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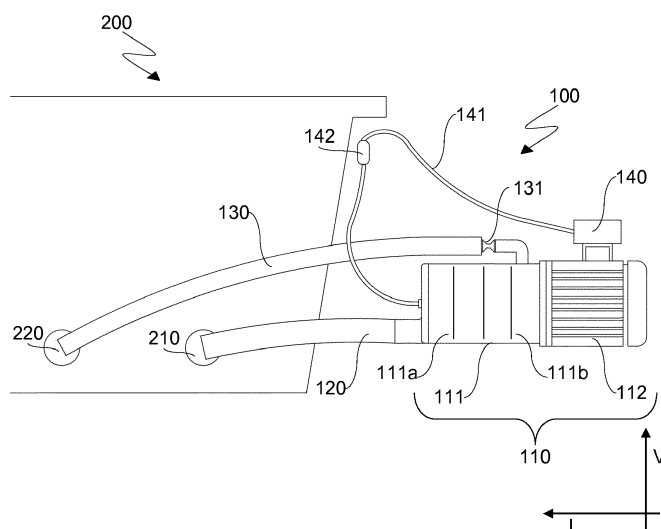
Amended claims in accordance with Rule 137(2) EPC.

(54) **MICRO BUBBLES GENERATING DEVICE FOR HYDROTHERAPY SYSTEMS**

(57) The invention relates to a device (100) for generating micro bubbles in a hydrotherapy system, said device (100) comprising a first pump (110) comprising a multistage pumping unit (111) and a motor (112) operatively connected thereto, at least one intake pipe (120) intended to be connected to a water supply, at least one discharge pipe (130) intended to be connected to a tub (200) of a hydrotherapy system. The device (100) also comprises a second pump (140) configured to generate an air flow, a supply conduit (141) for supplying said air

flow, wherein said supply conduit (141) is connected at one end to an outlet of the pump (140) and at the opposite end to a first stage (111a) of said multistage pumping unit (111) of said first pump (110), said first stage (111a) featuring a minimum head within the multistage pumping unit (111).

The invention also relates to a hydrotherapy system comprising the device above and a tank connected thereto through at least one intake pipe and one discharge pipe.



**Fig.1**

## Description

### Field of the invention

**[0001]** The present invention generally relates to devices for hydrotherapy and spa systems and in particular to a device for the generation of micro bubbles in such systems.

### Background

**[0002]** Hydrotherapy and spa systems are known including tanks, for example bathtubs for domestic use, wherein pressurized water flows are generated by way of pumps and supplied through suitable conduits so as to massage a user's body in order to relax muscles and/or for therapeutic purposes. These systems are also known as hydro-massage systems.

**[0003]** Also known are devices for hydrotherapy systems configured to generate micro bubbles, i.e. bubbles of micrometric size. It is known that micro bubbles have considerable benefits for human health, particularly because they contain gases such as oxygen and ozone, as well as oxygen ions, that are very effective to neutralize a wide variety of toxins. More generally, micro bubbles effectively contribute to the wellness feeling that a hydrotherapy system can usually give to users.

**[0004]** Patent US 8646759 B2 describes a micro bubbles generating device connectable to a bathtub. The device comprises a pump for feeding water to a tank and a device for injecting a gas into the water, for example air. The device is arranged downstream of the pump with respect to a direction along which water is fed. Gas injection occurs by Venturi effect due to the passage of the water fed to the tub, or with the aid of a pump.

**[0005]** The water with the gas dissolved therein are fed to the tank through a saturation and mixing device, wherein micro bubbles are formed due to the swirling motion generated inside it. The liquid coming out from the saturation and mixing device is fed to the tub through a suitable pipe and a connection port.

**[0006]** Patent US 8505575 B2 describes a micro bubbles generating device connectable to a bathtub. Water sucked by a pump through an inlet port is fed to two separate outlet ports, one configured to supply pressurized water with micro bubbles, and the other one configured to supply pressurized water only, as in a traditional whirlpool system. Micro bubbles are generated by sucking air by Venturi effect through a valve connected to a mixer. The mixer is arranged externally to the pump and is fed with water through a suitable pipe connected to an inlet pipe of the pump. The water enriched with air coming out from the mixer is fed to a relief valve to which a flow of pressurized water is also directly supplied by the pump. Inside the relief valve water is subjected to a swirling motion, which allows to generate micro bubbles.

