(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 3 945 212 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
02.02.2022 Bulletin 2022/05

(21) Application number: **21187901.0**

(22) Date of filing: **27.07.2021**

(51) International Patent Classification (IPC):
F04D 13/16 (2006.01) ***F04D 15/02*** (2006.01)
F04D 29/42 (2006.01) ***F04D 29/70*** (2006.01)
F04D 15/00 (2006.01) ***F24F 13/22*** (2006.01)
F04D 29/60 (2006.01)

(52) Cooperative Patent Classification (CPC):
F04D 13/16; F04D 29/4293; F04D 29/605; F04D 29/669; F04D 29/708; F05D 2250/52; F24F 13/222

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(30) Priority: **27.07.2020 GB 202011610**
27.07.2020 GB 202011606

(71) Applicant: **Aspen Pumps Limited**
Hailsham, East Sussex BN27 3WA (GB)

(72) Inventors:
- **Saich, Claire**
Horsham, West Sussex, RH12 4PF (GB)
- **Mabon, Jack**
St Leonards, East Sussex, TN38 8DU (GB)

(74) Representative: **HGF**
HGF Limited
1 City Walk
Leeds LS11 9DX (GB)

(54) CONDENSATE PUMP ARRANGEMENT

(57) A condensate pump arrangement comprising a housing; a reservoir portion formed within the housing; a pump portion formed within the housing; and a pump located within the pump portion and comprising a first fluid outlet, a second fluid outlet and a fluid inlet. The fluid inlet is configured to draw fluid from the reservoir portion. The first fluid outlet is configured to connect to a discharge line, and the second fluid outlet is configured to selectively expel a jet of fluid into the reservoir portion.

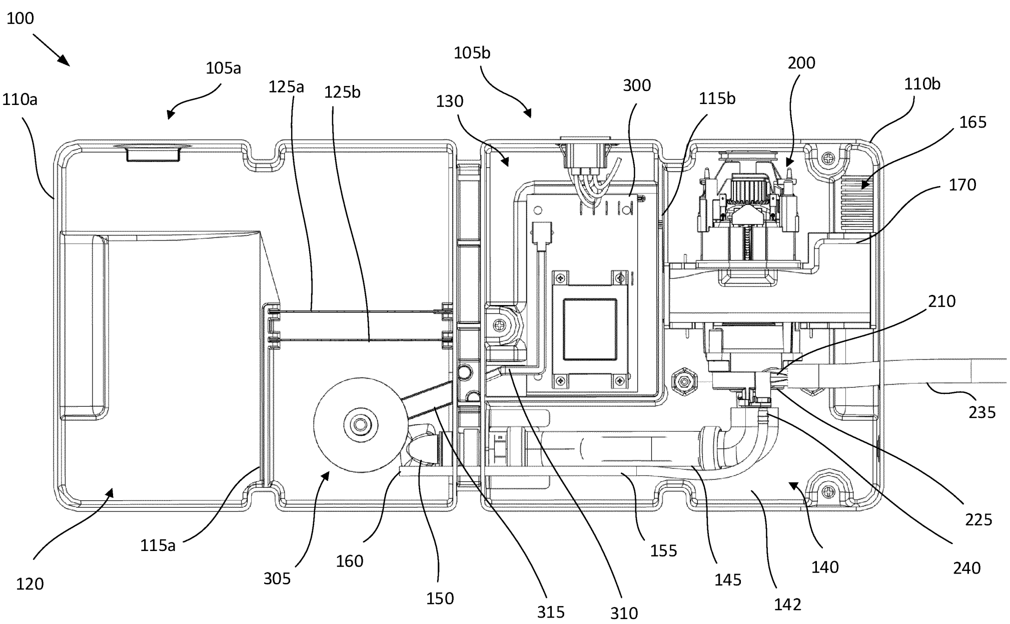

FIG. 2

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Description

[0001] This invention relates to a condensate pump arrangement.

BACKGROUND

[0002] Condensate pump assemblies are used to pump liquid condensate from appliances that produce condensate, for example an air conditioning system, a condensing boiler system or a refrigerator, out of a room or building. In a typical air conditioning system, the air conditioning unit produces liquid condensate, i.e. water, which drains from the air conditioning unit to a liquid reservoir in a condensate pump assembly, often located near the air conditioning unit. After sustained operation of the condensate pump assembly, contaminants such as dirt may enter the reservoir and are not removed by the pump. As there are damp conditions within the reservoir of a condensate pump, care should be taken to avoid mould growth within the reservoir which may result in harmful substances being introduced into the pump or products being refrigerated. Similar concerns apply with respect to condensate pumps of refrigeration units, particularly in industrial or commercial settings, which may also be installed in confined spaces. This can make cleaning of these units challenging and sometimes dangerous, particularly where chemicals are required to properly clean the units.

[0003] As refrigeration units may be operating for extended periods of time, it is important to reduce the vibrations of the condensate pump assembly due to the motor within the condensate pump. Excessive vibrations of the assembly can result in fatigue of components and materials used to secure the condensate pump assembly, and in extreme cases may result in damage to the condensate pump assembly. A further benefit to reducing the vibrations of the condensate pump assembly is the reduction in noise generated by the motor during operation. This is particularly important in residential and commercial settings, where the refrigeration unit may be located in a home or office or retail space.

[0004] As a motor is used to drive the condensate pump, extended periods of operating the pump will result in considerable heat generation by the motor. As refrigeration units may be installed in confined spaces, it is important to efficiently transfer heat away from the pump motor to prevent overheating of the motor and reduce the risk of damaging the remaining components in the condensate pump assembly and shorten the life of the condensate pump assembly.

[0005] The present disclosure seeks to provide at least an alternative to condensate pump arrangements of the prior art.

BRIEF SUMMARY OF THE DISCLOSURE

[0006] Viewed from a first aspect, the present invention provides a condensate pump arrangement, comprising a housing, a reservoir portion formed within the housing, a pump portion formed within the housing, and a pump located within the pump portion comprising a first fluid outlet, a second fluid outlet and a fluid inlet. The fluid inlet is configured to draw fluid from the reservoir portion. The first fluid outlet is configured to connect to a discharge line, and the second fluid outlet is configured to selectively expel a jet of fluid into the reservoir portion.

[0007] Thus, the present condensate pump arrangement provides a self-cleaning mechanism that utilises the otherwise undesirable pressure head generated when initiating a pump and diverting a proportion of the otherwise waste condensate back to the reservoir portion, typically through a bleed line. This advantageously provides an automatic method of agitating the liquid within the reservoir portion whenever the pump initiates and reduces the likelihood of bacterial growth within the reservoir portion. A further advantage of the condensate pump arrangement is the use of a mixture of liquid and air to enhance the cleaning effect when the condensate is fed back into the reservoir portion.

[0008] The second fluid outlet may be configured to connect to a fluid line extending between the reservoir portion and the pump. The second fluid outlet may be configured to expel the jet of fluid towards a filter within the reservoir portion. The second fluid outlet may be located above the first fluid outlet. Providing filters within the reservoir portion is desirable, as debris entering the pump can result in damage to the internal components of the pump. By introducing a filter and keeping the filter clear, the efficiency of the pump can be maintained and the noise of the pump in operation is reduced. A further advantage of maintaining a clean filter is the increased time between servicing the condensate pump assembly.

[0009] The pump arrangement may comprise a first bracket secured to the pump portion of the housing and configured to connect to a first portion of the fluid line. The first bracket may be arranged to secure the fluid line so as to provide at least one U-bend in the fluid line. The first bracket may be configured to secure the first fluid line in a serpentine arrangement, This helps to prevent accumulation of solid or liquid deposits within the first fluid line.

[0010] The pump arrangement may comprise a second bracket secured to the reservoir portion of the housing and configured to connect to a second portion of the fluid line. The second bracket may be arranged to direct the second fluid outlet in a pre-determined direction. This advantageously allows for liquid expelled from the second fluid line to be directed at, for example, a filter in the reservoir which helps to keep the filter clear of such deposits.

[0011] A first end of the fluid inlet, within the reservoir portion, may comprise an inlet port having an inlet axis, and the inlet axis may form a substantially perpendicular angle with a bottom surface of the reservoir portion.

[0012] This, in itself, is believed to be novel and so, in accordance with an example of the present disclosure, there is provided a condensate pump arrangement, comprising a housing, a reservoir portion formed within the housing, a pump portion formed within the housing, and a pump located within the pump portion comprising a first fluid outlet and a second fluid outlet, and a fluid inlet. The fluid inlet is configured to draw fluid from the reservoir portion. The first fluid outlet is configured to connect to a discharge line, and a first end of the fluid inlet, within the reservoir portion, comprises an inlet port having an inlet axis, and wherein the inlet axis forms a substantially perpendicular angle with a bottom surface of the reservoir portion. This advantageously allows the pump to reduce the liquid level within the reservoir portion much closer to the bottom surface without drawing in air from the reservoir portion. This advantageously reduces the risk of an air lock forming in the pump when the pump motor is primed.

[0013] The fluid inlet may comprise a face at the first end through which the fluid inlet passes, and the face may be arranged at an acute angle relative to the bottom surface of the reservoir portion. This advantageously provides a method of purging any air that is present in the inlet member when the pump is primed. Further, providing an inlet member with an angled face provides some flexibility during the installation procedure while minimising the risk that the inlet face will be installed parallel relative to the liquid level surface. The acute angle may be at least 10 degrees relative to the bottom surface. The acute angle may be up to 45 degrees relative to the bottom surface.

[0014] The fluid inlet may comprise a conduit extending from a first end within the reservoir portion to a second end connected to the pump within the pump portion, and the inlet port may be defined by a shroud member connected to the first end of the conduit. The shroud member may define a tapering inlet channel from the inlet port to the first end of the conduit, the area of the inlet port being greater than a cross sectional area of the conduit. The shroud member may have a first width and a second width, and the second width may be greater than the first width. Having a larger cross-sectional area at the first end lowers the fluid velocity of liquid entering the fluid inlet and spreads the area of suction across a wider area of the reservoir portion, further reducing the likelihood of drawing air into the liquid inlet.

[0015] The pump arrangement may further comprise an air duct secured within the housing. The pump may further comprise a motor casing having a first opening, an inner surface, and a second opening, and a motor. At least a portion of the motor may be contained within the motor casing and spaced from the inner surface. The space between the portion of the motor within the motor casing and the inner surface may define an inner region within the motor casing. An air flow path may be formed between an air inlet of the housing, the first opening, the inner region, the second opening, the air duct, and an air outlet of the housing. The motor may be configured to drive air along the air flow path.

[0016] This, in itself, is believed to be novel and so, in accordance with a further example of the present disclosure, there is provided a condensate pump arrangement, comprising a housing, a reservoir portion formed within the housing, a pump portion formed within the housing, a pump located within the pump portion comprising a first fluid outlet and a second fluid outlet and a fluid inlet, and an air duct secured within the housing. the fluid inlet is configured to draw fluid from the reservoir portion. The first fluid outlet is configured to connect to a discharge line. The pump further comprises a motor casing having a first opening, an inner surface, and a second opening, and a motor. At least a portion of the motor is contained within the motor casing and spaced from the inner surface. The space between the portion of the motor within the motor casing and the inner surface defines an inner region within the motor casing. An air flow path is formed between an air inlet of the housing, the first opening, the inner region, the second opening, the air duct, and an air outlet of the housing, and the motor is configured to drive air along the air flow path. This advantageously allows the motor to be ventilated by drawing cool ambient air through the air inlet and passing the cool air through the motor before being blown out of the duct and out of the first housing. This advantageously allows the operation of the pump motor to drive the air flow through the ventilation arrangement.

[0017] The pump may comprise a rotating shaft and a fan secured to the shaft. The fan may be configured to drive air along the air flow path.

[0018] The pump arrangement may further comprise at least one resiliently deformable member configured to support the motor casing. The resiliently deformable member may be configured to absorb vibrations from the motor casing, thereby reducing the transmission of vibrations from the motor casing to the housing. The resiliently deformable member may be arranged to circumscribe the motor casing. The resiliently deformable member may be arranged between at least one flange extending perpendicularly from the bottom surface of the first housing and the air duct.

[0019] The resiliently deformable member may comprise an outer surface having at least one rib extending radially therefrom. The at least one rib may extend by 1.5mm from the outer surface. The resiliently deformable member may be made from ethylene propylene diene monomer (EDPM) rubber. The resiliently deformable member may have a Shore A hardness of 60.

[0020] The pump arrangement may further comprise a liquid level sensor configured to detect a liquid level within the reservoir portion, and a controller configured to operate the pump when the liquid level sensor outputs a first signal indicative of a liquid level within the reservoir portion above a level of the liquid inlet to the pump and to stop the pump when the liquid level sensor outputs a second signal indicative of a liquid level within the reservoir portion approaching or below a level of the liquid inlet to the pump.

[0021] The controller may be configured to output a third signal indicative of a high liquid level within the reservoir portion. The controller may be configured to operate the pump at a second speed when the liquid level sensor The second speed may be greater than the first speed.

[0022] The reservoir portion may be arranged to receive condensate from an air-conditioning unit operatively connected to the controller. The controller may be configured to output a control signal to shut off the air-conditioning unit when the liquid level sensor outputs the third signal. The controller may be configured to output a control signal to a building management system operatively connected to the pump assembly in response to the high liquid level. The controller may be configured to operate the pump at the first speed in response to detecting the high liquid level.

[0023] The liquid level sensor may comprise one or more float sensors, and wherein each of the one or more float sensors are configured to output one or more of the signals indicative of one or more liquid levels within the reservoir portion.

[0024] When the liquid level sensor comprises more than one float sensor, each of the float sensors may be mounted at different heights within the housing and be configured to output a signal indicative of a different liquid level.

[0025] The controller may be configured to expel the jet of liquid from the second fluid outlet upon initiation of the pump motor.

[0026] The pump arrangement may further comprise a valve connector assembly comprising an inlet part, a one-way valve, and an outlet part releasably secured to the inlet part, wherein the first fluid outlet is configured to connect to the discharge line via the inlet part, wherein the inlet part and outlet part are mounted to opposed internal and external sides of the housing, wherein, in use, the valve connector assembly defines a fluid flow path from the inlet part to the outlet part via a fluid port extending between the opposed internal and external sides, wherein, in use, the valve connector assembly is configured to restrict fluid flow from the outlet part to the inlet part, and wherein, when the outlet part is released from the inlet part, the one-way valve is exposed through the fluid port, such that a user can access the one-way valve from the external side of the housing.

