

**WATER CONDITIONING UNIT FOR A WASHING DEVICE,
AND DISPENSING UNIT**

5 The invention relates to the field of devices for treating the human body, and in particular to a water conditioning unit for a washing device, and a dispensing unit, as described in the preamble of the corresponding independent claims.

Devices and methods for delivering additives to showerheads for application to the
10 human body are known, for example from EP 2543779 A2, or WO 2007/062536 A1.

US 2019/352889 A1 discloses a washing facility with multiple outlets for dispensing water or a water admixed with a consumable. It is controlled to operate in different operating modes, which can differ in the pressure, flow rate, temperature and whether
15 the consumable is admixed to the water or not.

WO 2012055272 A1 shows a liquid soap delivery device with a liquid suction chamber. Therein, delivery of the soap is driven by hydraulic pressure of water being delivered.

KR 20030008504 A shows a showerhead with control buttons, for controlling delivery of additives through a control and mixing box. The additives are provided by a set of additive containers.

- 5 Known systems are usually foreseen for fixed installation in connection with a bathtub or shower or faucet, and are limited in what they can do. There is a need for a water conditioning unit that is versatile and at the same time easy to handle. More generally, there is a need for improvement over existing systems.
- 10 It is therefore an object of the invention to create a water conditioning unit and a dispensing unit of the type mentioned initially, which overcomes the disadvantages mentioned above.

These objects are achieved by a water conditioning unit and a dispensing unit
15 according to the claims.

According to an aspect of the present invention, there is provided a water conditioning unit for a washing device, the water conditioning unit being configured to provide, controlled by a user, water at different flow rates and with different spraying
20 characteristics and with additives admixed to the water, the water conditioning unit comprising

- an inlet fitting for attaching the water conditioning unit to a water supply, in particular wherein the inlet fitting is configured for attaching a water supply hose;
- 25 • an outlet fitting for attaching the water conditioning unit to a dispensing unit, in particular wherein the outlet fitting is configured for attaching a hose leading to a showerhead; and
- one, two or more docking adapters configured for attaching, one, two or more additive containers;

- wherein hydraulic elements guiding and controlling a flow of water between the inlet fitting and the outlet fitting are implemented in a hydraulic assembly, the hydraulic assembly comprising a total manifold and hydraulic elements, in particular sensors and actuators controlling the flow of water, the total manifold comprising internal channels
- 5 guiding the flow of water and carrying the hydraulic elements, and
- wherein the total manifold comprises a first plate and second plate, attached to one another, with channels guiding the flow of water being arranged between the two plates and being defined by hollow spaces between the two plates.
- 10 In embodiments, the water conditioning unit is for use in a washing device, the water conditioning unit being configured to provide, controlled by a user, water at different flow rates and with different spraying characteristics and with additives admixed to the water, the water conditioning unit comprising
- an inlet fitting for attaching the water conditioning unit to a water supply, in
 - 15 particular wherein the inlet fitting is configured for attaching a water supply hose;
 - an outlet fitting for attaching the water conditioning unit to a dispensing unit, in particular wherein the outlet fitting is configured for attaching a hose leading to a showerhead;
 - 20 • one, two or more docking adapters configured for attaching, one, two or more additive containers.

In embodiments, the water conditioning unit is configured to provide at least one additive without mixing it with water.

In embodiments, one or more or all of the docking adapters are designed to receive an additive cartridge or capsule. The additive cartridge or capsule can contain the additive
5 in solid form or in a highly viscous form. The additive cartridge or capsule can comprise an amount of additive required for a single treatment cycle. That is, a treatment cycle for one user in one sitting. The docking adapter can be configured to guide water through the additive cartridge, thereby eroding the additive and carrying
10 it along out of the additive cartridge. The docking adapter can comprise a slot into which the additive cartridge or capsule is inserted, and then mechanically opened by the docking adapter.

As alternatives to the docking adapters, other additive sources can be present. For
15 example, instead of one or more or all of the docking adapters, a refillable additive container that forms part of the dispensing unit is present.

In embodiments, hydraulic elements guiding and controlling a flow of water between the inlet fitting and the outlet fitting are implemented in a hydraulic assembly, the
20 hydraulic assembly comprising a total manifold and hydraulic elements, in particular sensors and actuators controlling the flow of water, the total manifold comprising internal channels guiding the flow of water and carrying the hydraulic elements.

In embodiments, the total manifold functions as a support structure holding and
25 supporting the hydraulic elements.

This makes the water conditioning unit easy to assemble and allows for a compact arrangement of the hydraulic elements. The total manifold can also hold and support electronic elements such as a controller. The total manifold, together with the elements
30 it supports, can be transported and handled as a single, self-supporting unit. The total

manifold thus realises the technical functions of the washing device, and can be assembled and tested independently from a housing in which it is to be used, forming the base unit. Variations in the housing can be implemented without affecting the design of the total manifold, as long as the housing provides room to accommodate the
5 total manifold.

In embodiments, the internal channels are arranged inside the total manifold, guiding water and, as the case may be, also additives, between the hydraulic elements.

