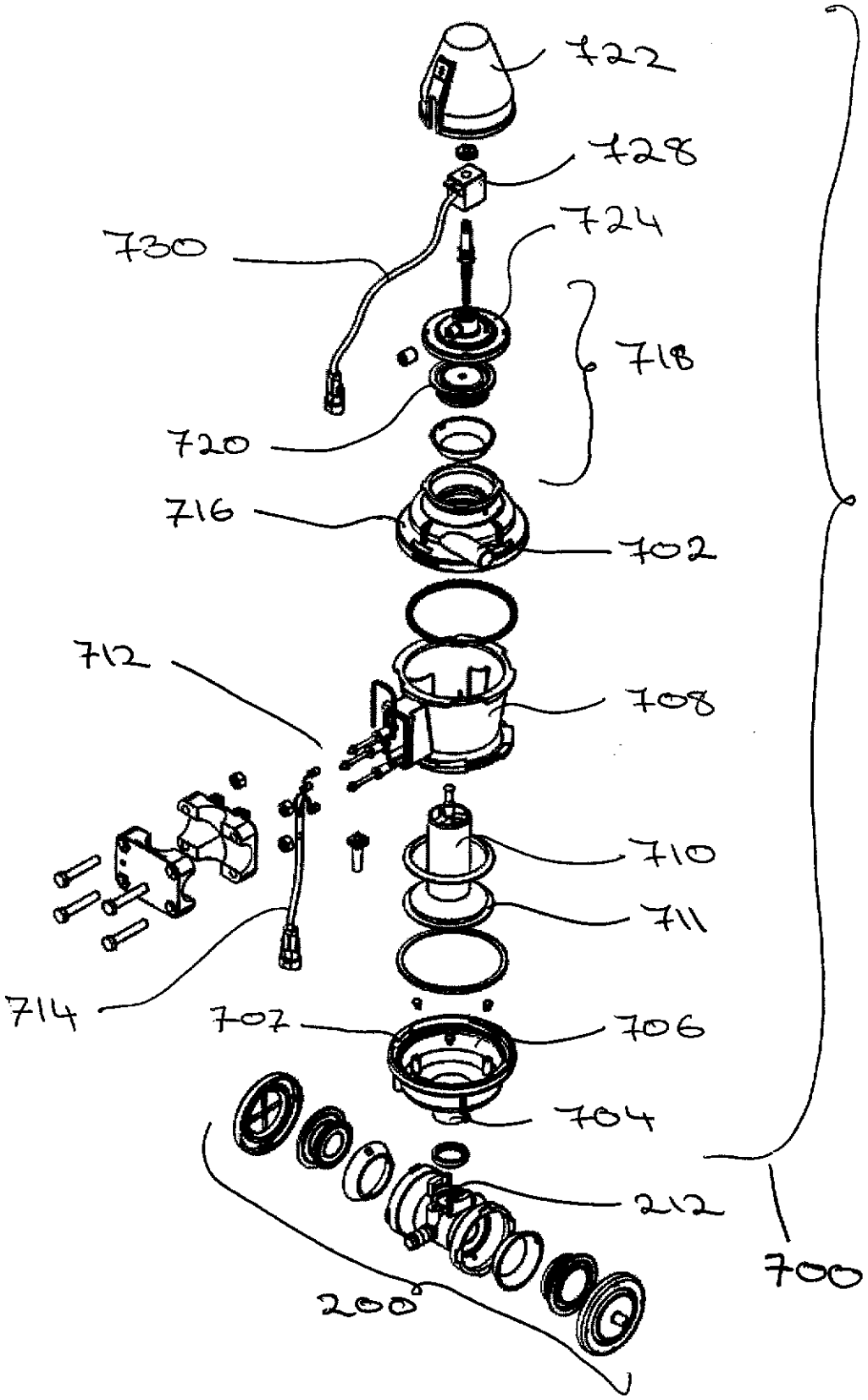

722
728
730
724
718
720
716
702