[0027] This, in itself, is believed to be novel and so, in accordance with a further example of the present disclosure, there is provided a condensate pump arrangement comprising: a housing; a reservoir portion formed within the housing; a pump portion formed within the housing; a pump located within the pump portion and comprising a first fluid outlet, a second fluid outlet, and a fluid inlet; and a valve connector assembly comprising an inlet part, a one-way valve, and an outlet part releasably secured to the inlet part. The fluid inlet is configured to draw fluid from the reservoir portion. The first fluid outlet is in fluid communication with the inlet part. The outlet part is configured to connect to a discharge line. The inlet part and outlet part are mounted to opposed internal and external sides of the housing. In use, the valve connector assembly defines a fluid flow path from the inlet part to the outlet part via a fluid port extending between the opposed internal and external sides. In use, the one-way valve is configured to restrict fluid flow from the outlet part to the inlet part. When the outlet part is released from the inlet part, the one-way valve is exposed through the fluid port, such that a user can access the one-way valve from the external side of the housing.

[0028] The releasable connection between the first and second parts of the present valve connector assembly advantageously allows for easy separation of the second part from the pump assembly while leaving the one-way valve exposed within the fluid port for cleaning and servicing. Thus, there is no need for a user to open the pump assembly housing to access the valve connector for maintenance, which would require further disconnecting of the liquid lines within the housing.

[0029] There is also provided a valve connector assembly for mounting to a panel having opposed first and second sides and a fluid port formed therein, the assembly comprising: an inlet part configured to connect to a liquid source; an outlet part releasably secured to the inlet part and arranged to allow fluid to flow therethrough, and a one-way valve configured, in use, to restrict fluid flow from the outlet part to the inlet part. In use, the inlet part is mounted to a first of the opposed sides and the outlet part is mounted to a second of the opposed sides and secured to the inlet part so as to define a fluid flow path from the inlet part to the outlet part via the fluid port. When the outlet part is released from the inlet part, the one-way valve is exposed through the fluid port, such that a user can access the one-way valve from the second side of the panel.

[0030] The one-way valve may be integrally formed with the inlet part. The outlet part may be secured to the inlet part by one or more mechanical fasteners. The outlet part may be secured to the inlet part by a plurality of mechanical fasteners. A first of the plurality of mechanical fasteners may extend from the inlet part to the outlet part and terminate within the outlet part. A second of the plurality of mechanical fasteners may extend from the outlet part to the inlet part and terminate within the inlet part.

[0031] The valve connector assembly may comprise a core member and a gasket. The inner part may be configured to receive a part of the core member. The gasket may be disposed around the part of the core member received by the inlet part so as to provide a fluid-tight seal between the core member and the inner part.

[0032] The core member may comprise a shoulder arranged to abut the external side of the housing. The outer part may comprise a recess for receiving the shoulder. In use, the outer part may be configured to press the shoulder against the external side of the housing. The one-way valve may be an umbrella valve.

[0033] The pump arrangement may further comprise a fluid port extending between opposed internal and external sides of the housing; a plug assembly having a resiliently deformable part and a stiffening part removably secured to the deformable part, wherein the resiliently deformable part extends from the external side of the housing through the fluid port to the internal side of the cavity so as to define a cavity for receiving the stiffening part on the internal side of the housing, wherein, in a first configuration when the stiffening part is inserted into the cavity, the stiffening part is configured to deform the resiliently deformable part so as to form a fluid-tight seal around the fluid port and to secure the resiliently deformable part to the housing, and wherein, in a second configuration when the stiffening part is removed from the cavity, the resiliently deformable part is releasable from the housing.

[0034] This, in itself, is believed to be novel and so, in accordance with a further aspect of the present invention, there is provided a condensate pump arrangement comprising: a housing; a reservoir portion formed within the housing; a pump portion formed within the housing; a pump located within the pump portion and comprising a first fluid outlet, a second fluid outlet, and a fluid inlet; a fluid port extending between opposed internal and external sides of the housing, a plug assembly having a resiliently deformable part and a stiffening part removably secured to the resiliently deformable part. The fluid inlet is configured to draw fluid from the reservoir portion. The first fluid outlet is configured to connect to a discharge line. The resiliently deformable part extends from the external side of the housing through the fluid port to the internal side of the housing so as to define a cavity for receiving the stiffening part on the internal side of the housing. In a first configuration when the stiffening part is inserted into the cavity, the stiffening part is configured to deform the resiliently deformable part so as to form a fluid-tight seal around the fluid port and to secure the resiliently deformable part to the housing. In a second configuration when the stiffening part is removed from the cavity, the resiliently deformable part is releasable from the housing. The present inlet plug assembly provides a reliable seal in the inlet port compared to prior art plugs which only utilise a single material in the inlet port.

[0035] The present invention also provides a plug assembly for selectively sealing a fluid port in a panel, the plug assembly comprising: a resiliently deformable part and a stiffening part removably secured to the resiliently deformable part. The resiliently deformable part extends from a first side of the panel through the fluid port to a second side of the panel opposed to the first side so as to define a cavity for receiving the stiffening part on the second side of the housing, In a first configuration when the stiffening part is inserted into the cavity, the stiffening part is configured to deform the resiliently deformable part so as to form a fluid-tight seal around the fluid port and to secure the resiliently deformable part to the panel. In a second configuration when the stiffening part is removed from the cavity, the resiliently deformable part is releasable from the panel.

[0036] In the second configuration, a part of the deformable member disposed on the internal side may have a first profile having a radius of curvature. In the first configuration, the stiffening member may be arranged to deform the deformable member such that the part of the deformable member has a second profile having a second radius of curvature larger than the first radius of curvature. The domed portion advantageously provides a convenient source of material for stretching to accommodate the second part in the cavity.

[0037] The deformable part may comprise a flange having a first face. In the second configuration, the first face may be arranged to form an angle with the external side. In the first configuration, the stiffening member may be arranged to deform the deformable member such that the first face is substantially flush with the external side so as to provide a fluid-tight seal around the fluid port.

[0038] The stiffening part may be tethered to the deformable member. The stiffening member may comprise a first recess configured to receive one or more means for removing the stiffening member from the cavity. By way of example, a tool or a finger of a user may engage the recess to separate the second part from the first part.

[0039] The cavity may be formed in a substantially central position of the deformable part. The housing may comprise any of a metal material or a plastic material. In some cases, the housing may comprise stainless steel or acrylonitrile butadiene styrene (ABS).

[0040] Viewed from a further aspect of the present invention, there is provided a method of operating a condensate pump arrangement, comprising the steps of providing a condensate pump arrangement, comprising a housing, a reservoir portion formed within the housing, a pump portion formed within the housing; a pump located within the pump portion comprising a first fluid outlet, a second fluid outlet and a fluid inlet, and a controller configured to operate the pump, wherein the fluid inlet is configured to draw fluid from the reservoir portion, wherein the first fluid outlet is configured to connect to a discharge line, and wherein the second fluid outlet is configured to selectively expel a jet of fluid into the reservoir portion; initiating the pump at a first operating speed, and expelling a jet of the fluid from the second fluid outlet into the reservoir portion.

[0041] The fluid expelled from the fluid outlet chamber may be directed towards a filter secured within the reservoir portion.

[0042] The method may comprise the steps of providing a liquid level sensor configured to detect a liquid level within the reservoir portion and output a signal indicative of a liquid level within the reservoir portion, receiving the signal from the liquid level sensor indicating the liquid level is above a first liquid level, and initiating the pump at the first operating speed.

[0043] The method may further comprise the steps of receiving a signal from a user, and discharging liquid via the second fluid outlet into the reservoir portion.

[0044] The method may further comprise the steps of detecting the liquid level is below the first liquid level, and terminating operation of the pump.

BRIEF DESCRIPTION OF THE DRAWINGS

[0045] Examples of a condensate pump assembly are further described hereinafter with reference to the accompanying drawings, in which:

Figure 1 illustrates a condensate pump arrangement;

Figure 2 illustrates internal components of the condensate pump arrangement;

Figure 3A and 3B illustrate a liquid level sensor and filtration system of the condensate pump arrangement;

Figure 4 illustrates a fluid inlet and fluid outlets of the condensate pump arrangement;

Figure 5 and 6 illustrate a ventilation arrangement of the condensate pump arrangement;

Figure 7 illustrates a cross-sectional view of a gasket;

Figure 8 illustrates a perspective underside view of a shroud member;

Figure 9 illustrates an alternative condensate pump arrangement;

Figure 10 illustrates internal components of an alternative condensate pump arrangement;

Figure 11 illustrates an exemplary fluid line arrangement;

Figure 12 illustrates an alternative liquid sensor arrangement;

Figure 13 illustrates a perspective view of the internal components of an alternative condensate pump arrangement;

Figure 14 illustrates a cross-sectional view of an exemplary valve connector assembly;

Figure 15 illustrates an exploded cross-sectional view of a valve connector assembly;

Figure 16 illustrates a cross-sectional view of an exemplary valve connector;

Figure 17 illustrates an exemplary inlet member;

Figures 18A to 18C illustrate views of an exemplary inlet plug assembly in a closed configuration;

Figures 18D and 18E illustrate views of an exemplary inlet plug assembly in an open configuration.

DETAILED DESCRIPTION

[0046] Figure 1 illustrates a condensate pump arrangement 100. The condensate pump arrangement 100 has a first compartment 105a and a second compartment 105b formed within a housing. The first compartment 105a is defined by a lid 112a, side walls 110a and a bottom surface 135 (see also Figure 3B). The lid 112a also comprises a fluid inlet port 102 so as to allow condensate into the first compartment 105a. The second compartment 105b is defined by a lid 112b, side walls 110b and a bottom surface 142. A discharge line 235 is also shown extending through the side wall 110b of the second compartment 105b. The discharge line 235 is the outlet for condensate pumped out of the condensate pump arrangement 100. The condensate pump arrangement may, for example, be used in dairy and refrigeration cabinets. In these applications, the height of the arrangement is important and so the present arrangement has been designed to have a maximum height of 75mm. Any of the first 105a and second 105b compartments may be made from ABS.

[0047] Figure 2 illustrates internal components of the condensate pump arrangement 100. The first compartment 105a has a reservoir 120 which receives condensate deposited through the fluid inlet 102 of the lid 112a. As condensate enters the first compartment 105a, a sloped bottom surface 135 directs condensate towards an inlet port 151 formed within a shroud member 150 located within the reservoir portion 120. The sloped bottom surface 135 facilitates pumping of condensate out of the reservoir portion 120 through the shroud member 150. Two filters 125a, 125b are also shown in Figure 2 which cross the fluid flow path between the fluid inlet port 102 and the shroud member 150 and act to prevent particulate debris above a certain size from reaching the shroud member 150. The filters 125a, 125b are secured to a dividing wall 115a extending perpendicularly away from one of the side walls 110a. Respective pairs of slots formed within one of the side walls 110a and the dividing wall 115a securely receive each of the filters 125a, 125b. The filters 125a, 125b are substantially planar and have a square cross-section (see also Figure 3B). A series of holes extending through the body of the filter 125a, 125b and prevent debris larger than the diameter of the holes from being able to pass through the filter 125a, 125b. The filters are preferably made from copper to help prevent bacterial growth. It would be apparent that the filters described herein are provided by way of example, and that other configurations, arrangement and materials of filters are conceived by this description.

[0048] A liquid level sensor 305 is also disposed within the first compartment 105. As shown in Figure 1, the liquid level sensor 305 is in close proximity to the shroud member 150. While the liquid level sensor 305 is shown having a mechanical float, it would be understood that this is provided as an example, and that other arrangements or types of liquid level sensors 305, including non-contact sensors, would be equally suitable. By placing the liquid level sensor 305 in close proximity to the shroud member 150, the pump 200 can be operated when the liquid level at the inlet port 151 is above a threshold value. This reduces the risk of drawing air into the pump 200 when starting the pump 200, which would result in excessive noise during operation. The liquid level sensor 305 is connected to a controller 300 in region 130 within the second compartment 105b by an electrical connection 310 that extends into the reservoir 120. The electrical connection 310 passes through a channel 315 within the reservoir 120 that prevents liquid contacting the electrical connection 310. Region 130 is defined by the side walls 110b and dividing wall 115b of the second compartment 105b. This allows the electrical components to be isolated from the pump 200 and any tubing that extends between the first 105a and second 105b compartments.

[0049] As shown in Figure 3A, the shroud member 150 is connected to a first end of an inlet tube 145 connecting the pump 200 to the reservoir portion 120 (see also Figures 2 and 8). The shroud member 150 is mounted just above the bottom surface 135 when drawing fluid into the pump 200. This helps to minimise the risk of an air lock forming in the system due to the liquid level dropping below the inlet port 151 and air entering the shroud member 150. The inlet port 151 may be spaced from the bottom surface 135 by a first distance 152. The first distance 152 may be in the range of 2 - 12mm.When the first distance 152 is 2mm, there is a risk debris may get trapped under the shroud member 150, blocking the flow of condensate into the inlet port 151. As such, a first distance 152 of 4mm is preferable. It is possible to position the inlet port 151 in such close proximity to the bottom surface because the inlet port 151 faces the bottom surface 135 of the reservoir 120. The inlet port 151 is formed within the shroud member 150 with a substantially rectangular cross-section at its distal end and a circular cross-section at its proximal end. The inlet port 151 has a first dimension (L1) and a second dimension (L2), as shown in Figure 3A. The first and second dimensions may be different. The inlet port 151 has an inlet axis along which liquid enters the shroud member 150. The inlet axis may be substantially perpendicular to the bottom surface 135. As shown in Figure 3A, the first dimension is smaller than the second dimension, however, this need not be the case. Further, while the distal end of the shroud member 150 is shown with a rectangular cross-section, this is also not essential, and other shapes and configurations would be conceived by this description. While the shroud member 150 defines a tapering inlet channel from the inlet port 151 to the first end of the inlet tube 145, this is not essential. While the area of the inlet port 151 is greater than a cross-sectional area of the inlet tube 145, this is not essential.

