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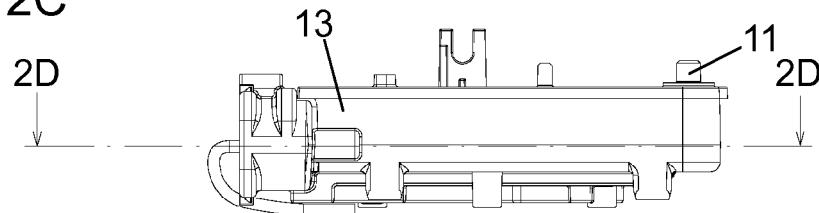
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(54) **HEATING DEVICE, AND SANITARY WASHING DEVICE AND EQUIPMENT USING SAME**

(57) A heating device is provided with housing (13) which has inlet port (11) and outlet port (12), heat exchange flow path (24) which communicates with inlet port (11), and heater (23) which heats fluid inside heat exchange flow path (24). The heating device is further provided with temperature buffer part (25) which communicates with outlet port (12) and one or more through holes (21) which allow heat exchange flow path (24) and temperature buffer part (25) to communicate with each other.

Heat exchange flow path (24) guides the fluid flowing in through inlet port (11) and allows the fluid after being heated to flow into temperature buffer part (25) through holes (21), and temperature buffer part (25) guides the fluid flowing in through through holes (21) to outlet port (12). Accordingly, the heating device capable of allowing the fluid having a uniform temperature to flow out is achieved.

FIG. 2C



Description

TECHNICAL FIELD

[0001] The present invention relates to a heating technique, and more particularly, to a heating device, and a sanitary washing device and equipment using the same.

BACKGROUND ART

[0002] Conventionally, in a so-called instantaneous heat exchanger provided in, for example, a sanitary washing device, when there is uneven heating in warm water emitted from the heat exchanger, a temperature of water to be jetted from a washing nozzle is stabilized before jetting. This enables a user to comfortably and safely perform washing. Specifically, a temperature stabilizer is provided between an emission part of the heat exchanger and the washing nozzle for absorbing temperature nonuniformity. There are disclosed sanitary washing devices that prevent washing water having temperature nonuniformity from being jetted from a washing nozzle (for example, refer to PTL1 and PTL2).

[0003] There is also disclosed a sanitary washing device having a configuration in which a water entry part of a temperature stabilizer is formed in a circular arc shape to accelerate mixing of warm water in the temperature stabilizer to thereby quickly make a temperature of warm water emitted from the temperature stabilizer uniform (for example, PTL 3).

[0004] The temperature stabilizer disclosed in each of the above patent literatures temporarily stores and mixes water heated by a heating device inside the temperature stabilizer to make the water temperature uniform. In this case, the temperature stabilizer is required to have a volume (capacity) for ensuring a certain amount of warm water. Thus, a conventional sanitary washing device typically employs a structure in which the temperature stabilizer and the heating device are separately placed.

[0005] At present, a temperature stabilizer of a sanitary washing device is indispensable for comfortably and safely performing warm water washing.

[0006] However, the structure in which the temperature stabilizer and the heating device are separately placed results in a large space occupied by the entire water heater in the sanitary washing device. Thus, use and attachment are disadvantageously made inconvenient.

[0007] In order to solve the above problem, the temperature stabilizer and the heating device may be integrated to achieve downsizing. However, when the temperature stabilizer and the heating device are integrated, it is necessary to ensure a space for disposing the temperature stabilizer having a considerable volume inside the heating device in design. That is, in the integration in a conventional heating device, even when a relationship in disposition between a heating element and a flow path is made optimal to efficiently perform heat exchange, a

configuration such as a temperature stabilizer in which a certain capacity to eliminate temperature nonuniformity is ensured is required. Thus, it is not possible to achieve space-saving and thus not possible to achieve downsizing. Therefore, an object to downsize a water heater while ensuring a space for disposing a temperature stabilizer has not yet been solved.

