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(54) A WATER FAUCET

(57) The invention relates to a water faucet for domestic outdoor use. The water faucet comprises: a faucet outlet; at least one faucet inlet; a faucet pipe fluidly coupling the faucet outlet with the at least one faucet inlet; a valve seat; a valve member positioned at the valve seat; and a flow element connected to the valve member and positioned at least partly within the faucet pipe. The valve member is shiftable from an open configuration to a closed configuration relative to the valve seat. The open configuration fluidly couples a faucet interior of the water faucet to a faucet exterior of the water faucet and the closed configuration fluidly seals the faucet interior from the faucet exterior. The invention further relates to a method of shifting a valve member, a valve assembly, and use of a valve assembly.

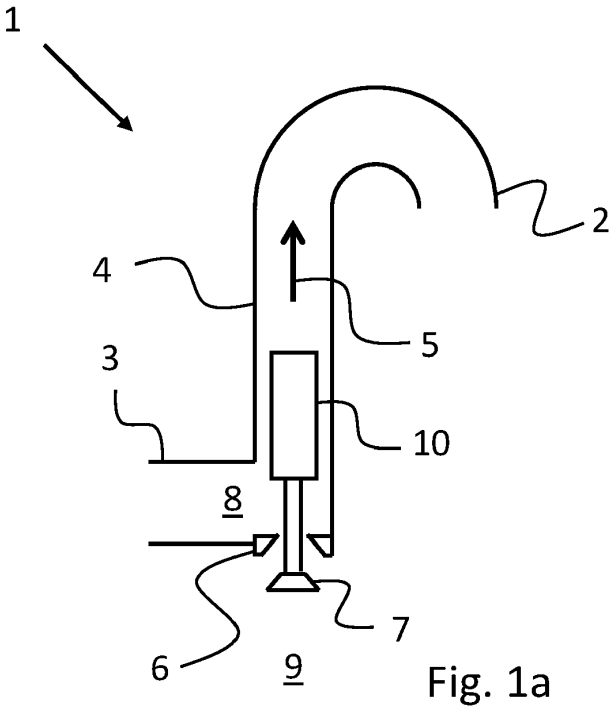

Fig. 1a

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to a water faucet, such as a shower faucet. The invention further relates method of shifting a valve member of a water faucet. Moreover, the invention relates to a valve assembly and use of such a valve assembly.

BACKGROUND OF THE INVENTION

[0002] Outdoor water faucets are exposed to various weather conditions including temperatures where water freezes into ice.

[0003] Ice in a water faucet may block water from flowing in the faucet, rendering the water faucet useless. More seriously, outdoor water faucets are at risk of bursting in low temperatures due to the spatial expansion of water as it solidifies. Such bursts will typically at least irreversibly damage the faucet, and in worst cases cause a great waste of water and potentially damage the surrounding areas and facilities.

[0004] One solution is to turn off water supply to the water faucet followed by draining water from the faucet. However, this is a highly unpractical solution, particularly if a vertically aligned faucet pipe has to drained. Further, such an unpractical solution is particularly undesirable for users which intend to use the water faucet under freezing conditions, since this will require turning on and off the water supply to the water faucet with each use.

[0005] Moreover, freezing and bursting conditions can be highly unpredictable. An unpractical solution in combination with unpredictable conditions greatly motivate alternative and improved solutions.

SUMMARY OF THE INVENTION

[0006] On the above background, it is an object of preferred embodiments of the invention to provide a water faucet having a reduced risk of being blocked and bursting due to freezing water. Further, it is an object of preferred embodiments of the invention to reduce waste of water and damage to areas and facilities surrounding outdoor water faucets. Moreover, it is an object of preferred embodiments of the invention to provide autonomous, simple, and reliable solutions. Finally, it is an object of preferred embodiments of the invention to serve as alternatives to conventional solutions.

[0007] A first aspect the present invention relates to a water faucet for domestic outdoor use, the water faucet comprising:

a faucet outlet;

at least one faucet inlet;

a faucet pipe fluidly coupling the faucet outlet with the at least one faucet inlet, wherein the faucet pipe internally defines a flow direction from the at least one faucet inlet to the faucet outlet;

a valve seat;

a valve member positioned at the valve seat, wherein the valve member is shiftable from an open configuration to a closed configuration relative to the valve seat, wherein the open configuration fluidly couples a faucet interior of the water faucet to a faucet exterior of the water faucet, wherein the closed configuration fluidly seals the faucet interior from the faucet exterior; and

a flow element connected to the valve member and positioned at least partly within the faucet pipe.

[0008] In embodiments of the invention, the flow element is configured to be dragged in the flow direction by water flow in the faucet pipe to support a shift of the valve member from the open configuration towards the closed configuration. This water flow may be from the at least one faucet inlet to the faucet outlet.

[0009] Optionally, the flow element is configured to be dragged in the flow direction by water flow in the faucet pipe to shift of the valve member from the open configuration towards the closed configu ration.

[0010] The provision of a flow element connected to the valve member and positioned at least partly within the faucet pipe may potentially support autonomous regulation of whether the valve member is positioned in the open configuration or the closed configuration, thereby ensuring that the faucet pipe is drained from water when water flow stops, minimizing risk of water blockage or water bursts due to freezing.

[0011] The valve seat and valve member collectively form a valve or valve assembly which regulate whether the faucet interior is coupled to the faucet exterior or not. In the open configuration, the faucet interior is coupled to the faucet exterior. For example, in the open configuration, water in the faucet interior is able to flow out via an opening between the valve seat and valve member, whereas in the closed configuration, it is not.

[0012] A flow element positioned at least partly within the faucet pipe will be affected by the presence of water in the pipe as well as flow in the pipe, and accordingly, the valve member will also be affected. For example, without water flow in the flow direction in the faucet pipe, the valve member is at rest at the open configuration, while with water flow in the flow direction in the faucet pipe, the valve member is dragged to the closed configuration. Thus, the water flow may autonomously and reliably support inducement of the closed configuration when water starts to flow. Similarly, when the water flow stops, the drag of the flow element is halted, which in turns stops the valve member is no longer dragged towards the closed configuration. Consequently, water

from the water faucet, particularly from the faucet pipe, is drained from the faucet interior to the faucet exterior.

[0013] Preferred embodiments of the invention are thus able to reduce risks of blockage and bursts, thereby reducing risks of water spillage and damage to surrounding areas and facilities in an autonomous, simple, and reliable manner.

[0014] Furthermore, preferred embodiments of the invention have weights and dimensions such that the presence of the water in the faucet pipe is not enough to shift the valve member to the closed configuration, but that the provision of drag from the water flow is determining factor in shifting and maintaining the valve member in the closed configuration.

[0015] In alternative embodiments, the valve member (or another part of the valve assembly) is spring loaded to supply an additional force towards or away from the closed configuration. However, even with such optional spring loading, a significant drag force is supplied to the valve member via drag of the flow element by the water flow.

[0016] In practice, the flow element can be made of any material, for example a metal/alloy, rubber, plastic, silicone, or combinations thereof. It may generally have any shape allowing for insertion into the faucet pipe without blocking water flow. It may have inner air-filled cavities, for example for reducing weight and thereby enhancing buoyancy. Such inner air-filled cavities may for example be manufacturing in practice by producing the flow element via additive manufacturing, in which inner air-filled cavities can be straightforwardly manufactured, simply by not filling the entire inner volume with material. A suitable material for additive manufacturing is a thermoplastic polymer material such as acrylonitrile butadiene styrene, high-density polyethylene, or polyethylene terephthalate.

[0017] In typical embodiments, the initiation of substantial water flow in the faucet pipe is sufficient to shift the valve member to the closed configuration and maintain it there. However, embodiments of the invention also include water faucets in which the valve member requires a user to toggle, such as push, the valve member to the closed configuration, at which the water flow then merely maintains the valve member at the closed configuration. Thus, within the scope of embodiments of the invention, water flow can support a shift of the valve member from the open configuration towards the closed configuration, in which user toggling of the valve member is also required.

[0018] Note that the closed configuration which fluidly seals the faucet interior from the faucet exterior needs not to provide a perfectly tight seal. The closed configuration is often desired when the water us flowing in the water faucet, for example in case a user showers. In such situations, water is already dispersed from the water faucet, and accordingly, small amounts of water leaking from the valve member and valve seat is typically of no concern. The closed configuration should merely at least substantially reduce the opening otherwise provided by the valve seat and the valve member in the closed configuration to thereby reduce the water spilled.

[0019] In some embodiments, the valve member has an outer conical frustum-shaped surface, and the valve seat has an inner conical frustum-shaped surface configured to accommodate the outer conical frustum-shaped surface of the valve member. However, embodiments of the invention are not restricted to any particular shapes of valve members and valve seats. In other embodiments, for example, the valve member has a disc-shaped surface, or a spherical surface.

[0020] In embodiments of the invention, a position of the valve member in the open configuration is distal relative to the faucet interior in comparison with a position of the valve member in the closed configuration.

[0021] In other words, the valve member is positioned outwards in the open configuration relative to in the closed configuration and relative to the faucet interior.

[0022] The provision of the valve member in the open configuration being distal relative to the faucet interior permits the user to simply push the valve member inwards to manually support a shift from the open configuration to the closed configuration. This is advantageous in case the water flow itself is not sufficient to shift the valve member to the closed configuration. Further, this permits the shiftable valve member to be exercised by a user, thereby potentially counteracting dirt, rust, and/or calcification of the valve seat and/or valve member.

