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(54) BACKFLOW PREVENTION VALVE AND METHOD OF PREVENTING BACKFLOW DURING WATER SUPPLY

(57) A backflow prevention valve (30) prevents backflow during the supply of water from a mains supply to a separate water system, for example a water tank on a boat. The backflow prevention valve (30) is provided comprising a valve body (32) defining a chamber (34), an inlet (36) opening into the chamber (34) and arranged on an inlet axis (38), an outlet (40) opening from the chamber (34) and arranged on an outlet axis (42), and a funnel arranged in the chamber (34) around the outlet (40). The outlet axis (42) is substantially collinear with the inlet axis (38). The funnel tapers from a first larger perimeter at a first end (48) to a second smaller perimeter at the outlet (40). The chamber (34) has one or more backflow outlet ports (52) arranged outside the first perimeter of the funnel.

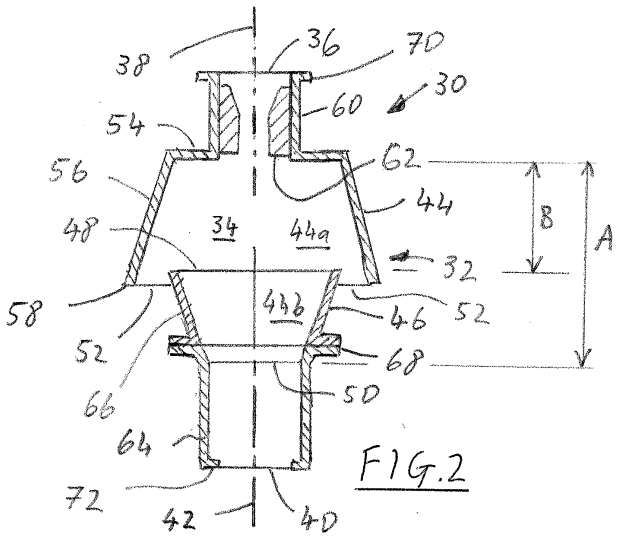

FIG.2

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Description

Field of the invention

[0001] The invention relates to a valve for preventing backflow during the supply of water from a mains supply to a separate water system, for example a water tank on a boat or other vehicle. The invention also relates to a method of preventing backflow during the supply of water from a mains supply to a separate water system.

Background of the invention

[0002] Where water is supplied from the mains supply to a separate water system, for example a tank on a vessel or vehicle, or a water storage and/or supply system on an industrial or construction site, regulations require the use of an appropriate means to prevent backflow, such that water, with potential contaminants, could flow back from the separate water system to the mains supply. In the UK the regulations include The Water Supply (Water Fittings) Regulations 1999 (as amended) in England and Wales, The Water Supply (Water Fittings) Regulations (Northern Ireland) 2009 in Northern Ireland and the Scottish Water Byelaws 2004 in Scotland. Fig. 1 illustrates a known backflow prevention system of the sort used to prevent backflow when filling a water tank on a boat. Water at mains pressure is fed from the mains supply 10 through a servicing valve 12 to an outlet 14 in an elevated storage cistern 16. The cistern 16 includes a ball valve 18 to prevent overfilling of the cistern 16, and includes an overflow pipe 20 through which water can flow if the cistern is overfilled, so that the water level in the cistern 16 can never be higher than the level of the overflow pipe 20. A control valve 22 is used to control the dispense of water from the cistern 16 under gravity through a filling hose 24 to a water tank on a boat 26. UK regulations require an air gap, in this example measured vertically, between the outlet 14 and the maximum water level in the cistern 16. UK regulations specify different categories of backflow protection, for example Category 5, depending on the nature of the water storage and/or supply system to which mains water is being supplied. UK regulations specify different air gaps, for example a type AG air gap, according to the nature of the backflow prevention means.

[0003] The use of an elevated storage cistern as backflow prevention device requires space to be made available to install the cistern. In many environments, for example in a harbour, space may be limited, and if space is used for the installation of a cistern it is not available for other uses, such as vehicle access, unloading and loading etc. Such backflow prevention devices are relatively expensive, and are not readily movable to different locations, so filling always has to take place at the location of the cistern. Such backflow prevention devices are large items of plant, requiring significant maintenance.

[0004] It is an object of the present invention to overcome one or more of the disadvantages of the prior art.

Disclosure of the invention

[0005] According to a first aspect of the present invention, there is provided a backflow prevention valve comprising:

a valve body defining a chamber;
an inlet opening into the chamber and arranged on an inlet axis;
an outlet opening from the chamber and arranged on an outlet axis, wherein the outlet axis is substantially collinear with the inlet axis; and
a funnel arranged in the chamber around the outlet, the funnel tapering from a first larger perimeter at a first end to a second smaller perimeter at the outlet;
wherein the chamber has one or more backflow outlet ports arranged outside the first perimeter of the funnel.

[0006] Preferably the chamber includes an upper portion extending from the inlet to a lower edge of the upper portion, the lower edge having a third perimeter which is larger than the first perimeter of the funnel, wherein the one or more backflow outlet ports are arranged between the first perimeter of the funnel and the third perimeter of the upper portion.

[0007] The upper portion of the chamber may have a generally planar top wall surrounding the inlet and a tapering cylindrical side wall extending to its lower edge. The side wall may include stiffening ribs arranged thereon.

[0008] The upper portion of the chamber may include one or more viewing ports arranged in the top wall or side wall thereof.