10 In embodiments, the total manifold comprises a first plate and second plate, attached to one another, with channels guiding the flow of water being arranged between the two plates, and being defined by hollow spaces between the two plates.

In embodiments, a gasket is arranged between the two plates, ensuring water tightness
15 of the channels. In embodiments, the plates are joined by one of ultrasonic welding, laser welding (with at least one of the plates being transparent to the laser light used for welding).

In embodiments, for one or more of the hydraulic elements, the total manifold is
20 shaped to form a functional part of the hydraulic element.

In embodiments, the total manifold is shaped to form at least one valve seat for a hydraulic element that implements a valve function.

25 In embodiments, the total manifold is shaped to form at least one flow restrictor for restricting a flow rate through one of the internal channels of the total manifold.

In embodiments, the hydraulic assembly has an elongated shape, with a first end and a second end opposed to the first end, the inlet fitting and the outlet fitting both being
30 arranged at the first end.

This allows to connect inlet and outlet hoses to the water conditioning unit adjacently to one another, which is practical in use, while minimising or eliminating the need for additional conduits to and from the hydraulic assembly.

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In embodiments, inside the hydraulic assembly, a high-flow water channel controlled by a high-flow valve, constitutes a shortest flow path for the water flowing from the inlet fitting to the outlet fitting, compared to other flow paths from the inlet fitting to the outlet fitting that are implemented in the hydraulic assembly.

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In embodiments, the flow through the high-flow water channel does not pass through any elements designed to reduce or limit the flow, except for the high-flow water channel.

15 In embodiments, inside the hydraulic assembly, an initial spray flow path leads from the inlet fitting to a branching point, where it branches into a spray water channel and an admixing channel,

- the spray water channel being controlled by a plain water valve and leading to a junction which in turn leads to the outlet fitting,

20 • the admixing channel being controlled by a mixer valve and leading to the second end and from there into an admixing section of the admixing channel, the admixing section leading back in the direction of the first end, to the junction.

25 This allows the admixing section to extend along the length of the elongated hydraulic assembly, which in turn allows to arrange additive containers and associated additive pumps in a space saving arrangement next to one another. In embodiments, the total manifold comprises two parallel levels of channels. In embodiments, it comprises three levels, or more.

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In embodiments, a pressure reducer is arranged to limit a pressure at a branching point, where it branches into a spray water channel and an admixing channel, in particular to a pressure of less than three bar, in particular to a pressure of two bar.

- 5 In embodiments, the pressure reducer is one of the hydraulic elements carried by the total manifold.

In embodiments, a flow restrictor is arranged to further limit a flow in the spray water channel, in particular to a flow between one and two litres per minute.

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- In embodiments, the total manifold further comprises a mixing manifold arranged on or being part of the second plate, the mixing manifold comprising an admixing channel arranged to guide a flow of water from the second end to the first end, with additive inlets, optionally comprising additive check valves, arranged along the admixing
15 channel for admixing additives to the flow of water.

The additive check valves can be duckbill valves.

- In embodiments, a volume of the admixing channel, from the first additive inlet, seen
20 in the direction of flow, to the junction, is less than thirty millilitres, in particular less than twenty millilitres, in particular less than ten millilitres.

- This relatively small volume leads to a short delay time between the moment that an additive is delivered to the admixing channel and the time that it is delivered to the
25 junction and then to the showerhead. Conversely, it also leads to a short delay time between the moment in which delivery is stopped and the time at which the additive is flushed from the admixing channel.

- In embodiments, the water conditioning unit comprises two or more peristaltic pumps
30 arranged in a row, with their axes of rotation at least approximately at a right angle to

a direction of the admixing channel, wherein two outermost peristaltic pumps of the row are arranged to turn in opposite directions.

In embodiments, all hydraulic elements guiding and controlling a flow of water
5 between the inlet fitting and the outlet fitting are arranged inside a compact base unit

In embodiments, the base unit is configured for the, one, two or more additive
containers to be inserted into and connected to corresponding docking adapters in a
vertical direction, in particular in a downward direction.

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In embodiments, the base unit is configured for three or more additive containers
arranged in a line to be inserted into and connected to corresponding docking adapters
in a vertical direction, in particular in a downward direction.

15 In embodiments, the base unit comprises user interface elements comprising additive
selecting elements, in particular one selector button for each docking adapter or
additive source, and an additive concentration controller for setting an amount of
additive delivered from one or more selected docking adapters or additive sources
when the water conditioning unit is in an additive dispensing mode, and optionally
20 dispensing mode selecting elements, and optionally indicator elements, in particular
indicator light rings, indicating the one or more selected docking adapter or additive
source.

In embodiments, mode indicating elements can be present, indicating that the one or
25 more selected docking adapter or additive source is either in continuous admixing,
pulses additive admixing mode or pulsing water admixing mode. A mode can be
indicated, for example, by a colour or pattern of brightness variation of an optical
indicator.

In embodiments, the user interface is configured to allow for more than one docking adapter or additive source to be selected, and a controller is configured to, for a particular setting of the additive concentration controller

- if a single docking adapter or additive source is selected, to control the amount of additive delivered by this single docking adapter or additive source to be equal to a reference amount corresponding to this particular setting of the additive concentration controller; and
- if two or more docking adapters or additive sources are selected, to control the total amount of additive delivered by these two or more docking adapters or additive sources to be equal to the same reference amount corresponding to this particular setting of the additive concentration controller.