Citation List

Patent Literature

[0008]

PTL 1: Japanese Patent No. 3,714,060

PTL 2: Unexamined Japanese Patent Publication No. 2000-1896

PTL 3: Unexamined Japanese Patent Publication No. 2009-235792

SUMMARY OF THE INVENTION

[0009] The present invention provides a heating device that enables a more stable temperature of flowing-out warm water and also enables downsizing, and a sanitary washing device and equipment provided with the same.

[0010] Specifically, the heating device of the present invention is provided with a housing which has an inlet port for allowing fluid to flow in and an outlet port for allowing the fluid to flow out, a heat exchange flow path which is placed inside the housing and communicates with the inlet port, and a heater which heats the fluid inside the heat exchange flow path. The heating device is further provided with a temperature buffer part which is placed inside the housing and communicates with the outlet port and one or more through holes which are formed between the heat exchange flow path and the temperature buffer part, and communicating between the heat exchange flow path and the temperature buffer part. The heat exchange flow path guides the fluid flowing in through the inlet port and allows the fluid after being heated to flow into the temperature buffer part through the through holes, and the temperature buffer part guides the fluid flowing in through the through holes to the outlet port.

[0011] In this configuration, the temperature buffer part is placed inside the housing, and the heat exchange flow path and the temperature buffer part communicate with each other through the through holes. Accordingly, the temperature of warm water flowing into the temperature buffer part from the heat exchange flow path can be made uniform in the temperature buffer part. Further, a space occupied by the temperature buffer part can be reduced. As a result, it is possible to achieve the heating device in which the temperature of warm water is made uniform, and the heat exchange flow path and the temperature buffer part are integrated to downsize the heating device.

BRIEF DESCRIPTION OF DRAWINGS

[0012]

FIG. 1 is a perspective view of a heating device according to a first exemplary embodiment of the present invention.

FIG. 2A is a front view of the heating device according to the first exemplary embodiment.

FIG. 2B is a top view of the heating device.

FIG. 2C is a bottom view of the heating device.

FIG. 2D is a sectional view taken along line 2D-2D of FIG. 2C.

FIG. 2E is a sectional view taken along line 2E-2E of FIG. 2D.

FIG. 2F is a sectional view taken along line 2F-2F of FIG. 2D.

FIG. 3 is a schematic view of a flow direction of water in the heating device having a plurality of through holes according to the first exemplary embodiment.

FIG. 4 is a schematic view of a flow direction of water in a temperature buffer part having a plurality of mixing ribs according to the first exemplary embodiment.

FIG. 5 is a schematic view of the entire flow direction of water in a heat exchange flow path and the temperature buffer part having the plurality of mixing ribs according to the first exemplary embodiment.

FIG. 6A is a schematic view of a heater in a modification of the first exemplary embodiment when disposed on an inner side of one side of the housing.

FIG. 6B is a schematic view of the heater when disposed on an outer side of one side of the housing.

FIG. 6C is a schematic view of the heater when disposed sideways on a bottom of the heat exchange flow path.

FIG. 7A is a schematic view of a heating device in which a flow direction of water flowing in through an inlet port is the same as a flow direction of water flowing out through an outlet port according to a modification of the first exemplary embodiment.

FIG. 7B is a schematic view of a heating device in which a flow direction of water flowing in through an inlet port intersects a flow direction of water flowing out through an outlet port according to the modification.

FIG. 8 is a perspective view of a sanitary washing device according to a second exemplary embodiment of the present invention to which the heating device is attached.

DESCRIPTION OF EMBODIMENTS

[0013] Hereinbelow, exemplary embodiments of the present invention will be described with reference to the drawings. The exemplary embodiments are merely examples, and the present invention is not limited by the exemplary embodiments.

FIRST EXEMPLARY EMBODIMENT

[0014] Hereinbelow, a configuration of a heating device in a first exemplary embodiment of the present invention will be described with reference to FIGS. 1 to 2F. In the heating device of the present exemplary embodiment, water is described as an example of fluid flowing through the inside of the heating device. However, it is needless to say that the fluid is not limited to water. For example, liquid other than water such as water added with a medicine or washing agent and functional water or gas may be used.