[0050] The inlet tube 145 extends to a fluid inlet 205 of the pump 200 and allows liquid to pass from the first compartment 105a to the second compartment 105b (see also Figure 4). As illustrated, the fluid inlet 205 is formed within a fluid chamber 225 and draws condensate in from the reservoir 120. The pump 200 is preferably a centrifugal pump. The fluid chamber 225 is also shown having a first fluid outlet 210 connected to a discharge line 235 and a second fluid outlet 215 connected to a bleed line 155. As shown, the second fluid outlet 215 is located above the first fluid outlet 210. The discharge line 235 is used to remove condensate from the condensate pump arrangement 100. The bleed line 155 extends back to the first compartment and has an outlet 160 that directs liquid towards the reservoir 120 and/or the filters 125a, 125b. The outlet 160 may be configured to spray or direct a jet of condensate into the reservoir 120 or towards the filters 125a, 125b. While the first 210 and second 215 fluid outlets are shown to be in fluid communication with one another via a common fluid channel within the fluid chamber 225, it would be apparent that this was not essential.

[0051] Figures 5 and 6 illustrate a ventilation arrangement of the condensate pump arrangement 100. In Figure 6, the duct 170 has been omitted for clarity. As best shown in Figure 6, one of the side walls 110b of the second compartment 105b has a series of inlet 165 and outlet 175 vents, that ventilate a motor within the second compartment 105b. The motor used to drive the pump 200 is preferably a universal motor. However, it would be apparent that other motors, such as a brushless DC motor would be equally suitable for driving the pump 200. The motor is contained within a casing 245 having a first opening 240 and a second opening 252. Heat generated by the motor during operation needs to be vented from the pump arrangement 100 in order to maintain a safe working temperature. To ventilate the motor, an air flow path is created between the inlet vent 165 and the outlet vent 175 passing over the motor. Relatively cool air is first drawn in from the ambient exterior of the housing through the inlet vents 165 of the second compartment 105b. The relatively cool ambient air is then passed from the second compartment 105b into the first opening 240 of the motor casing 245 and through the casing 245 across the motor to remove heat from around the motor. The heated air is then blown out of the motor casing 245 through the second opening 252 that opens into an air duct 170 arranged around the motor casing 245. The air duct 170 is arranged to channel heated air from the motor casing 245 to the outlet vent 175, so that heated air may be expelled from the second compartment 105b through the outlet vent 175. Air is driven along this air flow path by a fan 250 connected to the drive shaft of the motor. This allows the normal operation of the pump motor to also drive the cooling system of the condensate pump assembly 100.

[0052] The pump 200 is secured to the second compartment 105b by a first connection by a compressive force exerted between a first edge of the duct 170 and a flange 180a extending perpendicularly from the bottom surface of the second compartment. A rubber gasket 185 surrounding the motor casing 245 is compressed between the duct 170 and the flange 180a and provides the first connection. The gasket 185 creates an air-tight seal between the air inlet side of the motor 200 and the air outlet side of the motor 200. This air-tight seal prevents the flow of air around the motor casing 245 and forces air to pass through the motor casing 245 and across the motor, cooling the motor. The gasket 185 and a first exterior side 171a of the duct 170 together define a boundary between a first ’cool’ region, where cool air is introduced into the second compartment 105b, and a second ’hot’ region, where hot air is expelled from the second compartment 105b via the interior of the duct 170. A foam seal may also be provided between the duct 170 and the flange 180a to enhance the air-tight seal. A second gasket 187 is provided within the motor casing 245. The second gasket 187 is compressed between a second edge of the duct 170 and a second flange 180b extending perpendicularly from the bottom surface of the second compartment 105b. When the duct 170 is secured to the casing 245, the gasket 187 is secured in position and provides a fluid-tight seal between the inside of the casing 245, which needs to remain dry, and the fluid chamber 225, which contains liquid. This second gasket 185 and a second exterior side 171b of the duct 170 together define a boundary between a "wet" side and a "dry" side within the second compartment 105b. A water barrier 255 secured between the motor casing 245 and the fluid chamber 255 as illustrated in Figure 6 can be used to enhance the water-tight seal. A third gasket 183 is provided around the opening 240 of the motor casing 245 and adjacent to the side wall 110b of the second compartment 105b. In operation, the gaskets 183, 185, 187 provide an anti-vibration arrangement that support the weight of the motor and reduces the transmission of vibrations from the pump 200 to the second compartment 105b by isolating the pump 200 from the side walls 110b and bottom surface of the second compartment 105b. As the oscillations of the pump 200 are in a radial direction to the longitudinal axis of the pump drive shaft, the gaskets are able to significantly reduce the noise generated by the pump 200 during operation.

[0053] The gaskets 183, 185, 187 are preferably made from ethylene propylene diene monomer (EDPM) rubber having a Shore A hardness of 60. The gaskets are preferably 2.5mm thick with two 4mm thick ribs 184 (see Figure 7) that deform when clamped between the motor casing 245 and the duct 170. While a preferred gasket configuration has been described, it would be apparent that other configurations, dimensions and arrangements of gaskets would be equally suitable for the present condensate pump arrangement 100.

[0054] A method of operating the condensate pump arrangement is described below. The liquid level sensor 305 is preferably configured to detect a liquid level within the reservoir 120 and send a liquid level detection signal to the controller 300. The controller 300 is configured to operate the pump 200 when the liquid level sensor 305 outputs a first signal indicative of a liquid level within the reservoir 120 indicating the liquid level within the reservoir 120 is above a level of the shroud member 150. This causes the pump 200 to start, which pumps condensate out of the reservoir 120 through the inlet port 151 of the shroud member 150. Condensate is pumped from the shroud member 150 through the inlet tube 145 to the fluid inlet 205 of the fluid chamber 225. As the pump 200 pumps condensate from the reservoir portion 120, the liquid level within the fluid chamber 225 rises. Once the liquid level reaches the first fluid outlet 210, condensate will be discharged through the discharge line. As condensate is discharged, this will lower the liquid level within the reservoir portion 120. When the liquid level approaches or drops below the level of the shroud member 150, the controller 300 may output a second signal to stop the pump 200. The liquid level sensor 305 is configured to detect a high liquid level within the reservoir 120. At this point, the controller is configured to output a control signal to switch a relay between an open and closed position in order to provide a high liquid level alert. The alert is sent to a building management system which shuts off one or more or all air-conditioning units operatively connected to the pump assembly 100.

[0055] The spraying effect of the bleed line 155 on the filters 125a, 125b can be achieved by priming the pump 200. Priming the pump allows the fluid chamber 225 to partially fill before initiating the pump 200. As the fluid chamber 225 is only partially filled, an air pocket is formed within the fluid chamber 225. Once the optimal level of liquid within the fluid chamber 225 has been reached, the pump 200 can be initiated. Filling the fluid chamber 225 to approximately 70% full and covering the fluid inlet 205 is preferable, as this provides an optimal ratio of liquid to air within the fluid chamber 225.It would be apparent that other levels may be similarly suitable, depending on the refrigeration or pumping application. Initiating the pump generates a pressure head within the fluid chamber 225 which ejects the air pocket and some of the liquid within the fluid chamber 225 out of the bleed line 155 and the discharge line 235. The air-liquid mix within the bleed line is discharged through the bleed line 155 and sprays the reservoir 120 and/or the filters 125a, 125b. By spraying the filters 125a, 125b in this manner, any debris or bacterial growth can be dislodged from the filters 125a, 125b and prolong the operability of the condensate pump arrangement 100. Similarly, by agitating the liquid within the reservoir 120, the chance of bacterial growth on the surface of the reservoir 120 or on the liquid within the reservoir 120 is reduced. In normal operation and with the pump motor installed at the same height as the discharge line, the flow rate through the discharge line 235 is over 700 L per hour. When the pump motor is installed with a discharge line 235 height of 10m, the flow rate through the discharge line 235 is reduced to approximately 200L per hour. When the pump motor is installed at the same height as the discharge line 235, the bleed line 155 has a flow rate of approximately 5% of the main flow rate through the discharge line 235. When the pump motor is installed with a discharge line 235 height of 10m, the bleed line 155 has a flow rate of approximately 25% of the main flow rate through the discharge line 235. However, greater or lesser pumping capacities may be required depending on the application. Similarly, tuning the bleed line 155 and operating parameters of the pump 200 may achieve more or less discharge through the bleed line 155.

[0056] While the present configuration of the fluid chamber 225 enables the cleaning function to happen whenever the pump 200 is primed, it would be apparent that a user-initiated cleaning function may be implemented using the present condensate pump arrangement 100. For example, a valve may be incorporated in the fluid chamber 225 that selectively introduces air into the fluid chamber 225. This would enable a user to decide when to activate the cleaning function, which may be triggered by sending a signal to the controller 300 indicative of a user wishing to clean the filters 125a, 125b within the reservoir 120. In this case, the pump 200 may selectively direct a jet of liquid towards the filter 125a, 125b, before resuming normal pumping operation. Alternatively, the controller 300 may change the speed of the motor to allow a pocket of air to form in the fluid chamber 225 before changing the speed again to generate a spray from the end of the bleed line 155. This effectively primes the pump 200 from a normal mode of operation instead of priming prior to initiation.

[0057] Figure 9 illustrates an alternative condensate pump arrangement 400. The condensate pump arrangement 400 has a housing comprising a first compartment 405a and a second compartment 405b, similar to that described above in relation to pump assembly 100. The first compartment 405a is defined by a lid 412a, side walls 410a and a bottom surface 435 (see Figure 12). The lid 412a also comprises a fluid inlet port 402 for receiving condensate into the first compartment 405a, for example from an air-conditioning unit operatively connected to the condensate pump assembly 400. The side walls 410a comprise three fluid inlet ports 402 to provide flexibility when selecting the most appropriate orientation of the pump for installation. However, it would be apparent more or fewer than three inlet ports 402 may be present. The second compartment 405b is defined by a lid 412b, side walls 410b and a bottom surface. Also illustrate in Figure 9 are inlet plug assemblies 500 for plugging unused fluid inlet ports 402, a valve connector assembly 600 and a further valve connector 650 connected to the valve connector assembly 600 by a connecting tube 607. A discharge line (not shown) may be connected to the valve connector 650 so that condensate can be pumped from the pump assembly 400 through a fluid port 417 (see Figure 15) formed in the side wall 410b of the housing. It would be apparent that the valve connector 650 is not essential, and a discharge line may be connected directly to the valve connector assembly 600 or directly to the first fluid outlet 210 of the pump 200. Any of the first 405a or second 405b compartments may comprise stainless steel.

[0058] Figure 10 illustrates internal components of the condensate pump arrangement 400. The first compartment 405a has a reservoir 420 which receives condensate deposited through the fluid inlet 402. As condensate enters the first compartment 405a, the condensate flows towards an inlet port 451 formed within an inlet member 450 located within the reservoir portion 420. Some or all of the features of inlet member 450 and shroud member 150 may be used inter-changeably. Similarly, while the bottom surface 435 of condensate pump assembly 400 is illustrated as being substantially parallel to the lid 412a and/or perpendicular to the side walls 410a, it would be apparent that this was not essential and the bottom surface 435 may be sloped in a similar manner to pump assembly 100, so as to facilitate pumping of condensate out of the reservoir portion 420 through the inlet member 450. A filter 425 is also shown in Figure 10 which crosses a fluid flow path extending between the fluid inlet port 402 and the inlet member 450 and act to prevent particulate debris above a certain size from reaching the inlet member 150. The filter 425 is secured to the side walls 410a, by respective pairs of tabs 427 protruding from of the side walls 410a. The filter 425 has an arcuate profile such that particulate debris in the condensate will be directed towards the side walls 410a. As with the filters 125a, 125b described above, a series of holes extend through the body of the filter 425 to prevent debris larger than the diameter of the holes from being able to pass through the filter 425. The filter 425 is preferably made from copper to help prevent bacterial growth. As illustrated in Figure 10, the inlet plug assemblies 500 act to prevent condensate from leaking out of the reservoir portion 420 through the side walls 410a via the unused inlet ports 402. In the illustrated example, the fluid inlet port 402 formed in the lid 412a is used, however it would be apparent, this was merely an example, and that any one or more of the fluid inlet ports 402 may be used.

[0059] A liquid level sensor 305 is also disposed within the first compartment 405. As shown in Figure 10, the liquid level sensor 305 is in close proximity to the inlet member 450 and includes three mechanical floats 307A, 307B, 307C. While the liquid level sensor 305 is shown having mechanical floats 307A, 307B, 307C, it would be understood that this is provided as an example, and that other arrangements or types of liquid level sensors 305, including non-contact sensors, would be equally suitable. Similar while three mechanical floats are illustrated, it would be apparent, more or fewer than three floats may be suitable for use with the present pump assembly 400. As shown in Figure 12, each of the mechanical floats

307A, 307B, 307C are connected to a side wall 410a and arranged at different heights. This allows each float 307 to provide a signal to a controller corresponding to a specific liquid level. Thus, multiple liquid levels can be detected by using the illustrated arrangement of mechanical floats 307A, 307B, 307C. By placing the liquid level sensor 305 in close proximity to the inlet member 450, the pump 200 can be operated when the liquid level at the inlet port 451 is above a pre-determined value. The predetermined value may be related to the height of one or more of the mechanical floats 307A, 307B, 307C. This reduces the risk of air being drawn into the pump 200 when starting the pump 200, which would result in an air lock forming in the inlet member 450, resulting in excessive noise during operation. Each of the mechanical floats 307A, 307B, 307C illustrated in Figures 10 and 12 are connected to a respective stalk 309A, 309B, 309C which extends in a substantially perpendicular direction from the side wall 410 and through the body of the respective float 307A, 307B, 307C. A slot formed in the body of each of the floats 307A, 307B, 307C allows the float to move in a vertical direction as the level of condensate rises in the reservoir portion 420. This is in contrast to the mechanical float 307 illustrated in Figure 3B where the stalk 309 extends from the bottom surface 135 of the reservoir portion 120 in a substantially perpendicular direction to the bottom surface 135. The float sensor arrangement of Figure 12 allows for multiple liquid levels to be detected using a simple float system whilst also minimising the vertical height of the overall pump assembly 400, as the stalks 309A, 309B, 309C extend perpendicularly from the side wall 410a, as opposed to perpendicularly from the bottom surface 435. As such, a particular float 307A, 307B, 307C only needs to travel by a comparatively small amount to detect a particular liquid level within the reservoir portion 420. A further advantage of the float sensor arrangement illustrated in Figure 12 compared to the single float sensor arrangement of Figures 3A and 3B is that the float sensor arrangement of Figure 12 can be more easily accommodated in a metal housing.

