

Description

Field

[0001] The present disclosure relates to a handheld cleaning device. The cleaning device is adapted for cleaning solid objects. The disclosure is applicable in commercial cleaning services.

Background

[0002] It is known to clean surfaces using a wet cloth or sponge, soaked with warm water. When doing so, the user's hands are exposed to cleaning water and/or any contamination, and the water in the cloth or sponge is used up over time and must be manually re-moistened. Furthermore, the temperatures are limited to about 45°C to allow safe operation and drop rapidly during cleaning activity, since no additional heat is provided.

[0003] Another known solution is the use of steam cleaners, which allow cleaning at high temperatures, but require a high amount of energy. Furthermore, steam cleaners are typically bulky devices, require a long heat-up time, and they are connected to the power grid by a fixed power line. This makes their handling time-consuming and energetically inefficient.

Summary

[0004] Disclosed and claimed herein are cleaning devices, base stations for recharging, refilling, and cleaning the devices, and a corresponding use.

[0005] A first aspect of the present disclosure relates to a handheld cleaning device comprising a cleaning pad. A front surface of the cleaning pad is operable for wiping an object. The handheld cleaning device further comprises a droplet generator operable to generate droplets of a liquid and to expose a rear surface of the cleaning pad to the droplets.

[0006] When the droplet generator is in operation, droplets of a liquid are generated, which can include generation of an aerosol or a spray. The droplets then move by their own impulse or Brownian motion in the surrounding gas to the rear surface of the cleaning pad. The cleaning pad is thereby soaked with the liquid. The cleaning pad can thus be soaked evenly with the liquid, so that the moisture of the cleaning pad is comparably uniform.

[0007] In an embodiment, the droplet generator is comprised by a housing of the handheld cleaning device. The housing contains all other parts of the handheld device, and allows handling. The cleaning pad is attached, in particular detachably attached, to the housing. This allows changing cleaning pads after usage. The rear surface of the cleaning pad faces the housing. The housing is preferred to be adapted in size and shape so that a user can operate the handheld device in one hand without touching the cleaning pad when cleaning a surface. This allows using a liquid at a temperature above a tempera-

ture range that is safe for the unprotected user, such as water at temperatures between 45 C and 85 C.

[0008] In a further embodiment, the droplet generator comprises at least one duct for transporting the liquid. The droplet generator may further or alternatively comprise a vibratable member. The vibratable member is preferred to be comprised by the duct, or comprising the duct.

[0009] A vibration of the vibratable member, causes a liquid in contact with it to break up into droplets. By eliminating the need for further moving parts, the device benefits from a simpler construction, a reduced need for maintenance, and a reduced wear on its components.

[0010] In a further embodiment, the droplet generator further comprises a vibration generator. The vibration generator is operable to generate a vibration of the vibratable member. It is preferred that the vibration generator includes a piezoelectric element.

[0011] This setup benefits from low complexity. When the vibration generator is in operation, it generates a vibrating motion of the vibratable member. For example, the vibration generator may be mounted on a support, and the vibratable member may be connected to the vibration generator. Thus, the vibratable member can be shaped independently from any constraints on the shape of the vibration generator. In a further example of the embodiment, an electric energy supply is connected to a first and a second surface of the vibration generator. In a further example, the vibration generator and/or the vibratable member has an annular shape, or comprises a plate with a hole. Thereby, its hole or interior may constitute the duct, which further reduces complexity. Piezoelectric elements are operable to periodically contract and dilate when exposed to a suitable alternate current. They do not require moving mechanical parts for this effect, which further reduces complexity and wear. Furthermore, the system can be miniaturized.

[0012] In a further embodiment, the handheld device further comprises a cavity between the droplet generator and the rear surface of the cleaning pad. The droplet generator is preferably attached to or comprised by an inner wall of the handheld cleaning device that forms a cavity with the rear surface of the cleaning pad.

[0013] The generated droplets can spread within the cavity, so that the droplets are more evenly distributed across the rear surface of the cleaning pad. The cleaning pad is thus more evenly soaked.

[0014] It is preferred that the rate of liquid added to the cleaning pad is constant over time. In particular, it is preferred to adjust the rate of liquid to a typical rate of liquid loss of the sponge when in use for wiping a surface. The cleaning pad is then receiving enough but not too much liquid. The cavity is preferably fully closed, so that the droplets do not leave the handheld device by convection. The liquid comprises preferably a heated water-detergent solution, but may include a mixture of water with one or more disinfectants. The liquid can also transport heat to the cleaning pad. If the cavity is closed, heat loss

by convection is reduced.

[0015] In yet another embodiment, the handheld cleaning device further comprises a tank for a liquid, and the tank is connected with the droplet generator. The tank is preferably comprised by the or a housing of the handheld cleaning device.

[0016] The tank allows operating the handheld device without a hose connecting the handheld device to a water pipe. It is further preferred that the tank is in direct communication with the droplet generator, such that no tubes between tank and droplet generator are needed. The complexity of the device is thereby further reduced. The liquid can then flow from the tank interior to the droplet generator by gravity as long as the handheld device is oriented in space so that at least a part of the cleaning pad is below a droplet generator. In this manner, no further mechanism for liquid transport is needed. It is preferred that the tank is in direct communication to an inlet of a duct comprised in the droplet generator. Thereby, no intermediate ducts are needed. It is further preferred that the handheld device comprises a plurality of droplet generators, each of which is in direct communication with the tank. Thereby, the droplets are spread more evenly across the surface of the cleaning pad, and the device is constructed in an even simpler way.

[0017] In yet another embodiment, the handheld cleaning device further comprises a pump for transporting the liquid from the or a tank to the droplet generator.

[0018] The pump can supply the liquid to the droplet generator when the handheld device is at any orientation. Rather than relying on gravity, a constant supply and pressure of the liquid at the droplet generator can be obtained. The pump may be connected to the or a tank and one or more droplet generators.

[0019] In yet a further embodiment, the droplet generator, in particular the or a duct of the droplet generator, is adapted to prevent flow of the liquid if the droplet generator is not in operation, and/or if the handheld cleaning device is in an off state.

[0020] The duct therefore prevents the liquid from flowing out of the tank when the droplet generator is not in operation. For example, during a storage phase, when the handheld device is not in use, in particular when the vibration generator is not generating vibration, the liquid stays in the tank and no liquid is wasted.

[0021] Preferably, the shape and dimensions of the duct are chosen so that capillary forces prevent the liquid from flowing. A liquid in a capillary is subjected to a Laplace pressure that keeps the liquid in the capillary. This effect counteracts the hydrostatic pressure of the liquid caused by gravity. Thereby, a sufficiently small duct eliminates the need for a valve.

[0022] In yet a further embodiment, the droplet generator comprises at least one nozzle or nebulizer.

[0023] A nozzle can generate droplets at comparably fast rate. Thereby, the cleaning pad can be quickly moistened with the liquid by application of the nozzle. The nozzles can be supplied with the liquid by a pump, which

also avoids relying on gravity. It is further preferable to provide a plurality of droplet generators of two different types, wherein the types comprise a droplet generator with a nozzle and a droplet generator with a vibration generator. Thereby, the droplet generators with the nozzle allow quick moistening of the cleaning pad, including when used in a way that does not allow feeding the droplet generators by gravity, such as when the handheld device is oriented with the cleaning pad at the top. In addition, droplet generators including vibration generators allow for more even wetting of the cleaning pad.

[0024] A nebulizer generates a fog of smaller droplets that spread more in air, thereby allowing a better distribution of the liquid over the cleaning pad.

[0025] In yet another embodiment, the or a tank comprises one or more tank-internal walls that form a plurality of compartments in the tank.