**[0007]** A further device for the generation of micro bubbles is described in the Japanese patent publication JP

2011-31190 A. Also in this case, a pump draws water from a tank and feeds it to a group within which a mixer is arranged. The mixer features a reduced cross section adapted to generate turbulence in the flow of fluid. The device also comprises an inlet valve for the suction of air, which is injected into the water flow through a unidirectional valve arranged upstream of the group where the mixer is arranged. The water reaching the mixer contains a gas that forms micro bubbles due to the turbulent flow generated by the mixer.

**[0008]** The publication US 2007/094784 A1 describes a system for a spa comprising a water flow path and an air injection port in communication with the water flow path. An air supply system comprising an inlet opening and an inlet valve is periodically put in fluid communication with the air injection port. The air fed from the air supply system is fed into the water flow path by Venturi effect.

**[0009]** Further examples of hydro-massage and/or spa devices are described in the publications DE 3544002 A1, EP 0376843 A2, US 2003/172451 A1, DE 102011118893 A1, US 2010/223721 A1 and WO 90/01917 A1.

**[0010]** The devices for the generation of micro bubbles known in the art and exemplified above feature a remarkable structural complexity and thus have high manufacturing costs.

**[0011]** Moreover, the devices exploiting the Venturi effect as a means to draw air into a flow of water require delicate tuning operations in order to establish a pressure gradient allowing to ensure air suction during operation of a hydrotherapy system.

### Summary of the invention

**[0012]** There is therefore a need to simplify the devices for tub from a structural point of view, which is an object of the present invention. Said object is achieved with a device for the generation of micro bubbles whose main features are specified in the first claim, while other features are specified in the remaining claims.

**[0013]** An idea of solution underlying the invention is to generate micro bubbles without resorting to mixers or special valves nor by exploiting the Venturi effect. To this aim, the device according to the invention comprises a first pump comprising a multistage pumping unit and a second pump configured to generate a flow of air and to feed it into the multistage pumping unit of the first pump through a suitable conduit.

**[0014]** More particularly, the conduit of the second pump is connected to a first stage of the multistage pumping unit having a minimum head, whereby air is mixed with the water sucked by the pumping unit along the flow path leading to a stage of maximum head of the multistage pumping unit. A plurality of micro bubbles are thus generated inside the multistage pumping unit due to the swirling motion generated by its impellers.

**[0015]** The water flow coming out from the stage of the

pumping unit having the maximum head is thus enriched with micro bubbles and is supplied to a tank. In other words, micro bubbles are generated by pumping air directly into the pump supplying water, in particular into its multistage pumping unit, which is exploited as a mixing and homogenization means. This configuration is different from that of the devices known in the art, which generally exploit the Venturi effect by way of fittings and/or valves arranged upstream or downstream of a pump.

**[0016]** The main advantage offered by the invention is to provide a device for the generation of micro bubbles whose structure is simple and cheap because no external mixing device is employed. Differently, thanks to the use of a second pump for the generation of an air flow, the pump supplying water to a tank is also used to generate micro bubbles and homogenize them with the water.

**[0017]** The second pump may advantageously be a diaphragm pump, or an equivalent thereof, which features a simple structure and has low maintenance requirements. This type of pump is very cheap thereby having a minimum impact on the overall costs of the device according to the invention.

**[0018]** The configuration of the device according to the invention is therefore simple and robust thanks to the presence of a limited number of components, and extremely cheap.

**[0019]** According to an embodiment of the invention, the device for the generation of micro bubbles may advantageously comprise a control system configured to manage operation of the second pump in an intermittent manner. This feature of the invention allows to avoid an excessive accumulation of air within the multistage pumping unit, which would prevent the correct operation of the pump.

**[0020]** According to a further embodiment of the invention, a discharge pipe of the device may advantageously be provided with a flow control valve, for example a throttling sleeve or a ball valve, which serves to reduce the water flow rate downstream of the stage of maximum head of the multistage pumping unit, thereby causing a pressure increase inside it and promoting the swirling motions in order to enhance generation of micro bubbles.

**[0021]** Further advantages and features of the present invention will become clear from the following detailed description of embodiments thereof, given by way of non-limiting example.

#### Brief description of the drawings

**[0022]** Reference will be made to the figures of the accompanying drawings, wherein figure 1 is a side view that schematically shows a device for the generation of micro bubbles according to the invention.

#### Detailed description of preferred embodiments of the invention

**[0023]** Referring to figure 1, a device for the generation

of micro bubbles according to the invention it is indicated in general by reference number 100 and is schematically shown with respect to a reference system V, L. In this reference system a vertical direction V represents the direction along which gravity acts and a longitudinal direction L, perpendicular to the vertical direction V, represents the direction along which conduits of the device 100 mainly extend.