A corresponding method for operating the water conditioning unit comprises the steps of

- according to a user input, selecting a single docking adapter or additive source, or selecting two or more docking adapters or additive sources;
- and for a particular setting of the additive concentration controller
 - if a single docking adapter or additive source is selected, controlling the amount of additive delivered by this single docking adapter or additive source to be equal to a reference amount corresponding to this particular setting of the additive concentration controller; and
 - if two or more docking adapters or additive sources are selected, controlling the total amount of additive delivered by these two or more docking adapters or additive sources to be equal to the same reference amount corresponding to this particular setting of the additive concentration controller.

In embodiments, the selection of two or more docking adapters for operation in an admixing state (which can be continuous, pulsed additive or pulsed water admixing) can result in the mixing of two or more additives that undergo a chemical reaction

upon being mixed. The mixing of these additives can be done in the same proportion, that is, each docking delivering the same amount of product per time unit, or the same proportional part of the total amount. The device can be configured to control the amount of each additive delivered for these chemical reactions. The device can be
5 configured to generate a user alert signal indicating that a given total amount of additives has been dispensed.

The dispensing unit is in particular for use in combination with the water conditioning unit of the preceding claims. It comprises a showerhead with a spray outlet and a high-
10 flow outlet,

- the spray outlet being configured to create a spray of droplets at a spray flow rate, in particular by creating two or more colliding jets of water,
- the high-flow outlet being configured to create a jet of water at a high-flow flow rate,

15 the high-flow rate being at least twice, in particular three times the spray flow rate.

In embodiments, the dispensing unit comprises an additive button for selecting an operation mode of the mixer valve and the plain water valve for the water conditioning unit to deliver either water through the spray water channel, or water admixed with
20 additive through the admixing channel.

In embodiments, the dispensing unit comprises a flow selector for selecting an operation mode of the high-flow valve and the mixer valve or plain water valve, as the case may be, for the water conditioning unit

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- to deliver water through the high-flow water channel when the flow selector is in a high flow position, or
- to deliver water through either the spray water channel or the admixing channel, as the case may be, when the flow selector is in a spray position.

In embodiments, the flow selector is configured to operate a diverter to guide a flow of water from the hose

- to the high-flow outlet, when the flow selector is in the high flow position,
or
- 5 • to the spray outlet, when the flow selector is in the spray position.

Further preferred embodiments are evident from the dependent patent claims.

The subject matter of the invention will be explained in more detail in the following
10 text with reference to preferred exemplary embodiments which are illustrated in the
attached drawings, which schematically show:

- Figure 1 flow paths through the washing device;
Figures 2-5 views of a water conditioning unit;
15 Figure 6 a sectional view of the water conditioning unit;
Figure 7 details of a showerhead; and
Figure 8 a base unit with additive containers and a user interface.

The reference symbols used in the drawings, and their meanings, are listed in summary
20 form in the list of reference symbols. In principle, identical parts are provided with the
same reference symbols in the figures.

Figure 1 schematically shows a structure of flow paths through the washing device
10. Water from a water supply, for example a mains water supply and via a faucet 1,
25 enters the washing device 10 through an inlet fitting 11. It passes through a filter 12.
Optionally, before (as shown) or after the filter 12 it splits into a main water path and
a high-flow water channel 24, the optional path of the high-flow water channel
represented by a dashed line. The flow in the high-flow water channel 24 is controlled
by a high-flow valve 21. On the main water path, it passes through an optional inlet
30 one way valve 13. A pressure elevating pump, for example, a gear pump 14 can be

connected in parallel to or instead of the inlet one way valve 13. This pressure elevating pump can be present if the washing device 10 is foreseen to be used in a setting when the mains water supply pressure is too low. In other settings, the pressure elevating pump can be omitted. In the usual case, the pump is not present. The water then passes
5 through a flow meter 16, or, alternatively, a parallel arrangement of a flow meter 16 and an internal bypass 17, represented by a dashed line. If the internal bypass 17 is present, most of the water passes through the bypass, so that the flow meter 16 has a small influence on the flow rate. Subsequently the flow optionally passes through a pressure reducer at location 18' and, at a branching point 223, splits up into separate
10 branches, an admixing channel 22 and a spray water channel 23, and, as in the embodiment shown, the high-flow water channel 24. The optional pressure reducer at location 18' acts as a flow limiter, so that the flow rate through the subsequent elements is independent of a mains water pressure, in settings where no pressure elevating pump is present. The flow into each of these channels is controlled by an associated valve,
15 that is, a mixer valve 19 and a plain water valve 20 and a high-flow valve 21.

The plain water valve 20 can be controlled to create pulses of water by opening and closing the plain water valve 20 repeatedly at regular intervals, for example with a frequency between 0.5 Hz and 10 Hz, in particular between 1 Hz and 15 Hz, in
20 particular between 3 Hz and 10 Hz. Such pulsed delivery of water can be used to implement a pulsed water admixing mode, as described further below.