[0009] Preferably the distance between the inlet and the backflow outlet ports measured in the direction of the inlet axis is at least 20 mm, more preferably at least 65 mm, most preferably at least 100 mm. Preferably the inlet has a flow path therethrough having a substantially cylindrical bore. Preferably the distance between the inlet and the backflow outlet ports measured in the direction of the inlet axis is at least twice as large as the internal diameter of the cylindrical bore of the flow path through the inlet.

[0010] Preferably the one or more backflow outlet ports are arranged to open from the chamber in the same orientation as the outlet.

[0011] The one or more backflow outlet ports may comprise one or more apertures in a flange surrounding the funnel, the flange being arranged in a plane perpendicular to the inlet axis.

[0012] The backflow prevention valve may include inlet flow path adjustment means adapted to control the internal diameter of a flow path through the inlet.

[0013] The inlet flow path adjustment means may include one or more interchangeable inserts arranged to

be selectively located in the inlet to control the internal diameter of a flow path through the inlet.

[0014] The upper portion of the chamber may include an axially extending passage adapted to receive the interchangeable insert. The backflow prevention valve may include fixings to secure the interchangeable insert in the axially extending passage. The fixings may be fixing screws.

[0015] The backflow prevention valve may include outlet flow path adjustment means adapted to control the internal diameter of a flow path through the outlet.

[0016] The outlet flow path adjustment means may include one or more interchangeable lower funnel portions arranged to be selectively fixed to the lower end of an upper funnel portion. Preferably the lower funnel portion includes the outlet. Preferably the outlet is a cylindrical conduit of substantially uniform cross-section. Preferably the backflow prevention valve includes fixings adapted to secure the lower funnel portion to the upper funnel portion. The fixings may comprise bolts adapted to engage with apertures provided in mutually cooperating external flanges provided on the lower funnel portion and the upper funnel portion.

[0017] Preferably the internal diameter of the flow path through the outlet is at least 1.5 times the internal diameter of the flow path through the inlet, most preferably at least 2.0 times the internal diameter of the flow path through the inlet.

[0018] The inlet may include a standard connection for connection to a pipe, hose or source of pressurised fluid. The standard connection may be a 2.5" (63 mm) male coupling.

[0019] The outlet may include a standard connection for connection to a pipe or hose. The standard connection may be a 2.5" (63 mm) female coupling.

[0020] According to a second aspect of the present invention, there is provided a method of preventing backflow during the supply of water from a mains supply to a separate water system, the method comprising:

connecting the mains supply to an inlet of a backflow prevention valve;

connecting a supply conduit to an outlet of the backflow prevention valve, the outlet being arranged on an axis substantially collinear with the axis of the inlet;

causing water to flow under pressure through said inlet into a chamber to a funnel leading to said outlet, the chamber including an air gap between the inlet and the funnel; and

providing one or more backflow outlet ports arranged in the outer wall of the chamber between the funnel and the inlet remote from the axis of the inlet and outlet, such that if water flows in a reverse direction through the outlet into said chamber it can exit the chamber through the backflow outlet ports.

[0021] Preferably the backflow prevention valve is a backflow prevention valve according to the first aspect of the invention.

Brief description of the drawings

[0022] The invention will now be described by way of example only with reference to the following drawings, in which:

Fig. 1 is a schematic drawing of a prior art backflow prevention system;

Fig. 2 is a schematic cross sectional view of a backflow prevention valve according to the present invention;

Fig. 3 shows a side view of a backflow prevention valve according to the present invention;

Fig. 4 is an exploded view of the backflow prevention valve of Fig. 3; and

Figs. 5 to 9 are sectional views through embodiments of the backflow prevention valve of Fig. 3 with modified inlets and outlets.

Detailed description of the invention

[0023] Referring to Fig. 2 there is shown a schematic view of a backflow prevention valve 30 according to the present invention. The backflow prevention valve 30 comprises a valve body 32 which defines a chamber 34. The chamber 34 has an inlet 36 opening into the chamber and arranged on an inlet axis 38, and an outlet 40 opening from the chamber and arranged on an outlet axis 42. In the illustrated example the inlet axis 38 and the outlet axis 42 are collinear.

[0024] The valve body 32 includes an upper portion 44 and a lower portion 46, which define upper 44a and lower 44b portions of the chamber 34 respectively. The lower portion 46 includes a funnel section which tapers from a first larger perimeter at its upper end 48 to a second smaller perimeter at its lower end 50 where it meets the outlet at the outlet. The chamber has a number of backflow outlet ports 52 between the upper portion 44 and the lower portion 46 of the valve body 32. The backflow outlet ports 52 are arranged outside the upper end 48 of the funnel section. The backflow outlet ports 52 are separated from each other by ribs (not visible in Fig. 2) which connect the upper portion 44 and lower portion 46 of the valve body 32.

[0025] In the example the upper portion 44a of the chamber 34 is bounded by a planar top wall 54 surrounding the inlet and a tapering cylindrical side wall 56 extending to its lower edge 58. The side wall may be conical or bell-shaped or hemispherical, or any appropriate shape. The lower edge 58 has a third perimeter which surrounds the first larger perimeter at the upper end 48

of the funnel section. The backflow outlet ports 52 are arranged between the first and third perimeters so that in the example they are directed downwards parallel to the inlet axis 38.