[0015] FIG. 1 is a perspective view of the heating device according to the first exemplary embodiment of the present invention. FIG. 2A is a front view of the heating device according to the first exemplary embodiment. FIG. 2B is a top view of the heating device. FIG. 2C is a bottom view of the heating device. FIG. 2D is a sectional view taken along line 2D-2D of FIG. 2C. FIG. 2E is a sectional view taken along line 2E-2E of FIG. 2D. FIG. 2F is a sectional view taken along line 2F-2F of FIG. 2D.

[0016] As illustrated in FIGS. 1 to 2F, heating device 1 of the present exemplary embodiment includes at least housing 13, and mixing rib 22, heat exchange flow path 24, heater 23, temperature buffer part 25, and the like which are disposed inside housing 13. Through hole 21 is formed between heat exchange flow path 24 and temperature buffer part 25. Water heated by heater 23 flows through temperature buffer part 25. As illustrated in FIG. 1, heating device 1 is formed in, for example, a rectangular parallelepiped shape, and both side faces on long sides thereof are placed in up and down directions.

[0017] Housing 13 is provided with inlet port 11 which is located on a lower part of housing 13 for allowing water to flow in and outlet port 12 which is located on an upper part of housing 13 for allowing water to flow out. In the present exemplary embodiment, an example in which inlet port 11 and outlet port 12 are disposed on the same side face in right and left directions of housing 13 is illustrated.

[0018] Heat exchange flow path 24 is formed inside housing 13 and communicates with inlet port 11. Heater 23 is, for example, a flat heater made of ceramic. As illustrated in FIGS. 2E and 2F, heater 23 is partially supported and disposed inside heat exchange flow path 24 so that an entire face of heater 23 is not in contact with both wall surface 26a and wall surface 26b of heat exchange flow path 24. Heater 23 heats water flowing inside heat exchange flow path 24 by both faces of heater 23 as main heating surfaces. The water flowing inside heat exchange flow path 24 flows up along both the faces of heater 23 up to an upper end of heater 23, and water flowing up along one of the faces and water flowing up along the other face are then joined. Then, the water passes through through hole 21 which faces an end face of heater 23 and flows into temperature buffer part 25. Temperature buffer part 25 is placed above heat exchange flow path 24 inside housing 13 and communi-

cates with outlet port 12. As described above, through hole 21 is formed between heat exchange flow path 24 and temperature buffer part 25, and communicates between heat exchange flow path 24 and temperature buffer part 25.

[0019] As illustrated in FIG. 2D, mixing rib 22 is disposed inside temperature buffer part 25 to narrow a flow path for warm water flowing in through through hole 21. In the present exemplary embodiment, a number of mixing ribs 22 is equal to a number of through holes 21 (five, in FIG. 2D). Mixing rib 22 is disposed between the corresponding adjacent through hole 21 and outlet port 12. Mixing rib 22 may have, for example, a shape whose cross-sectional width increases toward outlet port 12 (not illustrated). This shape reduces a distance between an inner wall of temperature buffer part 25 and mixing rib 22 toward outlet port 12 and thus further obstructs a water flow. As a result, water having temperature nonuniformity can be sufficiently mixed inside temperature buffer part 25. That is, warm water flows through a narrow flow path formed in temperature buffer part 25 by mixing rib 22 and a wide flow path on the other part. Accordingly, it is possible to mix the warm water to eliminate temperature non-uniformity. A specific operation will be described below.

[0020] Heat exchange flow path 24 guides water flowing in through inlet port 11 and allows water heated by heater 23 to flow into temperature buffer part 25 through through hole 21. Further, temperature buffer part 25 guides the heated water flowing in through through hole 21 to outlet port 12 while mixing the heated water by mixing rib 22 so as to be fed to, for example, a nozzle of a sanitary washing device. Although, in the present exemplary embodiment, a space formed by housing 13 is used as heat exchange flow path 24, the present invention is not limited to this configuration. For example, heat exchange flow path 24 may be configured as a single member and independently placed inside housing 13. This configuration makes it possible to more accurately set a width of heat exchange flow path 24, that is, a gap size between heat exchange flow path 24 and heater 23.