[0026] It is preferred that the tank is divided by one or more tank-internal walls into compartments. The inner walls are arranged between the droplet generators in order to retain a part of the liquid proximate a droplet generator when the handheld device is inclined with respect to the vertical. For example, vertical surfaces can be cleaned this way. Alternatively, the tank-internal walls can either divide only part of the tank into compartments. Then, the effect of retaining the liquid is limited, but the tank can be filled from a single inlet.

[0027] In yet another embodiment, the cleaning pad comprises a sponge.

[0028] Due to its porosity, a sponge has a capillary effect that aids the transport of the liquid both from the rear surface to the front surface, but also across front and rear surfaces to level out any inhomogeneity of the distribution of the moisture in the sponge. A sponge is also highly elastically deformable, so that when using the cleaning device to wipe an uneven surface, or for example, a surface with a corner, the surface is homogeneously cleaned. Materials of the sponge may include polyurethane, natural sponge, microfiber, or other known materials. The sponge may comprise different zones made of different materials, e. g. a scouring pad on top.

[0029] In yet another embodiment, the cleaning pad is removably attached to the handheld cleaning device.

[0030] Removable attachment of the cleaning pad allows changing the cleaning pad, e. g. for rinsing. A set of cleaning pads of different size, shape, and material may allow adapting the handheld device for a plurality of purposes. Preferably, the cleaning pad is attachable using a hook-and-loop fastener. This allows fastening and removing the cleaning pad both when wet and dry. Preferably, the cleaning pad comprises a lid or loop that serves as a handle for easy removal.

[0031] A second aspect of the present disclosure relates to a base station comprising means for refilling the or a tank comprised in the handheld device, and/or means for recharging the or a battery comprised in the handheld device.

[0032] This avoids the need for refilling of the tank or

using a further device, and/or changing the battery or recharging the battery by an additional power supply.

[0033] In an embodiment, the base station further comprises a droplet generator of any of the embodiments of the first aspect of the disclosure. The droplet generator is operable to generate droplets of a liquid and to expose to the droplets at least one surface of a cleaning pad stored in or on the base station.

[0034] This allows exposing both surfaces of a sponge to the droplets. The base station may comprise a surface adapted for exposing the cleaning pad to the droplets when the cleaning pad is positioned on the surface. For example, an upper surface of the base station may comprise a storage area. When the cleaning pad is posed onto the storage area, the cleaning pad is exposed to the cleaning droplets. In another example, the storage area is included in a compartment in the base station.

[0035] The storage area is preferred to comprise a heating device for heating the cleaning pad. This allows killing microorganisms by heat, as well as drying the cleaning pad. The storage area is further preferred to comprise an ultraviolet lamp. This allows exposing the cleaning pad to ultraviolet light, which has germicidal properties. For users' safety and to prevent energy loss, the storage area may be located in a container, for example a drawer. Furthermore, the droplets may comprise a disinfectant.

[0036] A third aspect of the present disclosure relates to a system for cleaning a surface. The system comprises the handheld cleaning device of any of the embodiments of the first aspect, and the base station of any of the embodiments of the second aspect.

[0037] A fourth aspect of the present disclosure relates to a use of the handheld cleaning device or the system of any of the preceding embodiments for cleaning an object.

Brief description of the drawings

[0038] The features, objects, and advantages of the present disclosure will become more apparent from the detailed description set forth below when taken in conjunction with the drawings in which like reference numerals refer to similar elements.

Fig. 1 shows a schematic drawing of a droplet generator;

Fig. 2 shows a cross-section of a handheld cleaning device;

Fig. 3 shows a cross-section of a handheld cleaning device;

Fig. 4 shows a cross-section of a handheld cleaning device;

Fig. 5 shows a view of a handheld cleaning device;

Fig. 6 shows a view of a handheld cleaning device;

Fig. 7 shows a view of a cleaning pad;

Fig. 8 shows a schematic cut-through of base station;

Fig. 9 shows a top view of the base station; and

Fig. 10 shows a flowchart of a method for using the system of base station.

Detailed description of the preferred embodiments

[0039] Fig. 1 shows a schematic drawing of a droplet generator 100 according to an embodiment. The droplet generator 100 of this embodiment comprises a duct 102 leading from a tank 120 to a cavity 122. The tank is adapted for storing a liquid. The droplet generator further comprises a vibratable member 104 and a vibration generator 106 with a first surface 110 and a second surface 112. The vibration generator 106 is connected to a support 108 at the first surface 110 and to the vibratable member 104 at the second surface 112. Operation of the vibration generator 106 causes the vibratable member 104 to vibrate. The vibration generator 106 may, in principle, include any apparatus adapted to create a vibration, such as a mounted unbalanced rotating body. In this embodiment, however, the vibration generator 106 comprises a piezoelectric element, here a piezoelectric crystal, which is more compact and less affected by mechanical wear. A voltage supply 114 is connected to electrodes at the first surface 110 and the second surface 112. The voltage supply 114 is preferred to be a rechargeable battery. However, alternatively, a non-rechargeable swappable battery may be used, thereby eliminating the need for a recharging means. When in operation, the voltage supply 114 may deliver a periodic voltage that causes the piezoelectric element to contract periodically towards the duct, and thereby causes the vibratable member to vibrate.

[0040] A liquid stored in the tank 114 may flow through the duct 102 onto the vibratable member 104. A liquid backing pressure causing this flow is generated as hydrostatic pressure, when the droplet generator is oriented such that the tank is above the droplet generator.

[0041] When the vibration generator 106 is not in operation, the capillary force inside the duct holds the liquid in position for a sufficiently narrow duct. The duct 102 is thereby adapted to prevent flow when the vibration generator 106 is not in operation. In case the liquid backing pressure is lower than the Laplace pressure, the liquid is held in place by the capillary force as long as the vibration generator 106 is not in operation.

[0042] When the vibration generator 106 is in operation, the surface of the liquid is broken up and droplets exit the duct. Thereby, an aerosol is generated in the cavity 122. The liquid continues to be supplied from the tank.

[0043] In this embodiment, the vibratable member 106 is a metal plate. However, other forms are possible. For example, a plate with a plurality of holes can be used, so that each hole forms a single duct. This allows creating larger volumes of aerosol at a time. Also, the vibration generator could have, e. g. an annular form and be oriented to allow a vibration from and to the cavity 122, rather than laterally. Furthermore, the size of the holes

and the vibration frequency and amplitude of the vibration generator can be adjusted to control the amount of aerosol generated by varying these parameters and determining the amount of used liquid in the tank.

[0044] Fig. 2 shows a cross-section of a handheld cleaning device 200 according to a first embodiment. The handheld cleaning device comprises a cleaning pad 202. The front surface 204 of the cleaning pad 202 is oriented towards the exterior of the handheld cleaning device 200 and can be used for wiping an object. The rear surface 206 of the cleaning pad 202 is oriented towards the droplet generators 234, 236, so that droplets of a liquid generated by the droplet generators 234, 236 can impinge on the rear surface. Capillary forces in the cleaning pad 202 can then transport the liquid in any direction through the cleaning pad 202, including towards and across the front surface 204. In this embodiment, the cleaning pad 202 comprises a polyurethane sponge 208 and a scouring pad 210. Use of a sponge is preferred because a sponge allows elastic deformation under pressure. When used for wiping an uneven surface, the deformation facilitates wiping of rough parts and edges of the surface.

[0045] The cleaning pad 202 is removably attached to the handheld cleaning device 200. In this embodiment, a first hook-and-loop attachment part 212, on the cleaning pad 202, with a corresponding second hook-and-loop attachment part 214 on the cleaning device 200, is used. A hook-and-loop attachment allows easily attaching the cleaning device, so that a user has only limited contact with the cleaning pad, and liquid on the cleaning pad.