[0060] The liquid level sensor 305 of pump assembly 400 is connected to a controller 300 within the second compartment 405b by electrical connections 310A, 310B, 310C extending from stalks 309A, 309B, 309C. The electrical connections 310A, 310B, 310C pass through a channel extending between the side walls 410a, 410b to prevent liquid contacting the electrical connection 310A, 310B, 310C. It would be apparent that the liquid sensor 305 described in relation to pump assembly 100 (illustrated in Figures 2 to 3B) would be suitable for use in the pump assembly 400 (illustrated in Figures 10 to 12). It would also be apparent that the liquid sensor 305 in pump assembly 400 would be suitable for use in the pump assembly 100.

[0061] The inlet member 450 comprises an outlet 453 configured to connect to a first end of an inlet 457 connecting the pump 200 to the reservoir portion 420 (see also Figures 13 and 17). The inlet member 450 is mounted just above the bottom surface 435 when drawing fluid into the pump 200. The inlet port 451 may be defined by a face 452 that is spaced from the bottom surface 435 in a similar manner to that described in relation to the shroud member 150. As illustrated in Figure 17, the inlet port 451 is formed within the inlet member 150 with a substantially circular cross-section at its inlet end and a circular cross-section at its outlet end. The face 452 defining the inlet port 451 forms an acute angle with the bottom surface of the reservoir portion 420. The angled face 452 helps to purge air from the inlet in order to avoid an air lock forming within the system when the pump motor 200 primes. It has been found that by increasing the angle between face 452 and the bottom surface 435 this greatly reduces the risk of an air lock forming. An angled inlet face 452 of between 10 degrees and 45 degrees relative to the bottom surface has been found particularly effective at minimising the risk of the inlet face 452 being installed parallel to the liquid level surface within the reservoir 420, and thus minimising the risk of an air lock forming.

[0062] As illustrated in Figure 10, the pump 200 comprises a fluid chamber 225 and draws condensate from the reservoir portion 420. The fluid chamber 225 is also shown having a first fluid outlet 210 connected to a valve connector assembly 600 via a connecting tube 605 and a second fluid outlet 215 connected to a bleed line 455. As shown in Figure 13, the second fluid outlet 215 is located above the first fluid outlet 210. As with pump assembly 100, the bleed line 455 extends to the first compartment 405a and has an outlet 460 that directs liquid towards the reservoir 420 and/or the filter 425 as desired. The outlet 460 may be configured to spray or direct a jet of condensate into the reservoir 420 or towards the filter 425.

[0063] Figure 11 illustrates an exemplary bleed line arrangement. As shown, a first bracket 457A is used to secure a first portion of the bleed line 455 to the side wall 410a. In the illustrated example, the first bracket 457A is angled to direct the bleed line 455 in the desired direction as described above. As illustrated, the first bracket 457A includes two folds or creases in the body to provide a channel for the bleed line 455 to pass through between the side wall 410a and the body of the first bracket 457A. The body of the first bracket 457A has a substantially rectangular profile and the folds extend across the body from respective opposed edges of the body. The folds form an acute angle relative to the outer edges of the body in order to direct the bleed line 455 in a downward direction, away from the lid 412a, and towards the middle of the filter 425 (see also Figure 13). However, it would be apparent that the illustrated first bracket 457A is an exemplary bracket for directing the bleed line 455 and that other configurations of the bracket 457A would be suitable for directing the bleed line 455 in the desired manner. A second bracket 457B may also be used to secure a second portion of the bleed line 455 to a side wall 410b. The second bracket 457B is used to hold or contort the bleed line in a particular manner to avoid any sharp kinks in the bleed line 455. The second bracket 457B includes two folds in the body to provide a channel for the bleed line 455 to pass through between the side wall 410b and the body of the second bracket 457B. The body of the second bracket 457B has a substantially rectangular profile and the folds extend across the body from respective opposed edges of the body. The folds extend across the body to form an acute angle relative to the outer edges of the body in order to direct the bleed line 455 in a serpentine manner (see Figure 13). As illustrated in Figure 13, the bleed line 455 forms a single smooth curve 459A (referred to as a "U-bend") between the second fluid outlet 215 and the second bracket 457B. A second U-bend 459B is also provided in the bleed line 455 between the second bracket 457B and the side wall 410b. Thus, a smooth serpentine arrangement is provided by the second bracket 457B. This helps to prevent accumulation of solid or liquid deposits within the bleed line 455 which also helps to keep the filter 425 clear of such deposits. It would be apparent that one or both of the brackets 457A, 457B may be included or omitted in the pump assembly 400. It would also be apparent that while two U-bends 459A, 459B are described, having two U-bends 459, 459B is not essential, and that the second bracket 457B may contort the bleed line 455 such that one or more than two U-bends are present. The spraying effect of the bleed line 155 on the filters 425 is achieved by priming the pump 200 in the same manner as described above in relation to pump assembly 400 and will not be repeated here for brevity.

[0064] Also illustrated in Figure 13 is a casing 470 for the pump 200. The casing 470 includes an air inlet 475 for drawing air to the pump motor and an air outlet 480 for expelling exhaust air from the casing 470. As with pump assembly 100, a fan connected to the motor shaft drives air through the air flow path between the air inlet 470 and the air outlet 480 to maintain a safe operating temperature of the pump motor. This allows the normal operation of the pump motor to also drive the cooling system of the condensate pump assembly 100. The pump 200 is secured to the second compartment 405b in a similar manner to that of pump assembly 100 and will not be repeated here for brevity.

[0065] A method of operating the condensate pump arrangement 400 is described below. Liquid level sensor 305 is preferably configured to detect one or more liquid levels within the reservoir 420 and to send respective liquid level detection signals to the controller 300 in response to detecting the one or more liquid levels. The controller 300 is configured to operate the pump 200 when the liquid level sensor 305 outputs a first signal indicative of a first liquid level within the reservoir 420 indicating the liquid level within the reservoir 420 is above a level of the inlet member 450. This may, for example, be indicated by float 307B (the lower-most float of the three floats in Figure 12) moving in an upward direction while the other two floats 307A, 307C remain still. This situation would arise when the condensate has reached float 307B first and causes it to rise without also displacing the remaining floats 307A, 307C. This causes the pump 200 to start at a first speed so as to pump condensate out of the reservoir 420 through the inlet port 451 of the inlet member 150 at a corresponding first speed. Condensate is pumped through the inlet member 450 to the fluid inlet 205 of the fluid chamber 225. As the pump 200 pumps condensate from the reservoir portion 120, the liquid level within the fluid chamber 225 rises. Once the liquid level reaches the first fluid outlet 210, condensate will be discharged through the discharge line via the valve connector assembly 600. As condensate is discharged, this will lower the liquid level within the reservoir portion 120. When the liquid level approaches or drops below the level of the inlet member 150, the controller 300 may output a second signal to stop the pump 200.

[0066] In some cases, the level of condensate within the reservoir 420 may rise faster than the initial operating speed of the pump can discharge liquid through the discharge line 235. In this case, the second float 307C may output a third signal to the controller, indicating the liquid level has reached a second liquid level within the reservoir 420. In response to this third signal, the controller 300 may operate the pump at a higher speed in order to lower the level of condensate within the reservoir 420. Whilst this may also result in a temporary increase in noise, this is typically preferable to the reservoir portion overflowing. Once the liquid level within the reservoir 420 drops below the second level, the controller 300 may control the pump motor to operate at a lower speed, for example the first speed.

[0067] In some cases, the second speed may not be sufficient to lower the liquid level within the reservoir 420 and the condensate may continue to rise to a high level, for example the height of the third float 307A. This would cause the third float 307A to rise and output a fourth signal to the controller 300. At this point the controller 300 may output a signal indicative of a high liquid level alert. For example, the controller 300 may output the alert to a remote user or system. In response to the fourth signal, any of the controller 300 or remote system or user may shut off one or more air-conditioning units operatively connected to the pump assembly 400, thus reducing or stopping further flow of condensate into the reservoir 420. Alternatively or additionally, the controller 300 or remote system or user may operate the pump motor at a third speed, higher than the second speed in order to reduce the level of condensate in the reservoir. The third speed may be the maximum operating speed of the pump. Once the liquid level is reduced below the high level, the controller 300 may continue to operate the pump motor at the third speed, or at a lower speed, for example the second speed, to continue discharging condensate. The controller 300 may also re-initiate operation of one or more of the air-conditioning units that were shut off in response to the high level alert. In some cases, the controller 300 may operate the pump at the first speed in response to outputting the high liquid level alert. While three float sensors have been described, it would be apparent that not all three float sensors were essential, and that in some cases one or two float sensors may be suitable for use with the present pump assembly 400. For example, a liquid level sensor may include only one or two of float sensors 307A, 307B and 307C.

[0068] Figure 14 illustrates a cross-sectional view of the valve connector assembly 600. The valve connector assembly 600 includes a first part 610 with an inlet port 615 and a second part 620 with an outlet port 625. In use, the first part 610 is secured to an internal surface of the side wall 410b by a first pair of screws 630A, and the second part 620 is secured to an external surface of the side wall 410b and also to the first part 610 by a further pair of screws 630B. The inlet port 615 is connected to the outlet port 625 via the fluid port 417 formed within the side wall 410b. As illustrated in Figure 14, the second pair of screws 630B is accessible from the external surface of the side wall 410b, and thus from the outside of the housing, which provides greater ease of access to the valve connector assembly 600, for example for maintenance purposes. The first pair of screws 630A is not accessible from the external side of the housing, and thus, can not be removed by a user without access the internal volume of the housing. A brass barb 635 having an O-ring 645 provides a connection between the inlet port 615 and the outlet portion 625. In use, the brass barb 635 is clamped to the external side of the side wall 410b by the second part 620. For example, the brass barb 635 may have a shoulder against which a corresponding part of the second part can engage to clamp the brass barb 635 to the side wall 410b. While the fluid outlet 625 is provided by a brass barb 635, it would be apparent that this was not essential and the outlet may be integrally formed in the second part 620.

[0069] The valve connector 600 is also illustrated with an umbrella valve 640 secured to the first part 610. While an umbrella valve 640 is shown, it would be apparent this was merely an example of a one-way valve and other valves may be suitable. In one configuration (not shown), such as when liquid is entering the inlet port 615, the umbrella valve 640 is open and allows liquid to flow from the inlet port 615 to the outlet port 625. In a second configuration (illustrated in Figure 14), the umbrella valve 640 is closed and restricts fluid flow from the outlet port 625 to the inlet port 615. This is advantageous, as the pressure head generated by the discharge line 235 rising vertically above the pump assembly 400 could force condensate back through the fluid chamber 255 and back into the reservoir 420, which would be highly undesirable. One situation where this may occur is when the pump is switched off, but liquid remains in the discharge line. The connector assembly 600 thus restricts any backflow while the pump motor is switched off.

[0070] Routine maintenance of the pump assembly 400 requires cleaning and servicing different parts of the pump assembly 400, including the umbrella valve 640. The releasable connection between the first 610 and second 620 parts of the present valve connector assembly 600 allow the user to easily unscrew the second pair of screws 630B to remove the second part 620 and barb 635 from the side wall 410b (as illustrated in Figure 15), leaving the umbrella valve 640 exposed within the fluid port 417 for cleaning and servicing. There is no need for the user to open the second compartment 405b to access the valve connector 600, which would also require further disconnecting of the liquid lines, e.g. connecting tube 605, within the housing to prevent liquid leaking into the second compartment 402b where the electrical components for operating the pump are located. While the first set of screws are received within a cavity of the second part 620 it would be apparent this was not essential and that in some cases, the first pair of screws 630A may extend through the second part 620. Preferably, the first pair of screws 630A are secured to the side wall 410 and are not to the second part 620. While screws 630A, 630B have been described, it would be apparent that this was merely exemplary and that other mechanical fixings would be suitable for use with the present valve connector assembly 600. Similarly, it would be apparent that while the valve connector assembly 600 has been described in relation to a condensate pump assembly, the connector valve assembly 600 could be used in conjunction with other devices or equipment where it would be desirable to control fluid flow in this manner.

[0071] Figure 16 illustrates a cross-sectional view of an exemplary valve connector 650. The valve connector 650 has an inlet port 655 and an outlet port 660 and an umbrella valve 665. In use, the inlet port 655 is connected to the outlet port 625 by a connecting tube 607 (see Figure 9), and the outlet port 660 is connected to a discharge line (not shown) for discharging condensate to a drain. In a first configuration, the umbrella valve 665 is open and liquid can flow between the inlet port 655 and the outlet port 660. In a second configuration (illustrated in Figure 16), the umbrella valve 665 is closed and liquid is restricted from flowing from the outlet port 660 and the inlet port 655. While an umbrella valve 665 is shown, it would be apparent that other one-way valves would be suitable for use in the valve connector 650. When the pump assembly 400 needs to be removed from under a refrigeration unit, for example for maintenance, it is necessary to disconnect the pump assembly 400 from the discharge line 235. However, doing so would result in condensate liquid flowing onto the area where the pump assembly 400 was located as the valve connector assembly 600 no longer prevents liquid flowing back through the discharge line 235. The valve connector 650 acts as a secondary flow restrictor between the discharge line 235 and the valve connector assembly 600 of the pump assembly 400 to prevent this. The pump assembly 400 can therefore be disconnected from the discharge line 235 without the undesirable discharge of condensate back through the discharge line 235.

[0072] Figures 18A to 18C illustrate views of an exemplary inlet plug assembly 500 in a closed configuration and Figures 18D and 18E illustrate an exemplary inlet plug assembly in an open configuration. In Figure 18C, a part of the side wall 410a is illustrated in a transparent manner. The inlet plug assembly 500 has a first resiliently deformable part 505 and a second stiffening part 510 for securing the first part 505 within a respective inlet port 402. In the open configuration, as illustrated in Figures 18D and 18E, a portion 545 of the first part 505 extends from an external side 411b of the side wall 410a through the inlet port 402 to the internal side 411a of the side wall 410a. The first part 505 comprises a solid web of material and defines a cavity 550 for receiving the stiffening part 510 on the internal side 411a of the housing. The first part 505 is moulded during manufacturing such that when the second part 510 is not received within the cavity 550 (as illustrated in Figures 18D and 18E), an abutting face 507 of the first part 505 forms an angle relative to the external side 411b. Furthermore, a domed portion 550 on the internal side 411a of the side wall is present in the open configuration.