[0021] The heating device of the present exemplary embodiment is configured as described above.

[0022] Hereinbelow, the principle of operation of a heating device that includes a plurality of through holes, that is, for example, four through holes in the present exemplary embodiment will be described with reference to FIG. 3.

[0023] FIG. 3 is a schematic view of a flow direction of water in the heating device having the plurality of through holes in the present exemplary embodiment.

[0024] In the heating device having a configuration illustrated in FIG. 3, water flows in a direction indicated by arrow F_1 . At this time, water flows into temperature buffer part 25 through region 24c near through hole 21a and region 24d near through hole 21d. In this case, four through holes 21 are formed and an area of each of through holes 21 is an extremely small area having a diameter of, for example, 2.4 mm. Thus, when water flows

in through through holes 21a to 21d, pressure loss occurs. Since water flows along the flow direction indicated by arrow F_1 of FIG. 3, the pressure loss becomes largest in through hole 21a and smallest in through hole 21d.

That is, the pressure loss has a relationship of through hole $21a > 21b > 21c > 21d$. Accordingly, water in region 24e tends to flow into temperature buffer part 25 through through hole 21d having a relatively small pressure loss. Thus, it is possible to prevent formation of a stagnation part in region 24e. Further, long-time heating of water in region 24e is prevented. Accordingly, it is possible to prevent a temperature of water in region 24e from excessively increasing. That is, when the temperature excessively increases, fur is generated inside heat exchange flow path 24 due to local temperature rise. As a result, scale is adhered to the flow path to narrow the flow path or is adhered to the face of the heater to cause an adverse effect on the heating surface. These adverse effects can be prevented by allowing water to efficiently flow into temperature buffer part 25 without generation of the stagnation part on the heating surface.

[0025] Water flowing into through holes 21a to 21d from heat exchange flow path 24 is mixed inside temperature buffer part 25. Thus, equilibrium (uniformization) of the temperature of water can be achieved before the water flows out through outlet port 12 of temperature buffer part 25. As a result, it is possible to allow the water having a uniform temperature to flow out through outlet port 12.

[0026] Hereinbelow, the principle of operation of a heating device that is provided with four mixing ribs 22 corresponding to the four through holes of FIG. 3 will be described as an example with reference to FIG. 4.

[0027] FIG. 4 is a schematic view of a flow direction of water in a temperature buffer part having the plurality of mixing ribs in the present exemplary embodiment. For easy understanding, FIG. 4 illustrates, in an enlarged manner, a vicinity of temperature buffer part 25 which has mixing ribs 22a to 22d each having a rectangular cross section.

[0028] As illustrated in FIG. 4, when four mixing ribs 22a to 22d are placed inside temperature buffer part 25, mixing ribs 22a to 22d obstruct a water flow toward outlet port 12 as indicated by arrows F_2 , which causes a mixed flow. Accordingly, water is mixed while flowing to outlet port 12. As a result, the temperature of water flowing out through outlet port 12 becomes more uniform. That is, providing the plurality of mixing ribs 22a to 22d corresponding to the plurality of through holes 21a to 21d enables the temperature of water to be more uniform inside temperature buffer part 25.

[0029] Next, the principle of operation of the heating device provided with the four mixing ribs illustrated in FIG. 4 will be described in more detail with reference to FIG. 5.

[0030] FIG. 5 is a schematic view of the entire flow direction of water inside the heat exchange flow path and the temperature buffer part having the plurality of mixing ribs in the present exemplary embodiment. In FIG. 5, the

number of through holes is equal to the number of mixing ribs, specifically, four. In this case, mixing rib 22a is disposed adjacent to through hole 21a at a side facing outlet port 12. Similarly, mixing ribs 22b, 22c, and 22d are respectively disposed corresponding to adjacent through holes 21b, 21c, and 21d at the side facing outlet port 12.