[0026] In an alternative arrangement (not illustrated) a flange may be provided between the upper end 48 of the funnel section and the lower edge 58 of the upper section 44, to connect the upper section 44 to the lower section 46 of the valve body 32, the flange being arranged to extend in a plane perpendicular to the inlet axis. In this case, the backflow outlet ports 52 are provided as apertures in the flange surrounding the perimeter of the funnel.

[0027] The upper portion 44 of the valve body 32 includes an axially extending passage 60 in which is located an interchangeable insert 62, secured by any suitable fixings. The insert 62 serves as an inlet flow path adjustment means, and controls the internal diameter of the flow path through the inlet 36. Different inserts 62 can be used to provide different size inlet flow paths.

[0028] The inlet 36 is provided at its upper end with a standard connection 70 (for example a 2.5" (63 mm) male coupling) for connection to a pipe, hose or source of pressurised fluid.

[0029] The lower portion 46 of the valve body 32 includes an interchangeable lower funnel portion 64 fixed to the lower end of an upper funnel portion 66 by fixings (not shown) which engage with connecting flanges 68. The outlet 40 is provided in the lower funnel portion 64. Different lower funnel portions 64 can be provided with different diameters of flow path through the outlet 40, by extending or reducing the tapered portion of the lower funnel portion 64. Hence the interchangeable lower funnel portion 64 serves as an outlet flow path adjustment means for controlling the internal diameter of the flow path through the outlet 40.

[0030] The outlet 40 is provided at its lower end with a standard connection 72 for connection to a pipe or hose, for example a 2.5" (63 mm) female coupling.

[0031] In use the inlet 36 of the of the backflow prevention valve 30 is connected to a mains supply, and a hose or other supply conduit is connected to the outlet 40 of the backflow prevention valve 30, in order to fill a tank or similar at the other end of the hose or other supply conduit. When water is supplied under pressure from the mains supply, the water flows through the inlet 36 and any insert 62 as a jet and across the air gap in the chamber 34.

[0032] The internal diameter of the flow path through the outlet 40 is typically between 1.4 and 2.5 times the internal diameter of the flow path through the inlet 36, so the cross-sectional area of the outlet flow path is about twice to six times the cross-sectional area of the inlet flow path. It has been found advantageous if the internal diameter of the flow path through the outlet 40 is about twice the internal diameter of the flow path through the inlet 36. Hence under normal operation, even with some dispersal of the jet of water entering the chamber 34, most of the water passes directly to the outlet 40. Any divergent water which moves away from the inlet axis 38 hits the funnel of the lower portion 46 of the valve body 32 and is directed towards the outlet. Hence in normal operation there is an air gap of length A, being the axial distance between the lower end 50 of the funnel section and the top wall 54 of the chamber 34 where the inlet 36 enters the chamber.

[0033] If the outlet 40 is subject to backflow, whereby water returns from the tank being filled along the hose or other supply conduit to the outlet 40, the jet of water from the inlet 36 can no longer pass through the outlet, and the lower chamber 44b will fill with water. This water may be contaminated since it may include water returned under backflow from the tank being filled. However the water from the inlet will simply hit the surface of the water in the lower chamber 44b and flow over the upper end 48 of the funnel and exit through the backflow outlet ports 52. The upper end 48 of the funnel acts as a weir, and there remains an air gap of length B, being the axial distance between the upper end 50 of the funnel section and the top wall 54 of the chamber 34 where the inlet 36 enters the chamber.

[0034] The air gap of length B is selected so that the backflow prevention valve 30 complies with regulatory requirements by providing an appropriate minimum air gap. For example to meet UK regulations the distance between the inlet, being the point where the inlet 36 enters the chamber 34, and the backflow outlet ports, being the upper end 50 of the of the funnel section, measured in the direction of the inlet axis is selected to be at least 20 mm, and at least twice the internal diameter of the cylindrical bore of the flow path through the inlet 36. In practice this distance may be selected to be at least 65 mm, or at least 100 mm.

[0035] Although Fig. 2 shows the orientation of the backflow prevention valve 30 arranged so that the inlet and outlet axes 38, 42 are vertical, and water flows down wards though the chamber 34, the invention functions equally successfully if the inlet and outlet axes 38, 42 are horizontal or in any other orientation, since the air gap remains.

[0036] Figs. 3 and 4 show a non-limiting embodiment of a backflow prevention valve 30 according to the present invention. The operation of the backflow prevention valve 30 is exactly the same as that described with reference to Fig. 2, so description of the operation is not repeated. The same reference numerals are used to denote the same features where these are common to the schematic embodiment of Fig. 2 and the illustrated embodiment of Figs. 3 and 4. The valve body 32 comprises three separate moulded parts, the upper portion 44, the upper funnel portion 66 and the lower funnel portion 64. The upper funnel portion 66 and the lower funnel portion 64 are joined together by bolts 90 and nuts 92, which pass through apertures in the flanges 68, to form the lower portion 46 of the valve body 32, which defines the funnel. The lower funnel portion 64 is interchangeable,

and the bolts 90 and nuts 92 can be removed and reused to attach a different lower funnel portion 64 with a different flow path size if required.

[0037] The upper portion 44 and lower portion 46 of the valve body 32 are joined permanently by self tapping screws 94 which pass through apertures 96 in a flange 98 extending from the first perimeter at the upper end 48 of the funnel section of the lower portion 46 and engage with apertures in ribs 100 provided on the side wall 56 of the upper portion 44. In the illustrated embodiment the upper and lower portions 44, 46 are formed separately by moulding and then joined permanently. However if required the upper and lower portions 44, 46 can be manufactured as an integral unit.

