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(54) **AIR CONDITIONING AND OTHER INSTALLATIONS**

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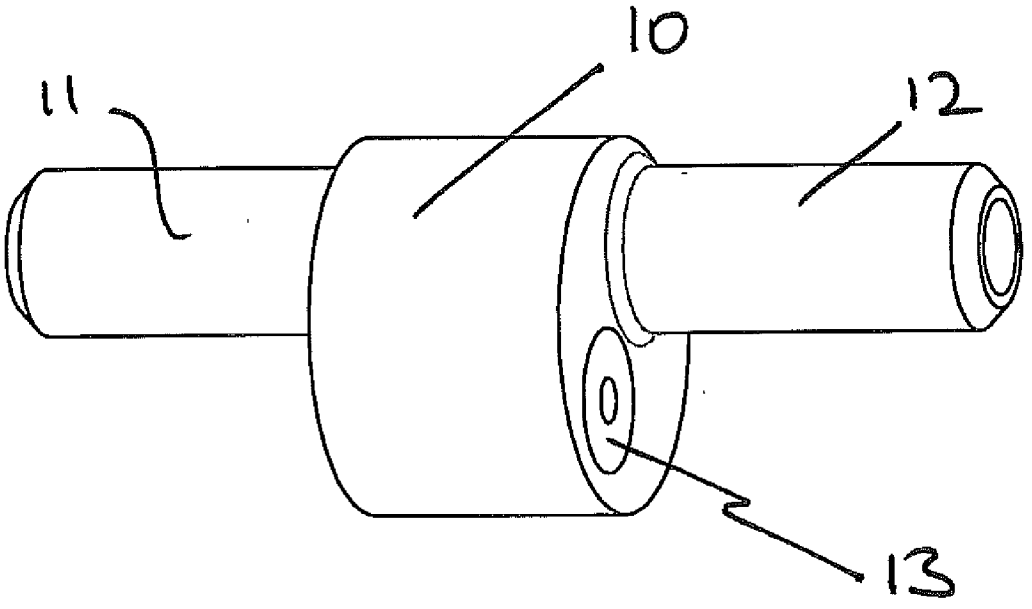
(57) **ABSTRACT**

The present invention relates to improvements in or relating to air conditioning and other installations, in particular to the removal of condensate and other liquids. We describe a method of preventing siphoning of a liquid through a pump having an inlet and an outlet, which outlet is coupled to a discharge line; the method comprising providing an air inlet valve in the discharge line. We also describe an air-inlet valve comprising a valve body having a liquid inlet and a liquid outlet and a through-bore therebetween further comprising an air-inlet in fluid communication with the through-bore. Preferably, the air-inlet comprises a non-return or one-way valve.