[0023] In embodiments of the invention, a position of the valve member in the closed configuration relative to a position of the valve member in the open configuration is towards the flow direction in the faucet pipe.

[0024] By having the position of the valve member in the closed configuration being towards the flow direction in the faucet pipe, the drag force of water flow onto the flow element is efficiently transferred to the valve member, thereby potentially improving the capability of shifting the valve member to the closed configuration.

[0025] In embodiments of the invention, the valve seat, the valve member, and the flow element collectively forms a valve assembly, wherein the valve assembly is detachably attached to the faucet pipe, for example via an outer thread of the valve seat.

[0026] The provision of a detachably attachable valve assembly permits easy adjustment, replacement, or repair of the valve assembly, which is advantageous.

[0027] The water flow in the faucet pipe may vary between users, since the water pressure typically varies across a water supply network. Further, users may have personal preferences regarding the flow rate as controlled by a conventional manual control valve when, e.g., showering. As a result, the water flow in the faucet pipe may vary between different users, and consequently, the drag force onto the flow element may vary as well, which changes the circumstances for actually shifting the valve member between open and closed configuration. Thereby, having the possibility of adjusting the valve assembly,

for example by adjusting the flow element, allows the use to adapt the valve assembly to local conditions and personal preferences. As an example, the distance between the valve member and the flow element may for example be configurable, which in practice may alter how far the flow element is positioned into the faucet pipe, thereby affecting the drag force. Alternatively, the flow element or other parts of the valve assembly may be exchangeable, for example a used may be provided with a set of differently sized and/or weighted flow elements between which he can select a preferred flow element for the water faucet.

[0028] Furthermore, the provision of a detachably attachable valve assembly permits the user to manually establish an opening into the faucet interior. Such a manually established opening could for example be motivated by the valve member being stuck in the closed configuration.

[0029] A valve assembly may optionally comprise a stopper ring connected to the valve member and positioned between the valve member and the flow element. Alternatively, or additionally, a valve assembly may optionally comprise a connecting rod fixed to the valve member, wherein the flow element is connected to the valve member by the connecting rod.

[0030] In embodiments of the invention, the flow element is adjustable relative to the valve member, for example via an inner thread of the flow element.

[0031] In embodiments of the invention, the water faucet further comprises a stopper ring connected to the valve member and positioned between the valve member and the flow element.

[0032] In embodiments of the invention, the stopper ring is adjustable relative to the valve member, for example via an inner thread of the stopper ring.

[0033] The provision of a stopper ring restricts the distance by which the valve member is shiftable. In turn, this may ensure that the valve member is more rapidly shifted to the closed configuration upon the initiation of water flow in the faucet pipe. Moreover, this may ensure that the size of the opening between the valve seat and the valve member in the open configuration is restricted, thereby reducing water spillage in the period up to the valve member being shifted to the closed configuration. In addition, this may permit improved positioning of the flow element relative to the faucet pipe when the valve member is in the closed configuration.

[0034] The provision of the stopper ring being adjustable further permits the user to adapt the stopper ring to local conditions and/or personal preferences.

[0035] Alternatively, the flow element may be configured to provide the above-described functionalities. That is, the flow element may be configured to restrict the distance by which the valve member is shiftable between the open configuration and the closed configuration.

[0036] In embodiments of the invention, the flow element is connected to the valve member by a connecting rod fixed to the valve member.

[0037] In embodiments of the invention, the connecting rod has an outer thread matching any of the inner thread of the stopper ring and the inner thread of the flow element.

[0038] A connecting rod may provide a simple and rigid connection between the flow element and the valve member, which is able to efficiently transfer the drag force applied to the flow element onto the valve member. Moreover, the connecting rod may provide weight to the valve assembly, to ensure an adequate balance between buoyancy and gravity.

[0039] Furthermore, the provision of a connecting rod may serve as a simultaneous means of connection and adjustment of the flow element, and optionally also the stopper ring. This is particularly the case if the connecting rod has an outer thread. However, other means of adjustment of the flow element and the stopper ring may also be implemented, such as a clamping mechanism integrated in the flow element and/or stopper ring, or such as a pin insertable in matching holes of the connecting rod and flow element.

[0040] In alternative embodiments, the flow element is connected to the valve member by a flexible strand fixed to the valve member. The flexible strand may for example be a cable, a wire, or a chain. Such a flexible strand may ensure flexibility as to how the faucet pipe, flow element, and valve member is positioned relative to each other. Particularly, it may ensure that the drag force applied by the water flow onto the flow element can be curved around, e.g., corners or bends via the tension force in the strand.

[0041] In embodiments of the invention, the flow element and the valve member have dimensions and weight such that a net force of buoyancy force and force of gravity on the flow element and the valve member is in a direction of gravity when the flow element is submerged in water and the valve member is in the closed configuration.

[0042] In some other embodiments comprising a connecting rod, the flow element, the valve member, and the connecting rod have dimensions and weight such that a net force of buoyancy force and force of gravity on the flow element, the valve member, and the connecting rod is in a direction of gravity when the flow element is submerged in water and the valve member is in the closed configuration.

[0043] In typical scenarios of use, the flow element will be affected both by a drag force and a buoyancy force in the presence of flowing water in the faucet pipe. Buoyancy force is an upward force exerted by the surrounding fluid, in this case water. The drag force is a force acting opposite to the relative motion of any object moving with respect to a surrounding fluid. When water flows in the faucet pipe, the flow element has a relative motion with respect to the flowing water, even if the flow element is stationary (with respect to the faucet pipe. In typical embodiments, these two forces have the same directionality, i.e., upwards opposite the direction of gravity. Depending

on the exact choice of material of the flow element (and, optionally, the connecting rod), the buoyancy force can potentially by itself be sufficient to shift the valve member from the open configuration to a closed configuration. This can for example be the case for a light-weight flow element. However, in this case, the valve member will typically not automatically shift back to the open configuration when the water flow stops, since the buoyancy force alone is sufficient to lift the flow element and thereby maintain the valve member in the closed configuration.

[0044] Therefore, it is preferable that a net force of buoyancy force and gravity on the flow element is in a direction of gravity when the flow element is submerged in water and the valve member is in the closed configuration. As a result, the valve member may advantageously be automatically shifted to the open when there is no water flow.

[0045] The condition of a net force in a direction of gravity (disregarding drag force) can typically be met merely by using materials with a sufficiently great density, such as a density above 1.0 gram per cubic centimetre. This mainly regards the flow element, optionally the connecting rod, and the valve member. However, since the flow element is connected to the valve member, which in turn interfaces the faucet exterior with the faucet interior potentially filled with water, the buoyancy force will typically not apply to the valve member in the same manner as it applies to the flow element. More specifically, in typical scenarios of use, water pressure will only be applied from the faucet interior, whereas atmospheric pressure is applied from the faucet exterior. Accordingly, it may potentially be possible to meet the condition of having a net force in the direction of gravity using materials with a density slightly below 1.0 gram per cubic centimetre.

[0046] In embodiments of the invention, the net force of buoyancy force and force of gravity is less than 50 percent of the force of gravity, for example less than 60 percent, for example less than 70 percent, such as less than 80 percent.

[0047] For heavy materials of the flow element, there is a risk that the sum of the drag force and the buoyancy force cannot sufficiently counteract gravity. This risk is reduced by having a buoyancy which nearly, but not entirely cancels gravity. In other words, the net force of buoyancy force and force of gravity should be small in comparison to the force of gravity by itself.

[0048] In embodiments of the invention, the faucet pipe has an internal cross-sectional pipe area transverse to the flow direction, wherein the flow element has a cross-sectional element area transverse to the flow direction, wherein the cross-sectional element area is at least 15 percent of the cross-sectional pipe area, for example at least 25 percent, for example at least 35 percent, such as at least 45 percent.

[0049] By having a substantial cross-sectional element area, as exemplified above, an improved drag force onto the flow element may advantageously be ensured, which in turn may improve reliability of autonomous operation of the valve arrangement.

[0050] The cross-sectional pipe area and the cross-sectional element area may typically be evaluated at a position of the flow element inside the faucet pipe when the valve member is in the closed configuration.

[0051] In embodiments of the invention, the cross-sectional element area is at most 80 percent of the cross-sectional pipe area, for example at most 70 percent, such as at most 60 percent.

[0052] The provision of a cross-sectional element area which is not too large, as exemplified above, may ensure that water is still able to flow properly through the faucet pipe in the presence of a flow element.

[0053] In embodiments of the invention, the flow element has a length in the flow direction greater than a diameter of the flow element transverse to the flow direction, for example the flow element has a length in the flow direction greater than twice a diameter of the flow element transverse to the flow direction, for example the flow element has a length in the flow direction greater than thrice a diameter of the flow element transverse to the flow direction.

[0054] In embodiments of the invention, the flow element has a length in the flow direction greater than an inner diameter if the faucet pipe transverse to the flow direction, for example the flow element has a length in the flow direction greater than twice an inner diameter if the faucet pipe transverse to the flow direction, for example the flow element has a length in the flow direction greater than thrice an inner diameter if the faucet pipe transverse to the flow direction.

[0055] The provision of a flow element having a substantial length as exemplified above may ensure an improved drag force onto the flow element, which in turn may improve reliability of autonomous operation of the valve arrangement.

[0056] In embodiments of the invention, the flow element has a density smaller than the valve member.

[0057] In embodiments of the invention, the flow element has a density smaller than the connecting rod.