[0046] The rear surface 206 of the sponge is oriented towards the cavity 230. The cavity 230 is formed by the rear surface of the cleaning pad 202 and the inner wall 232 of the cleaning device. Droplets, in particular an aerosol, generated by the droplet generators 234, 236, move through the cavity 230 and impinge on the rear surface 206 of the cleaning pad. Smaller droplets are moved through the air in the cavity 230 by Brownian motion and spread within the cavity 230 in all directions, especially across the rear surface of the cleaning pad. Thereby, the cleaning pad is more evenly soaked with the liquid, because the liquid is distributed already in the cavity 230 in the form of droplets.

[0047] The handheld device further comprises a tank 238 for storing the liquid. The tank 238 is in direct communication to the droplet generators 234, 236 so that the liquid is supplied without the need for any more ducts. The tank 238, as shown, comprises a plurality of tank-internal walls 240, 242, which split the tank 238 into a plurality of compartments. The tank-internal walls 240, 242 are substantially parallel, and they cover only a part of the tank 238. When the cleaning device is oriented in space so that the cleaning pad is horizontal and the front surface 204 is oriented downwards, the tank-internal walls 240, 242 are substantially vertical. This allows filling the tank 238 from one filling valve 216, so that all compartments are filled. To allow also removing liquid from the tank, such as to exchange the liquid, a tube 218 and

a backflow valve 220 provide a second connection. The filling valve 216 and the backflow valve 220 allow connection to corresponding external ducts for filling and/or flushing the tank after removal of the cleaning pad. They are covered by the attached cleaning pad to prevent exposure and contamination with dirt and accidental damaging when wiping uneven surfaces. Their positions are adapted to allow connection to corresponding ducts when the handheld device is placed on a base station.

[0048] When a user is using the handheld device for wiping a surface, the liquid in the tank 238 is transported by gravity towards the droplet generators 234, 236. The liquid will diminish as more and more of the liquid is converted into droplets and sent to the cleaning pad. If, at a time where the tank 238 is filled only in part, the user is wiping an inclined surface, then the tank-internal walls 240, 242 retain a part of the liquid in each of the compartments, and thereby the liquid stays available at the droplet generators 234, 236 in the respective compartment. If, in an alternative embodiment, there are no tank-internal walls, the liquid flows to the lowermost part of the tank, and the liquid is only available at any droplet generators in that part of the tank, so that the cleaning pad can still be moistened, but the humidity is distributed more unevenly.

[0049] In alternative embodiments, the tank-internal walls 240, 242 can cover the entire tank 238 to increase the available liquid. Then, a plurality of filling valves is required to fill each of the compartments.

[0050] The droplet generator is connected to a rechargeable battery 222, to allow cordless use of the handheld device. The rechargeable battery 222 may be recharged when the handheld device is connected to a base station using an inductive charging area 224 that allows receiving energy by inductive coupling, thereby avoiding the need for electric contacts which may corrode.

[0051] The droplet generators 234, 236 may be switched on and off using a control button 226. The electric components are controlled by a control unit 228 and connected by wiring (dashed lines). The handheld device is disposed in a housing 244, which holds the other components and allows handling without the need to touch the cleaning pad 202. In alternative embodiments, instead of a control button 226, a motion sensor is used that sends a control signal to the control unit 228 when the handheld device is in motion, so that a user need not operate a control button. In response, the control unit 228 activates the droplet generators as long as the handheld device is in motion. In further alternative embodiments, the droplet generators are continuously in operation, further simplifying the handheld device.

[0052] The embodiment is adapted for and was tested with water as a liquid, at temperatures between 20 C and 85 C. No temperature dependence was found.

[0053] Fig. 3 shows a cross-section of a handheld cleaning device 300 according to a second embodiment.

[0054] The handheld cleaning device 300 comprises

a cleaning pad 302 with a front surface 304, a rear surface 306, a sponge 308, a scouring pad 310, and hook-and-loop attachments 312, 314, similarly to the embodiment of Fig. 2.

[0055] In addition and similarly to Fig. 2, the handheld cleaning device 300 comprises a filling valve 316, a tube 318, a backflow valve 320, a rechargeable battery 322, an inductive charging area 324, a control button 326, a control unit 328, and a housing 342.

[0056] However, in difference to the embodiment of Fig. 2, this embodiment does not have a cavity. Rather, the cleaning pad 302 is directly attached to the inner wall 330. The droplets are thus sent locally to the cleaning pads, at the locations proximate the droplet generators. Capillary forces in the cleaning pad can then spread the liquid across the cleaning pad. This allows a user to apply more force by the handheld device onto the cleaned surface, because the cleaning pad is supported by the inner wall 330 over most of its area. Furthermore, the hook-and-loop attachment parts 312, 314 can be larger to better hold the cleaning pad.

[0057] Fig. 4 shows a cross-section of a handheld cleaning device 400 according to a second embodiment.

[0058] The handheld cleaning device 400 comprises a cleaning pad 402 with a front surface 404 and a rear surface 406 and hook-and-loop attachments 412, 414, similarly to the embodiment of Fig. 2. However, the cleaning pad is only made of one layer made of microfiber material. This allows for a softer cleaning pad that better adapts to irregular surface forms of the cleaned objects.

[0059] The droplet generators 434, 436, are nozzles rather than piezoelectric vaporizers. They are connected to the tank 438 via a pump 426 which moves and pressurizes the liquid through a duct 428 to the droplet generators 426, 428. This allows faster generation of droplets, and also generation of droplets when the handheld device is oriented with the cleaning pad on top, i. e. for cleaning a ceiling. The droplets can spread through cavity 432 and are thus distributed across the rear surface 406 of the cleaning pad 402.

[0060] In addition and again similarly to Fig. 2, the handheld cleaning device 400 comprises a filling valve 412, a tube 414, a backflow valve 416, a rechargeable battery 418, an inductive charging area 420, a control button 422, a control unit 424, and a housing 440.

[0061] In a different embodiment (not shown), both types of the droplet generator can be combined in one handheld device.

[0062] Fig. 5 shows a view of a handheld cleaning device 500 according to an embodiment, shown from the side opposite the cleaning pad. The handheld cleaning device 500 comprises a control button 502 that is operable to start or stop operation of the droplet generators.

[0063] Fig. 6 shows a view of a handheld cleaning device 600 according to an embodiment, shown at the side at which the cleaning pad is attachable. The cleaning pad itself is not shown. The handheld device comprises three droplet generators 602. The handheld device further

comprises a filling valve 604 and a backflow valve 606. The hook-and-loop attachment 608, indicated by the dotted area, allows attaching a cleaning pad.

[0064] Fig. 7 shows a view of a cleaning pad 700 according to an embodiment. The cleaning pad 700 is shown from the side at which it is attachable to the handheld cleaning device. The cleaning pad 700 comprises a hook-and-loop attachment area 702, which allows attaching to the handheld cleaning device, and is adapted to work together with the hook-and-loop attachment 608 of the handheld cleaning device. The area 704 between the hook-and-loop attachment area is configured to receive the droplets, so that the liquid can spread across and through the cleaning pad to the front. The lid 706 allows removing and handling the cleaning pad without touching the possibly wet and dirty cleaning pad itself.

[0065] Fig. 8 shows a schematic cut-through of base station 800 according to an embodiment. Fig. 9 shows a top view of the base station.

[0066] The base station 800 can serve as storage and charging station for the handheld device without the cleaning pad. It can further allow setting the temperature of the liquid by providing pre-heated liquid to the handheld device. It is powered by a fixed power line 802, controlled by a control unit 804, connected to the other components by electric connections 826, and contains on its top side a user interface area 806 containing an on/off button, a fill button and a status indicator. A handheld device can be connected to the base station 800 by storing it at the docking area 808 of the base station 800.