[0073] In the closed configuration where an annular portion 515 of the second part 510 is inserted into the cavity 550 (as illustrated in Figures 18A to 18C), the portion 545 of the first part 510 on the internal side 411a is stretched and the domed portion 550 is flattened. In this closed configuration, the second part 510 sits in the middle of the cavity 550 and presses the material between the annular portion 515 and the inlet port 402 against the side wall 410a to form a fluid-tight seal 547. As the annular portion 515 is stiffer than the first part this ensures a reliable seal 547 is formed in the inlet port 402 compared to prior art plugs which only utilise a single material in the inlet port 402. The domed portion 550 facilitates the stretching of the portion 545 of material disposed on the internal side 411a. In the closed configuration the first part 505 is deformed such that the abutting face 507 is substantially flush with the external side 411b and forms a flange to provide a liquid-tight seal around the inlet port 402 as shown in Figures 18B and 18C. The first part 505 and the second part 510 comprise materials that are resistant to creep to ensure a reliable fluid-tight seal 547 is maintained over time. A material having a Shore A hardness between 55 - 80 has been found to be suitable for the present inlet plug assembly 500. The first part 505 may comprise any of a Thermoplastic elastomer (TPE) material, an Ethylene Propylene Diene Monomer (EPDM) material, and silicon. The second part 510 may comprise any of polypropylene (PP) and polyoxymethylene (POM).

[0074] In some cases, the domed portion 550 may flatten completely. In some cases, the domed portion 550 may deform from a first radius of curvature to a second radius of curvature larger than the first radius of curvature. While an annular portion 515 has been described, it would be apparent that this was merely an example of a suitably formed member that could provide a stiffening component for stretching the first part 505, and that other forms of stiffening components could be used. It would also be apparent the abutting face 507 and domed portion 550 are not essential and that one or both of these may be omitted.

[0075] The second part 510 also includes a handle 520 for a user to pull the second part 510 out of the cavity 550 to release the inlet plug assembly 500 from the pump assembly 400. This provides a convenient method of releasing the inlet plug assembly 500 from the housing during installation of the pump assembly, as no tools are required for releasing the inlet plug assembly 500 from the housing. The handle 520 is preferably made from the same material as the annular portion 515, however, it would be apparent this was not essential. The illustrated second part 510 also includes a slot 525 for receiving a tool for separating the second part 510 from the first part 505. In some cases, a slot 525 for receiving a screwdriver may be provided. This provides a convenient method of releasing the second part 510 by inserting a screwdriver into the slot 525 and levering the second part 510 out of the cavity 550. While a slot 525 for a screwdriver has been described, it would be apparent this was merely an example and other slots or recesses for receiving a suitable tool may be provided. Similarly, while a levering action has been described, a rotation or translation or sliding motion may be used alternatively or in combination to release the annular portion 515 from the first part 505.

[0076] A tether 535 is also provided to connect the first part 505 to the second part 510. This provides a convenient way to keep the two parts 505, 510 together once the second part 510 is released from the first part 505. In some cases, the tether 535 is moulded as part of the first part 505. While the inlet plug assembly 500 has been described in relation to a condensate pump assembly, it would be apparent that the inlet plug assembly 500 could be used in conjunction with other devices or equipment where it would be desirable to plug a fluid port in manner described above.

[0077] Similar components present in the exemplary condensate pump arrangements 100 and 400 described above have not been repeated, but are annotated by like reference numerals in the description and accompanying drawings. Similarly, it would be apparent that certain aspects or components described in relation to condensate pump arrangement 100 may be swapped with corresponding or similar aspects or components described in relation to condensate pump arrangement 400.

[0078] Throughout the description and claims of this specification, the words "comprise" and "contain" and variations of them mean "including but not limited to", and they are not intended to (and do not) exclude other components, integers or steps. Throughout the description and claims of this specification, the singular encompasses the plural unless the context otherwise requires. In particular, where the indefinite article is used, the specification is to be understood as contemplating plurality as well as singularity, unless the context requires otherwise.

[0079] Features, integers, characteristics or groups described in conjunction with a particular aspect, embodiment or example of the invention are to be understood to be applicable to any other aspect, embodiment or example described herein unless incompatible therewith. All of the features disclosed in this specification (including any accompanying claims, abstract and drawings), and/or all of the steps of any method or process so disclosed, may be combined in any combination, except combinations where at least some of such features and/or steps are mutually exclusive. The invention is not restricted to the details of any foregoing embodiments. The invention extends to any novel one, or any novel combination, of the features disclosed in this specification (including any accompanying claims, abstract and drawings), or to any novel one, or any novel combination, of the steps of any method or process so disclosed.

Claims

1. A condensate pump arrangement comprising:

a housing;
a reservoir portion formed within the housing;
a pump portion formed within the housing; and
a pump located within the pump portion and comprising a first fluid outlet, a second fluid outlet and a fluid inlet;
wherein the fluid inlet is configured to draw fluid from the reservoir portion,
wherein the first fluid outlet is configured to connect to a discharge line, and
wherein the second fluid outlet is configured to selectively expel a jet of fluid into the reservoir portion.

2. A pump arrangement according to claim 1, wherein the second fluid outlet is configured to expel the jet of fluid towards a filter within the reservoir portion.

3. A pump arrangement according to claim 1 or claim 2, wherein the second fluid outlet is located above the first fluid outlet.

4. A pump arrangement according to any preceding claim, wherein the second fluid outlet comprises a fluid line extending between the reservoir portion and the pump.

5. A pump arrangement according to claim 4 comprising a first bracket secured to the pump portion of the housing and configured to connect to a first portion of the fluid line, wherein the first bracket is arranged to secure the fluid line so as to provide at least one U-bend in the fluid line.

6. A pump arrangement according to claim 4 or claim 5 comprising a second bracket secured to the reservoir portion of the housing and configured to connect to a second portion of the fluid line, wherein the second bracket is arranged to direct the second fluid outlet in a pre-determined direction.

7. A pump arrangement as claimed in any preceding claim further comprising a liquid level sensor configured to detect a liquid level within the reservoir portion, and a controller configured to operate the pump at a first speed when the liquid level sensor outputs a first signal indicative of a liquid level within the reservoir portion above a level of the liquid inlet to the pump and to stop the pump when the liquid level sensor outputs a second signal indicative of a liquid level within the reservoir portion approaching or below a level of the liquid inlet to the pump.

8. A pump arrangement according to claim 7, wherein the controller is configured to output a third signal indicative of a high liquid level within the reservoir portion, wherein the reservoir portion is arranged to receive condensate from an air-conditioning unit operatively connected to the controller, and wherein the controller is configured to output a control signal to shut off the air-conditioning unit when the liquid level sensor outputs the third signal.

9. A pump arrangement according to claim 7 or claim 8, wherein the liquid level sensor comprises one or more float sensors, and wherein each of the one or more float sensors are configured to output one or more of the signals indicative of one or more liquid levels within the reservoir portion and wherein each of the float sensors are mounted at different heights within the housing and are configured to output a signal indicative of a different liquid level.

10. A pump arrangement according to any of claims 7 to 9, wherein the controller is configured to expel the jet of liquid from the second fluid outlet upon initiation of the pump motor.

11. A pump arrangement according to any preceding claim, wherein the housing comprises any of a metal material or a plastic material.

12. A method of operating a condensate pump arrangement, comprising the steps of:

providing a condensate pump arrangement, comprising a housing; a reservoir portion formed within the housing; a pump portion formed within the housing; a pump located within the pump portion and comprising a first fluid outlet, a second fluid outlet and a fluid inlet, and a controller configured to operate the pump, wherein the fluid inlet is configured to draw fluid from the res-

ervoir portion, wherein the first fluid outlet is configured to connect to a discharge line, and wherein the second fluid outlet is configured to selectively expel a jet of fluid into the reservoir portion,
initiating the pump at a first operating speed, and expelling a jet of the fluid from the second fluid outlet into the reservoir portion.

13. A method according to claim 12 comprising the steps of providing a liquid level sensor configured to detect a liquid level within the reservoir portion and output a signal indicative of a liquid level within the reservoir portion, receiving the signal from the liquid level sensor indicating the liquid level is above a first liquid level, and initiating the pump at the first operating speed.

14. A method according to claim 12 or claim 13, further comprising the step of receiving a signal from a user, and discharging liquid via the second fluid outlet into the reservoir portion.

15. A method according to any of claims 12 to 14, comprising the steps of detecting the liquid level is below the first liquid level, and terminating operation of the pump.

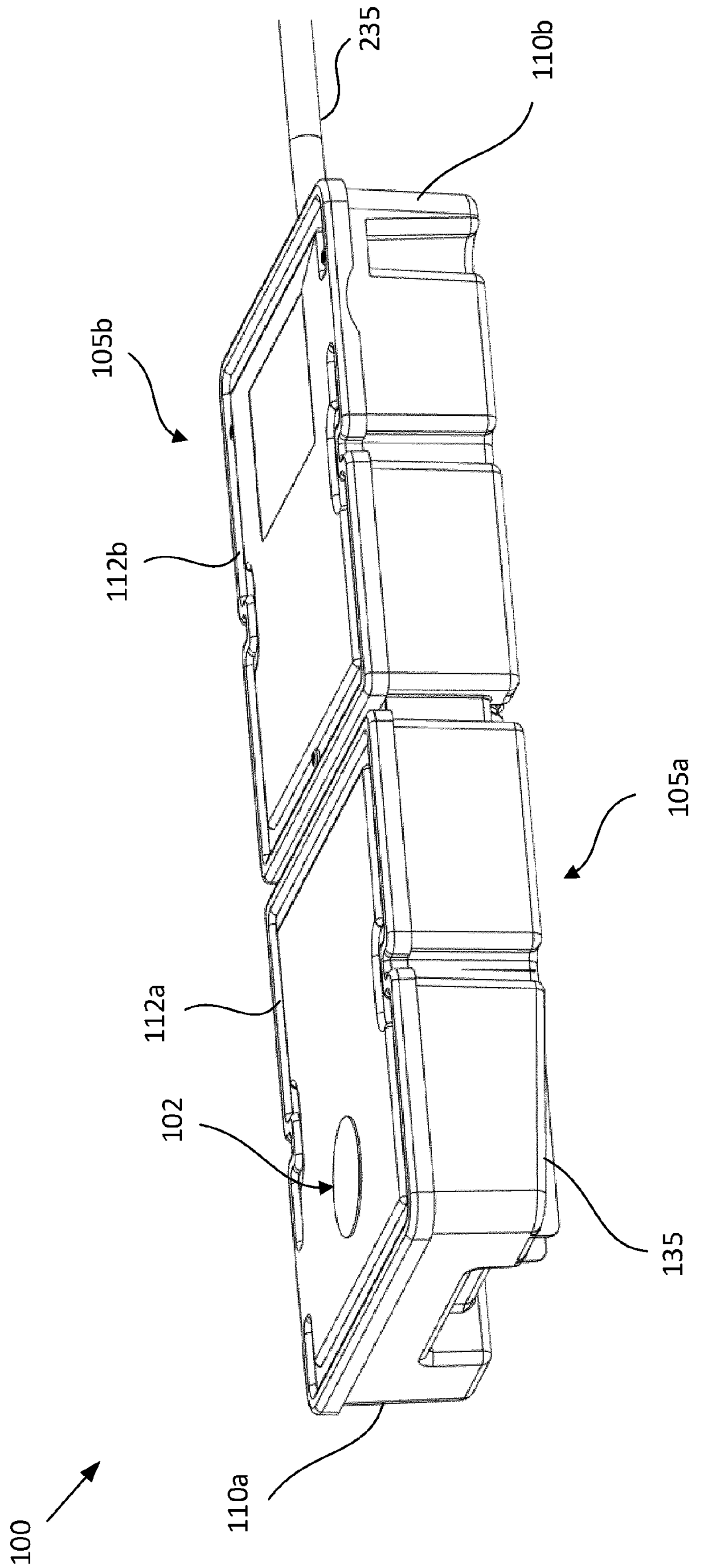
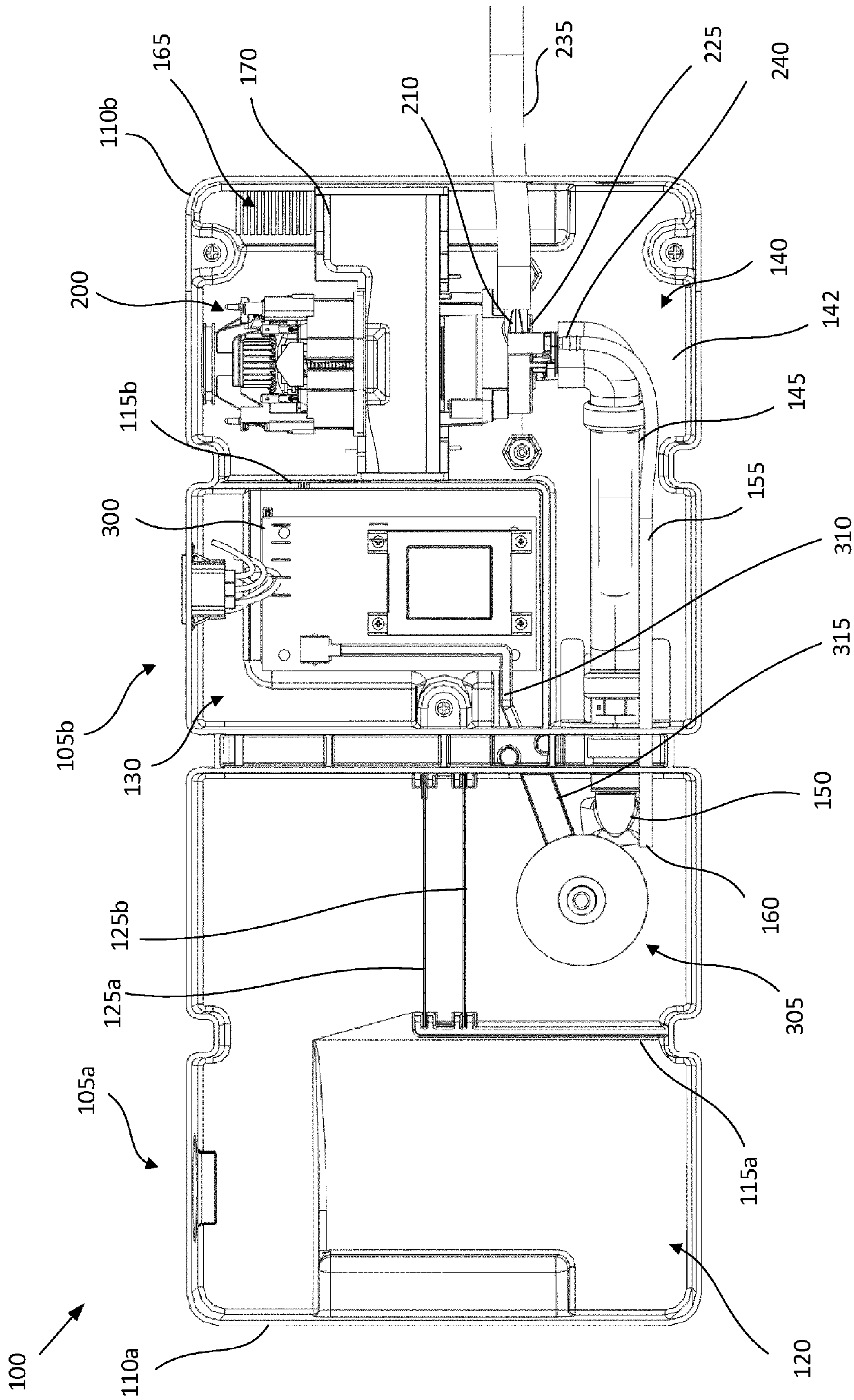