[0038] In this embodiment the inlet 36 comprises a separate metal coupling piece 110 which includes the standard 2.5" male coupling connection 70 and an axially extending internal passage 60. The coupling piece 110 is held in the top of the upper portion 44 of the valve body 32 by three fixing screws 112 which engage the coupling piece through three apertures 114. An O-ring seal 116 is provided to seal between the coupling piece 110 and the upper portion 44. An internal retaining plate 117 with a central aperture is held by long screws 118 (shown in Figs. 5 to 9) which engage with the retaining plate 117 through longitudinal apertures 119, to hold the retaining plate 117 against the top wall 54 of the upper portion 44. The retaining plate 117 serves to hold an insert 62 in place if an insert is used in the inlet 36.

[0039] In this embodiment the outlet 40 comprises a separate metal coupling piece 120 which includes the standard 2.5" female coupling connection 72 and handles 128. The coupling piece 120 is held in the bottom of the lower portion 46 of the valve body 32 by three fixing screws 122 which engage the coupling piece through three apertures 124. An O-ring seal 126 is provided to seal between the coupling piece 120 and the lower portion 46.

[0040] Figs 5 to 9 are cross-sectional views of the backflow prevention valve illustrated in Figs. 3 and 4 with various arrangements of interchangeable inlet inserts and outlet attachments. In each view the cross-section is taken through the ribs 100, which are located between the backflow outlet ports 52, so the backflow outlet ports 52 are not visible in these views.

[0041] In Fig. 5 no insert is provided at the inlet 36, and the lower funnel portion 64 is as illustrated in Figs. 3 and 4.

[0042] In Fig. 6 an insert 62a is provided at the inlet 36, and the lower funnel portion 64 is as illustrated in Figs. 3 and 4. The insert 62a reduces the diameter of the flow passage by about 50% and thus reduces the flow area by about 75%. The insert 62a is held in place by the retaining plate 117, which itself is held in place by three screws 118.

[0043] In Fig. 7 an insert 62b is provided at the inlet 36, and the lower funnel portion 64 is as illustrated in Figs. 3 and 4. The insert 62b reduces the diameter of the flow passage by about 40% and thus reduces the flow area by about 64%. The insert 62b is held in place by the retaining plate 117, and it extends into the upper portion 44a of the chamber, so that in this embodiment the air gap is measured between the bottom 130 of the insert 62b and the top 48 of the funnel.

[0044] In Fig. 8 an insert 62c is provided at the inlet 36, and a lower funnel portion 64a with a smaller diameter flow passage is provided at the outlet 40. The insert 62c reduces the diameter of the flow passage by about 75% and thus reduces the flow area by about 94%. The insert 62c is held in place by the retaining plate 117, which itself is held in place by three screws 118. The interchangeable lower funnel portion 64a has a longer funnel section and a corresponding smaller diameter flow passage. Compared to the outlet flow passage in Fig. 7, the interchangeable lower funnel portion 64a reduces the diameter of the flow passage by about 50% and thus reduces the flow area by about 75%.

[0045] In Fig. 9 no insert is provided at the inlet 36, and a lower funnel portion 64b with a larger diameter flow passage is provided at the outlet 40. The interchangeable lower funnel portion 64b has a shorter funnel section and a corresponding larger diameter flow passage. Compared to the outlet flow passage in Fig. 7, the interchangeable lower funnel portion 64b increases the diameter of the flow passage by about 100% and thus increases the flow area by about 300%.

[0046] Although the illustrated embodiments include interchangeable components so that the size of the inlet and outlet flow passages are each adjustable by selecting different interchangeable components, it is possible to provide a backflow prevention valve according to the present invention which is not adjustable, and has fixed inlet and outlet sizes. Such a valve is useful if it is intended to be used in one particular location for one particular purpose, and water supply is provided under constant conditions.

[0047] The inventors have found that the best results are obtained if the internal diameter of the flow path through the outlet 40 is at least twice the internal diameter of the flow path through the inlet 36. However successful results are obtained provided that the outlet flow area is larger than the inlet flow area, for example if the outlet flow area is at least 50% larger than the inlet flow area, or is at least twice the inlet flow area.

[0048] The optimum cone angle achieves maximum catchment while minimising spillage through the backflow outlet ports 52. The inventors have found that the best results are obtained if the angle of the conical surface of the funnel (measured from the cone axis) is between 15 and 55 degrees, preferably about 25 to 40 degrees.

[0049] The valve of the present invention provides a simpler, more cost effective way of complying with regulations concerning supplying water from a mains water supply to a third party system. The valve of the invention is portable, and can be lifted by one person. It can be transported easily to the location of use. It can be stored

indoors when not in use.

[0050] A user is alerted immediately when backflow occurs, as water is released from the backflow outlet ports, serving as a visible signal. The user can then turn off water supply to the inlet.

[0051] The valve of the present invention can be used in any suitable location and for any suitable purpose, including but not limited to the following:

in ports and harbours for supplying water to ships, boats and other vessels,
at industrial sites for supplying water for industrial processes;
to fill water storage tanks;
to supply water for construction purposes;
to supply water for irrigation;
in agricultural use for filling chemical sprayers;
at waste water treatment sites;
to fill chemical drums;
for veterinary purposes including X-ray equipment;
for the supply of water to any high risk equipment which could potentially
contaminate the wholesome water supply;
to supply butchers' top up vats;
to supply water for saw mills treatment;
to supply water for chemical top up cisterns; and
in conjunction with the supply of water to any vessel or equipment from a flexible hose at point of use.