[0067] The base station 800 comprises means for refilling the tank of the handheld device. The means include a tank 810 of the base station 800, which in turn can be filled via opening 812. The tank 810 is connected via ducts 824 to a pump 814 and a heating element 816 that directs the liquid to the handheld device. A station fill valve 818 allows flow to the handheld device only when open. In case the tank of the handheld device is full, a backflow mechanism in the handheld device can send part of the liquid back to the base station. The base station receives this part of the liquid at a backflow valve 820, so that the liquid flows back to the tank 810 of the base station. This way, the handheld device, and a tank therein, can be flushed so that liquid in the handheld device is replaced. This is advantageous in case the base station comprises a heating element to heat the liquid, and the handheld device comprises no means for heating the liquid. Then, cold liquid in the handheld device can be replaced by heated liquid from the base station. Also, hot liquid may be replaced by cooler liquid in case the user sets, at the user interface area 806, a lower temperature compared to the temperature of the liquid in the tank. The control unit 804 is configured to receive an input from a button on the user interface area 806 indicating that the handheld device should be refilled. The control unit 804 further receives an indication from the inductive charging area 822 that the handheld cleaning device is charging, thus indicating that the handheld cleaning de-

vice is positioned correctly on the docking area 806. If these two signals are received, the control unit 804 opens the fill valve 818 and activates pump 814 and heating element 816. The user interface area 806 may include further control elements, including a temperature selector to determine the temperature to which the liquid is to be heated.

[0068] The station also includes means for recharging the battery of the handheld device. These means comprise the power line 802 and an inductive charging area 822, which is opposite an inductive charging area of the handheld device when the handheld device is attached to the base station, i. e. positioned on the docking area 808. This allows charging the battery without need for any electric contacts, which may corrode. Furthermore, the inductive charging area 822 acts as a position detector by indicating to the control unit 804 whether the handheld cleaning device is connected, so that the control unit 804 is aware of presence or absence of the handheld cleaning device. The base station is integrated into housing 828.

[0069] Optionally, a base station may comprise means for moistening, heating and/or cleaning the handheld device. In particular, the storage area may comprise one or more droplet generators and an inner wall that is formed similarly to those of the handheld cleaning device. Thereby, the cleaning pad can be pre-wetted, so that the handheld device is ready for usage without delay. In this case, the docking area of the base station is adapted to receive the handheld device with the cleaning pad. Alternatively, the base station may comprise a cleaning pad holder, which is preferred to be integrated into housing 828. For example, a tray for storing a cleaning pad can be integrated.

[0070] Furthermore, a cleaning pad heating device can heat and dry the cleaning device, and kill microorganisms (e. g. germs, bacteria) by heat. In another example, the base station may comprise an ultraviolet lamp and/or a further heating element that is activated by the control unit 804 when presence of a handheld device is detected. This allows disinfecting a cleaning pad. The storage area is then preferred to be integrated into the housing 828 and/or a drawer to avoid exposing users to ultraviolet radiation or gases.

[0071] Fig. 10 is a flowchart of a method 900 for using the system of base station, handheld device and cleaning pad, as executed by a user of the system.

[0072] At step 902, the power line 802 is plugged in to provide electric energy to the system. At step 904, the tank 810 of the base station is filled with a liquid through the inlet opening 812. At step 906, the device is switched on using a power button, e. g. on the user interface area 806. This causes the heating element 816 to preheat. It is thereby ready for starting a refilling operation. At step 908, the handheld device is placed at the docking area. The base station begins recharging the battery of the handheld device, using inductive charging area 822 and the corresponding inductive charging area of the hand-

held device. At step 910, the user pushes a fill button at the user interface 806, giving an input to the base station 800 to begin filling the tank. The control unit 804 receives the input and a signal from the inductive charging area 822 indicating that the handheld device is correctly placed. In response, the control unit opens the station fill valve 818 and activates pump 814 to fill the tank of the handheld device. If there is leftover liquid in the tank of the handheld device, it will flow back to the base station via the backflow valve 820 and into the tank. The base station continues pumping liquid into the handheld device until the user pushes the fill button again to stop the filling process, or until a predetermined time has elapsed. This time can be chosen to correspond to the time it takes to fill the tank of the handheld device. Thereby, the tank is completely filled, and any remaining liquid present before beginning filling, is replaced. This allows replacing the cold liquid in the handheld device by pre-heated liquid. A status indicator, e. g. a light-emitting diode, on the user interface area, indicates the end of the filling process to the user. At step 912, the user removes the handheld device from the docking area and attaches a cleaning pad onto the handheld device. At step 914, the user pushes the control button 502 of the handheld device to initiate droplet generation by the droplet generators, so that the cleaning pad is moistened. At step 916, the user wipes an object using the handheld device. The cleaning pad is re-moistened if the user pushes the control button on the handheld device. At step 918, the user removes the cleaning pad and cleans it. At step 920, the user places the handheld device on the docking area 808.

Reference signs

[0073]

100	Droplet generator
102	Duct
104	Vibratable member
106	Vibration generator
108	Support
110	First surface
112	Second surface
114	Voltage supply
116, 118	Electric connections
120	Tank
122	Cavity
124	Inner wall
200	Handheld cleaning device
202	Cleaning pad
204	Front surface
206	Rear surface
208	Sponge
210	Scouring pad
212	First hook-and-loop attachment
214	Second hook-and-loop attachment
216	Handheld device filling valve

218 Tube
 220 Handheld device backflow valve
 222 Rechargeable battery
 224 Inductive charging area
 226 Control button
 228 Control unit
 230 Cavity between inner wall and rear surface
 232 Inner wall
 234, 236 Droplet generators
 238 Tank
 240, 242 Tank-internal walls
 244 Housing

 300 Handheld cleaning device
 302 Cleaning pad
 304 Front surface
 306 Rear surface
 308 Sponge
 310 Scouring pad
 312 First hook-and-loop attachment
 314 Second hook-and-loop attachment
 316 Handheld device filling valve
 318 Tube
 320 Handheld device backflow valve
 322 Rechargeable battery
 324 Inductive charging area
 326 Control button
 328 Control unit
 330 Inner wall comprising droplet generator
 332, 334 Droplet generators
 336 Tank
 338, 340 Tank-internal walls
 342 Housing
 400 Handheld cleaning device
 402 Cleaning pad
 404 Front surface
 406 Rear surface
 408 First hook-and-loop attachment
 410 Second hook-and-loop attachment
 412 Handheld device filling valve
 414 Tube
 416 Handheld device backflow valve
 418 Rechargeable battery
 420 Inductive charging area
 422 Control button
 424 Control unit
 426 Pump
 428 Duct
 430 Inner wall comprising droplet generator
 432 Cavity between inner wall and rear surface
 434, 436 Droplet generators
 438 Tank
 440 Housing

 500 Handheld cleaning device
 502 Control button

 600 Handheld cleaning device

502 Droplet generators
 504 Filling valve
 506 Backflow valve
 508 Hook-and-loop attachment

 700 Cleaning pad
 702 Hook-and-loop attachment area
 704 Area
 706 Lid

 800 Base station
 802 Power line
 804 Control unit
 806 User interface area
 808 Docking area
 810 Tank
 812 Opening
 814 Pump
 816 Heating element
 818 Station fill valve
 820 Backflow valve
 822 Inductive charging area
 824 Ducts
 826 Electric connections
 828 Housing

 900 Method for using the system
 902-920 Steps of method 900

Claims

1. A handheld cleaning device comprising:
 - a cleaning pad (202, 302, 402, 700), wherein a front surface (204, 304, 404) of the cleaning pad (202, 302, 402, 700) is operable for wiping an object, and
 - a droplet generator (100, 234, 236, 332, 334, 434, 436, 602) operable to generate droplets of a liquid and to expose a rear surface (206, 306, 406) of the cleaning pad (202, 302, 402, 700) to the droplets.
2. The handheld cleaning device of claim 1, wherein the droplet generator (100, 234, 236, 332, 334, 434, 436, 602) is comprised by a housing (244, 342, 440, 828) of the handheld cleaning device, wherein the cleaning pad (202, 302, 402, 700) is attached, in particular detachably attached, to the housing (244, 342, 440, 828), wherein the rear surface (206, 306, 406) of the cleaning pad (202, 302, 402, 700) faces the housing (244, 342, 440, 828).
3. The handheld cleaning device of claim 1 or 2, wherein the droplet generator (100, 234, 236, 332, 334, 434, 436, 602) comprises:

at least one duct (102) for transporting the liquid, and/or
a vibratable member (104), in particular comprised by or comprising the duct (102).