The plain water valve 20 can be a proportional valve. That means that it can be controlled to be kept in an opened state in which it is open to less than a maximum degree of opening. In its opened state it can be open to a degree between ten or twenty
25 and a hundred percent of a maximum degree of opening.

The flow path comprising the combination of the following elements: inlet one-way valve 13 and gear pump 14, the pressure sensor 15, the temperature sensor 31, and the

flow meter 16, shall be called initial spray flow path 222. One or more of these elements can be omitted from the initial spray flow path 222.

In the admixing channel 22, the flow passes through a flow restrictor or pressure
5 reducer 221 into an admixing section where it is joined by one or more additive flows. The flow restrictor or pressure reducer 221 reduces the flow, or further reduces the flow if the pressure reducer at location 18' is present. Each of the additive flows is delivered by an associated peristaltic pump 26 from an associated additive container 25 into the admixing channel 22 through an associated additive check valve 27. The
10 additive check valve 27 can be a duck bill valve. In embodiments, the additive check valve 27 is not present. Following the admixing section, the flow – now optionally comprising one or more additives, depending on operation of the peristaltic pumps 26 – passes through a mixture check valve 29, which can be a duck bill valve, into a junction 30. At the junction 30, the admixing channel 22 reunites with the spray water
15 channel 23 and the high-flow water channel 24, forming a reunited flow.

The spray water channel 23 is separate from the admixing channel 22 in order to allow to quickly switch between water with and without additives. Another reason is that the flow rate in the two channels and the flow rates for dispensing spray water or water
20 with an additive can be set to be different. For this purpose, if the pressure reducer at location 18' is not present, then a spray water flow restrictor or pressure reducer 18 is present in the spray water channel, in addition to the flow restrictor 221 in the admixing channel 22. Alternatively, if the pressure reducer at location 18' is present, then a spray water flow restrictor or pressure reducer 18 in the spray water channel can be omitted,
25 and the difference in flow rates is determined by the flow restrictor or pressure reducer 221 in the admixing channel 22. Furthermore, if the pressure reducer at location 18' is present, then the high-flow water channel 24 should branch off from the initial spray flow path 222 before this pressure reducer.

The reunited flow optionally passes along an outlet temperature sensor (not illustrated, placed at location 31') to an outlet fitting 32. From the outlet fitting 32, the flow passes through an optional outlet filter 28 and is guided by a hose 33 to a showerhead 34.

- 5 The volume of the admixing channel 22 is relatively small, so that a delay time between starting and stopping an additive pump and delivery of the additive by the showerhead 34 is kept short. In particular, a time for flushing an additive from the admixing channel 22 after stopping the corresponding pump is kept short. For example, the volume of the admixing channel 22 is less than thirty millilitres, in
10 particular less than twenty millilitres, in particular less than ten millilitres.

In contrast the volume of the spray water channel 23 can be between thirty and sixty millilitres, in particular between forty and fifty millilitres. The volume of the high-flow water channel 24 can be between ten and thirty millilitres, in particular between
15 fifteen and twenty-five millilitres.

The elements between the inlet fitting 11 and outlet fitting 32 constitute a **water conditioning unit 2**. The hose 33 and showerhead 34 form a **dispensing unit 3**.

- 20 The water conditioning unit 2 comprises a **controller 100** arranged to read sensor values, to read the state from user input elements (described below), to control actuators such as the valves and pumps in accordance with such sensor or user inputs, and to display information to the user. The controller 100 can further be configured to communicate with an external computer system. Communication can comprise
25 sending operating data to the external computer system and receiving operating parameters, including user and client preferences, from the external system. Operating data can comprise measurements made by sensors of the device, information on user actions, usage of additives, device status data, error messages etc. Such data can be used for improving operation of the washing device itself or a fleet of devices, for
30 ordering replacement containers for additives, scheduling maintenance etc. The

external computer can be operated by a manufacturer and/or supplier of additives, or by a user. In the latter case, the external computer can be a handheld computing device, and can implement a user interface or dashboard displaying information from the washing device 10 and allowing to control the washing device 10.

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The sensors shown in the embodiment of **Figure 1** allow to monitor operation of the washing device 10. In simplified embodiments, one or more of the sensors, in particular the pressure sensor 15, the flow meter 16, and temperature sensor 31 are not present.

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In embodiments, water flow into the water conditioning unit 2 is controlled by the **faucet** 1. In particular the temperature of the flow can be controlled by the faucet being a mixing faucet. In this way the washing device 10 can be combined with existing haircare installations, replacing an existing showerhead. Users operating the washing device 10 can keep their habit of controlling the temperature by means of the faucet 1. With regard to water flow, the faucet can be fully opened, with the flow being controlled by the mixer valve 19, plain water valve 20 and high-flow valve 21.

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Figures 2 to 5 show views of the **water conditioning unit** 2, in particular of a hydraulic assembly 50. The hydraulic assembly 50 comprises a manifold that implements on the one hand conduits or channels between the various **hydraulic elements** affecting the flow, as presented above. The hydraulic elements are sensors and actuators, in particular valves or pumps. On the other hand, the manifold serves as a carrier for these hydraulic elements, that is, these elements are carried and held in place by the manifold.