**[0024]** The device 100 comprises a first pump 110 in turn comprising a multistage pumping unit 111, for example comprising centrifugal impellers, and a motor 112 to which the multistage pumping unit 111 is operatively connected.

**[0025]** At least one suction pipe 120 is connected to the multistage pumping unit 111. In an operative configuration of the device 100 the suction pipe 120 for example extends in the longitudinal direction L and is connected to a tank 200, for example a bathtub, that is only partially and schematically shown in figure 1. The suction pipe 120 is connected to the tank 200 through a first port 210.

**[0026]** At least one discharge pipe 130 is also connected to the multistage pumping unit 111. In an operative configuration of the device 100 the discharge pipe 130 for example extends in the longitudinal direction L and is connected to the tank 200 at a second port 220.

**[0027]** The suction pipe 120 and the discharge pipe 130 are respectively connected in a known manner to a first stage 111a of the multistage pumping unit 111 having a minimum head, as well as to a stage 111b of the multistage pumping unit 111 having a maximum head.

**[0028]** More particularly, as shown in figure 1, the stage 111a having a minimum head is arranged at a free end of the multistage pumping unit 111 in the longitudinal direction L, whereas the stage 111b of the multistage pumping unit 111 having a maximum head is adjacent to the motor 112 of the pump 110.

**[0029]** The first and the second ports 210, 220 are arranged close to the bottom of the tank 200, thereby ensuring water suction and supply of a water stream with micro bubbles even when the tank is not completely full.

**[0030]** The device 100 and the tank 200 so connected together define a hydrotherapy system.

**[0031]** It will be appreciated that the operational configuration of the hydrotherapy system disclosed above allows a recirculation of water already present in the tank 200. Alternatively, the suction pipe 120 connected to the multistage pumping unit 111 may be in turn connected to the mains so as to allow filling of the tank 200. Moreover, additional suction pipes might also be connected between the multistage pumping unit 111 and the tank 200 through suitable valve systems and hydraulic fittings.

**[0032]** According to the invention, the device 100 for the generation of micro bubbles further comprises a second pump 140 configured to supply a flow of air. The device 100 also comprises a supply conduit 141 connected at one end to an outlet of the second pump 140 and at the opposite end to the first stage 111a of minimum prevalence of multistage pumping unit 111 of the first

pump 110. The second pump 140 may for example be a membrane type pump, that features a particularly simple and cheap structure, or an equivalent thereof.

[0033] The flow of air fed by the second pump 140 to the first stage 111a of the multistage pumping unit 111 is mixed with the water coming from the suction pipe 120 and, as a result of the swirling motion caused by the impellers of the multistage pumping unit 111, micro bubbles are progressively generated. The micro bubbles are discharged together with the water from the stage 111b of maximum head of the multistage pumping unit 111 and flow through the discharge pipe 130.

[0034] In other words, the connection of the supply conduit 141 of the second pump 140 to the multistage pumping unit 111 allows to exploit the entire water path inside it for the generation of micro bubbles.

[0035] According to an embodiment of the invention, the discharge pipe 130 is advantageously provided with a flow adjusting means 131, for example a throttling sleeve or a ball valve, which serves to reduce the water flow rate coming out from the stage 111b of maximum head of the multistage pumping unit 111, thereby causing a pressure increase inside it. This enhances the generation of micro bubbles.

[0036] According to an embodiment of the invention, the device for the generation of micro bubbles may advantageously comprise a control system (not shown) configured to manage operation of the second pump 140 intermittently. This feature of the invention allows to avoid accumulation of air in the multistage pumping unit, which would penalize the correct operation of the pump.

[0037] During operation of the device 100, the pump 140 is cyclically activated for a first predetermined time, for example 2 minutes, and then turned off for a second predetermined period of time, for example 30 seconds. Possible excess air within the multistage pumping unit 111 can thus be effectively discharged.

[0038] According to an embodiment of the invention, the conduit 141 of the second pump 140 for feeding the air flow to the pumping unit 111 is advantageously provided with flow intercepting means configured to prevent entry of water into the second pump 140 should water leak out from the multistage pumping group 111.

[0039] Such flow intercepting means can be formed in a simple and economic manner by a siphon 142 arranged above the multistage pumping unit 111 with respect to a vertical direction V.