4. The handheld cleaning device of claim 3, wherein the droplet generator (100, 234, 236, 332, 334, 434, 436, 602) further comprises a vibration generator (106) operable to generate a vibration of the vibratable member (104), in particular wherein the vibration generator (106) includes a piezoelectric element.
5. The handheld cleaning device of any of the preceding claims, further comprising a cavity (122, 230, 432) between the droplet generator (100, 234, 236, 332, 334, 434, 436, 602) and the rear surface (206, 306, 406) of the cleaning pad (202, 302, 402, 700), in particular wherein the droplet generator (100, 234, 236, 332, 334, 434, 436, 602) is attached to or comprised by an inner wall (124, 232, 330, 430) of the handheld cleaning device that forms a cavity (122, 230, 432) with the rear surface (206, 306, 406) of the cleaning pad (202, 302, 402, 700).
6. The handheld cleaning device of any of the preceding claims, further comprising a tank (120, 238, 336, 438) for a liquid, wherein the tank (120, 238, 336, 438) is connected with the droplet generator (100, 234, 236, 332, 334, 434, 436, 602), in particular wherein the tank (120, 238, 336, 438) is comprised by the or a housing (244, 342, 440, 828) of the handheld cleaning device.
7. The handheld cleaning device of any of the preceding claims, further comprising a pump (426, 814) for transporting the liquid from the or a tank (120, 238, 336, 438) to the droplet generator (100, 234, 236, 332, 334, 434, 436, 602).
8. The handheld cleaning device of any of the preceding claims, wherein the droplet generator (100, 234, 236, 332, 334, 434, 436, 602), in particular the or a duct (102) of the droplet generator (100, 234, 236, 332, 334, 434, 436, 602), is adapted to prevent flow of the liquid if the droplet generator (100, 234, 236, 332, 334, 434, 436, 602) is not in operation and/or if the handheld cleaning device is in an off state.
9. The handheld cleaning device of any of the preceding claims, wherein the droplet generator (100, 234, 236, 332, 334, 434, 436, 602) comprises at least one nozzle or nebulizer.
10. The handheld cleaning device of any of the preced-

ing claims, wherein the or a tank (120, 238, 336, 438) comprises one or more tank (120, 238, 336, 438)-internal walls (240, 242, 338, 340) that form a plurality of compartments in the tank (120, 238, 336, 438).

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11. The handheld cleaning device of any of the preceding claims, wherein the cleaning pad (202, 302, 402, 700) comprises a sponge (208, 308); and/or wherein the cleaning pad (202, 302, 402, 700) is removably attached to the handheld cleaning device.
12. A base station for a handheld cleaning device of any of the preceding claims, the base station (800) comprising:
 - means for refilling the or a tank (120, 238, 336, 438) comprised in the handheld device, and/or
 - means for recharging the or a battery comprised in the handheld device.
13. The base station of claim 12, comprising a droplet generator (100, 234, 236, 332, 334, 434, 436, 602), in particular a droplet generator (100, 234, 236, 332, 334, 434, 436, 602) of any of the preceding claims, wherein the droplet generator (100, 234, 236, 332, 334, 434, 436, 602) is operable to generate droplets of a liquid and to expose to the droplets at least one surface of a cleaning pad (202, 302, 402, 700) stored in or on the base station (800).
14. A system for cleaning a surface, the system comprising the handheld cleaning device of any of claims 1-11 and the base station (800) of claim 12 or 13.
15. A use of the handheld cleaning device or the system of any of the preceding claims for cleaning an object.