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The hydraulic assembly 50 can be manufactured from one or more parts by injection moulding or additive manufacturing.

In the embodiment presented here, the hydraulic assembly 50 comprises a total manifold 57 which in turn comprises a base manifold 55 connected to a mixing

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manifold 56. The base manifold 55 in turn comprises a first plate 51 and second plate 52. In one of these plates, channels 54 are formed by recesses in the plate. The channels 54 run in parallel to a plane, called channel plane. A gasket 53 can be arranged to ensure water tightness between the two plates in regions where the channels 54 are located. The channels in the base manifold 55 implement the channels of the spray water channel 23 and leading into it, and of the high-flow water channel 24. In the embodiment presented here, the high-flow water channel 24 branches off from the initial spray flow path 222 prior to measurement elements, as shown by the dashed line in Figure faucet 1.

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The admixing channel 22 is implemented in the mixing manifold 56. The mixing manifold 56 implements a second level of internal channels, in a plane that is parallel to the channels 54 in the base manifold 55.

15 **Figure 2** shows an overview of the hydraulic assembly 50, seen from the side at which most of the hydraulic elements are attached to the base manifold 55. **Figure 3** shows the same side, but with the first plate 51 removed, leaving the gasket 53 on the second plate 52, showing the location of channels 54 relative to the hydraulic elements. **Figure 3** shows, on the left side, just the gasket 53 on the second plate 52, and on the right side, the first plate 51, flipped over to show the channels 54. **Figure 5** shows different views of the opposite side, illustrating the arrangement of the mixing manifold 56 comprising the admixing channel 22: a solid view, a view with a wireframe representation of the mixing manifold 56, and a sectional view.

25 A space saving arrangement of the hydraulic elements can be achieved by the total manifold 57 having an elongated shape, extending from a first end 61 in a first half section 63 to a second end 62 in a second half section 64 of the total manifold 57, and arranging the hydraulic elements in the following manner:

- Locating the inlet fitting 11 and outlet fitting 32 adjacent to one another, at the first end 61. This allows to connect a corresponding inlet hose and the hose 33 adjacent to one another.
- Guiding the flow from the inlet fitting 11 to the flow meter 16 and pressure reducer 18 arranged in the second half section 64 of the total manifold 57.
- Arranging the spray water channel 23 to extend through the first half section 63 back to the outlet fitting 32. In embodiments, the spray water channel 23 has a length (measured from the inlet fitting 11 to the outlet fitting 32) of less than 70 centimetres, in particular less than 60 centimetres, and a cross sectional area of between 0.2 cm² and 1 cm², in particular between 0.3 cm² and 0.5 cm².
- Arranging the high-flow water channel 24 including the high-flow valve 21 to extend, within the first half section 63, closer to the inlet fitting 11 and outlet fitting 32 than the other channels and hydraulic elements. Thereby the flow path for the high flow water is the shortest and can be implemented with a minimal pressure loss. In embodiments, the high-flow water channel 24 has a length (measured from the inlet fitting 11 to the outlet fitting 32) of less than 20 centimetres, in particular less than 15 centimetres, and a cross sectional area of between 0.3 cm² and 1 cm², in particular between 0.4 cm² and 0.6 cm².
- Arranging the admixing channel 22 to extend from the second half section 64, in particular from the second end 62, back to the outlet fitting 32. In embodiments, the admixing channel 22 has a length (measured from the first additive check valve 27 to the outlet fitting 32) of less than 40 centimetres, in particular less than 30 centimetres, and a cross sectional area of between 0.1 cm² and 0.5 cm², in particular between 0.2 cm² and 0.4 cm².

It is understood that the expressions “the first end” and “the second end” are understood to denote a region at the respective end. Such a region can comprise one fifth or one seventh or one tenth of the length of the hydraulic assembly.

Furthermore, the admixing channel 22 can be arranged in a plane different from the channel plane in which the other channels lie. In the embodiment shown, the admixing channel 22 is arranged in the mixing manifold 56, the mixing manifold 56 being attached to the second plate 52. Part of the admixing channel 22 runs approximately
5 parallel to the spray water channel 23, at a distance in the direction normal to the channel plane.

Figure 5 shows elements on the side of the hydraulic assembly 50 opposite to the side shown so far, with the mixing manifold 56 attached to the second plate 52. The
10 admixing channel 22 branching off at the branching point 223 (see **Figure 4**) near the second end 62 passes through the second plate 52 into the mixing manifold 56. It runs along the length of the mixing manifold 56, and is successively joined by outlets, being, for example, duck bill valves acting as additive check valves 27, of the peristaltic pumps 26. Each of the peristaltic pumps 26 is supplied from the
15 corresponding additive container 25 (not shown) through an additive pipe 261 leading into the mixing manifold 56, and an additive conduit 262 leading to an inlet of the peristaltic pump 26. A section of the additive conduit 262 is formed by a recess in the side of the mixing manifold 56 that faces the second plate 52. Near the first end 61, the admixing channel 22 passes back through the second plate 52 into the junction 30
20 (see **Figure 4**) in the first plate 51.