[0040] Alternatively, the supply conduit 141 a one-way valve may be installed, the one-way valve being arranged so as to allow a fluid flow, i.e. an air flow, only from the second pump 140 to the multistage pumping unit 111.

[0041] As shown in figure 1, the suction pipe 120 is connected to the multistage pumping unit 111 at a lower portion thereof with respect to the vertical direction V, thus allowing to drain by gravity residual water present in the pumping unit 111 of the pump 110 at the end of an operating cycle of the hydrotherapy system, for example when the tank 200 is empty in the operational configura-

tion illustrated.

[0042] Furthermore, in an operative configuration of the hydrotherapy system, such as that shown in figure 1, and with reference to the vertical direction V, the multistage pumping unit 111 is arranged higher than the port 210 connecting the suction pipe 120 to the tank 200. In this way the suction pipe 120 connected to the tank 200 in the longitudinal direction L is slightly inclined downwards in the vertical direction V, thereby allowing to discharge by gravity residual water from the first pump 110 to the tank 200 after it has been emptied, thus allowing complete drain of the first pump 110.

[0043] In the alternative embodiment of the invention shown in figure 2, the device 100 comprises the same components, the only difference being that the stage 111a having a minimum head of the multistage pumping unit 111 is arranged adjacent to the motor 112 of the pump 110, whereas the stage 111b having a maximum head is arranged at a free end of the multistage pumping unit 111 in the longitudinal direction L.

[0044] The invention has hereto been disclosed with reference to preferred embodiments thereof. It will be appreciated that there may be further embodiments based on the same inventive idea as defined by the scope of protection of the claims set out below.

## Claims

1. A device (100) for generating micro bubbles in a hydrotherapy system, said device (100) comprising:

- i) a first pump (110) comprising a multistage pumping unit (111) and a motor (112) operatively connected thereto,
- ii) at least one intake pipe (120) intended to be connected to a water supply;
- iii) at least one discharge pipe (130) intended to be connected to a tub (200) of a hydrotherapy system;

the device being **characterized by** further comprising:

- iv) a second pump (140) configured to generate an air flow;
- v) a supply conduit (141) for supplying said air flow, wherein said supply conduit (141) is connected at one end to an outlet of the pump (140) and at the opposite end to a first stage (111a) of said multistage pumping unit (111) of said first pump (110), said first stage (111a) featuring a minimum head within the multistage pumping unit (111).

2. A device (100) according to claim 1, wherein said second pump is a diaphragm type pump.

3. A device (100) according to claim 1 or 2, wherein said discharge pipe (130) comprises a flow intercepting and regulating member (131).
4. A device (100) according to any one of claims 1 to 3, wherein the supply conduit (141) for feeding the air flow comprises flow intercepting means configured to prevent entry of water into the second pump (140).
5. A device (100) according to claim 4, wherein said flow intercepting means consist of a siphon (142), said siphon (142) being arranged above the pumping unit (111) of the first pump (110) with respect to a vertical direction (V).
6. A hydrotherapy system, said hydrotherapy system comprising a device (100) for the generation of micro bubbles according to any one of claims 1 to 5 and a tub (200), wherein said device (100) is connected to said tub (200) via at least one intake pipe (120) and at least one discharge pipe (130).
7. A hydrotherapy system according to the preceding claim, wherein, with reference to a vertical direction (V), a pumping unit (111) of the device (100) for the generation of micro bubbles is arranged higher than a nozzle (210) connecting said intake pipe (120) to the tub (200).

#### Amended claims in accordance with Rule 137(2) EPC.

1. A device (100) for generating micro bubbles in a hydrotherapy system, said device (100) comprising:
  - i) a first pump (110) comprising a multistage pumping unit (111) and a motor (112) operatively connected thereto,
  - ii) at least one suction pipe (120) intended to be connected to a water supply;
  - iii) at least one discharge pipe (130) intended to be connected to a tub (200) of a hydrotherapy system;

wherein said suction pipe (120) and said discharge pipe (130) are respectively connected to a first stage (111a) of said multistage pumping unit (111) having a minimum head, and to a second stage (111b) of the multistage pumping unit (111) having a maximum head, the device being **characterized by** further comprising:

- iv) a second pump (140) configured to generate an air flow;
- v) a supply conduit (141) for supplying said air

flow, wherein said supply conduit (141) is connected at one end to an outlet of the second pump (140) and at the opposite end to said first stage (111a) of the multistage pumping unit (111) of said first pump (110), whereby air is mixed with the water sucked by the multistage pumping unit (111) along the flow path leading to its stage (111b) of maximum head and micro bubbles are generated and discharged together with the water through the discharge pipe (130).