[0031] As described above with reference to FIG. 3, due to the principle of pressure loss, water flowing in heat exchange flow path 24 indicated by arrows F_1 , F_3 , F_4 , and F_5 in FIG. 5 flows into temperature buffer part 25 through through hole 21d, through hole 21c, through hole 21b, and through hole 21a in this order, that is, in an ascending order of pressure loss. Then, the water flowing into temperature buffer part 25 from heat exchange flow path 24 through through holes 21d to 21a flows to outlet port 12 while being mixed with water previously present inside temperature buffer part 25. At this time, since the diameter of each of through holes 21a to 21d is extremely small, a flow speed of the water flowing in through through holes 21d to 21a is relatively high. Thus, the water flowing into temperature buffer part 25 and the water inside temperature buffer part 25 are easily mixed. Accordingly, the water flowing into temperature buffer part 25 from heat exchange flow path 24 and the water previously present inside temperature buffer part 25 are easily mixed to have a uniform temperature. As a result, it is possible to allow water having a uniform temperature to flow out through outlet port 12 of heating device 1.

[0032] As illustrated in FIG. 5, since mixing ribs 22a to 22d are placed inside temperature buffer part 25, mixed flow can be further generated in water flow inside temperature buffer part 25. As a result, it is possible to allow water having a more uniform temperature to flow out through outlet port 12.

[0033] Although, in the present embodiment, the configuration in which heater 23 is disposed without contact with both wall surface 26a and wall surface 26b of heat exchange flow path 24 has been described as an example, the present invention is not limited to this configuration. For example, heater 23 may be placed on a wall surface of heat exchange flow path 24 or may be placed on an outer wall surface of heat exchange flow path 24 as specifically described below. That is, heater 23 may be placed at any position that enables heater 23 to heat water inside heat exchange flow path 24.

[0034] Other examples of disposition of the heater will be specifically described with reference to FIGS. 6A to 6C.

[0035] FIG. 6A is a schematic view of a heater according to a modification of the first exemplary embodiment of the present invention when disposed on an inner side of one side of the housing. FIG. 6B is a schematic view of the heater when disposed on an outer side of one side of the housing. FIG. 6C is a schematic view of the heater when disposed sideways on a bottom of the heat exchange flow path.

[0036] First, as illustrated in FIG. 6A, heater 23 is brought into intimate contact with one inner wall inside

heat exchange flow path 24 with heating surface 23a facing heat exchange flow path 24. This configuration makes it possible to effectively heat water flowing through heat exchange flow path 24. Further, heater 23 can be easily attached and stably disposed.

[0037] As illustrated in FIG. 6B, heater 23 may be stuck to one outer wall surface outside heat exchange flow path 24 with heating surface 23a stuck to the outer wall surface. In this case, since a space inside housing 13 is used as heat exchange flow path 24, sticking heater 23 to one outer wall outside heat exchange flow path 24 corresponds to sticking heater 23 to an outer wall of housing 13. This configuration increases a capacity of heat exchange flow path 24, which enables an increase in an amount of warm water.

[0038] As illustrated in FIG. 6C, heater 23 may be disposed, for example, sideways on the bottom of heat exchange flow path 24 with heating surface 23a facing heat exchange flow path 24. This configuration makes it possible to effectively heat water flowing through heat exchange flow path 24 in the same manner as in the configuration illustrated in FIG. 6A. Further, heater 23 can be easily attached and stably disposed.

[0039] The present invention is not limited to examples as illustrated in FIGS. 6A to 6C in which only one heater 23 is disposed with respect to heat exchange flow path 24. One or more heaters 23 may be disposed. This configuration makes it possible to more effectively heat water flowing through heat exchange flow path 24.

[0040] Although, in the present exemplary embodiment, there has been described an example in which the space formed by the housing is used as the heat exchange flow path, the present invention is not limited to this configuration. For example, when the heat exchange flow path is placed independently in the housing, the heater may be stuck to one outer wall outside the heat exchange flow path. In this case, the heater is placed on the outer wall of the heat exchange flow path located between the housing and the heat exchange flow path. This configuration makes it possible to effectively heat the heat exchange flow path.