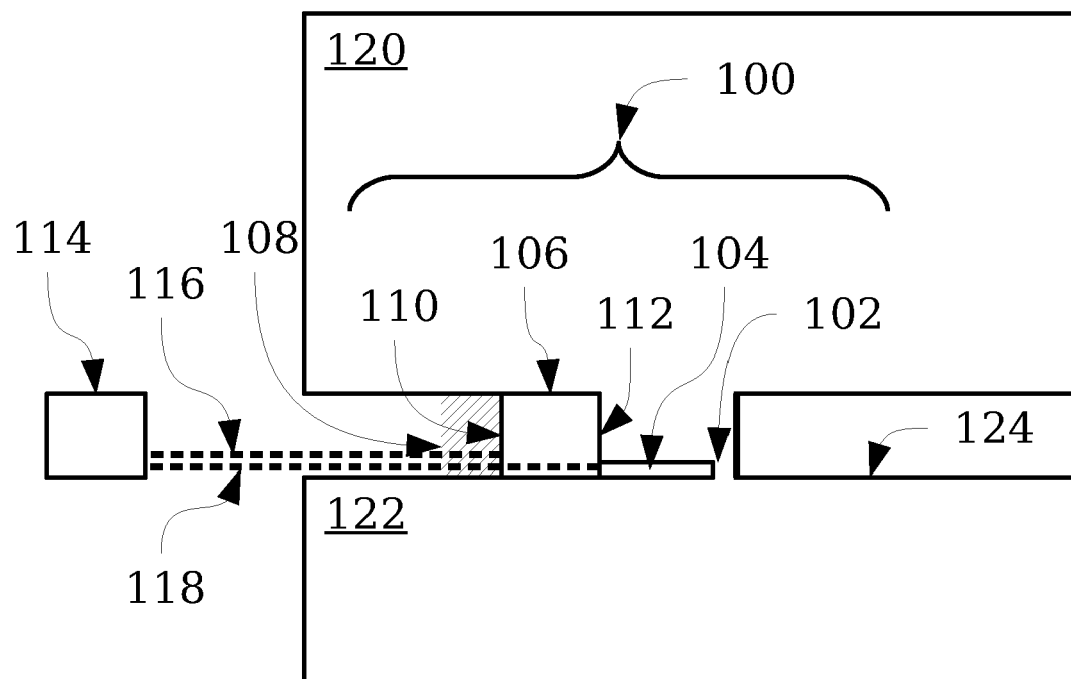


Fig. 1

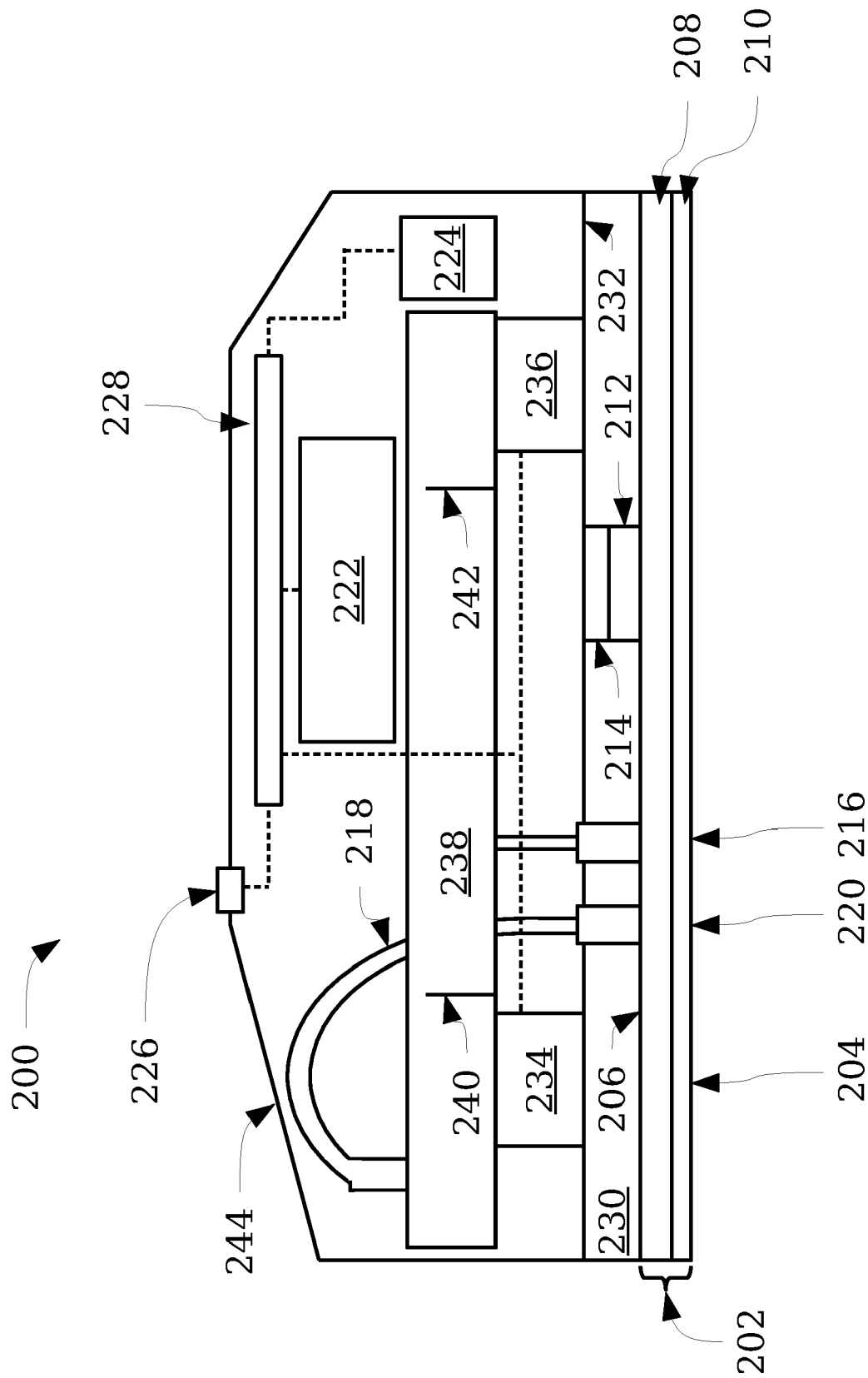


Fig. 2

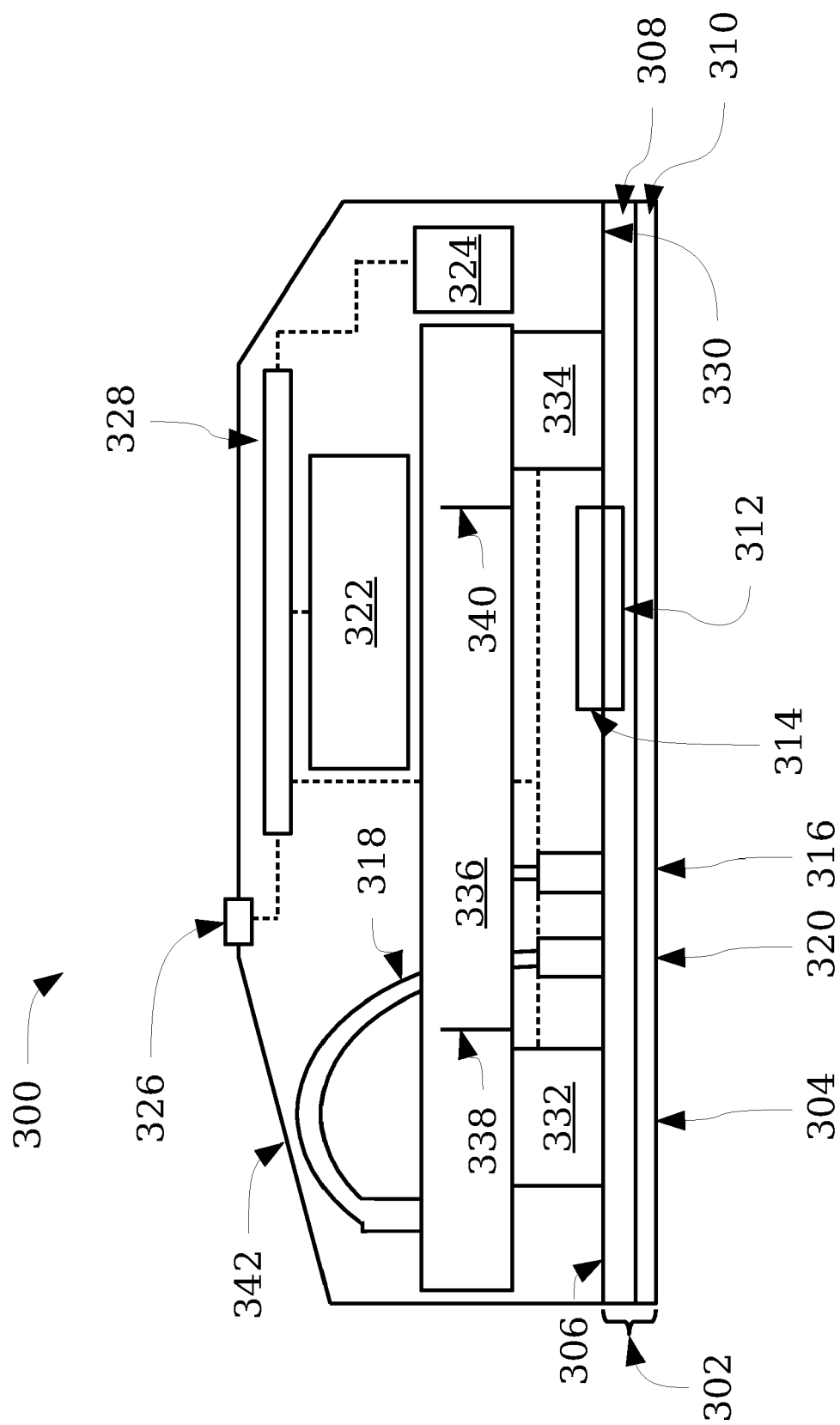


Fig. 3

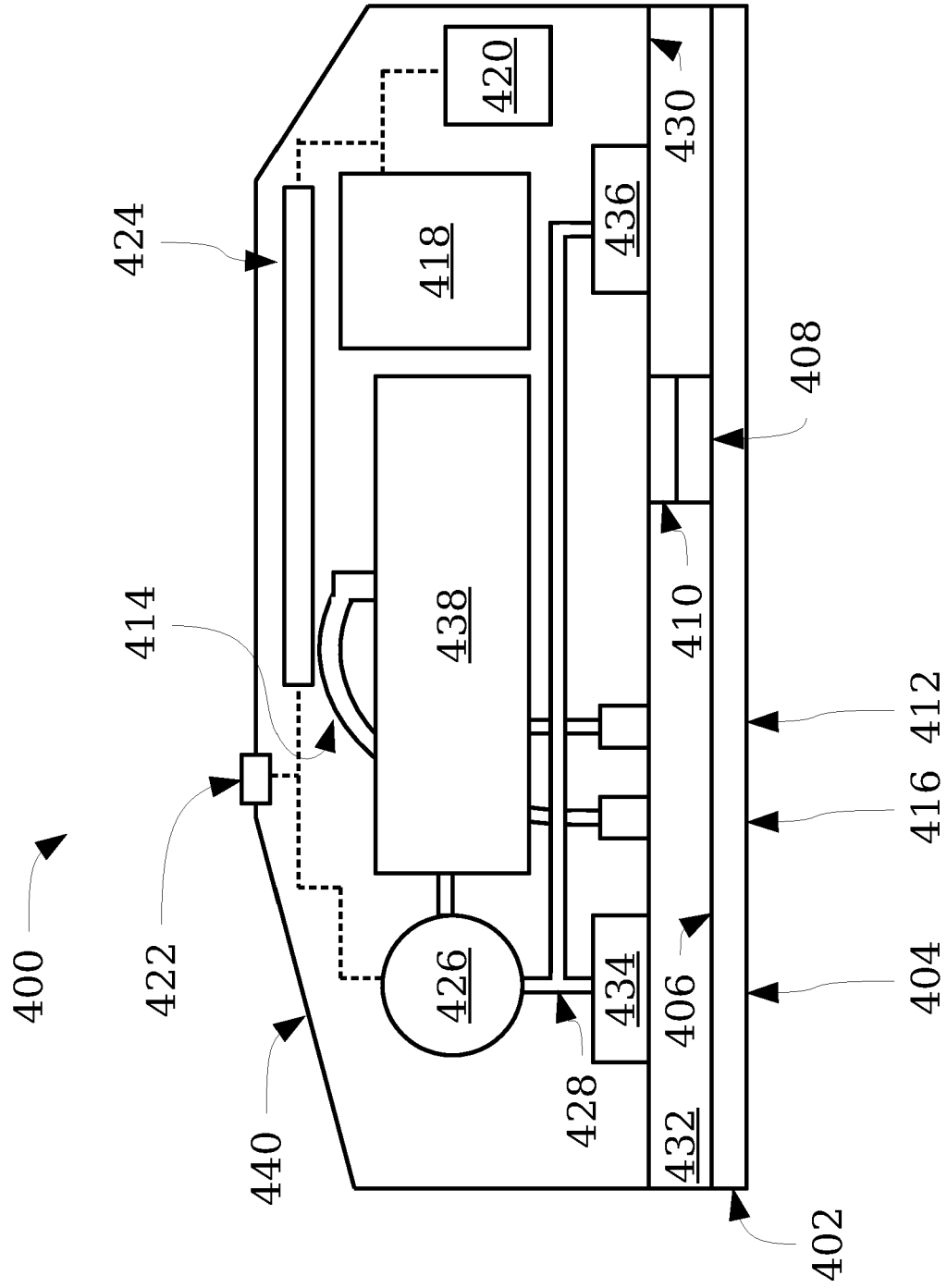


Fig. 4

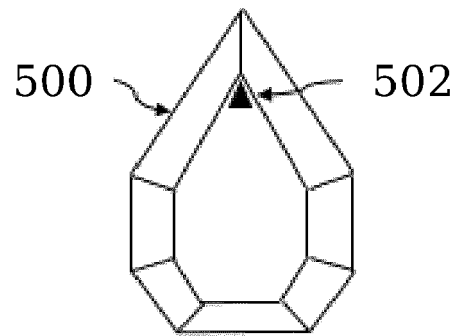


Fig. 5