2. A device (100) according to claim 1, wherein said second pump (140) is a diaphragm type pump.
3. A device (100) according to claim 1 or 2, wherein said discharge pipe (130) comprises a flow intercepting and regulating member (131).
4. A device (100) according to any one of claims 1 to 3, wherein the supply conduit (141) for feeding the air flow comprises flow intercepting means configured to prevent entry of water into the second pump (140).
5. A device (100) according to claim 4, wherein said flow intercepting means consist of a siphon (142), said siphon (142) being arranged above the pumping unit (111) of the first pump (110) with respect to a vertical direction (V).
6. A hydrotherapy system, said hydrotherapy system comprising a device (100) for the generation of micro bubbles according to any one of claims 1 to 5 and a tub (200), wherein said device (100) is connected to said tub (200) via at least one suction pipe (120) and at least one discharge pipe (130).
7. A hydrotherapy system according to the preceding claim, wherein, with reference to a vertical direction (V), a pumping unit (111) of the device (100) for the generation of micro bubbles is arranged higher than a nozzle (210) connecting said suction pipe (120) to the tub (200).

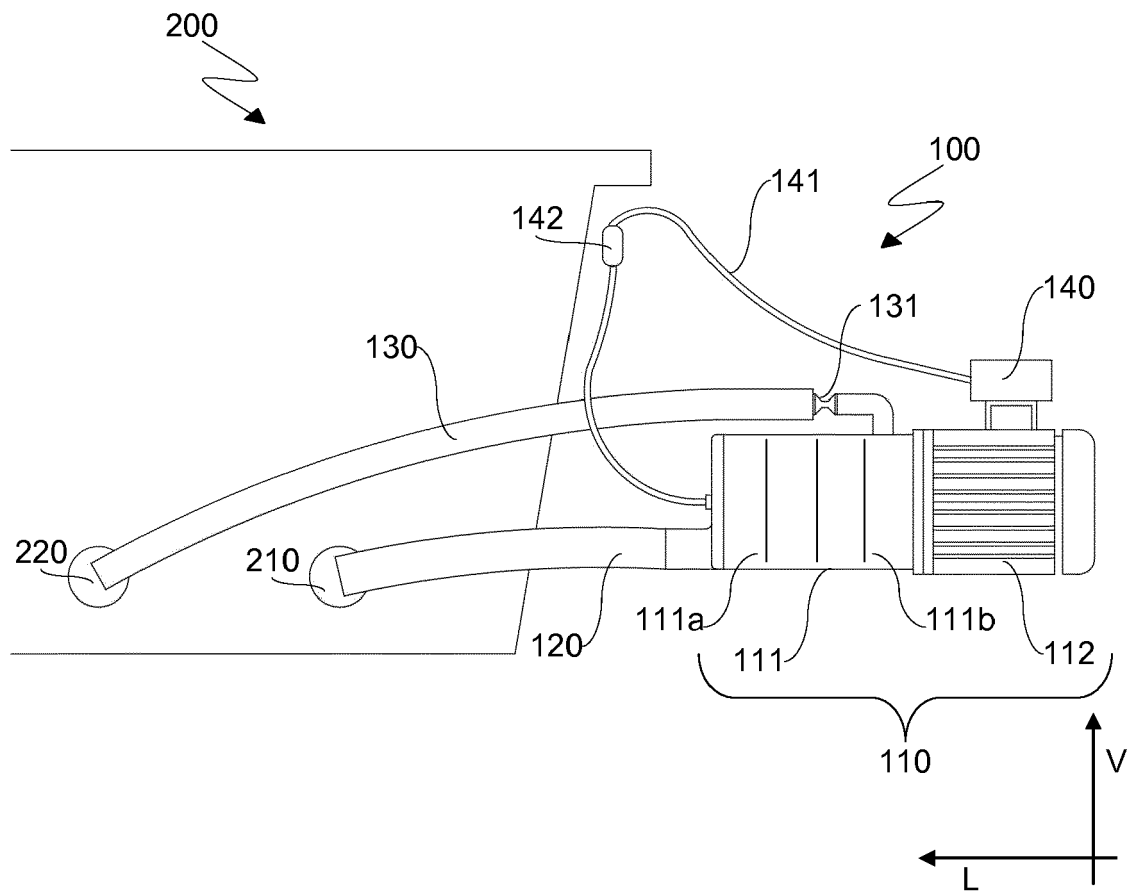


Fig.1

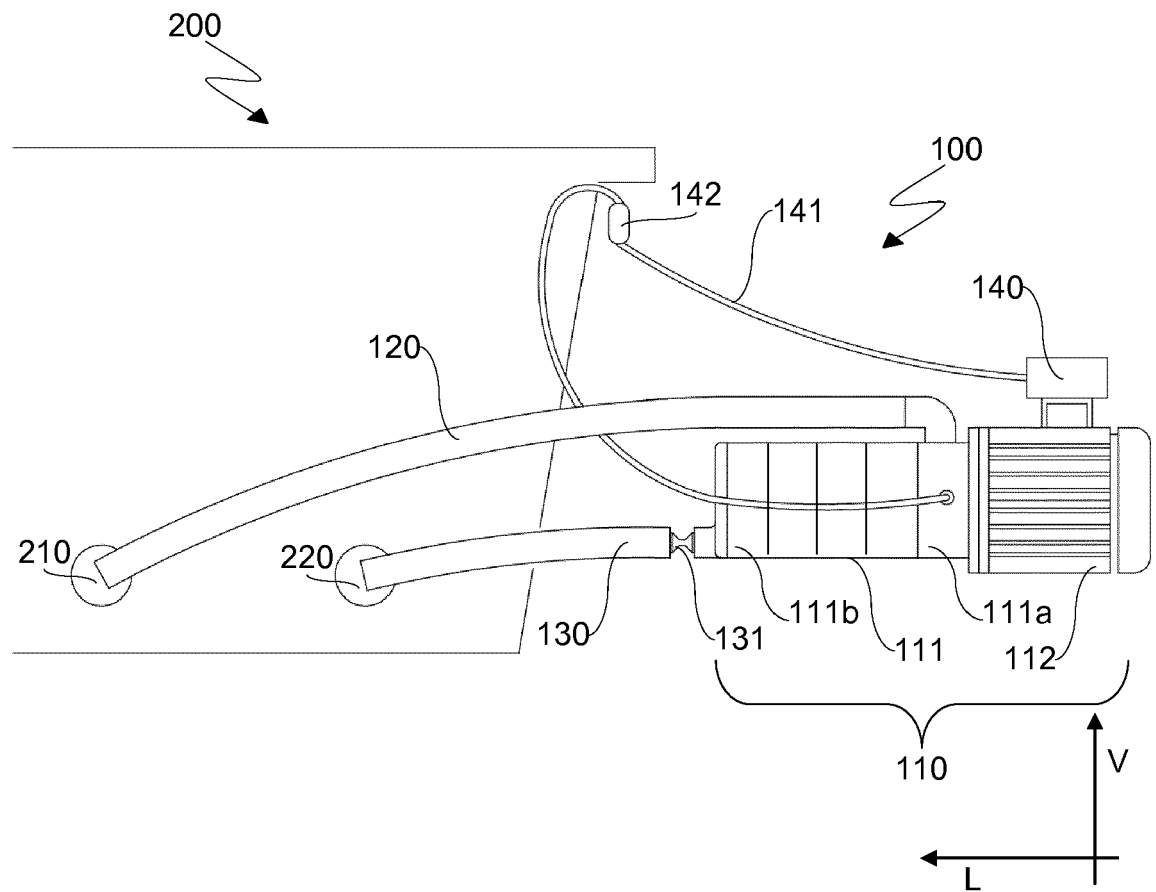


Fig.2



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| DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                    |                                                                                                                                          |                                                                                                                                                                                                                                                                              |                                         |
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| The present search report has been drawn up for all claims                                                                                                                                                                                             |                                                                                                                                          |                                                                                                                                                                                                                                                                              |                                         |
| Place of search<br><b>Munich</b>                                                                                                                                                                                                                       |                                                                                                                                          | Date of completion of the search<br><b>27 January 2017</b>                                                                                                                                                                                                                   | Examiner<br><b>Borrás González, E</b>   |
| CATEGORY OF CITED DOCUMENTS<br>X : particularly relevant if taken alone<br>Y : particularly relevant if combined with another document of the same category<br>A : technological background<br>O : non-written disclosure<br>P : intermediate document |                                                                                                                                          | T : theory or principle underlying the invention<br>E : earlier patent document, but published on, or after the filing date<br>D : document cited in the application<br>L : document cited for other reasons<br>& : member of the same patent family, corresponding document |                                         |



**ANNEX TO THE EUROPEAN SEARCH REPORT  
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