FIG. 1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315

FIG. 2

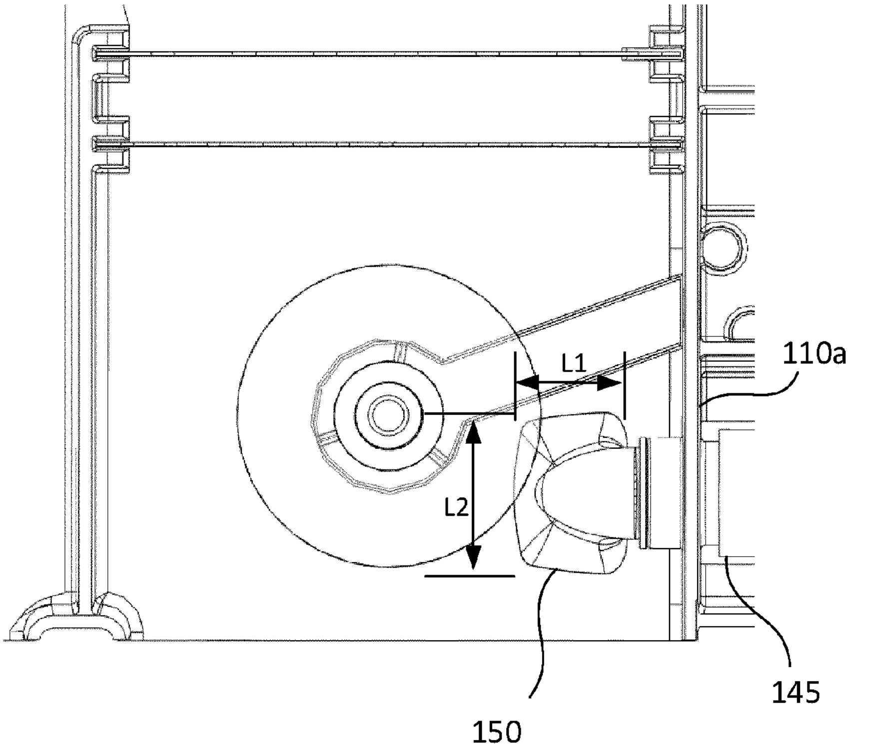


FIG. 3A

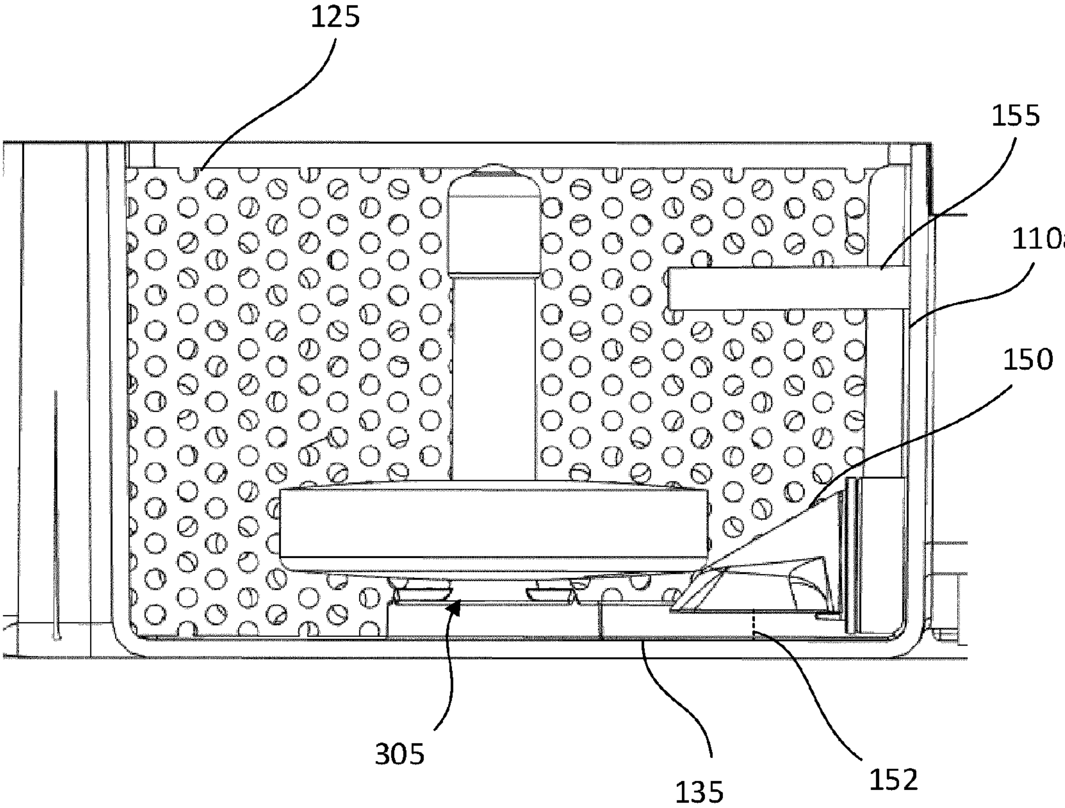


FIG. 3B

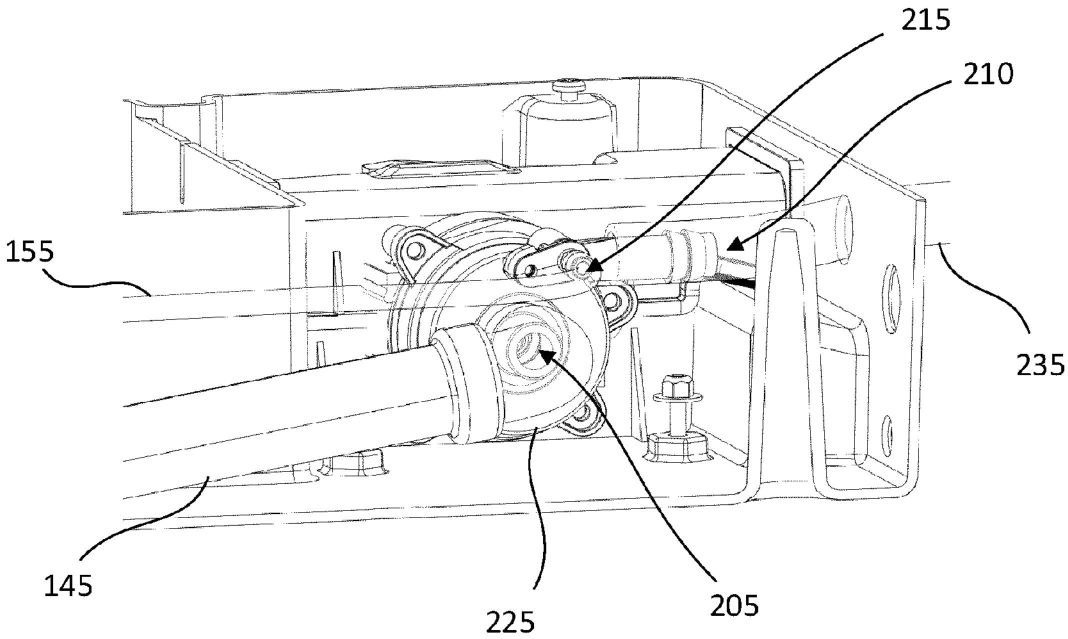


FIG. 4

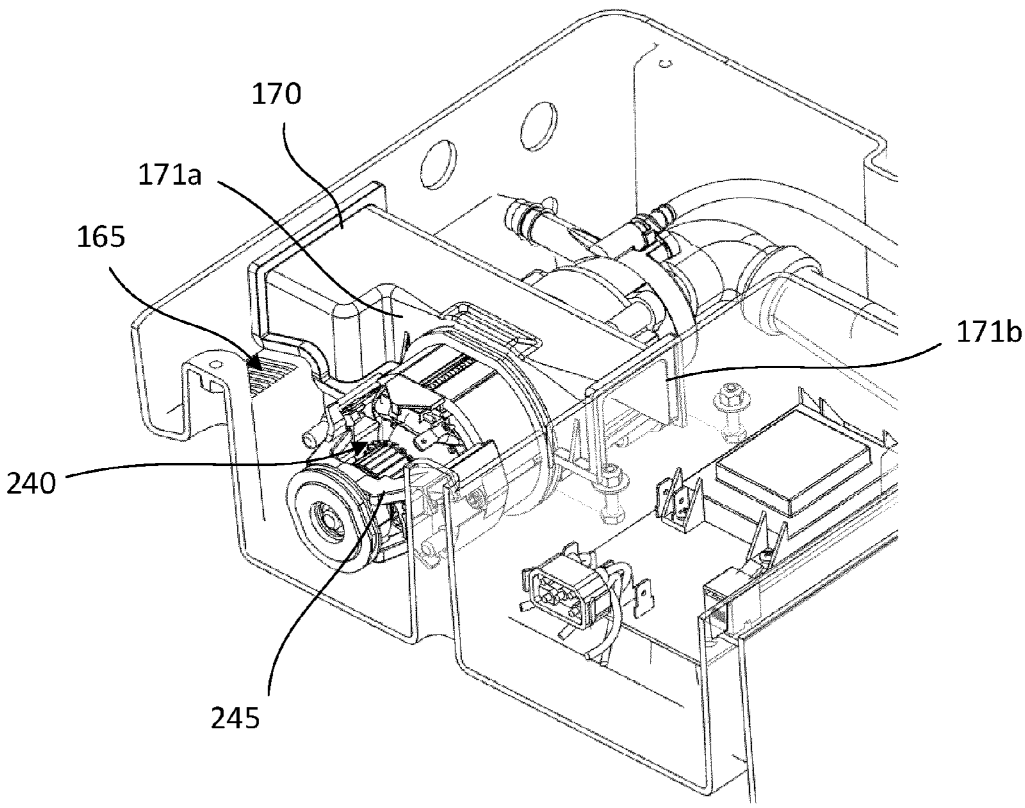


FIG. 5

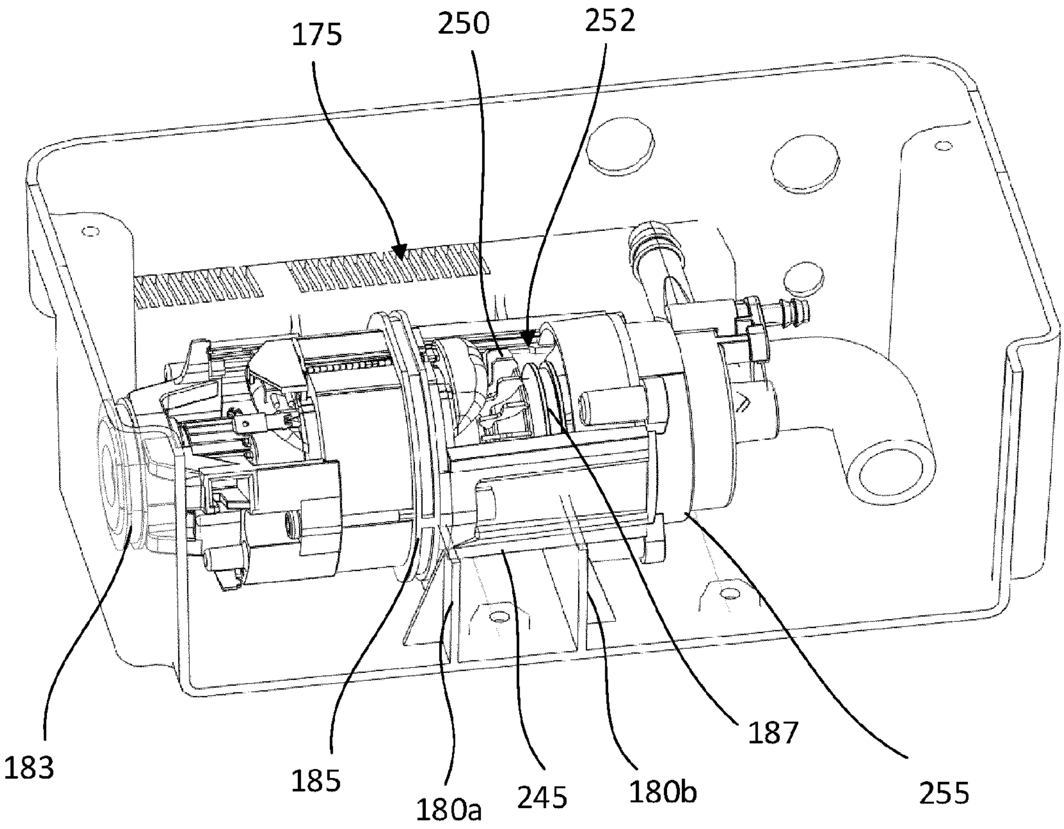
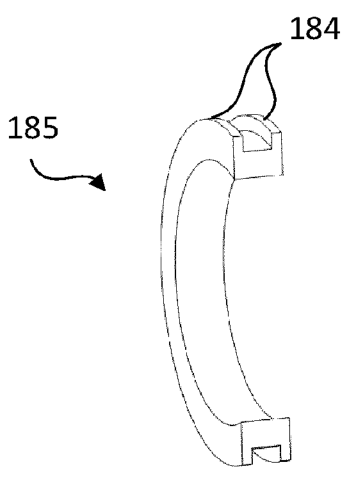