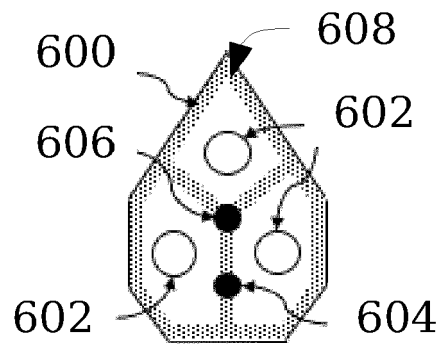


Fig. 6

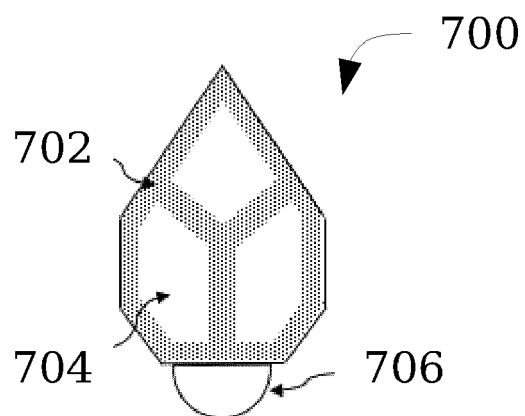


Fig. 7

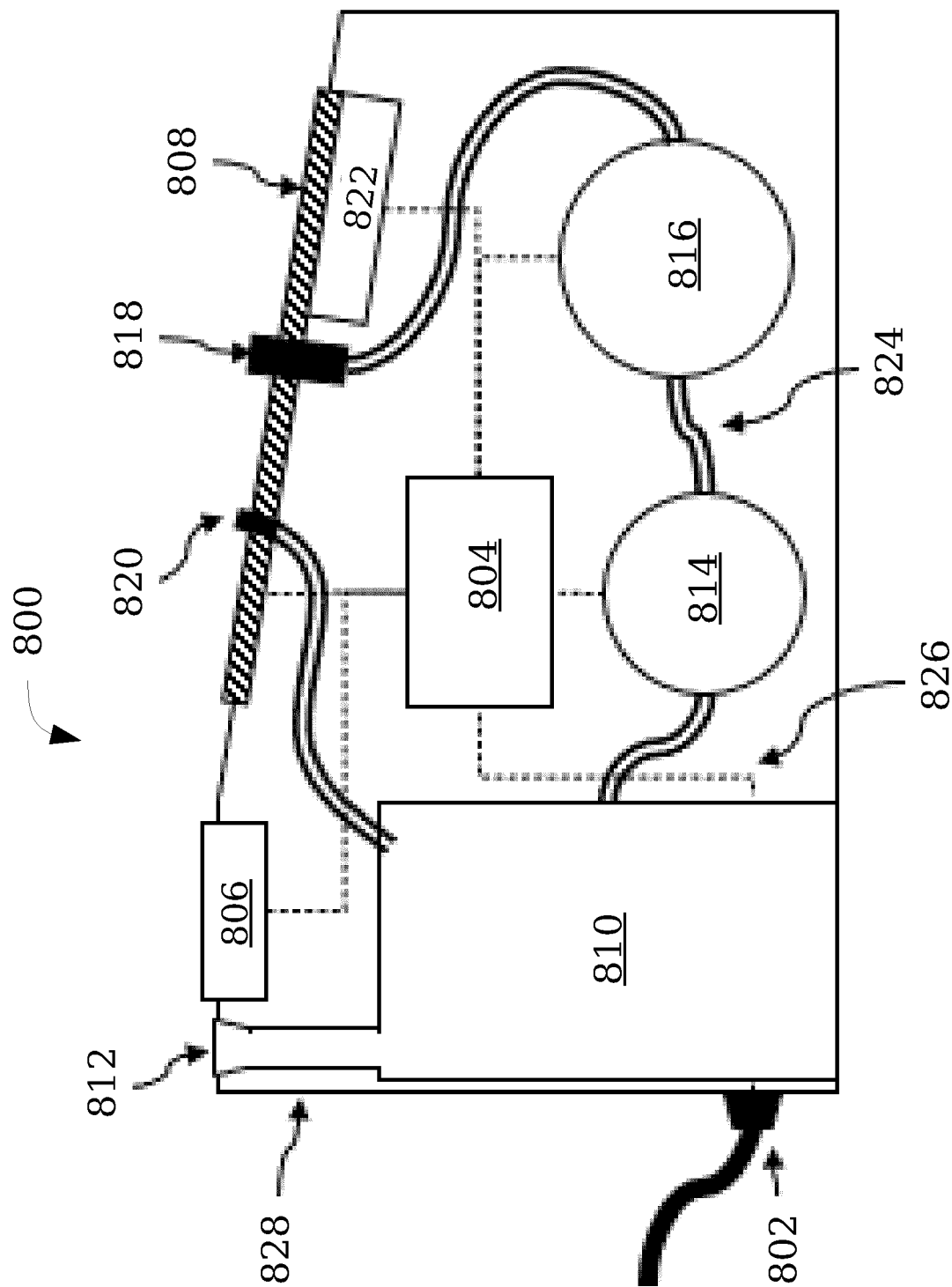


Fig. 8

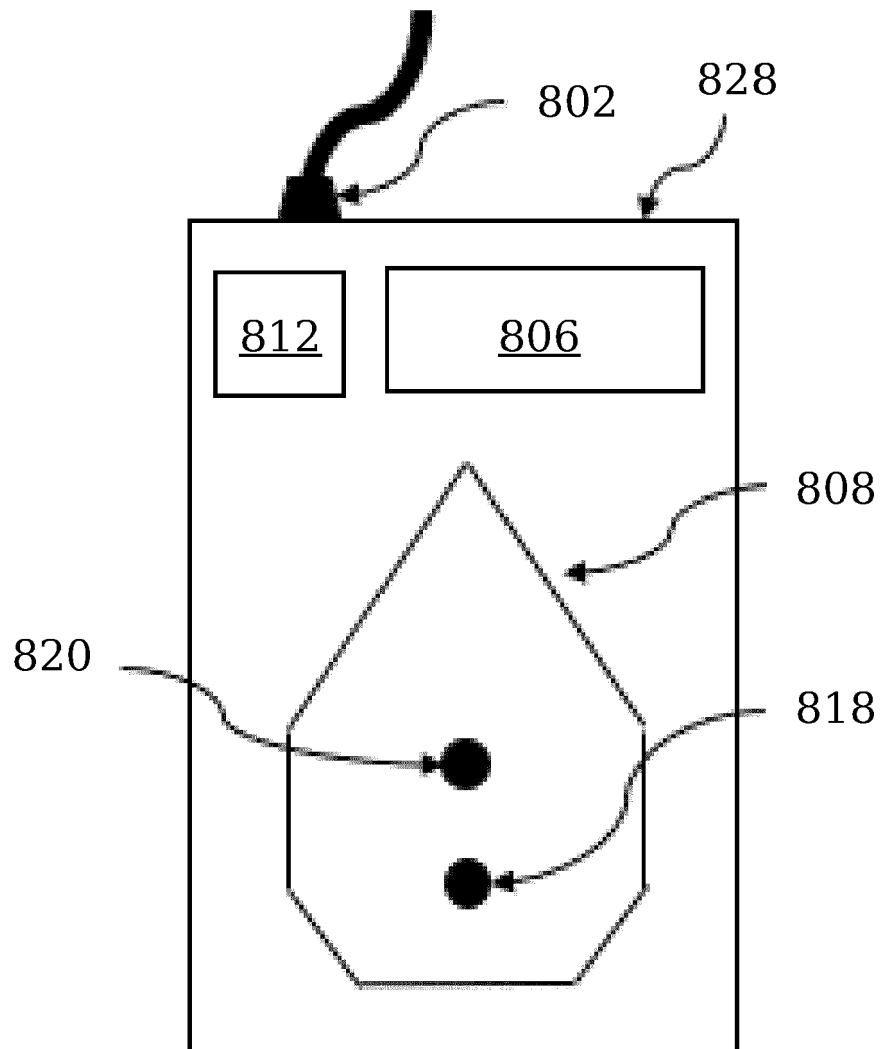
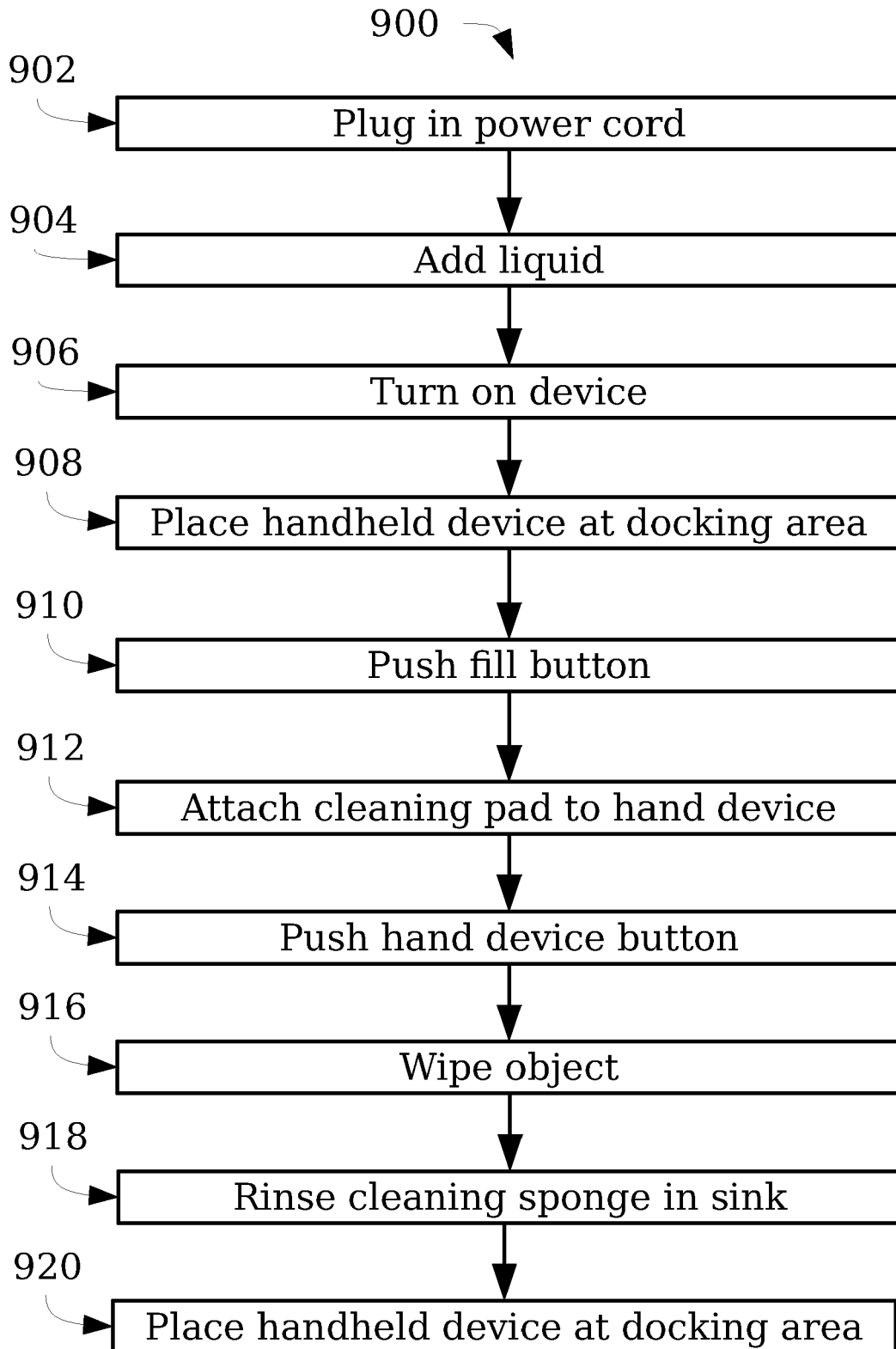


Fig. 9

**Fig. 10**



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Application Number

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Place of search Munich		Date of completion of the search 10 February 2023	Examiner Hubrich, Klaus
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