The hydraulic elements are attached to the total manifold 57. In more detail: the peristaltic pumps 26 are attached to the mixing manifold 56, and the other elements to one side of the base manifold 55, such as the first plate 51.

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In order to achieve a space-saving arrangement of the peristaltic pumps 26, the outermost two peristaltic pumps 26, in a row of two, three or more pumps, are arranged to turn in opposite directions. This allows to locate the respective inlets of the two outermost peristaltic pumps 26 at the outer periphery or end of the row of pumps,

which in turn allows to arrange the corresponding additive pipes 261 at the outer periphery of the row as well.

In embodiments, two or more pumps are present, and respective additive pipes 261
5 supplying the pumps are arranged at an outer end of the row of pumps, each outside the inlet of the respective pump. In embodiments in which a third pump is present, its respective additive pipe 261 can be arranged to lie between the inlet and the outlet of the third pump.

10 **Figure 6** shows a cross section of the total manifold 57 including a valve 58. The valve itself, that is, the valve seat 581 and the valve disc 582, is located in the base manifold 55. The valve seat 581 is formed as part of the base manifold 55. In the example shown, the valve seat 581 is formed as part of the first plate 51, in other embodiments, it can be formed as part of the second plate 52. An actuator 583 for the valve is located
15 outside of and attached to the base manifold 55.

The flow restrictor 221 can be formed as part of the total manifold 57. In embodiments, not illustrated in detail, the total manifold 57 is shaped to form at least one part of a filter carrier for a hydraulic element that implements a filter function.

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Figure 7 shows details of the **dispensing unit** 3, in particular of the showerhead 34. The showerhead 34 comprises two distinct outlets, a spray outlet 37 and a high-flow outlet 38. The spray outlet 37 is configured to create a spray of water by creating two or more colliding jets of water. Methods and devices, in particular cartridges for
25 generating such a spray are described, for example, in

- WO 2011/054120 A2
- WO 2011/054121 A2
- WO 2019/233958 A1
- WO 2020/070159 A1

The spray outlet 37 thus generates a fine spray of water, optionally comprising an additive. This allows to apply the additive and perform effective wetting and rinsing operations using relatively little water.

5 For situations in which a high flow of water is required, the high-flow outlet 38 is arranged to dispense water at a significantly higher flow rate than the spray outlet 37. The high-flow outlet 38 comprises a ring-like outlet opening surrounding an outlet opening of the spray outlet 37.

10 In embodiments, the washing device 10 is configured, in a **spray state**, to have a flow rate through the spray outlet 37, without additives, of between two and three litres per minute, in particular 2.5 litres/minute +/- 20%. This flow rate can be controlled by the pressure reducer 18. This flow passes through the spray water channel 23.

15 In embodiments, the washing device 10 is configured, in an **admixing state**, to have a flow rate through the spray outlet 37, with additives, of between one and two litres per minute, in particular 1.5 litres/minute +/- 20%. This flow rate can be controlled by the flow restrictor 221. This flow passes through the admixing channel admixing channel 22.

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The admixing state can be implemented as one of the following substates or admixing modes, or the washing device 10 can be configured, for at least one of the additives, to switch between two or more of the following admixing modes:

- **continuous admixing:** herein, the flow of the additive and the water is continuous;
- **pulsed additive admixing:** herein, the flow of the additive is pulsed. This can be implemented by turning the corresponding additive pump on and off periodically. This allows to save additive and/or precisely dose the additive. This in turn allows to use a highly concentrated additive.

- **pulsed water admixing:** herein, the flow of the water is pulsed. This “pulsing” is a preferred mode of application for additives that serve for coloration or toning, because a higher concentration of the additive can be dispensed. This in turn results in a higher efficiency of the application of the additive. The pulsing of the water allows to decrease the total water flow dispensed. It still allows for sufficiently high flow to maintain the colliding jets in the spray outlet 37.

In embodiments, the washing device 10 is configured, in a **high-flow state**, to have a flow rate through the high-flow outlet 38 of between five and nine litres per minute, depending on the water pressure at the inlet fitting 11. In particular this flow rate can be, for an inlet pressure of

- 2 bar: 4 to 6 litres per minute, in particular 5 litres per minute +/- 20%;
- 2.5 bar: 5 to 7 litres per minute, in particular 6 litres per minute +/- 20%;
- 3 bar: 5 to 8 litres per minute, in particular 7 litres per minute +/- 20%.

Operation of the showerhead 34 is controlled by means of an additive button 35 and a flow selector 36. Both are control elements for setting operation modes of the water conditioning unit 2 through electrical signal lines, and are typically arranged on the showerhead 34. In other embodiments, one or both are arranged on a sink or treatment chair, on a base unit 75, or in a foot pedal.

The **additive button** 35 controls operation of the valves in the water conditioning unit 2 to open the mixer valve 19 and close the plain water valve 20 when the additive button 35 is activated to be in an “admixing” position. The opposite valve position is set in a “plain water” position. Typically, this is the default position in which the additive button 35 is not activated.