[0058] The provision of a flow element having a relatively small density may improve the balance between buoyancy and gravity, thereby potentially improving reliability of autonomous operation of the valve arrangement.

[0059] In embodiments of the invention, the water faucet further comprises a manual control valve for regulating flow from the at least one faucet inlet to the faucet outlet.

[0060] In this context, a manual control valve for regulating flow from the faucet inlet to the faucet inlet may be understood as the type of conventional valve often found in water faucets permitting the user to regulate water flow. Such a conventional manual control valve may for example be regulated by an exterior user-operatable tab.

[0061] In some embodiments, the water faucet comprises two faucet inlets (for, e.g., cold and hot water),

wherein each of the two flow inlets are linked to a respective manual control valve for regulating flow from respect inlets of the two respective inlets to the faucet outlet.

[0062] The manual control valve is typically arranged upstream of the flow direction relative to the flow element and/or valve seat. In other words, water flow has to pass the manual control valve before it arrives at the flow element and/or valve seat.

[0063] The provision of a separate manual control valve emphasizes that the valve seat and the valve member are indeed not part of a conventional manual control valve.

[0064] In embodiments of the invention, the manual control valve is regulatable via a valve stem connected to a user-operatable tab, wherein a length of the valve stem permits the user-operatable tab to be located in an outdoor environment while the manual control valve is located within an outer building wall boundary.

[0065] In embodiments of the invention, the valve stem is arranged in a valve stem volume of the water faucet, the valve stem volume being located between the user-operatable tab and the manual control valve, wherein the valve stem volume is fluidly coupled to the faucet pipe when the manual control valve is closed.

[0066] In embodiments of the invention, the water faucet is geometrically formed such that at least 50 percent of the valve stem volume is drainable via the valve seat and the valve member when the valve member is in the open configuration.

[0067] The water faucet may for example be geometrically formed by having an opening from the valve stem volume to the valve seat which permits water flow from the valve stem volume to the valve seat. The water faucet may further be shaped with an internal tilt, for example at the valve stem volume, such that gravity may induce internal water flow.

[0068] The provision of a valve stem volume which is fluidly coupled to the faucet pipe, for example via a geometrical form which ensures that at least 50 percent of the valve stem volume is drainable via the valve seat, may ensure that the valve stem volume is also emptied when the valve member is in the open configuration.

[0069] In embodiments of the invention, the at least one faucet inlet is two faucet inlets, wherein the water faucet comprises a faucet manifold fluidly coupling the faucet pipe to the two facet inlets, wherein the valve seat is positioned on the manifold such that the valve seat is aligned with an interface between the faucet pipe and the faucet manifold along the flow direction in the faucet pipe.

[0070] The above-described positioning of the valve seat in a faucet manifold may provide efficient water drainage from the faucet interior.

[0071] With a faucet manifold, a water faucet may constitute a mixer tap, optionally a thermostatic mixer tap.

[0072] In embodiments of the invention, the faucet outlet is located higher than the faucet inlet when the water faucet is oriented in an installation orientation.

[0073] In embodiments of the invention, the faucet pipe has a vertical orientation when the water faucet is oriented in an installation orientation, wherein the valve seat is positioned below the faucet pipe.

[0074] Typical water faucets have an intended orientation at which they are intended to be installed, i.e., an installation orientation.

[0075] In a water faucet in which the faucet outlet is located higher than the faucet inlet and/or in which the faucet pipe has a vertical orientation, draining water is particularly difficult, since some conventional methods may be applicable. Hence, the solutions offered by the invention are particularly advantageous when applied to such water faucets.

[0076] In embodiments of the invention, the valve seat is located at a bottom level of the faucet interior.

[0077] The provision of the valve seat being located at a bottom level of the faucet interior may improve drainage of water from the faucet interior.

[0078] In this contest, a bottom level of the faucet interior may be understood as the bottom-most (horizontal) level within the faucet interior, when the water faucet is oriented in an installation orientation.

[0079] In embodiments of the invention, the water faucet comprises an auxiliary valve arrangement which is arranged at the valve outlet, wherein the auxiliary valve arrangement is configured to:

fluidly couple an interior of the faucet pipe to the faucet exterior in absence of water flow in the flow direction at the auxiliary valve arrangement; and

fluidly decouple the interior of the faucet pipe to the faucet exterior in presence of water flow in the flow direction at the auxiliary valve arrangement,

such that in absence of water flow in the flow direction at the auxiliary valve arrangement the auxiliary valve arrangement permits air to enter the faucet pipe via the auxiliary valve arrangement.

[0080] One factor which may be considered when implementing embodiments of the invention in practice, is that a minimum cross-sectional outlet area of the faucet outlet is preferable to enable rapid draining of water from the faucet interior. In order for water to leave the faucet interior and the faucet pipe, atmospheric air should preferably enter the water faucet to fill out interior volumes of the water faucet previously occupied by the water. A small cross-sectional outlet area may lead to slow and inefficient drainage.

[0081] In the case of shower faucets, the cross-sectional outlet area is typically provided by an array of apertures in a shower head, which provides a desired spray pattern of water from the shower head. Unfortunately, the array of apertures may be designed with a relatively small cross-sectional outlet area to provide such a desired spray pattern of water.

[0082] To compensate for a small cross-sectional out-

let area, some embodiments therefore comprise an auxiliary valve arrangement. The provision of an auxiliary valve arrangement arranged at or near the valve outlet may ensure that atmospheric air can enter the interior of the water faucet, thereby ensuring that water is drained efficiently when the valve member is in an open configuration.

[0083] In embodiments of the invention, the water faucet is a shower faucet.

[0084] In alternative embodiments, the water faucet is configured to receive a garden hose fitting. In other alternative embodiments, the water faucet is a drinking fountain.

[0085] A second aspect of the present invention relates to a method for shifting a valve member of a water faucet, the method comprising the steps of:

positioning the valve member at a valve seat, wherein the valve member is in an open configuration relative to the valve seat, wherein the open configuration fluidly couples a faucet interior of the water faucet to a faucet exterior of the water faucet;

connecting the valve member to a flow element;

positioning the flow element in a faucet pipe of the water faucet;

providing water flow in the faucet pipe in a flow direction from at least one faucet inlet of the water faucet to a faucet outlet of the water faucet; and

shifting the valve member from the open configuration to a closed configuration relative to the valve seat at least partly via fluid flow drag of the flow element by the water flow, wherein the closed configuration fluidly seals the faucet interior from the faucet exterior.

[0086] Methods for shifting a valve member of a water faucet may according to embodiments of the invention may ensure that the faucet pipe is drained from water when water flow stops, and that this drainage is halted when the water flow starts, thereby minimizing risk of water blockage or water bursts due to freezing, in a manner similar to water faucets according to embodiments of the invention.

[0087] In embodiments of the invention, the method comprises a step of terminating the water flow to reduce the fluid flow drag of the flow element, thereby reducing support of the valve member in the closed configuration.

[0088] The water flow may for example be terminated via a manual control valve for regulating clow from a faucet inlet to the faucet outlet. In turn, the manual control valve may be closed by a user to thereby terminate the water flow.

[0089] In embodiments of the invention, the step of terminating the water flow autonomously releases the valve member from the closed configuration shifting the valve member into the open configuration such that water in the faucet pipe is drained from the faucet pipe through the valve seat.

[0090] In embodiments of the invention, the valve member is shifted from the open configuration to the closed configuration without a spring force from a spring.

[0091] In embodiments of the invention, the valve member is shifted from the closed configuration to the open configuration without a spring force from a spring.

[0092] In embodiments of the invention, the faucet outlet is dimensioned to facilitate air backflow such the step of terminating the water flow autonomously permits air to enter the faucet pipe via the faucet outlet as water in the faucet pipe is drained.

[0093] The faucet outlet may be dimensioned to facilitate air backflow by providing the faucet outlet with a sufficiently large cross-sectional outlet area.

[0094] In embodiments of the invention, the method comprises a step of draining the faucet interior of water via the open configuration after the step of terminating the water flow.

[0095] In embodiments of the invention, the step of draining the faucet interior comprises draining at least 50 percent of water from the faucet interior.

[0096] In embodiments of the invention, the water faucet of the second aspect is a water faucet according to the first aspect.

[0097] A third aspect of the present invention relates to a valve assembly, preferably for a water faucet according to the present disclosure, the valve assembly comprising:

a valve seat having an inner seat aperture;

a valve member;

a connecting rod fixed to the valve member, wherein the connecting rod has a rod diameter allowing insertion through the inner seat aperture, wherein the valve member is arranged to provide a fluid seal collectively with the valve seat to restrict fluid flow through the inner seat aperture when the connecting rod is inserted through the inner seat aperture; and

a flow element arranged on the connecting rod.

[0098] A valve assembly as disclosed herein may provide autonomous shifts between open and closed configurations, for example to permit drainage of a fluid from an interior of a pipe, for example to permit drainage of water such as described herein in relation to a water faucet. A valve assembly in isolation may serve as a rapid replacement, for example for a water faucet with a faulty or incorrectly dimensioned valve assembly.

[0099] The valve member is arranged to provide a fluid seal collectively with the valve seat to restrict water flow through the seat aperture when the connecting rod is

inserted through the inner seat aperture in the sense that the valve member may be shiftable to a closed configuration relative to the valve seat in which the valve member fluidly seals any water flow through the seat aperture. In addition, the valve member may be shiftable to an open configuration relative to the valve seat in which the valve member fluidly opens for any water flow through the seat aperture.