FIG. 6



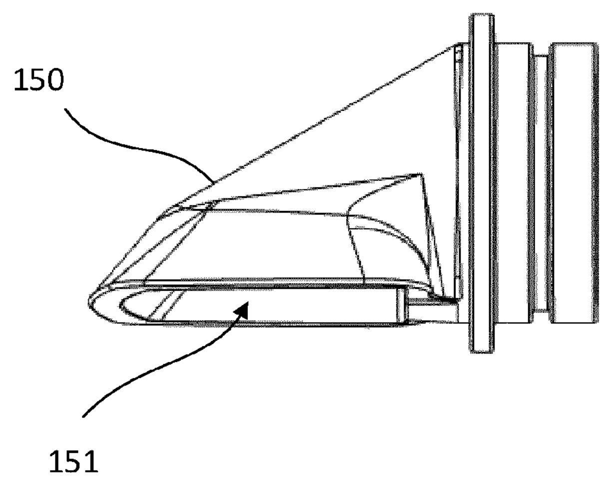


FIG. 7

FIG. 8

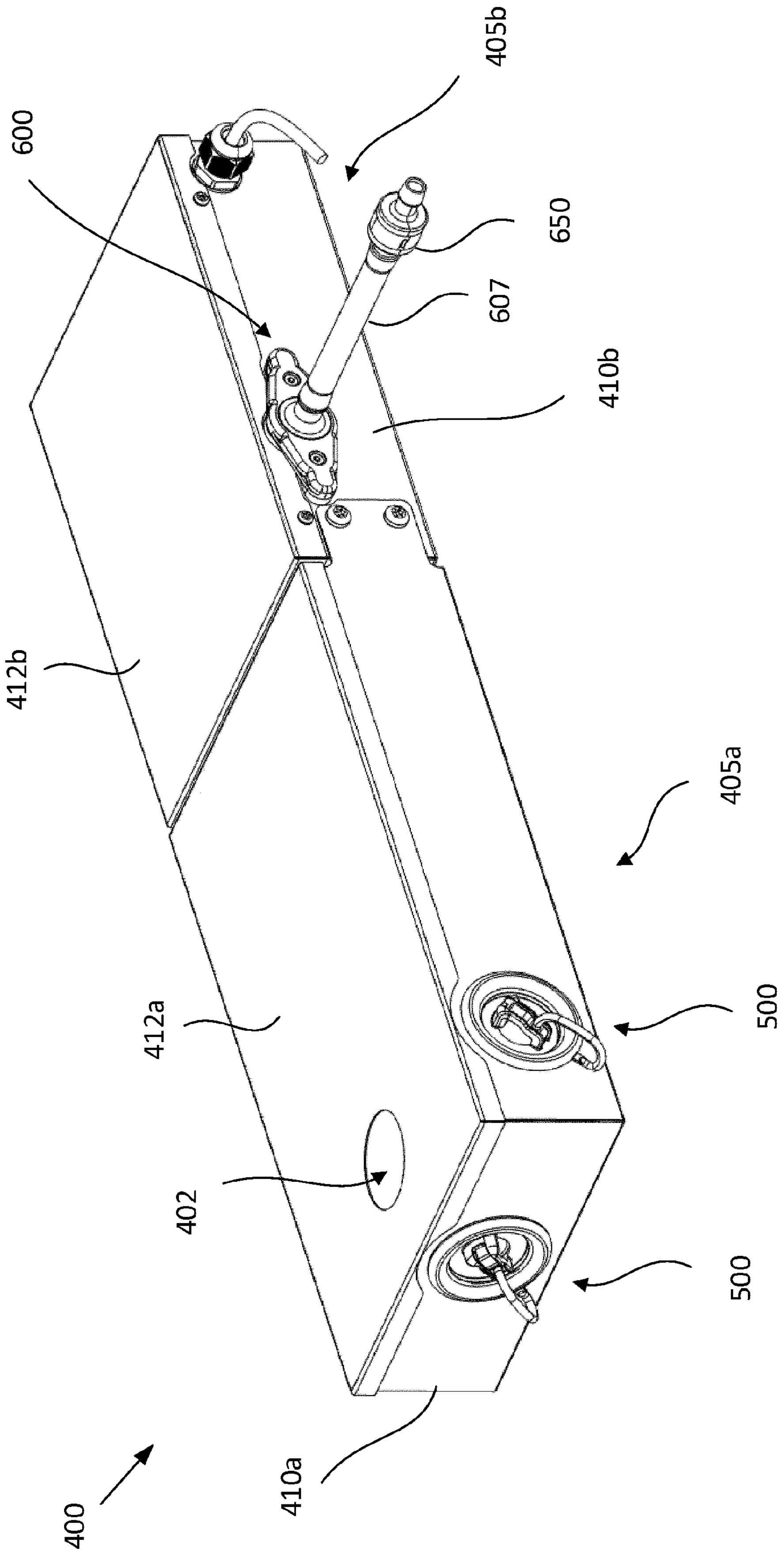
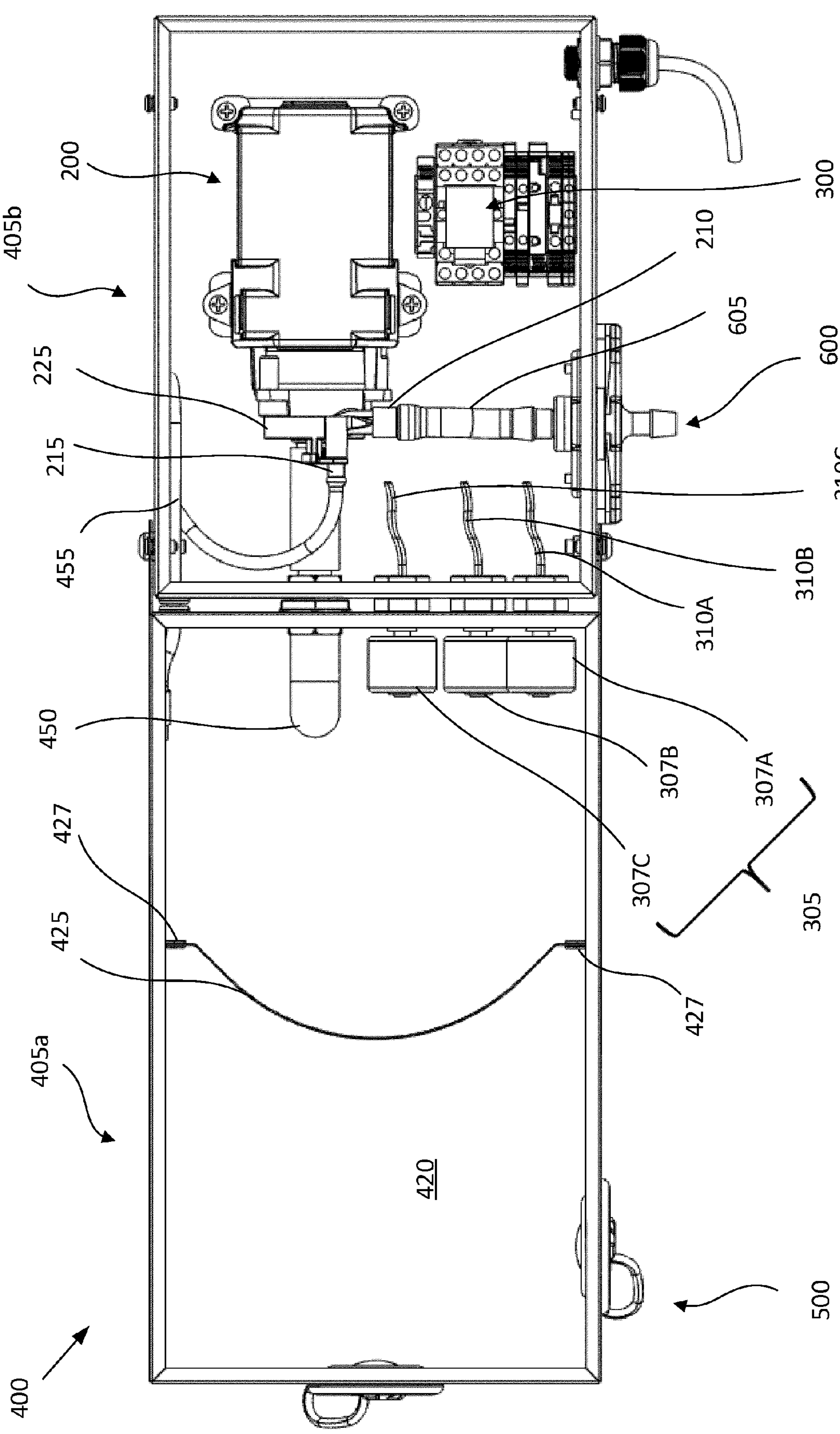


FIG. 9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307A
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307C
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420
500
400

FIG. 10

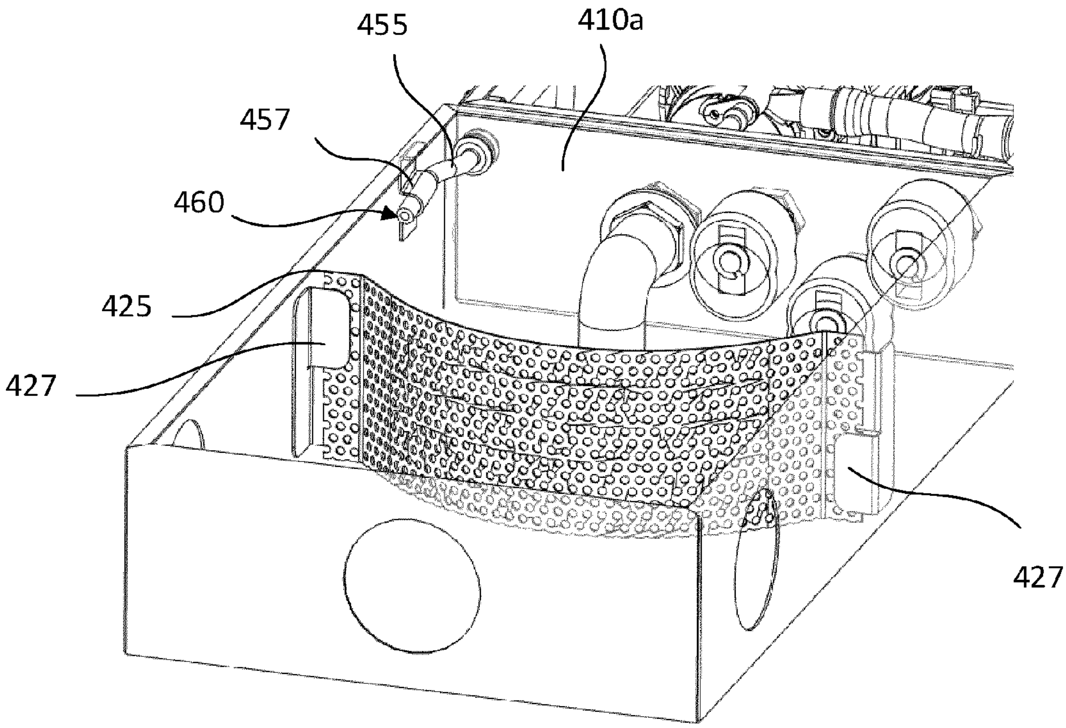
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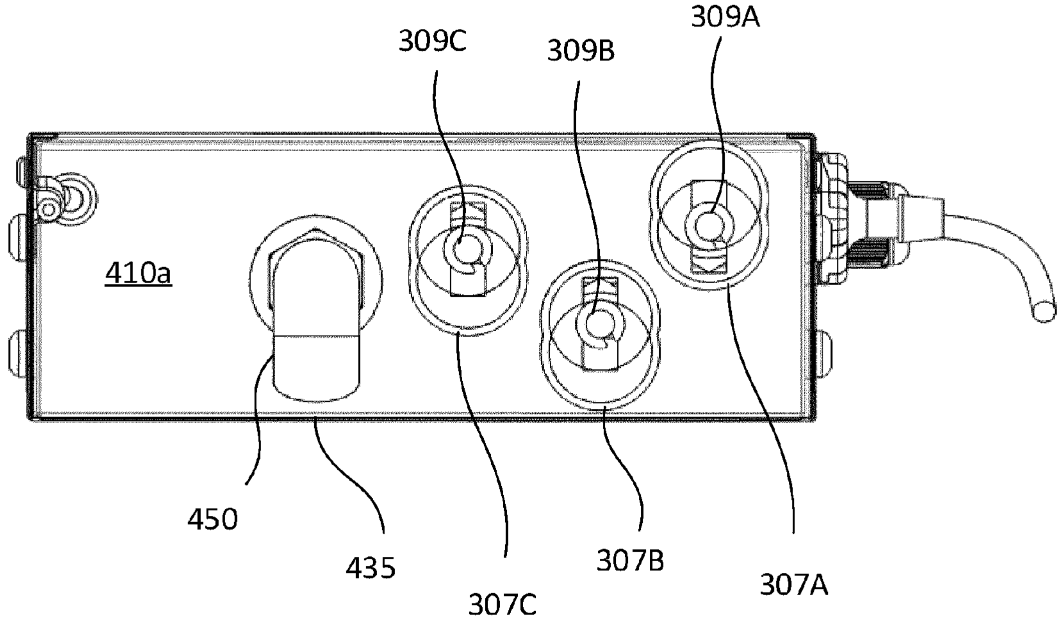
FIG. 11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307C
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307A