The **flow selector** 36 controls operation of the valves in the water conditioning unit 2 to open the high-flow valve 21 and close the mixer valve 19 and plain water valve 20

when the flow selector 36 is activated to be in a "high-flow" position. The high-flow valve 21 is closed in a "normal flow" or "spray" position. Typically, this is the default position in which the flow selector 36 is not activated.

- 5 As the valves in the water conditioning unit 2 are operated to switching between the high-flow water channel 24 and the other two channels, the showerhead 34 switches between spray outlet 37 and high-flow outlet 38. This can be done by the flow selector 36 mechanically or electrically actuating a diverter 39 that diverts the flow from the hose 33 to either the spray outlet 37 or the high-flow outlet 38, depending on the state
10 of the flow selector 36.

In embodiments, the flow selector 36 controls the valves of the water conditioning unit 2 by a dedicated signal line, e.g. carrying an electrical signal. In this case, a sensor such as a Hall sensor can be arranged to detect the position of the flow selector 36.
15 In other embodiments, the flow selector 36 indirectly controls the valves in that a change in pressure or flow caused by the flow being diverted to the high-flow outlet 38 is detected by a corresponding sensor in the water conditioning unit 2.

In summary, the washing device 10 can be in the following operating states:

- 20
- Off state
 - It is entered from any other operating states by closing the faucet 1.
 - Spray state:
 - It is entered from the off state by opening the faucet 1.
 - It is entered from the admixing state by moving the additive button 35
25 to the "plain water" position.
 - It is entered from the high flow state by moving the flow selector 36 to the "normal flow" position.
 - Admixing state, also called shampoo state if the additive is shampoo:
 - It is entered from the spray or high flow state by moving the additive
30 button 35 to the "admixing" position.

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- High flow state, also called rinsing state:
 - It is entered from the spray or admixing state by moving the flow selector 36 to the "high flow" position.

5 In other embodiments, the high-flow water channel 24 does not join the flow from the spray water channel 23 and admixing channel 22, but is guided through a second hose, running in parallel to the hose 33, to the showerhead 34 and the high-flow outlet 38.

10 If the admixing state has more than one admixing mode, switching between these modes can be done with a corresponding mode selector or admixing mode selecting element, operated by a user. For example, the mode selector is arranged on the base unit 75. A corresponding user interaction can comprise the user selecting the admixing mode by operating the mode selector. This causes the base unit 75, when the admixing state is entered, typically by the user operating the additive button 35, to perform the
15 admixing according to the selected admixing mode. In other embodiments, the mode selector is arranged on the showerhead 34, and/or it is combined with the additive button 35. Regardless of the placement of the mode selector, the selected mode can be indicated by a corresponding mode indicator element on the base unit 75 or on the showerhead 34, for example by a visual or optical indicator.

20

In embodiments, the washing device 10 is configured to perform a method comprising multiple phases for dispensing additives at different times as part of a procedure chosen by user. A possible procedure is:

1. First **admixing state**, in which a defined amount of a first additive is dispensed.
25 The first additive can be a catalyst used in hair care, dispensed in **pulsed water admixing mode**.
2. Waiting for a defined period of time, e.g. 5 to 10 minutes.
3. **High flow state**, for rinsing.
4. Second **admixing state**, in which a defined amount of a second and third
30 additive are dispensed. The second additive can be an oxidant used in hair care,

and the third additive can be a colorant used in hair care. The second and third additive are dispensed in **pulsed water admixing mode**,

5. Waiting for a defined period of time, e.g. 5 to 20 minutes,
6. **High flow state**, for rinsing.
- 5 7. Third **admixing state**, in which a defined amount of a fourth additive is dispensed. The fourth additive can be a shampoo used in hair care.
8. **High flow state**, for rinsing.

The elements of the water conditioning unit 2 are arranged in a single unit, for example
10 in a compact base unit 75 to which additive containers 25 are coupled.

Figure 8 shows such a base unit 75 with additive containers 25 (schematically represented with dashed lines) attached to its top. The elongated and compact construction of the hydraulic assembly 50 allows for an equally compact appearance
15 of the base unit 75, with a linear and closely spaced arrangement of the additive containers 25.

A user interface 70 to the controller 100 for operating the hydraulic assembly 50 comprise selector buttons 71 and an additive concentration controller 72. Each selector
20 button 71 is associated with one additive container 25. Pressing a selector button 71 selects the associated additive container 25 for delivery of additive when the additive button 35 of the dispensing unit 3 is operated. When this happens, the amount of additive delivered by the peristaltic pump 26 per time unit is set according to a setting of the additive concentration controller 72. Selection of a particular additive container
25 25 can be indicated by an indicator light located near a coupling to the additive container 25. In particular the indicator light can be an indicator light ring 73 running around a base of such a coupling. The light can indicate selection of the corresponding additive container 25 by lighting up. Specific operating conditions can be indicated by flashing the light and/or by changing its colour. Such operating conditions can be, for
30 example, delivery of the additive being in progress, no additive having been selected,

or an empty additive container 25. Such operating conditions are each associated with an additive and/or an additive container 25.