[0100] Such a valve assembly may for example be used with a water faucet such as a shower faucet as exemplified in this disclosure. However, in principle, the valve assembly may alternatively be used in other contexts as well, such as in an industrial context, for example for manufacturing. In such contexts, the valve assembly may for example be utilized to drain any type of fluid from a pipe of a container whenever the fluid is not flowing.

[0101] Optionally, the flow element has an outer element diameter greater than the rod diameter. Optionally, the outer element diameter is less than an outer diameter of the valve seat, for example less than an outer thread diameter of an outer thread of the valve seat. This permits partial insertion of the valve assembly through an opening at which the valve seat is to be attached.

[0102] Optionally, the connecting rod may have an outer thread matching an inner thread of the flow element.

[0103] The valve assembly may optionally comprise a stopper ring arranged on the connecting rod and positioned between the valve member and the flow element, wherein the stopper ring has a diameter greater than an inner diameter of the inner seat aperture. This stopper ring may optionally be adjustable relative to the valve member, for example via an inner thread of the stopper ring matching an outer thread of the connecting rod.

[0104] The valve member, connecting rod, and flow element may collectively have an average density above 1.0 gram per cubic centimetre. The flow element may have a density lesser than the connecting rod and/or lesser than the valve member.

[0105] Optionally, the flow element has a length in a longitudinal direction greater than a diameter of the flow element transverse to the longitudinal direction, for example the flow element has a length in the longitudinal direction greater than twice a diameter of the flow element transverse to the longitudinal direction, for example the flow element has a length in a longitudinal direction greater than thrice a diameter of the flow element transverse to the longitudinal direction.

[0106] In this context, the longitudinal direction may be a longitudinal direction of the connecting rod, and/or may correspond to a direction perpendicular to a plane of the inner seat aperture.

[0107] Optionally, an inner diameter of the inner seat aperture is at most 1.5 centimetre, for example at most 1.2 centimetre, such as at most 0.9 centimetre. This may ensure that the drag force induced by typical water flow is not exceeded by force applied by the water pressure onto the valve member in the closed configuration.

[0108] A fourth aspect of the present invention relates to use of a valve assembly according to the present disclosure in a water faucet, preferably a domestic outdoor water faucet.

BRIEF DESCRIPTION OF THE DRAWINGS

[0109] Embodiments of the invention will now be further described by reference to the accompanying drawings, in which:

Fig. 1a-b illustrate a water faucet according to an embodiment of the invention in an open configuration and in a closed configuration,

Fig. 2a-c illustrate various views of a valve assembly for a water faucet according to embodiments of the invention,

Fig. 3 illustrates a shower faucet according to an embodiment of the invention,

Fig. 4a-b illustrate cross-sectional partial views of a manual control valve of a water faucet according to an embodiment of the invention, and

Fig. 5 illustrates a cross-sectional partial view of a valve assembly in a water faucet according to an embodiment of the invention,

Fig. 6 illustrates method steps for shifting a valve member according to an embodiment of the invention.

DETAILED DESCRIPTION

[0110] Fig. 1a-b illustrate a water faucet 1 according to an embodiment of the invention in an open configuration (Fig. 1a) and in a closed configuration (Fig. 1b). Both illustrations are provided as cross-sectional views.

[0111] The illustrated water faucet 1 comprises a faucet outlet 2, a faucet inlet 3, and a faucet pipe 4 which fluidly couples the faucet outlet 2 with the faucet inlet 3. The faucet inlet is arranged to be coupled to a water supply, such as a public water supply network providing water for, e.g., drinking or showering. The faucet outlet 2 may then provide an outlet for the water supplied to the faucet inlet 3.

[0112] The faucet pipe 4 has an internal flow direction 5, as indicated by an arrow in Fig. 1a-b. within the faucet pipe 4, the flow direction has a directionality from the faucet inlet 3 to the faucet outlet 2.

[0113] In addition, the water faucet 1 comprises a valve seat 6, a valve member 7 positioned at the valve seat 6, and a flow element 10 connected to the valve member 7 and positioned within the faucet pipe 4. Due to the positioning of the flow element 10 in the faucet pipe 4, the flow element 10 is affected by water flow inside the faucet pipe 4. In case water flows from the faucet inlet 3 to the

faucet outlet 2, this flow applies a drag force to the flow element 10, which drags the flow element 10 in the flow direction 5 of the faucet pipe 4.

[0114] The valve member is shiftable between an open configuration and a closed configuration relative to the valve seat. In this embodiment, the valve member 7 and flow element 10 are connected via a rod having an outer diameter sufficiently small to allow the rod to pass through an inner seat aperture of the valve seat 6. The rod, and thereby the valve member 7 and the flow element 10, can hence be shifted back and forth relative to the valve seat 6. The geometry of the valve member 7 and the outer diameter of the flow member 10 restrict the distance by which the rod can be shifted back and forth through the valve seat 6.

[0115] In Fig. 1a, the valve member 7 is illustrated in the open configuration, whereas in Fig. 1b, the valve member 7 is illustrated in a closed configuration. These configurations may also be referred to as open and closed configurations of the water faucet 1 (instead of open and closed configurations of the valve member 7). In the open configuration, the position of the valve member 7 is distal relative to the faucet interior in comparison with the position of the valve member in the closed configuration. In the closed configuration, the valve member 7 is shifted in the flow direction 5, such that the valve seat 6 and valve member 7 collectively establish a fluid seal between a faucet interior 8 of the water faucet 1 and a faucet exterior 9 of the water faucet. In contrast, in the open configuration, the valve member 7 is not positioned against or abutting the valve seat 6, and as a consequence, the faucet interior 8 is coupled to the faucet exterior 9.

[0116] In practice, water in the faucet pipe 4 can then be drained from the water faucet 1 via the valve seat 6 when the valve member 7 is in the open configuration. However, when the valve member 7 is in the closed configuration, water drainage from the faucet pipe 4 via the valve seat 6 is restricted due to the seal between the valve member and the valve seat.

[0117] The drag applied to the flow element 10 by water flow inside the faucet pipe 4 can be used to regulate whether the water faucet 1 is in the open configuration or in the closed configuration.

[0118] In a typical scenario of use, the water faucet 1 is initially in an open configuration, and no water flows inside the faucet pipe 4. Water flow is then supplied to the water faucet 1 via the faucet inlet 3. This water flows in in the faucet pipe in the flow direction 5, and thereby, drag from the water flow pulls the flow element 10 in the flow direction 5. As a result, the flow element, and the valve member are each shifted upwardly, such that the valve member is shifted from the open configuration to the closed configuration. Thus, while water flows inside the water faucet, water drainage via the valve member 6 is restricted.

[0119] When a water flow is initially supplied, the valve member 6 is in the open configuration, and thereby, some water may exit the faucet interior via the opening provided by the valve seat 6. However, the embodiment is shaped such that relatively small amounts of water drain via this opening, relative to the amount of water which flows on through the water faucet 1 via the faucet pipe 4. Consequently, a water flow capable of moving the flow element 10 via drag, and thereby capable of shifting the valve member 7 to the closed configuration, is quickly established, reducing the amount of water initially drained via the valve member 7.

[0120] In some situations, a low water flow or low water pressure provided to the faucet inlet 3 can be insufficient to drag the flow element 10 adequately, especially since some water drains through the valve seat 6. In such a situation, a user of the water faucet 1 can manually push the valve member 7 upwards to reduce water drainage via the valve seat 6 and thereby increase water flow in the flow direction 5 in the faucet pipe 4, which in turn increases the drag of the flow element 10. Hence, even when a user releases the upwards push onto the valve member 7, the established water flow in the faucet pipe 4 may be sufficient to maintain the valve member 7 in the closed configuration via drag of the flow element 10.

[0121] When the water faucet 1 is in the closed configuration and the water flow is terminated, the drag from the water flow onto the flow element 10 is terminated as well. Consequently, due to gravity, the valve member 7 is shifted downwards from the closed configuration to the open configuration. Note particularly that the gravitational force onto the column of water in the faucet pipe 4 above the valve member 7 will typically be transferred onto the valve member, at least partially, thereby inducing the shift from the closed configuration to the open configuration whenever no drag onto the flow element 10 is present.

[0122] When the valve member 7, and hence the water faucet 1, is in the open configuration, water from the faucet pipe 4 is drained via the valve seat 6. Additionally, in this embodiment, water is also drained from the faucet interior 8 between the faucet inlet and the valve seat 6. The result is that water is more or less entirely drained from the water faucet 1 whenever water flow is terminated. If the water faucet 1 is subjected to freezing conditions, any water remnants freezing into ice in the water faucet 1 will not block or damage the faucet 1.

[0123] Fig. 2a-c illustrate various views of a valve assembly 11 for a water faucet according to embodiments of the invention. Namely, Fig. 2a illustrates a cross-sectional view of the valve assembly 11, Fig. 2b illustrates an angled view of the valve assembly 11, and Fig. 2c illustrates a disassembled view of various components 6, 7, 10, 13 of the valve assembly 11.

[0124] The illustrated valve assembly 11 may for example be used with a water faucet such as a shower faucet as exemplified in this disclosure.

[0125] The valve assembly 11 comprises a valve seat 6, a valve member 7, a connecting rod 12 fixed to the valve member 7, and a flow element 10 arranged on the

connecting rod 12. The valve seat 6 has an inner seat aperture 29 and the connecting rod 12 has a rod diameter which is sufficiently small to allow the connecting rod 12 to pass through the inner seat aperture 29.