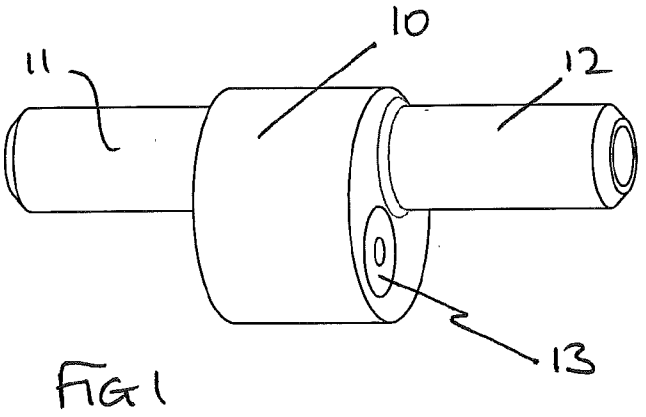


FIG 1

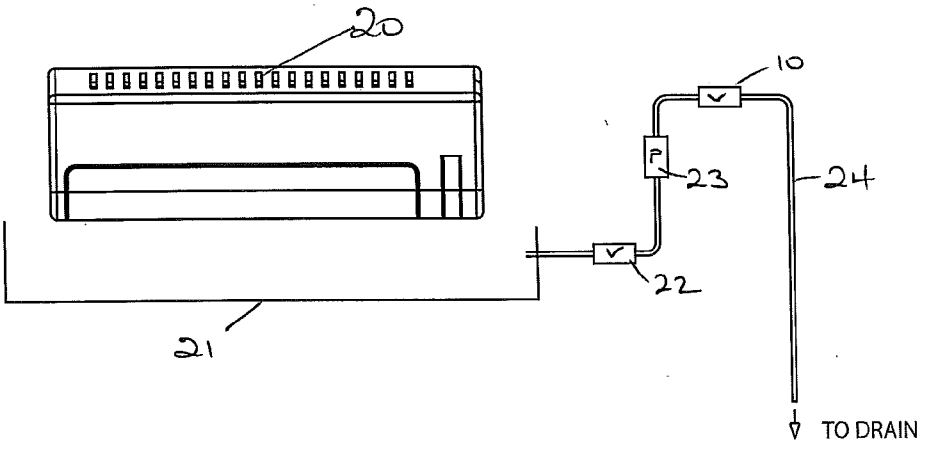


FIG 2

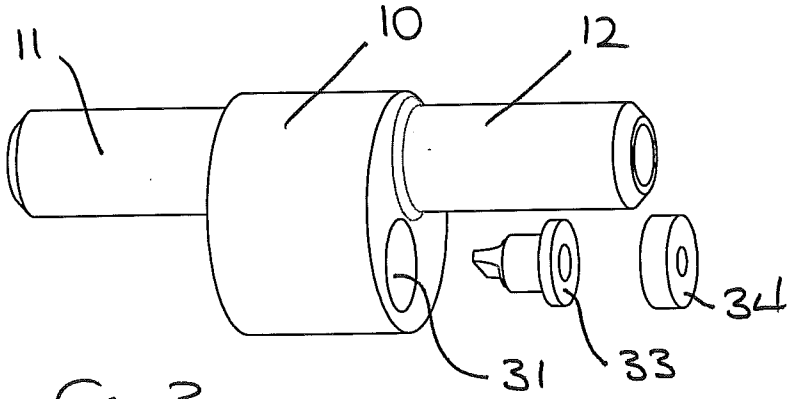


FIG 3

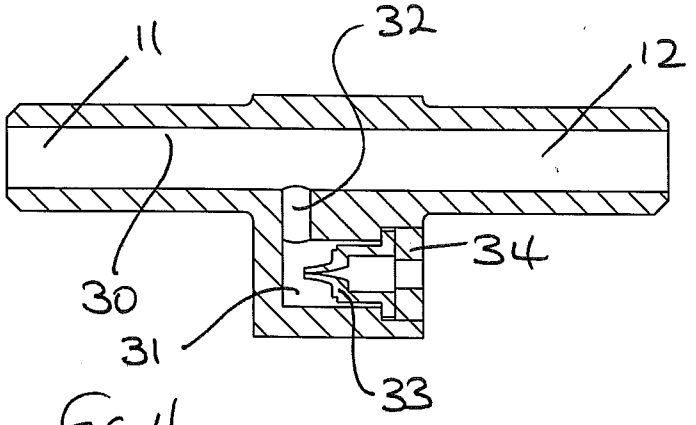


FIG4

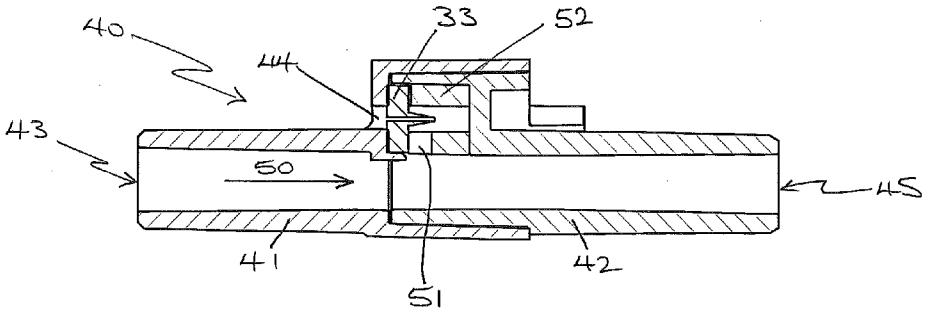


FIG 5

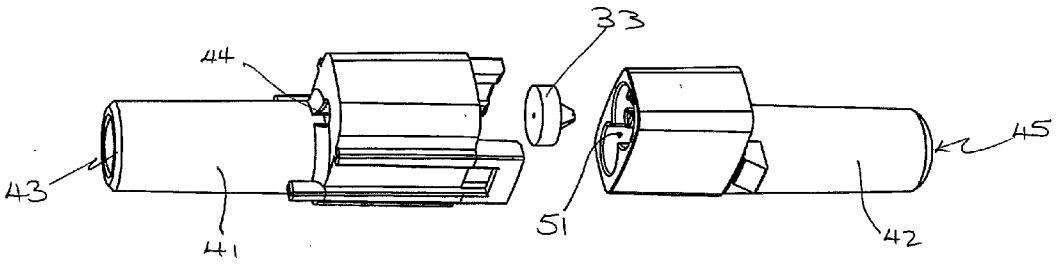


FIG 6

AIR CONDITIONING AND OTHER INSTALLATIONS

[0001] The present invention relates to improvements in or relating to air conditioning and other installations, in particular to the removal of condensate and other liquids.

[0002] In an air conditioning installation, a condenser is used to cool fluid which is used for space-cooling. The condenser produces condensate water which must be removed. Typically, a positive displacement pump is used as a condensate pump to remove condensate from a reservoir adjacent the condenser to a drain via a small bore tube forming a discharge line. A float valve is used to sense when condensate needs evacuating from the reservoir and actuates the pump in response, switching off the pump when all condensate has been removed. The condensate pump is a self-priming pump, but nevertheless, such pumps are typically very noisy when picking up air as they start. Such pumps include a reciprocating metal piston in a cylindrical body and damage can be suffered when the pump runs with no water in it.

[0003] Condensers are typically mounted at an elevated position with respect to the drain. As such, once the pump has been switched off in response to the float valve sensing no further condensate, condensate left upstream of the condensate pump tends to siphon through the pump to the drain leaving the pump with no condensate in it and hence leading to increased noise on the next start-up of the pump and increased wear on the pump surfaces and thus a decreased lifespan for the pump, often as little as a few months.