The embodiments shown so far show three additive containers 25 and a corresponding number of peristaltic pumps 26. In other embodiments, a single one, or two additive
5 containers 25 are present, or four, or more than four additive containers 25. The hydraulic assembly 50 can be adapted accordingly.

While the invention has been described in present preferred embodiments of the invention, it is distinctly understood that the invention is not limited thereto, but may
10 be otherwise variously embodied and practised within the scope of the claims.

PATENT CLAIMS

1. A water conditioning unit for a washing device, the water conditioning unit being
5 configured to provide, controlled by a user, water at different flow rates and with
different spraying characteristics and with additives admixed to the water, the
water conditioning unit comprising
- an inlet fitting for attaching the water conditioning unit to a water supply,
in particular wherein the inlet fitting is configured for attaching a water
10 supply hose;
 - an outlet fitting for attaching the water conditioning unit to a dispensing
unit, in particular wherein the outlet fitting is configured for attaching a
hose leading to a showerhead; and
 - one, two or more docking adapters configured for attaching, one, two or
15 more additive containers;
- wherein hydraulic elements guiding and controlling a flow of water between the
inlet fitting and the outlet fitting are implemented in a hydraulic assembly, the
hydraulic assembly comprising a total manifold and hydraulic elements, in
particular sensors and actuators controlling the flow of water, the total manifold
20 comprising internal channels guiding the flow of water and carrying the hydraulic
elements, and
- wherein the total manifold comprises a first plate and second plate, attached to
one another, with channels guiding the flow of water being arranged between the
two plates and being defined by hollow spaces between the two plates.
- 25
2. The water conditioning unit of claim 1, wherein the total manifold functions as a
support structure holding and supporting the hydraulic elements.

3. The water conditioning unit of claim 1 or 2, wherein the internal channels are arranged inside the total manifold, guiding water and, as the case may be, also additives, between the hydraulic elements.
- 5 4. The water conditioning unit of one of claims 1 to 3, wherein, for one or more of the hydraulic elements, the total manifold is shaped to form a functional part of the hydraulic element.
5. The water conditioning unit of claim 4, wherein the total manifold is shaped to
10 form at least one valve seat for a hydraulic element that implements a valve function.
6. The water conditioning unit of claim 4 or 5, wherein the total manifold is shaped
15 to form at least one flow restrictor for restricting a flow rate through one of the internal channels of the total manifold.
7. The water conditioning unit of one of claims 1 to 6, wherein, inside the hydraulic assembly, a high-flow water channel controlled by a high-flow valve, constitutes a shortest flow path for the water flowing from the inlet fitting to the outlet fitting,
20 compared to other flow paths from the inlet fitting to the outlet fitting that are implemented in the hydraulic assembly.
8. The water conditioning unit of one of claims 1 to 7, wherein, inside the hydraulic assembly, an initial spray flow path leads from the inlet fitting to a branching
25 point, where it branches into a spray water channel and an admixing channel,
 - the spray water channel being controlled by a plain water valve and leading to a junction which in turn leads to the outlet fitting,
 - the admixing channel being controlled by a mixer valve and leading to the second end and from there into an admixing section of the admixing

channel, the admixing section leading back in the direction of the first end, to the junction.

- 5 9. The water conditioning unit of one of claims 1 to 8, wherein a pressure reducer is arranged to limit a pressure at a branching point, where it branches into a spray water channel and an admixing channel, in particular to a pressure of less than three bar, in particular to a pressure of two bar.
- 10 10. The water conditioning unit of one of claims 1 to 9, wherein a flow restrictor is arranged to further limit a flow in the spray water channel, in particular to a flow between one and two litres per minute.
- 15 11. The water conditioning unit of one of claims 1 to 10, wherein the total manifold further comprises a mixing manifold arranged on *or being part of* the second plate, the mixing manifold comprising an admixing channel arranged to guide a flow of water from the second end to the first end, with additive inlets, optionally comprising additive check valves, arranged along the admixing channel for admixing additives to the flow of water.
- 20 12. The water conditioning unit of claim 11, wherein a volume of the admixing channel, from the first additive inlet, seen in the direction of flow, to the junction, is less than thirty millilitres, in particular less than twenty millilitres, in particular less than ten millilitres.
- 25 13. The water conditioning unit of claim 11 or 12, comprising two or more peristaltic pumps arranged in a row, with their axes of rotation at least approximately at a right angle to a direction of the admixing channel, wherein two outermost peristaltic pumps of the row are arranged to turn in opposite directions.

14. The water conditioning unit of one of the preceding claims, wherein all hydraulic elements guiding and controlling a flow of water between the inlet fitting and the outlet fitting are arranged inside a compact base unit.
- 5 15. The water conditioning unit of claim 14, wherein the base unit is configured for the, one, two or more additive containers to be inserted into and connected to corresponding docking adapters in a vertical direction, in particular in a downward direction.
- 10 16. The water conditioning unit of one of the preceding claims, configured to implement, for at least one of the additives, one or more of the following admixing modes
- a continuous admixing mode, wherein, the flow of the additive and the water is continuous;
 - 15 • a pulsed additive admixing mode, wherein the flow of the additive is pulsed;
 - a pulsed water admixing mode, wherein the flow of the water is pulsed.