[0126] The valve member 7 and the valve seat 6 are collectively configured to provide a fluid seal which restricts water flow through the inner seat aperture 29 when the connecting rod 12 is inserted through the inner seat aperture 29. In particular, the fluid seal is established when the valve member 7 is in a closed configuration relatively to the valve seat 6. In this closed configuration, the valve member 7 is positioned against and/or abutting the valve seat 6.

[0127] In this embodiment, the fluid seal is tightened by a sealing gasket 18 positioned in a gasket groove 19 of the valve member 7. In practice, a rubber o-ring may be used as the sealing gasket 18. Further, in this embodiment, the valve member 7 has an outer conical frustum-shaped surface which complements an inner conical frustum-shaped surface of the valve seat 6.

[0128] The valve seat 6 is manufactured from stainless steel, and the valve member 7 and the connecting rod 12 are manufactured as a single piece of brass. Further, the connecting rod 12 is manufactured with an outer thread 17.

[0129] The valve assembly 11 comprises a stopper ring 13 positioned on the connecting rod 12. This stopper ring restricts the distance by which the valve member 7 is shiftable relative to the valve seat 6. In turn, this can improve the autonomous shift between open and closed configurations, upon initiation and termination of water flow.

[0130] To improve fluid flow past the stopper ring 13 in the open configuration, the stopper ring 13 has been manufactured with outer indentations 30 allowing, e.g., water to flow past the stopper ring 3 and out the valve seat aperture 29. In embodiments without a stopper ring, the flow element 10 can be manufactured with outer indentations, as also indicated in Fig. 2b-c. However, embodiments without outer indentations 30 are also possible, but may simply have slightly reduced drainage of water.

[0131] The stopper ring 13 has an inner thread 16 matching the outer thread 17 of the connecting rod 12. This permits the stopper ring 13 to be positioned on the according to local conditions such as local water pressure, and according to personal preferences of the user. In this embodiment, the stopper ring is manufactured of stainless steel.

[0132] The flow element 10 of the valve assembly 11 similarly has an inner thread 15 matching the outer thread 17 of the connecting rod 12.

[0133] Since the outer thread 17 of the connecting rod 12 matches inner threads 15, 16 of the flow element 10 and the stopper ring 13, assembly and disassembly of the valve assembly 11 is easily permitted.

[0134] The flow element 10 of this embodiment is manufactured via additive manufacturing, namely fused deposition modelling, using polyoxymethylene. The inner thread 15 of the flow element 10 is threaded after the additive manufacturing using a conventional threading method.

[0135] The additive manufacturing method permits the flow element 10 to be manufactured with an inner air-filled cavity, which in turn provides the valve assembly 11 with advantageous weight properties with regards to the valve assembly being at least partially submerged in fluid. Moreover, as illustrated in the cross-sectional view of Fig. 2a, the valve member 6 is manufactured with an inner axial indentation, which further provide advantageous weight properties.

[0136] The valve assembly 11 is illustrated in a disassembled state in Fig. 2c and may be assembled into an assembled state as illustrated in Fig. 2b as follows. First, the connecting rod 12 is inserted through the valve seat aperture 29 of the valve seat 6. The connecting rod is inserted such that the valve member 7 fixed to the connecting rod 12 can be shifted into the valve seat 6 to provide a fluid seal. Next, the stopper ring 13 is screwed onto the connecting rod 12 using the matching threads 16, 17 thereof until a desired distance by which the valve member 7 is shiftable relative to the valve seat 6 has been obtained. This shift distance may typically be some millimetres, but can iteratively be adjusted according to local conditions and personal preferences. Finally, the flow element 10 is screwed onto the connecting rod 12 using the matching threads 15, 17 thereof until a desired position of the flow element relative to the stopper ring 13 and/or valve member 7 has been obtained. This desired position may be some centimetres away from the valve member 7 and may typically depend on the geometry and positioning of the faucet pipe where the valve assembly is to be installed. Once again, the position can be iteratively adjusted according to local conditions and personal preferences.

[0137] The valve seat 6 has an outer thread 14, which permits attachment of the valve assembly to, e.g., a water faucet having an inner thread matching the outer thread 14 of the valve seat.

[0138] The outer diameter of the flow element 10 and the stopper ring 13 is smaller than the outer diameter of the outer thread 14 of the valve seat 6. Accordingly, when the outer thread 14 of the valve seat 6 is to be screwed onto the inner thread of an exemplary water faucet, the flow element 10 and the stopper ring 13 can be straightforwardly inserted through the inner thread 14 of this water faucet prior to screwing.

[0139] Fig. 3 illustrates a shower faucet 20 according to an embodiment of the invention. The shower faucet 20 comprises two faucet inlets 3 and a faucet outlet 2 in the form of a shower head. A faucet pipe 4 fluidly couples the shower head 2 to the two faucet inlets 3. The faucet pipe 4 is fluidly coupled to the two faucet inlets 3 via a faucet manifold 22. At the bottom of this manifold 22, a valve assembly 11 is partly inserted into the shower faucet 20. The valve assembly 11 can for example be

the valve assembly illustrated in Fig. 2a-c. In this particular illustration, only the valve seat 6 is clearly visible, due to the scale of the drawing and the insertion of the valve assembly 11.

[0140] Water flow through each of the two faucet inlets can be regulated by a user via respective manual control valves 21. Each of the manual control valves 21 are regulatable via an internal valve stem connecting a user-operatable tab to the position at which the actual fluid seal is established by a control valve sealing of the manual control valve.

[0141] The shower faucet 20 comprises a wall plate 26 which is positioned against a wall when the shower faucet is installed as intended. The valve stems associated with the manual control valves 21 allows the control valve sealings of the manual control valves 21 to be located within an outer building wall boundary, which in this embodiment is defined by the wall plate 26, while that tabs, valve assembly 11, faucet pipe 4, and shower head 2 is located in an outdoor environment.

[0142] Fig. 4a-b illustrate cross-sectional partial views of a manual control valve 21 of a water faucet according to an embodiment of the invention. The water faucet may for example be the shower faucet illustrated in Fig. 3 (with the plane of the cross-sectional partial view of Fig. 4a-b being perpendicular to the wall plate 26 in Fig. 3).

[0143] Fig. 4a illustrates one end of the valve with a user-operatable tab 25, while Fig. 4b illustrates another end in which the control valve sealing 31 is located.

[0144] As illustrated in the two figures, the manual control valve 21 comprises a valve stem 28 which connects the user-operatable tab 25 with the control valve sealing 31. In these partial views, the valve stem 28 extends beyond the left-hand side of Fig. 4a to connect with the control valve sealing 31 illustrated in Fig. 4b. A rotation of the user-operatable tab 25 rotates the valve stem 28, which in turn opens or seals the control valve sealing 31. Note that in Fig. 4a, the valve stem 28 is illustrated in a disconnected state. Upon installation of the water faucet, these disconnected parts of the valve stem 28 are connected to allow communication between the user-operatable tab 25 and the control valve sealing 31.

[0145] The valve stem 28 is arranged in a valve stem volume 27 of the water faucet. This valve stem volume 28 is located between the user-operatable tab 25 and the control valve sealing 31. In particular, the valve stem volume 28 extends beyond the wall plate 26.

[0146] The water faucet is geometrically formed such that at least 70 percent of the valve stem volume 27 is drained from water when the valve member is in the open configuration. Referring to Fig. 3, the valve stem volume 27 is fluidly coupled to the faucet manifold at which the valve arrangement is located, and thereby, water can be drained from the valve stem volume via the valve arrangement.

[0147] Fig. 5 illustrates a cross-sectional partial view of a valve assembly 11 in a water faucet according to an embodiment of the invention. The valve assembly of this figure is substantially similar to the valve assembly illustrated in Fig. 2a-c. The water faucet in which it is installed may for example be the shower faucet illustrated in Fig. 3 (with the plane of the cross-sectional partial view of Fig. 5 being perpendicular to the wall plate 26 in Fig. 3 and shifted in comparison with the cross-sectional partial view of Fig. 4a-b).

[0148] The water faucet comprises a threaded cylinder 23 adapted to receive the valve assembly 11, particularly to receive the valve seat 6 of the valve assembly 11. In this embodiment, the threaded cylinder 23 is attached to the bottom of the faucet manifold 22. Thereby, the valve seat 6 can be detachably attached to the water faucet via the outer thread 14 of the valve seat 6 matching an inner thread of the threaded cylinder 23.

[0149] The flow element 10 is positioned inside the faucet pipe 4 and is thereby susceptible to drag of water flow inside the faucet pipe 4 in the flow direction 5.

[0150] Fig. 6 illustrates method steps for shifting a valve member of a water faucet according to an embodiment of the invention.

[0151] In a first step S1, the valve member is positioned at a valve seat. The valve member is in an open configuration relative to the valve seat. The open configuration fluidly couples a faucet a faucet interior of the water faucet to a faucet exterior of the water faucet.

[0152] In another step S2, the valve member is connected to a flow element.

[0153] In another step S3, the flow element is positioned in a faucet pipe of the water faucet.

[0154] In another step S4, water flow is provided in the faucet pipe in a flow direction from at least one faucet inlet of the water faucet to a faucet outlet of the water faucet.

[0155] In another step S5, the valve member is shifted from the open configuration to a closed configuration relative to the valve seat. The valve member is shifted at least partly via fluid flow drag of the flow element by the water flow. The closed configuration fluidly seals the faucet interior from the faucet exterior.