[0052] Although the invention has been described with reference to the supply of mains water, the invention can be used in the supply of any liquid where backflow should be prevented.

[0053] The scope of the claims is not limited to the particular embodiments described herein. Other embodiments and variations are possible. In particular the valve of the invention and its components may have other shapes and may be constructed from other materials.

Claims

1. A backflow prevention valve (30) comprising:

a valve body (32) defining a chamber (34);
an inlet (36) opening into the chamber (34) and arranged on an inlet axis (38);
an outlet (40) opening from the chamber (34) and arranged on an outlet axis (42), wherein the outlet axis (42) is substantially collinear with the inlet axis (38); and
a funnel arranged in the chamber (34) around the outlet (40), the funnel tapering from a first larger perimeter at a first end (48) to a second smaller perimeter at the outlet (40);
wherein the chamber (34) has one or more backflow outlet ports (52) arranged outside the first perimeter of the funnel.

2. A backflow prevention valve (30) according to claim 1, wherein the chamber (34) includes an upper portion (44a) extending from the inlet (36) to a lower edge (58) of the upper portion (44a), the lower edge (58) having a third perimeter which is larger than the first perimeter of the funnel, wherein the one or more backflow outlet ports (52) are arranged between the first perimeter of the funnel and the third perimeter of the upper portion (44a).

3. A backflow prevention valve (30) according to claim 2, wherein the upper portion (44a) of the chamber (34) has a generally planar top wall (54) surrounding the inlet (36) and a tapering cylindrical side wall extending to the lower edge (58).

4. A backflow prevention valve (30) according to any preceding claim, wherein the distance between the inlet (36) and the backflow outlet ports (52) measured in the direction of the inlet axis (38) is at least twice as large as the internal diameter of a cylindrical bore of a flow path through the inlet (36).

5. A backflow prevention valve (30) according to any preceding claim, wherein the one or more backflow outlet ports (52) are arranged to open from the chamber (34) in the same orientation as the outlet (40).

6. A backflow prevention valve (30) according to any preceding claim, further including inlet flow path adjustment means adapted to control the internal diameter of a flow path through the inlet (36).

7. A backflow prevention valve (30) according to claim 6, wherein the inlet flow path adjustment means includes one or more interchangeable inserts arranged to be selectively located in the outlet (40) to control the internal diameter of a flow path through the inlet (36).

8. A backflow prevention valve (30) according to any preceding claim, further including outlet flow path adjustment means adapted to control the internal diameter of a flow path through the outlet (40).

9. A backflow prevention valve (30) according to claim 8, wherein the outlet flow path adjustment means includes one or more interchangeable lower funnel portions arranged to be selectively fixed to the lower end of an upper funnel portion (66).

10. A backflow prevention valve (30) according to any preceding claim, wherein the internal diameter of the flow path through the outlet (40) is at least 1.5 times, preferably at least 2.0 times, the internal diameter of the flow path through the inlet (36).

11. A backflow prevention valve (30) according to any

preceding claim, wherein the inlet includes a standard connection for connection to a pipe, hose or source of pressurised fluid, for example a 2.5" (63 mm) male coupling.

12. A backflow prevention valve (30) according to any preceding claim, wherein the outlet includes a standard connection for connection to a pipe or hose, for example a 2.5" (63 mm) female coupling.

13. A method of preventing backflow during the supply of water from a mains supply to a separate water system, the method comprising:

connecting the mains supply to an inlet (36) of a backflow prevention valve (30);
connecting a supply conduit to an outlet (40) of the backflow prevention valve (30), the outlet (40) being arranged on an axis substantially collinear with the axis of the inlet (36);
causing water to flow under pressure through said inlet into a chamber (34) to a funnel leading to said outlet (40), the chamber (34) including an air gap between the inlet (36) and the funnel; and
providing one or more backflow outlet ports (52) arranged in the outer wall of the chamber (34) between the funnel and the inlet (36) remote from the axis of the inlet (36) and outlet (40), such that if water flows in a reverse direction through the outlet (40) into said chamber (34) it can exit the chamber (34) through the backflow outlet ports (52).

14. A method according to claim 13, wherein the backflow prevention valve (30) is a backflow prevention valve (30) according to any of claims 1 to 12.