712
708
710
711
714
707
706
704
212
700
200

Fig. 8

SC5095

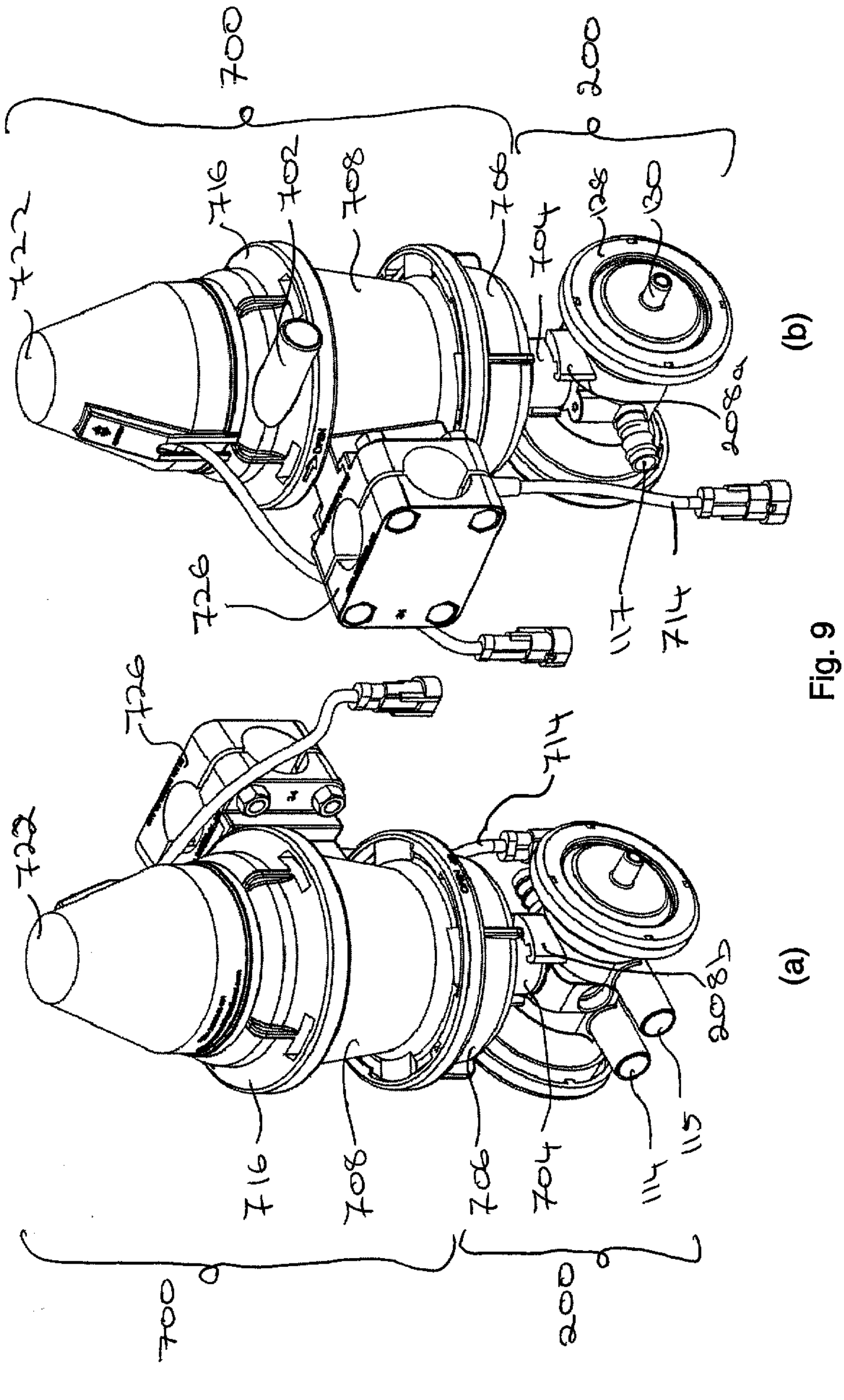
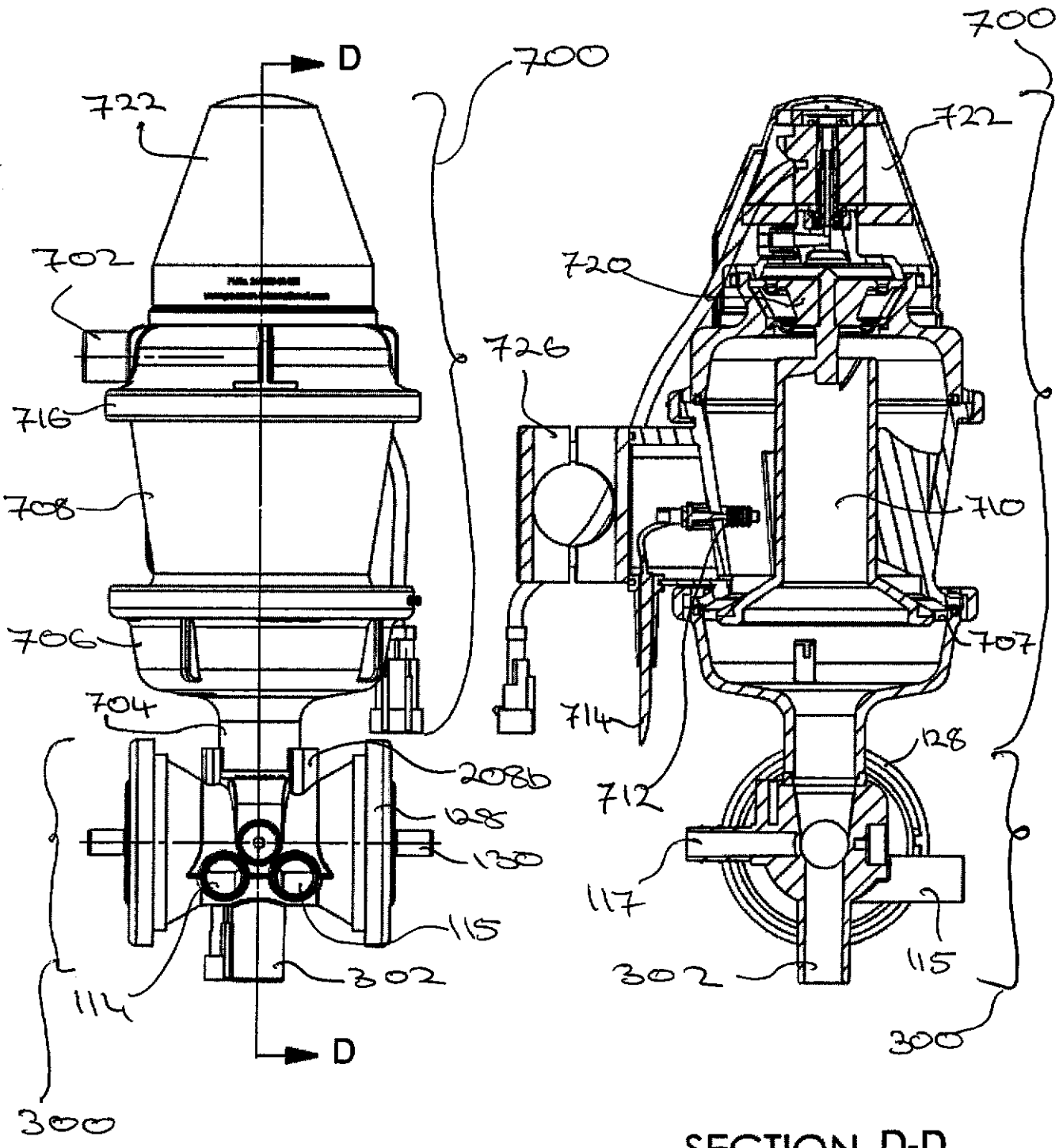