[0156] As a result, water can flow via the faucet pipe to the faucet outlet with minimal drainage via the valve seat. Prior to the providing water flow and shifting the valve member from the open configuration to the closed configuration, (still) water in the faucet pipe could be drained via the valve seat.

[0157] Note that methods according to embodiments of the invention are not restricted to a particular sequence of performing method steps, and that steps may potentially be performed at least partially simultaneously. However, at least typically, the step of providing a water flow S4 at least partially induces the step of shifting the valve member S5.

[0158] Further, methods according to the invention may optionally comprise a step of terminating the water flow, for example to autonomously release the valve member from the closed configuration, and/or a step of draining the faucet interior or faucet pipe of water.

List of figure references:

[0159]

1	water faucet
2	faucet outlet
3	faucet inlet
4	faucet pipe
5	flow direction
6	valve seat
7	valve member
8	faucet interior
9	faucet exterior
10	flow element
11	valve assembly
12	connecting rod
13	stopper ring
14	outer thread of valve seat
15	inner thread of flow element
16	inner thread of stopper ring
17	outer thread of connecting rod
18	sealing gasket
19	gasket groove
20	shower faucet
21	manual control valve
22	faucet manifold
23	threaded cylinder
24	inner thread of threaded cylinder
25	user-operatable tab
26	wall plate
27	valve stem volume
28	valve stem
29	inner seat aperture
30	outer indentation
31	control valve sealing

S1-S5 method steps

Claims

1. A water faucet (1) for domestic outdoor use, said water faucet (1) comprising:

a faucet outlet (2);
at least one faucet inlet (3);
a faucet pipe (4) fluidly coupling said faucet outlet (2) with said at least one faucet inlet (3), wherein said faucet pipe (4) internally defines a flow direction (5) from said at least one faucet inlet (3) to said faucet outlet (2);
a valve seat (6);
a valve member (7) positioned at said valve seat (6), wherein said valve member (7) is shiftable from an open configuration to a closed configuration relative to said valve seat (6), wherein said open configuration fluidly couples a faucet interior (8) of said water faucet (1) to a faucet exterior (9) of said water faucet (1), wherein said closed configuration fluidly seals said faucet interior (8) from said faucet exterior (9); and
a flow element (10) connected to said valve member (7) and positioned at least partly within said faucet pipe (4).

2. A water faucet (1) according to claim 1, wherein said flow element (10) is configured to be dragged in said flow direction (5) by water flow in said faucet pipe (4) to support a shift of said valve member (7) from said open configuration towards said closed configuration.

3. A water faucet (1) according to any of the preceding claims, wherein said valve seat (6), said valve member (7), and said flow element (10) collectively forms a valve assembly (11), wherein said valve assembly (11) is detachably attached to said faucet pipe (4), for example via an outer thread (14) of said valve seat (6).

4. A water faucet (1) according to any of the preceding claims, wherein said flow element (10) is adjustable relative to said valve member (7), for example via an inner thread (15) of said flow element (10).

5. A water faucet (1) according to any of the preceding claims, wherein said water faucet (1) further comprises a stopper ring (13) connected to said valve member (7) and positioned between said valve member (7) and said flow element (10).

6. A water faucet (1) according to any of the preceding claims, wherein said flow element (10) is connected to said valve member (7) by a connecting rod (12) fixed to said valve member (7).

7. A water faucet (1) according to any of the preceding claims, wherein said flow element (10) and said valve member (7) have dimensions and weight such that a net force of buoyancy force and force of gravity on said flow element (10) and said valve member (7) is in a direction of gravity when said flow element (10) is submerged in water and said valve member (7) is in said closed configuration.

8. A water faucet (1) according to any of the preceding claims, wherein said faucet pipe (4) has an internal cross-sectional pipe area transverse to said flow direction (5), wherein said flow element (10) has a cross-sectional element area transverse to said flow direction (5), wherein said cross-sectional element area is at least 15 percent of said cross-sectional pipe area, for example at least 25 percent, for example at least 35 percent, such as at least 45 percent.

9. A water faucet (1) according to any of the preceding

claims, wherein said water faucet (1) further comprises a manual control valve (21) for regulating flow from said at least one faucet inlet (3) to said faucet outlet (2).

10. A water faucet (1) according to any of the preceding claims, wherein said valve seat (6) is located at a bottom level of said faucet interior (8).

11. A water faucet (1) according to any of the preceding claims, wherein said water faucet (1) is a shower faucet (20).

12. A method for shifting a valve member (7) of a water faucet (1), said method comprising the steps of:

positioning said valve member (7) at a valve seat (6), wherein said valve member (7) is in an open configuration relative to said valve seat (6), wherein said open configuration fluidly couples a faucet interior (8) of said water faucet (1) to a faucet exterior (9) of said water faucet (1);
connecting said valve member (7) to a flow element (10);
positioning said flow element (10) in a faucet pipe (4) of said water faucet (1);
providing water flow in said faucet pipe (4) in a flow direction (5) from at least one faucet inlet (3) of said water faucet (1) to a faucet outlet (2) of said water faucet (1); and
shifting said valve member (7) from said open configuration to a closed configuration relative to said valve seat (6) at least partly via fluid flow drag of said flow element (10) by said water flow, wherein said closed configuration fluidly seals said faucet interior (8) from said faucet exterior (9).

13. A method according to claim 12, wherein said method comprises a step of terminating said water flow to reduce said fluid flow drag of said flow element (10), thereby reducing support of said valve member (7) in said closed configuration.

14. A valve assembly, preferably for a water faucet (1) according to any of claims 1-11, said valve assembly comprising:

a valve seat (6) having an inner seat aperture (29);
a valve member (7);
a connecting rod (12) fixed to said valve member (7), wherein the connecting rod (12) has a rod diameter allowing insertion through said inner seat aperture (29), wherein the valve member (7) is arranged to provide a fluid seal collectively with said valve seat (6) to restrict fluid flow through said inner seat aperture (29) when said connecting rod (12) is inserted through said inner seat aperture (29); and
a flow element (10) arranged on said connecting rod (12).