[0004] The present invention seeks to provide a solution to this problem. Accordingly, in its broadest sense, the present invention provides a method of preventing siphoning of a liquid through a pump having an inlet and an outlet, which outlet is coupled to a discharge line; the method comprising providing an air inlet valve in the discharge line.

[0005] Preferably, the air-inlet valve is positioned at a height not less than slightly below the height of the outlet of the pump.

[0006] Accordingly, in a second aspect, the present invention provides an air-inlet valve. The air-inlet valve comprises a valve body having a liquid inlet and a liquid outlet and a through-bore therebetween further comprising an air-inlet in fluid communication with the through-bore.

[0007] Preferably, the air-inlet comprises a non-return or one-way valve. More preferably, the valve is a duck-bill valve.

[0008] The above and other aspects of the invention will now be described in further detail with reference to the accompanying drawings in which:

[0009] FIG. **1** is a perspective view of a first embodiment of an air-inlet valve in accordance with the present invention;

[0010] FIG. **2** is a schematic view of a portion of a typical air-conditioning installation incorporating the valve of FIG. **1**;

[0011] FIG. **3** is an exploded view of the valve of FIG. **1**;

[0012] FIG. **4** is a cross-sectional view of the valve of FIG. **1**;

[0013] FIG. **5** is a cross-sectional view of a second embodiment of a valve in accordance with the present invention; and

[0014] FIG. **6** is an exploded perspective view of the embodiment of FIG. **5**.

[0015] The embodiment of the air-inlet valve in accordance with the present invention illustrated in the figures has a valve body **10**, a liquid inlet **11** and liquid outlet **12**. Liquid inlet **11** is couplable to a source of liquid, such as the outlet of a pump liquid outlet **12** is couplable to a drain, such as by means of a discharge line **24**. The valve further comprises an air-inlet valve **13** within the valve body **10**.