700
200
722
716
702
708
706
704
126
130
208a
117
714
726
(b)
722
726
714
716
708
706
704
208b
114
115
(a)
700
200

Fig. 9



(a)

SECTION D-D

(b)

Fig. 10

S85895

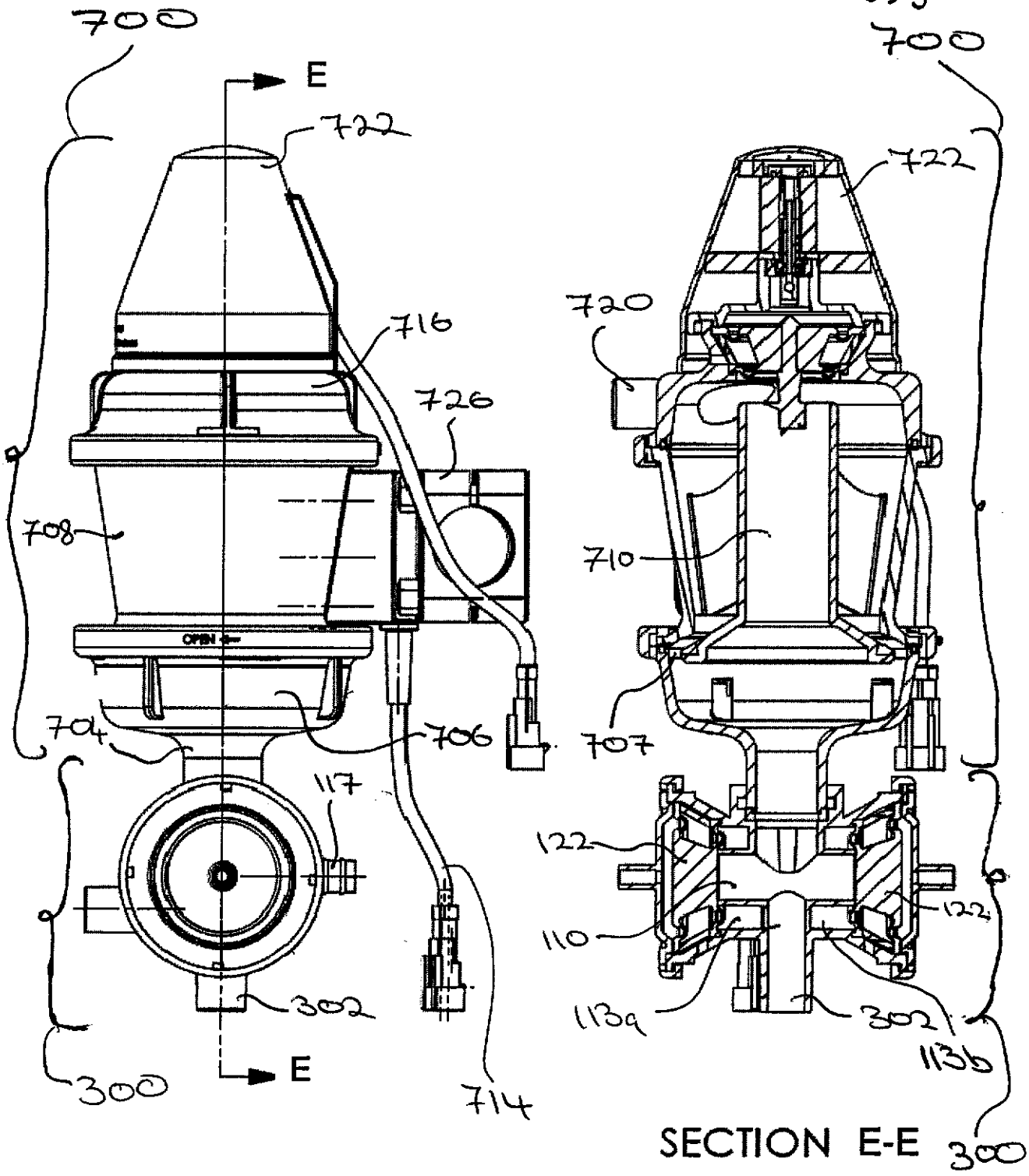