15. Use of a valve assembly according to claim 14 in a water faucet (1), preferably a domestic outdoor water faucet (1).

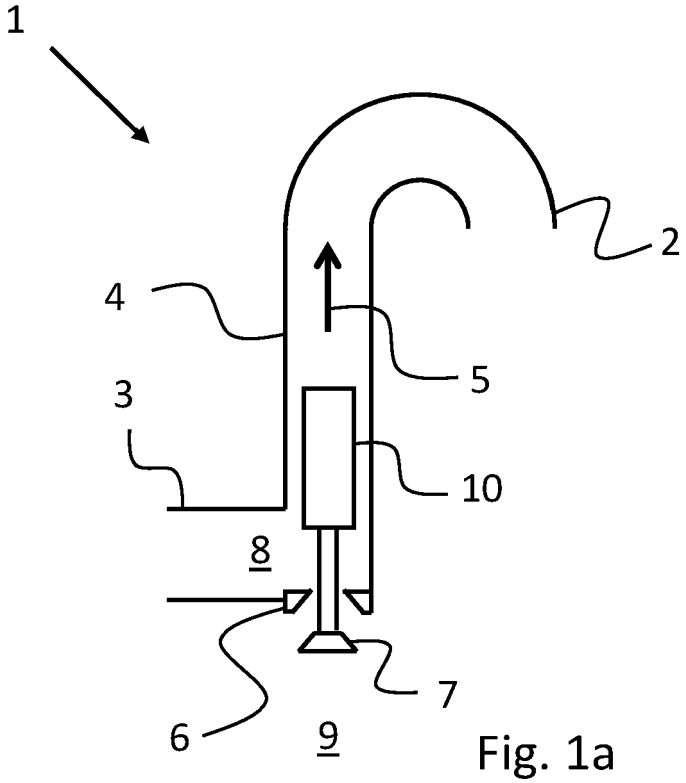

Fig. 1a

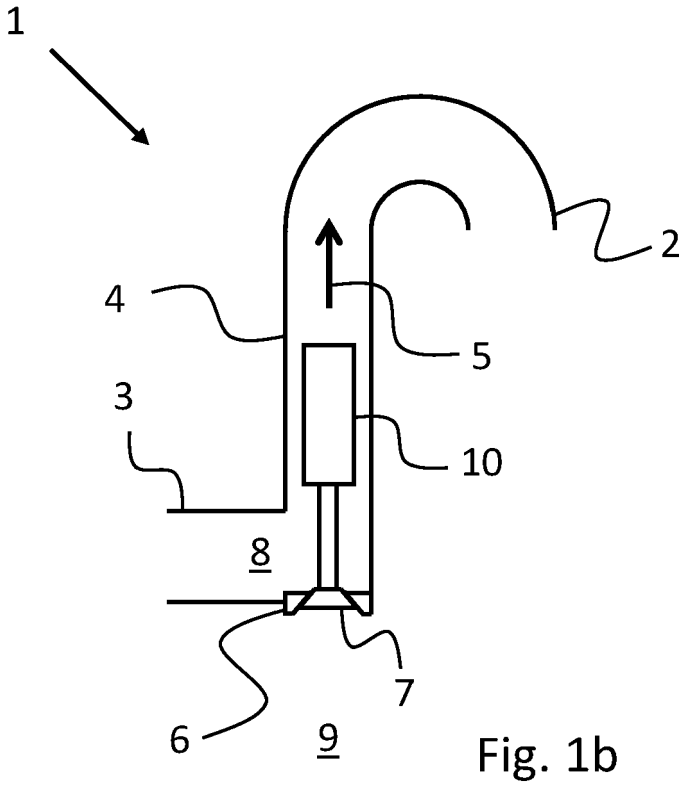

Fig. 1b

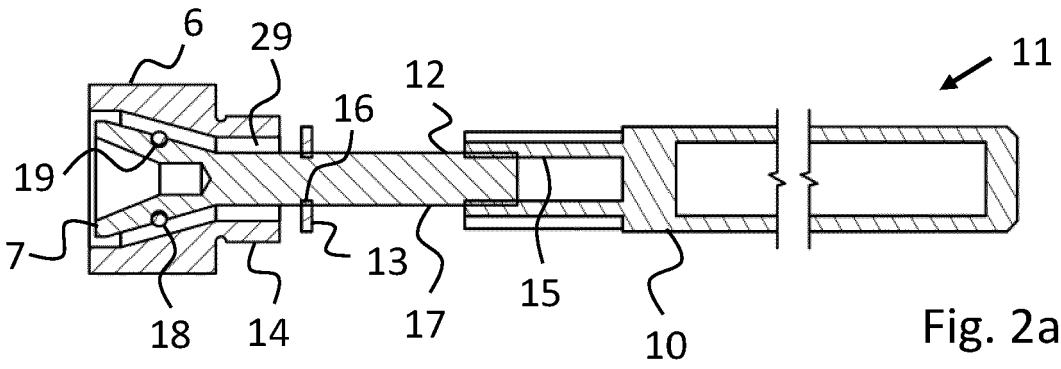

Fig. 2a

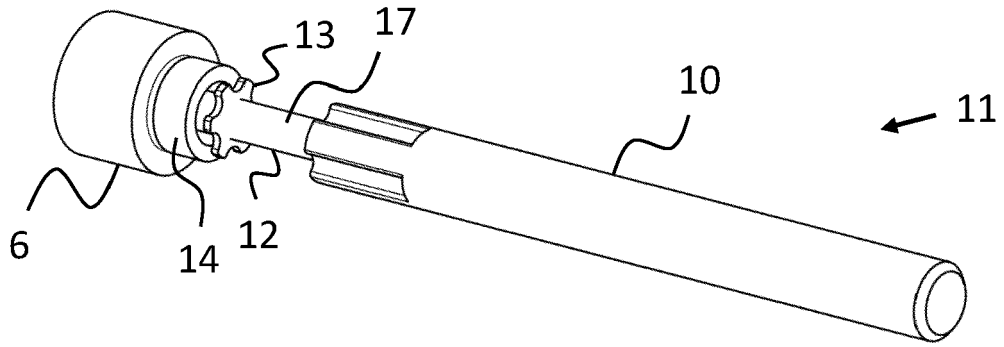

Fig. 2b

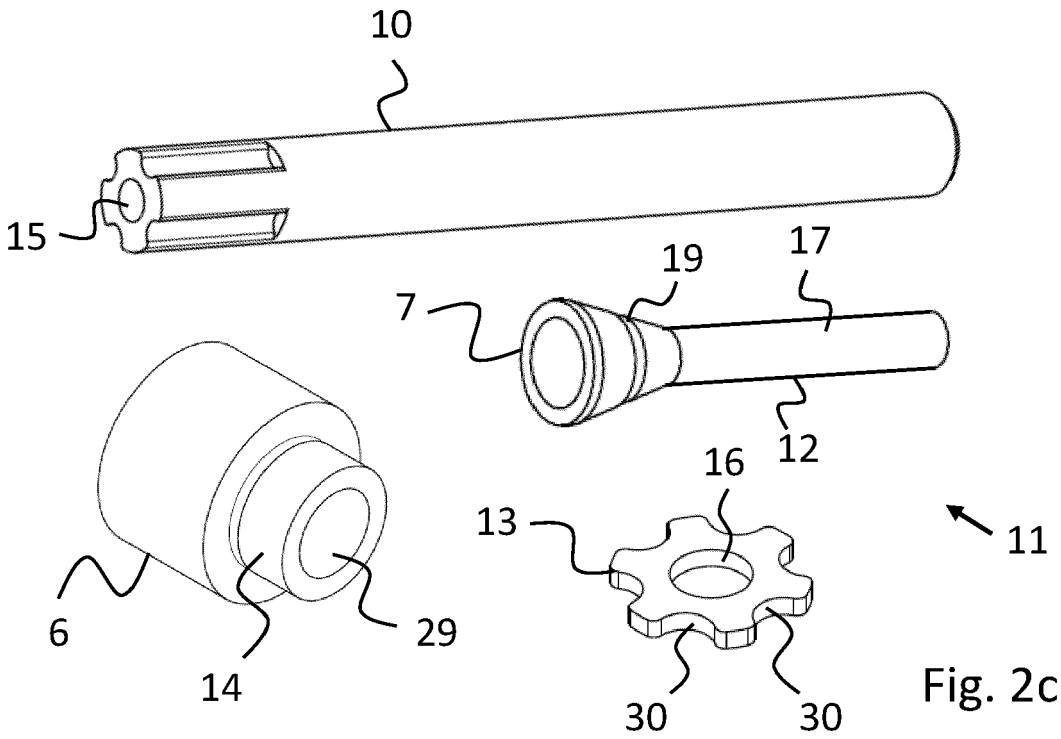

Fig. 2c

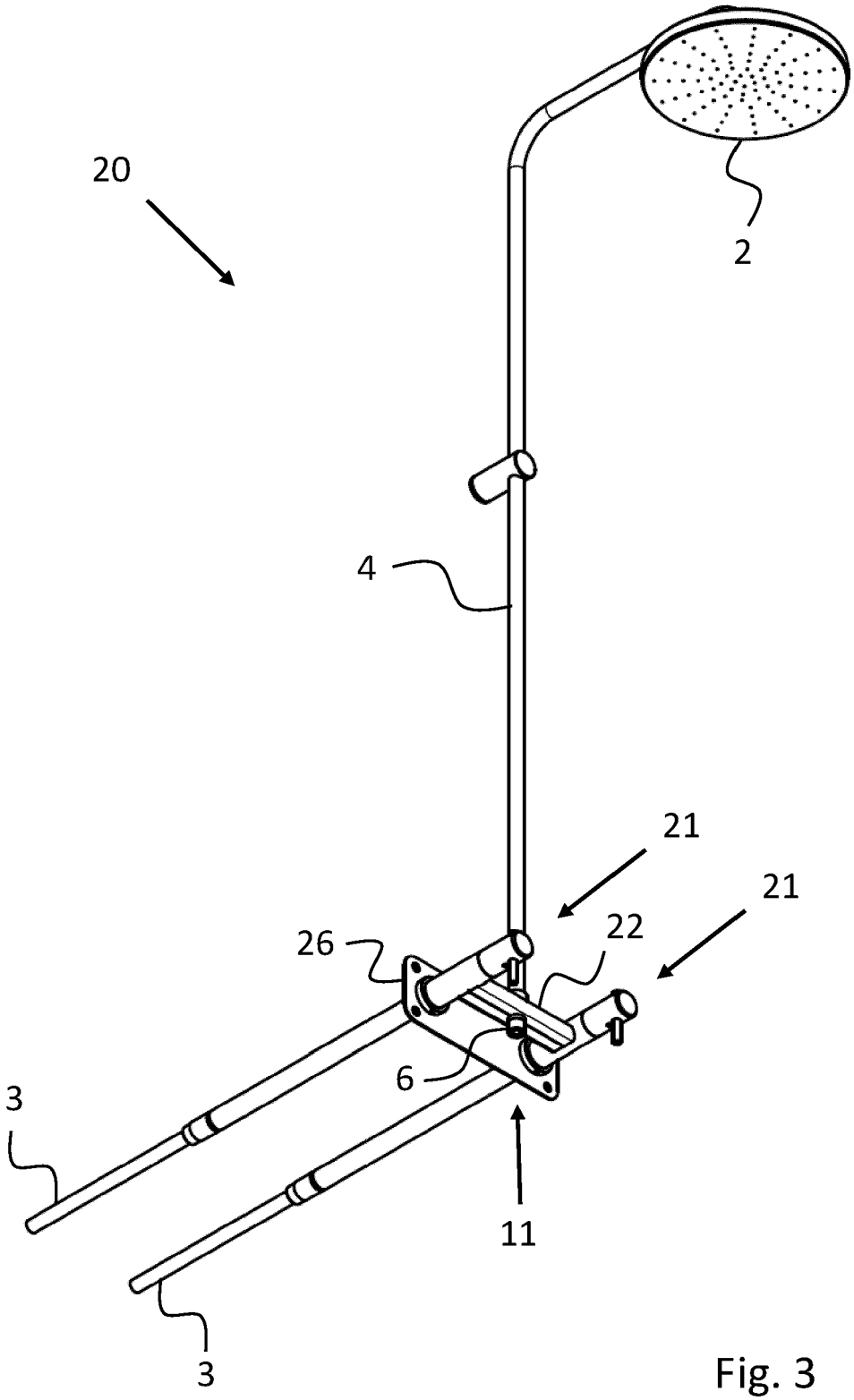

Fig. 3

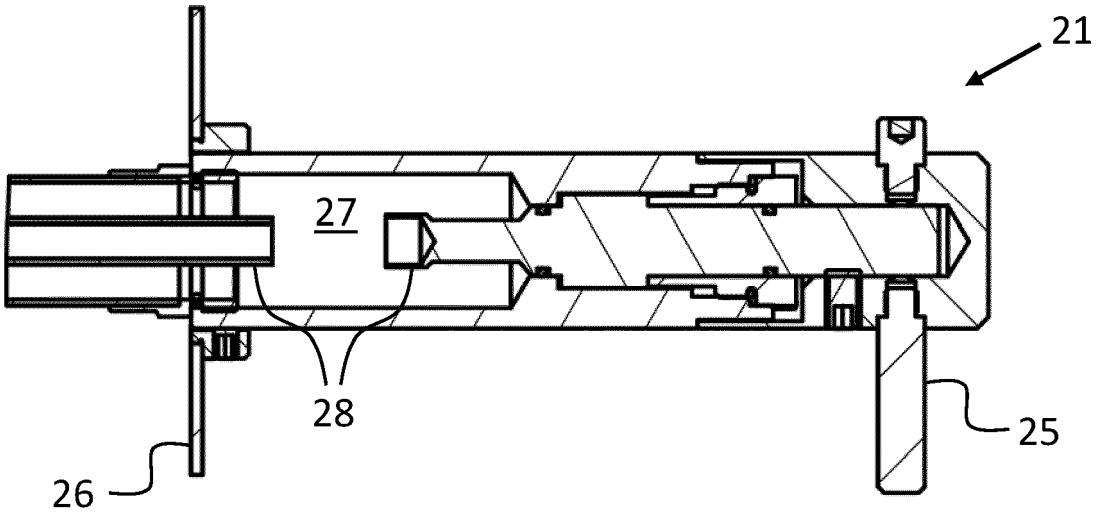

Fig. 4a

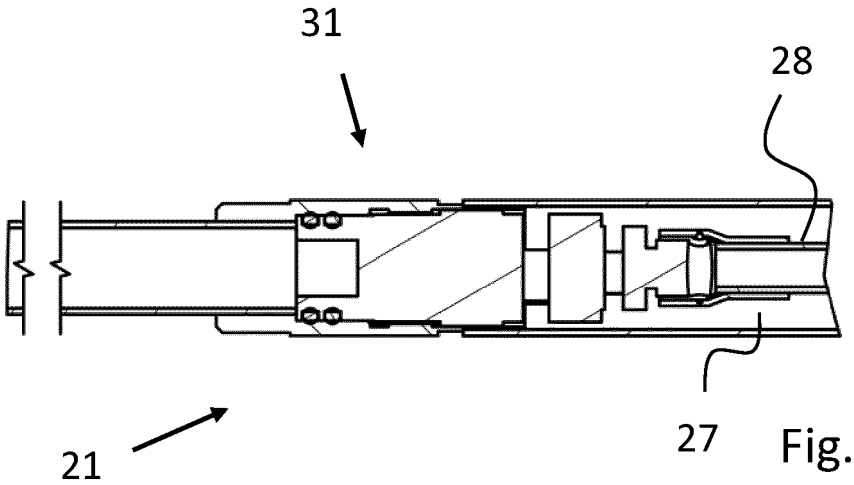

Fig. 4b

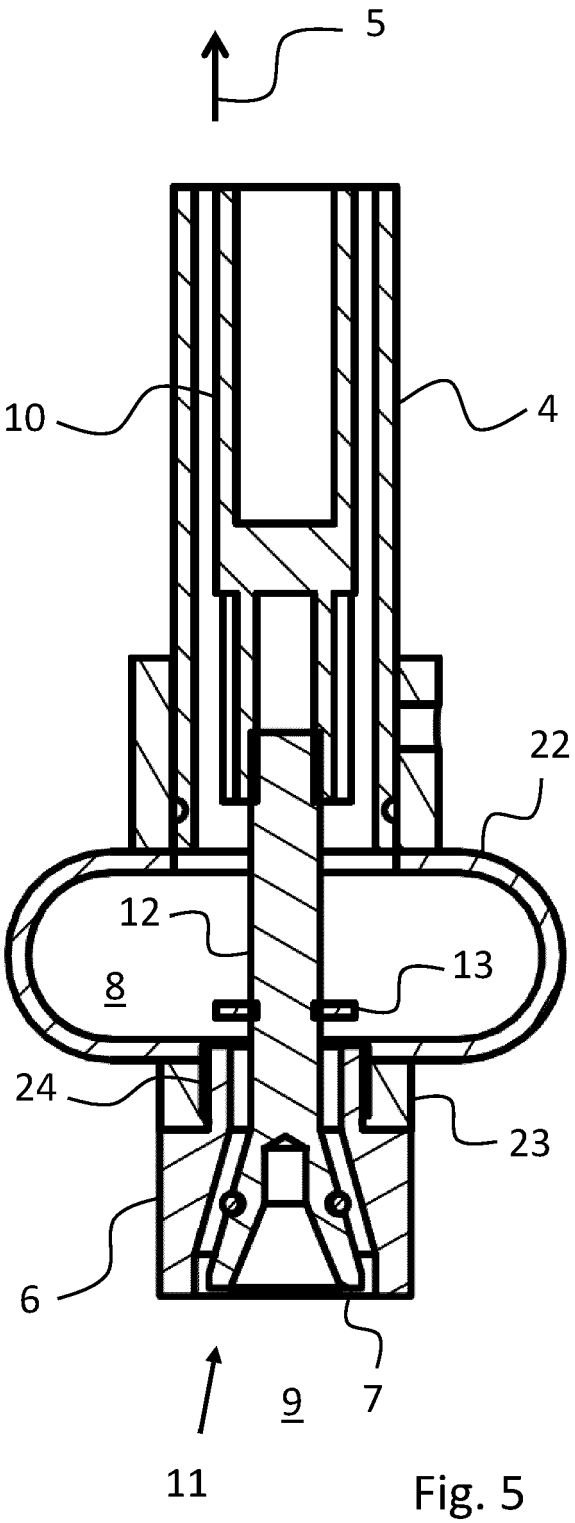

Fig. 5

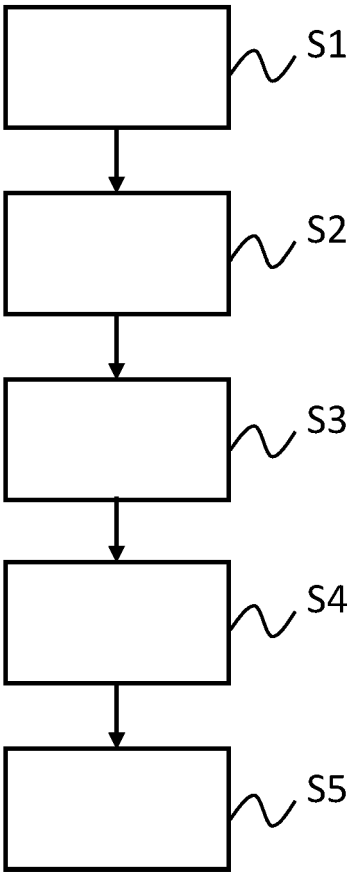

Fig. 6

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EUROPEAN SEARCH REPORT

Application Number
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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	KR 200 180 790 Y1 (CHOI YOUNG HO [KR]) 15 May 2000 (2000-05-15) * pages 1-3; figures 1-5 * -----	1-13	INV. E03B9/02 F16K31/12 F16K33/00
X	US 4 700 732 A (FRANCISCO ROBERT D [US]) 20 October 1987 (1987-10-20) * columns 1-10; figures 1-3 * -----	1,8,10, 11	ADD. E03B7/12
X	DE 10 2020 134274 A1 (HEINRICH SCHULTE & SOHN GMBH & CO KG [DE]) 23 June 2022 (2022-06-23) * paragraphs [0001] - [0032]; figures 1-3 * -----	1,8,10, 11	

TECHNICAL FIELDS SEARCHED (IPC)

E03B
F16K

~~The present search report has been drawn up for all claims~~

Place of search	Date of completion of the search	Examiner
The Hague	17 February 2023	Posavec, Daniel

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

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
.....
& : member of the same patent family, corresponding document

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CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing claims for which payment was due.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☒ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

1-5, 7-13(completely); 6(partially)

☐ The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).

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LACK OF UNITY OF INVENTION