[0016] FIG. **2** shows the air-inlet valve in a typical air-conditioning installation in which a condenser **20** collects condensate water from the air-conditioning unit. This collects in a reservoir **21**. A float valve **22** senses when the water level in reservoir **21** reaches a predetermined level and activates pump **23** in response thereto. Pump **23** removes condensate to drain through a discharge line **24**. Air-inlet valve **10** is interposed into discharge line **24** downstream of pump **23**. Valve **10** can be positioned slightly below pump **23** but is preferably positioned level with or above the height of pump **23**.

[0017] The air-inlet valve is illustrated in further detail in FIGS. **3** and **4**. Body **10** of the valve has a bore **30** communicating the inlet **11** and outlet **12**; and a cavity **31** in fluid communication with bore **30** by means of a communicating line **32**.

[0018] Cavity **31** is fitted with a uni-directional valve, as shown, in the form of a duck-billed elastomeric valve **33** held in position within cavity **31** by means of a retaining cap **34**.

[0019] As condensate flows through bore **30** as a consequence of the operation of pump **23** air is caused to enter cavity **31** through valve **33** from the atmosphere.

[0020] As a consequence of the admission of air to the condensate flowing through the air-inlet valve, a body of water does not build up downstream of the valve. As a consequence, there is an inadequate weight of condensate liquid to cause condensate to siphon from that part of the discharge line upstream of the pump (that is to say between float valve **22** and pump **23**). A full body of condensate is therefore maintained in pump **23** such that the pump noise and damage apparent with prior art arrangements is avoided.

[0021] An alternative construction is shown in FIGS. **5** and **6**. In this embodiment, valve body **40** consists of two couplable valve body halves **41**, **42**. First valve body half **41** includes a liquid inlet **43** and an air-inlet **44**. Second valve body half **42** includes a liquid outlet **45**.

[0022] In the assembled air inlet valve, liquid inlet **43** and liquid outlet **45** define a bore **50** through the valve.

[0023] Duck-billed elastomeric valve **33** is positioned between valve body halves **41**, **42** and held in place thereby, and is in communication with air inlet **44** and a cavity **51** opening from bore **50**. Second valve body half **42** also includes internal ribs **52** to retain valve **33** in place and ensure that the valve is not compressed closed.

[0024] The operation of this embodiment is as per the first embodiment described above. The two-part assembly simplifies moulding of the components.

[0025] The present invention is of particular benefit for use with piston pumps, for which this is a particular problem and so will find utility also in other uses, such as coffee machines. Such pumps typically include an internal valve, for example providing the self-priming function, typically providing a bias into a closed position against a spring force. The duck-billed valve **33**, or other valve, will be selected to be rated at less than the spring force of any internal pump valve to avoid siphoning.

1. A method of preventing siphoning of a liquid through a pump having an inlet and an outlet, which outlet is coupled to a discharge line; the method comprising providing an air-inlet valve in the discharge line, the air-inlet valve arranged to admit air to the discharge line as the liquid flows through the discharge line.

2. A method as claimed in claim **1** wherein the air-inlet valve is positioned at about the height of, or above the height of the outlet of the pump.

3. A device for preventing siphoning of a condensate liquid through a pump, wherein the device comprises a liquid inlet couplable to an outlet of the pump, and wherein the device further comprises a liquid outlet forming a bore through the device with the liquid inlet, wherein the device further comprises an air-inlet in fluid communication with the bore and wherein the air-inlet comprises a uni-directional valve arranged to admit air into the device in response to a flow of condensate liquid through the bore.

4. A device as claimed in claim **3** wherein the valve is a duck-bill valve.

5. A device as claimed in claim **4** wherein the valve is made of an elastomeric material.

6. A device as claimed in claim **3** wherein the air-inlet comprises a cavity in fluid communication with the bore by means of a communicating line.

7. A device as claimed in claim **6** wherein the valve is a duck-bill valve and is held in position within the cavity by means of a retaining cap.

8. A device as claimed in claim **4** wherein the air-inlet comprises a cavity in fluid communication with the bore by means of a communicating line.

9. A device as claimed in claim **8** wherein the valve is held in position within the cavity by means of a retaining cap.

10. A device as claimed in claim **5** wherein the air-inlet comprises a cavity in fluid communication with the bore by means of a communicating line.

11. A device as claimed in claim **10** wherein the valve is a duck-bill valve and is held in position within the cavity by means of a retaining cap.

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