Fig. 11

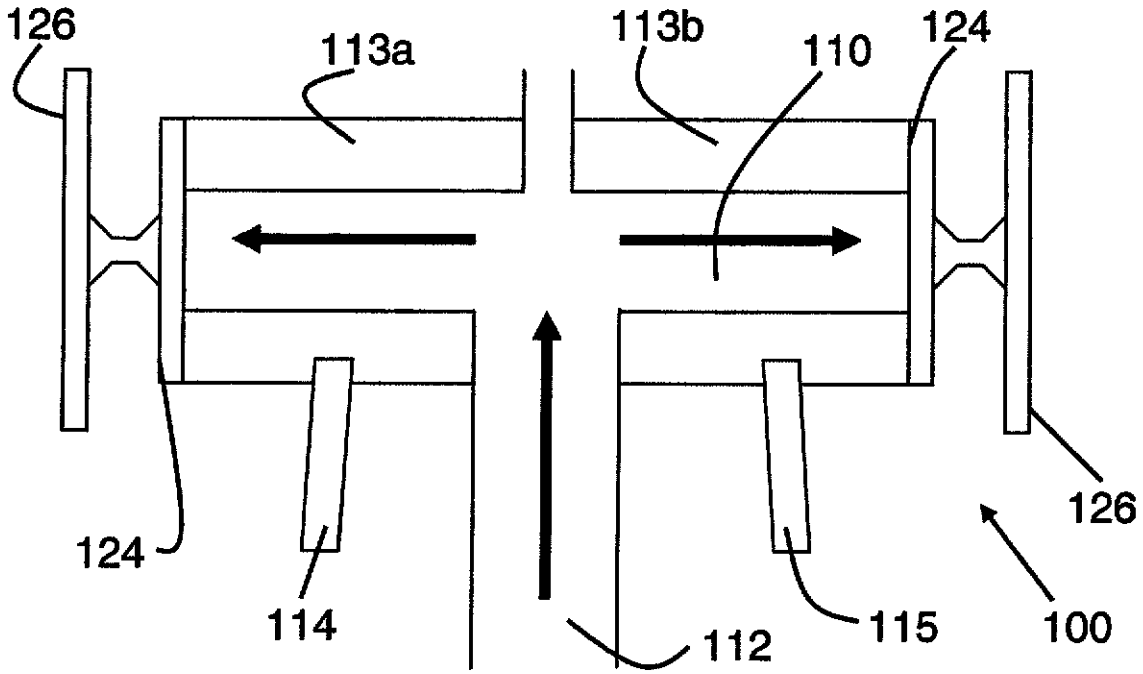

126
113a
113b
110
124
124
114
112
115
126
100

Fig. 12

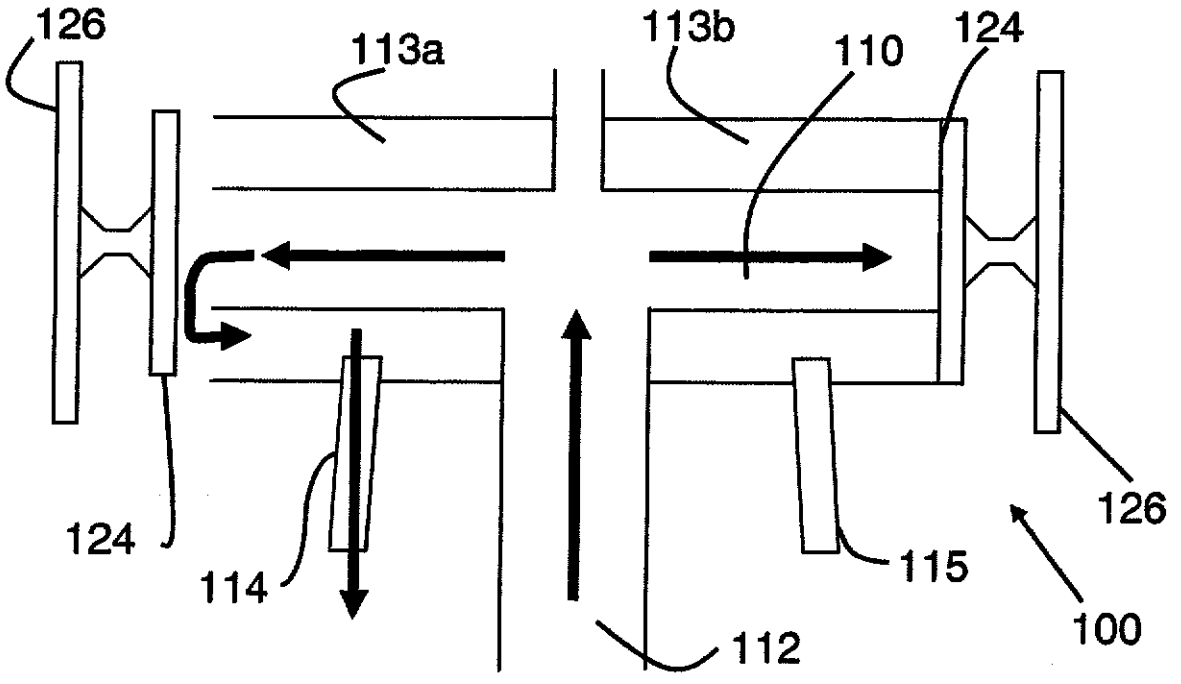

126
113a
113b
110
124
124
114
112
115
126
100

Fig. 13