SHEET B

Application Number
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The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-5, 7-13(completely); 6(partially)

A water faucet for domestic outdoor use, said water faucet comprising: a faucet outlet;at least one faucet inlet;a faucet pipe fluidly coupling said faucet outlet with said at least one faucet inlet, wherein said faucet pipe internally defines a flow direction from said at least one faucet inlet to said faucet outlet;a valve seat;a valve member positioned at said valve seat, wherein said valve member is shiftable from an open configuration to a closed configuration relative to said valve seat, wherein said open configuration fluidly couples a faucet interior of said water faucet to a faucet exterior of said water faucet, wherein said closed configuration fluidly seals said faucet interior from said faucet exterior; and a flow element connected to said valve member and positioned at least partly within said faucet pipe.

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2. claims: 14, 15(completely); 6(partially)

A valve assembly, preferably for a water faucet according to any of claims 1-11, said valve assembly comprising: a valve seat having an inner seat aperture;a valve member;a connecting rod fixed to said valve member, wherein the connecting rod has a rod diameter allowing insertion through said inner seat aperture, wherein the valve member is arranged to provide a fluid seal collectively with said valve seat to restrict fluid flow through said inner seat aperture when said connecting rod is inserted through said inner seat aperture; and a flow element arranged on said connecting rod.

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 22 19 8069

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

17-02-2023

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
KR 200180790 Y1	15-05-2000	NONE	
US 4700732 A	20-10-1987	NONE	
DE 102020134274 A1	23-06-2022	NONE	

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