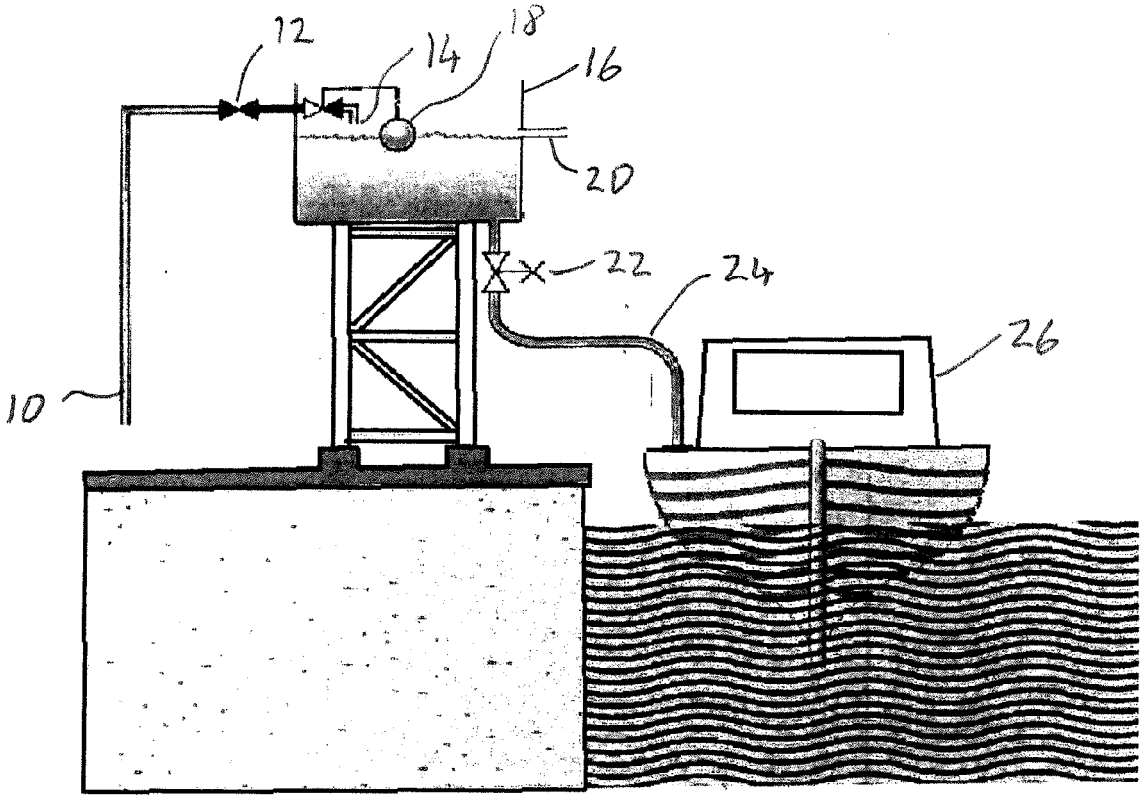
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FIG. 1

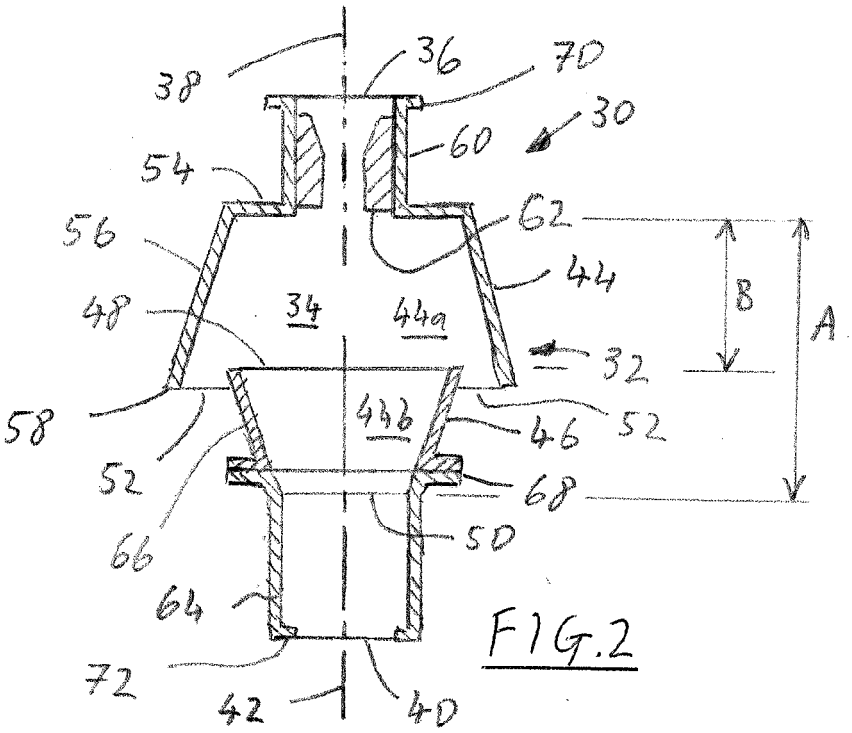
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FIG.2