FIG. 12

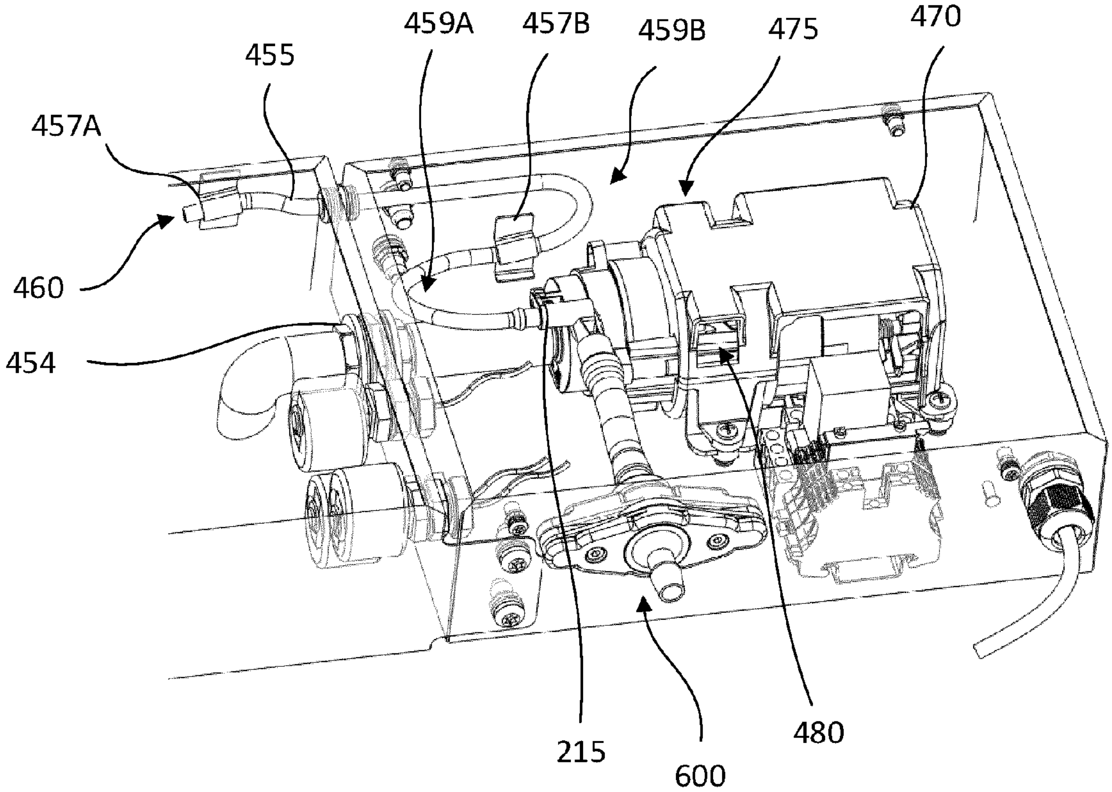
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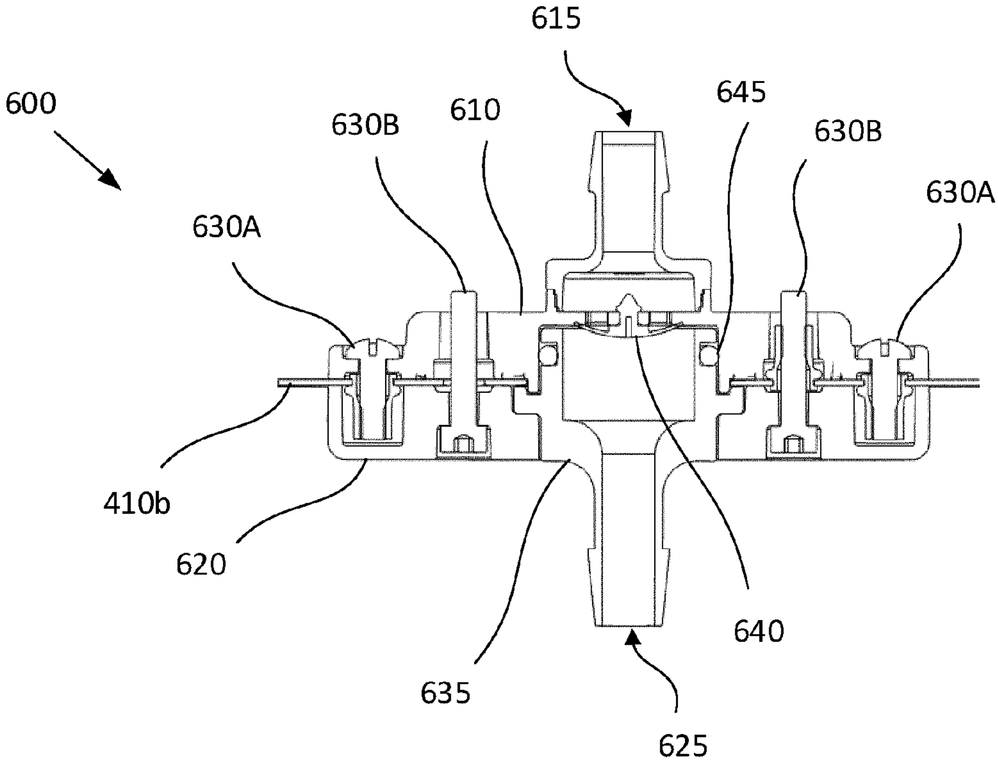
FIG. 13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635
625

FIG. 14

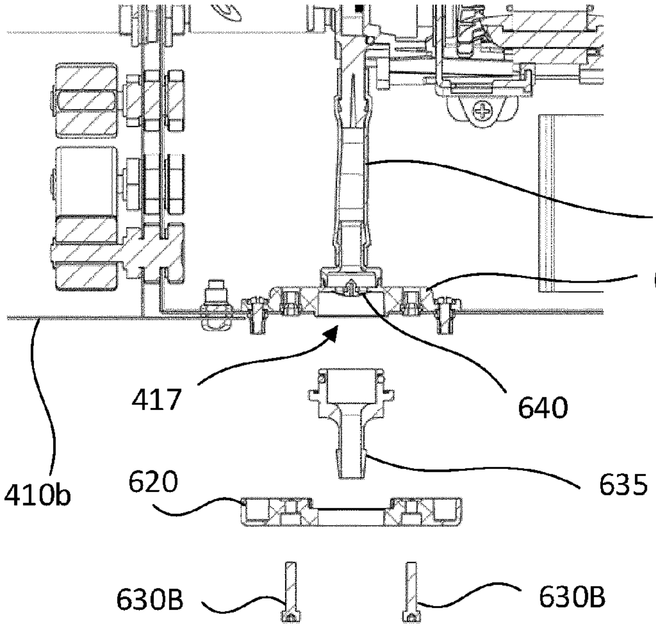

FIG. 15

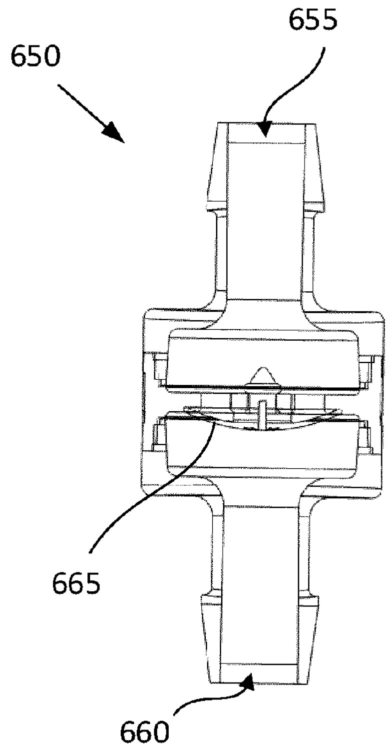

FIG. 16

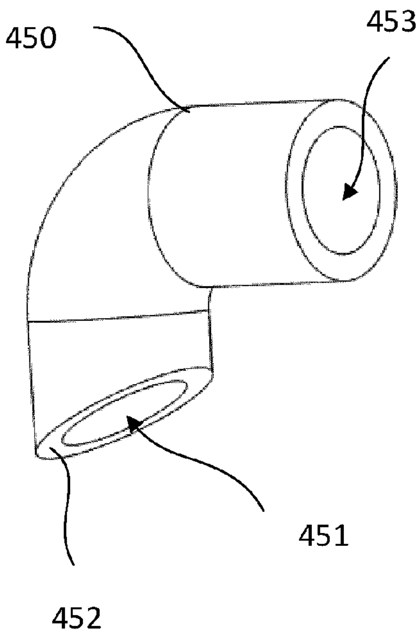

FIG. 17

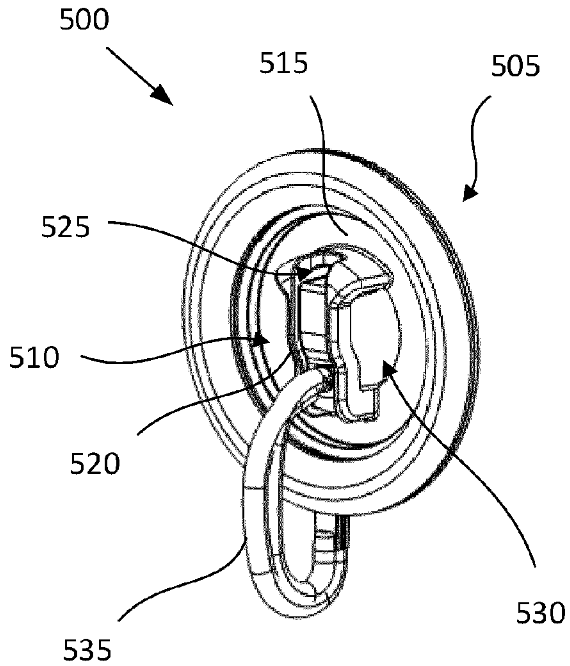

FIG. 18A

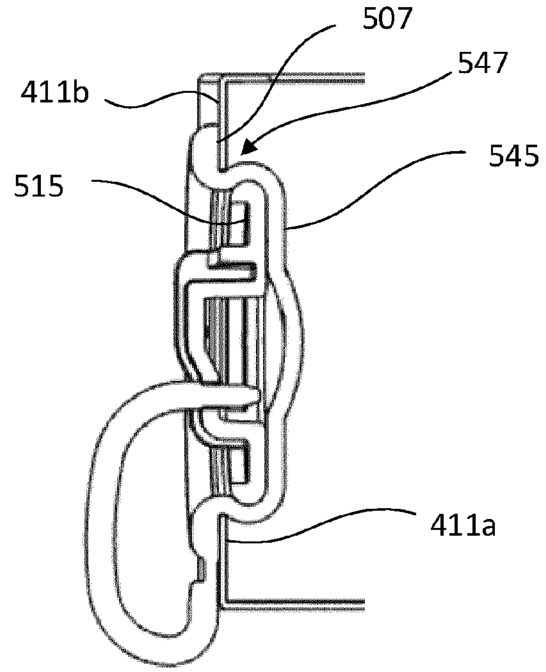

FIG. 18B

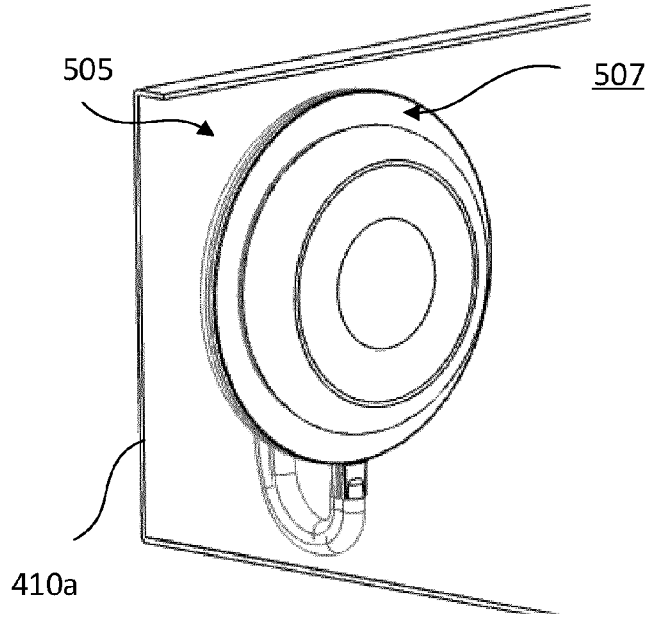

FIG. 18C

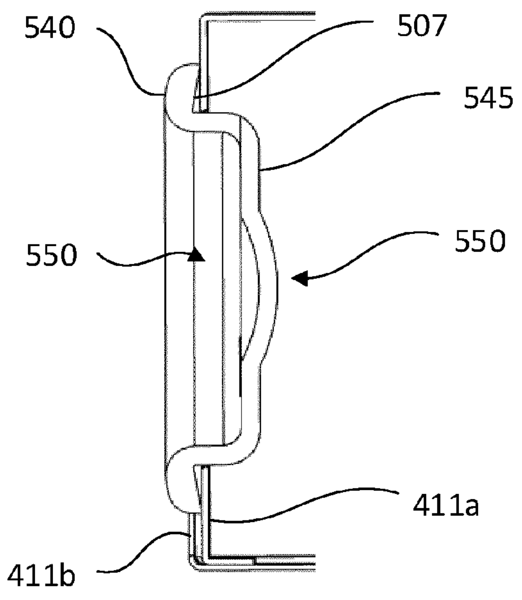

FIG. 18D

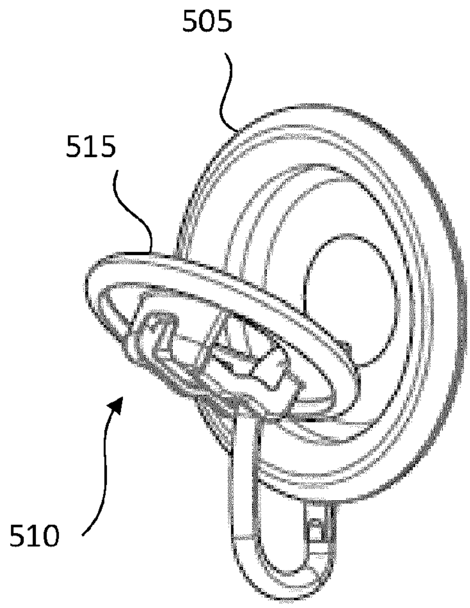

FIG. 18E

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EUROPEAN SEARCH REPORT

Application Number
EP 21 18 7901

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y	CN 111 043 671 A (GREE ELECTRIC APPLIANCES INC ZHUHAI) 21 April 2020 (2020-04-21) * abstract * * figures 1, 6, 8 * -----	1-6,11, 12 7-10, 13-15	INV. F04D13/16 F04D15/02 F04D29/42 F04D29/70 F04D15/00 F24F13/22 F04D29/60
Y	WO 2019/025765 A1 (ASPEN PUMPS LTD [GB]) 7 February 2019 (2019-02-07) * paragraph [0029] - paragraph [0031] * * paragraph [0039] * * figure 2 * -----	1-15	
Y	DE 10 2018 210207 A1 (EGO ELEKTRO GERAETEBAU GMBH [DE]) 24 December 2019 (2019-12-24) * paragraph [0014] * * paragraph [0030] - paragraph [0035] * * figures 1-3 * -----	1-15	
Y	WO 2015/135811 A1 (HYDRO & [BE]) 17 September 2015 (2015-09-17) * paragraph [0053] - paragraph [0054] * * figures 1, 5 * -----	1-15	TECHNICAL FIELDS SEARCHED (IPC)
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A	US 2002/114702 A1 (HOUSE GLENN P [US]) 22 August 2002 (2002-08-22) * figure 1 * -----	1-15	

1

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	17 November 2021	Oliveira, Damien

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
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T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

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17-11-2021

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82