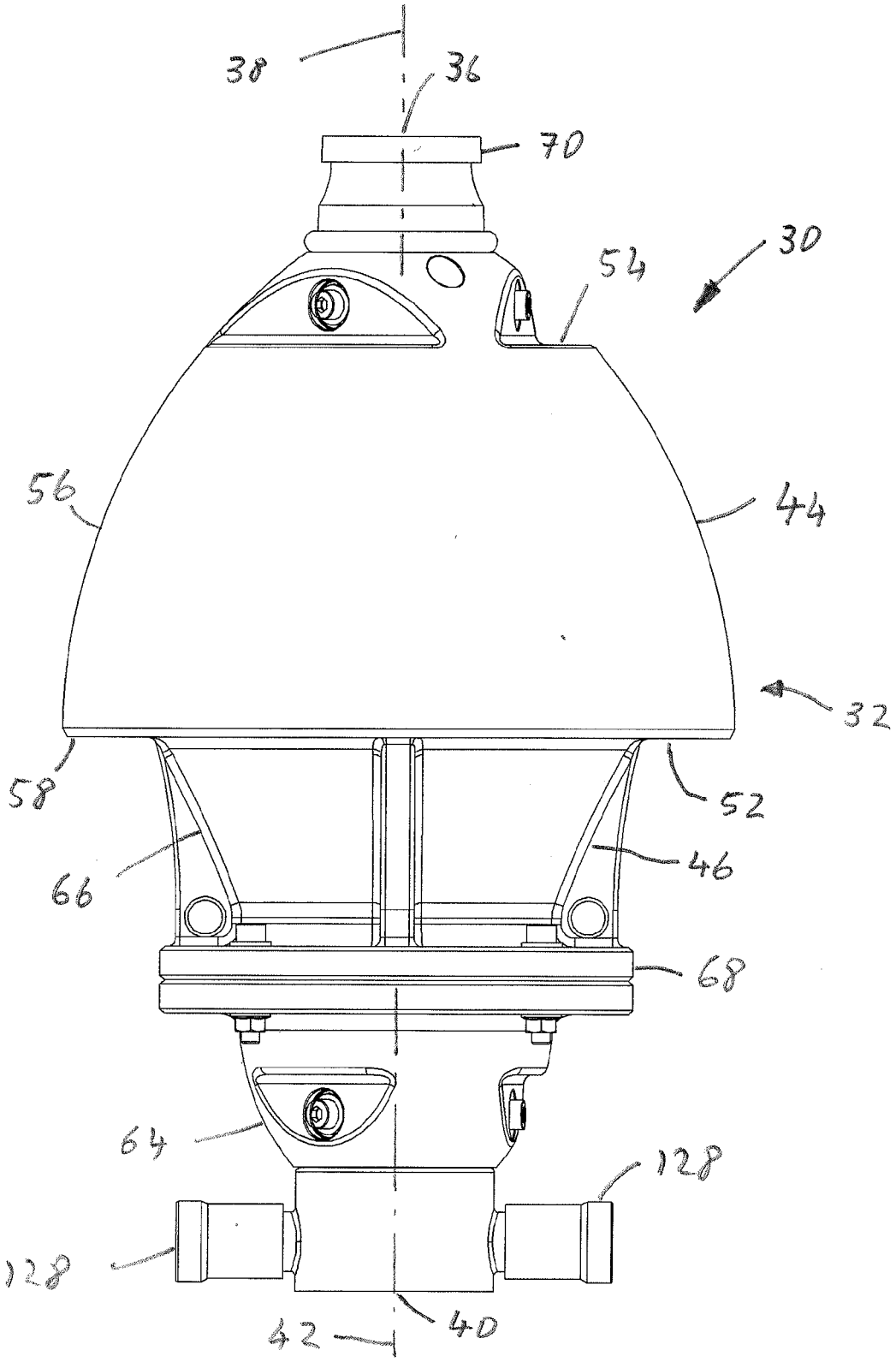

FIG. 3

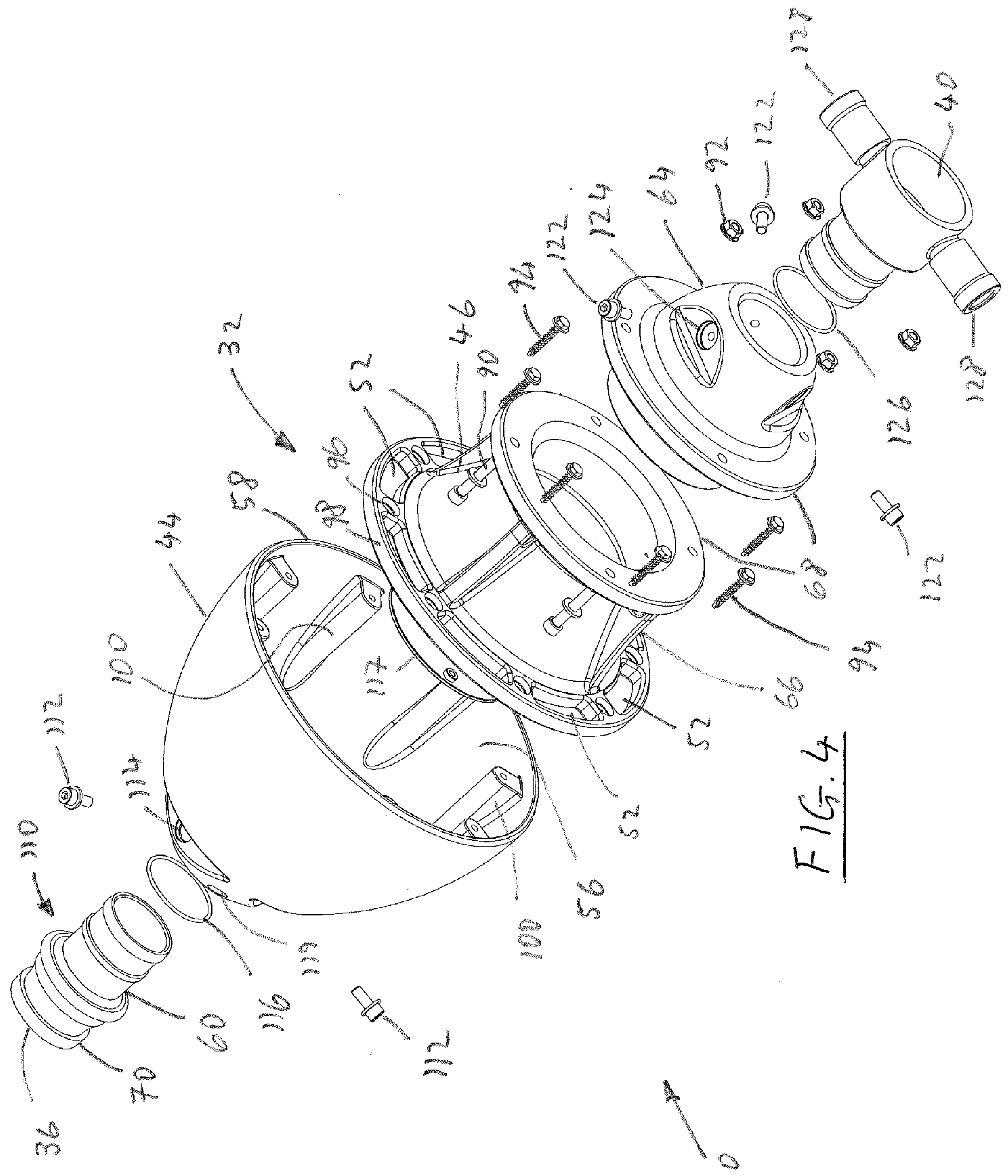

FIG. 4

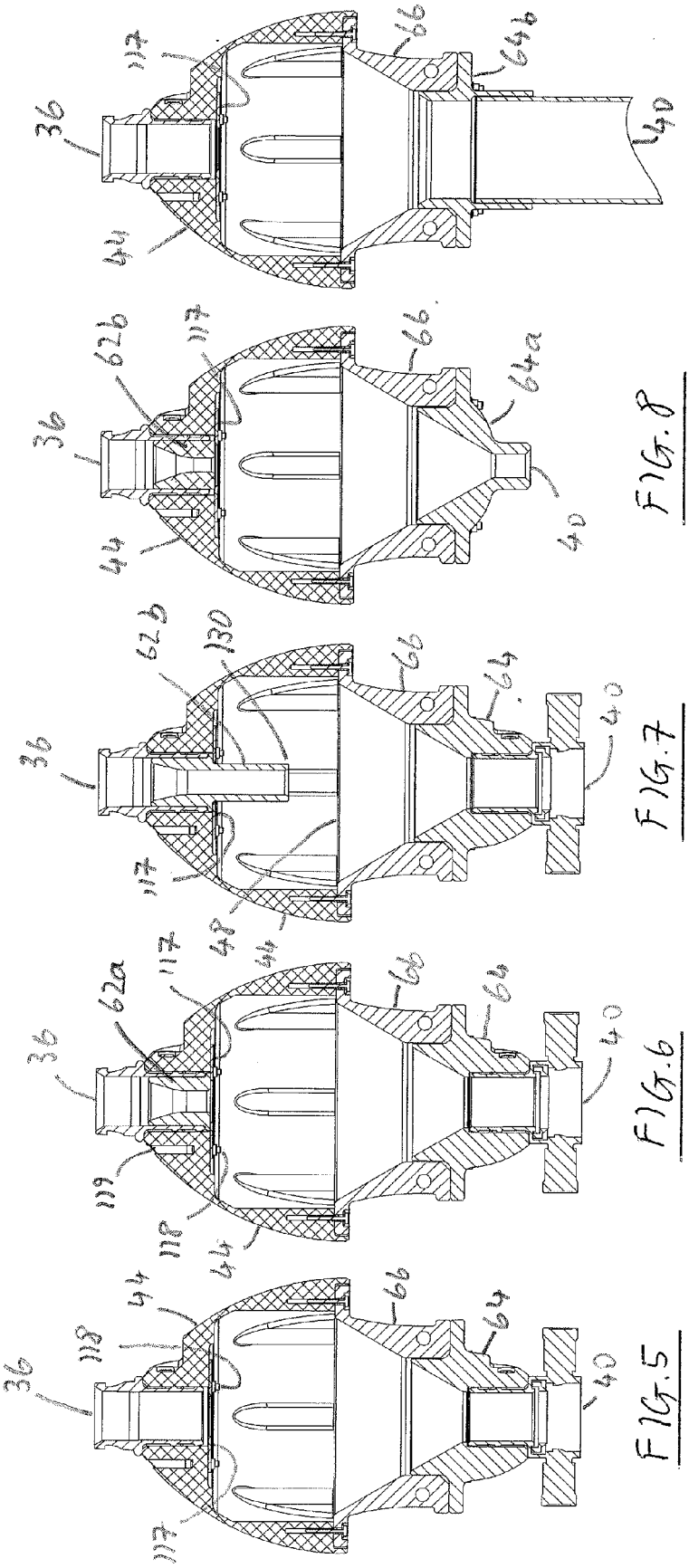

FIG. 9

FIG. 8

FIG. 7

FIG. 6

FIG. 5

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European Patent Office
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EUROPEAN SEARCH REPORT

Application Number
EP 15 16 8624

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	GB 897 965 A (HOOVER LTD) 6 June 1962 (1962-06-06) * figures 2,3 *	1-14	INV. E03C1/10
X A	US 2 023 178 A (LUFF HENRY J) 3 December 1935 (1935-12-03) * figures 1,2,3 *	1,2,5-7, 13,14 3,4,8, 10-12	
X	US 2014/048147 A1 (MILNE JAY BRADLEY [CA]) 20 February 2014 (2014-02-20) * figure 4 *	1,3,4,6, 7,10,13, 14	
X	US 2 047 163 A (CEKAL JAMES G) 7 July 1936 (1936-07-07) * figures 1,2 *	1	
X	DE 297 17 363 U1 (WISY AG [DE]) 13 November 1997 (1997-11-13) * figure 2 *	1	
			TECHNICAL FIELDS SEARCHED (IPC) E03C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	15 September 2015	Leher, Valentina

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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