[0041] Although, in the present exemplary embodiment, there has been described an example in which inlet port 11 and outlet port 12 are disposed on the housing in such a manner that a flow direction of water flowing into heat exchange flow path 24 through inlet port 11 is opposite to a flow direction of water flowing out to outlet port 12 from temperature buffer part 25 as illustrated in FIGS. 2D, 3 and 5, the present invention is not limited to this configuration. For example, inlet port 11 and outlet port 12 may be disposed on housing 13 in such a manner as described below with reference to FIGS. 7A and 7B.

[0042] FIG. 7A is a schematic view of a heating device in which a flow direction of water flowing in through an inlet port is the same as a flow direction of water flowing out through an outlet port in a modification of the present exemplary embodiment. FIG. 7B is a schematic view of a heating device in which a flow direction of water flowing

in through an inlet port intersects a flow direction of water flowing out through an outlet port in the modification.

[0043] That is, as illustrated in FIG. 7A, inlet port 11 and outlet port 12 of housing 13 may be disposed in such a manner that the flow direction of water flowing in through inlet port 11 is the same as the flow direction of water flowing out through outlet port 12. This configuration enables stabilization of the temperature of flowing-out water in the same manner as above.

[0044] As illustrated in FIG. 7B, inlet port 11 and outlet port 12 of housing 13 may be disposed in such a manner that the flow direction of water flowing in through inlet port 11 intersects the flow direction of water flowing out through outlet port 12. Here, "intersection" is, for example, a relationship in which water flows into inlet port 11 along a horizontal direction and flows out through outlet port 12 along a vertical direction, as illustrated in FIG. 7B. However, the intersection is not limited this relationship. It is needless to say that any oblique direction that intersects the horizontal direction may be employed. Accordingly, the same effect as above can be obtained.

[0045] Although, in the present exemplary embodiment, there has been described examples in which the cross section of mixing rib 22 (the cross section taken along line 2D-2D of FIG. 2C) has a shape whose cross-sectional width increases toward the outlet port and has a rectangular shape illustrated in FIG. 4, the present invention is not limited to this configuration. A shape of mixing rib 22 may be, for example, a columnar shape or a spherical shape. The cross-sectional shape of mixing rib 22 may be a rectangular shape, a circular shape, or an elliptical shape. That is, any shape that enables mixing rib 22 to restrict a water flow to sufficiently mix water having a nonuniform temperature inside temperature buffer part 25 may be employed.

[0046] Specifically, as illustrated in FIG. 2D, mixing rib 22 may have a substantially crescent cross section (including a crescent cross section). In this case, an upstream side of mixing rib 22 has a rounded projecting shape with no angular part and thus has less pressure loss. On the other hand, a downstream side of mixing rib 22 is formed in a substantially recessed shape (including a recessed shape) toward outlet port 12. Accordingly, when water flows in through through hole 21 and flows through temperature buffer part 25 toward outlet port 12, a washing water flows along the rounded projecting shape of mixing rib 22 and then flows toward an inner side of the recessed part so as to be mixed. That is, the shape of mixing rib 22 illustrated in FIG. 2D enables further acceleration of mixing to make the temperature uniform.

[0047] In the present exemplary embodiment, as illustrated in FIGS. 2D and 2E, heating device 1 is provided with temperature buffer part 25 which communicates with outlet port 12 and the plurality of through holes 21 which are placed between heat exchange flow path 24 and temperature buffer part 25 to allow heat exchange flow path 24 and temperature buffer part 25 to communicate with

each other. The plurality of through holes 21 are formed at intermediate positions between heat exchange flow path 24 and temperature buffer part 25. The plurality of mixing ribs 22 are disposed on the downstream side of the respective through holes 21. Each of mixing ribs 22 has a cross-sectional shape having a substantially rounded projecting part with no angular part on the upstream side and has a cross-sectional shape having a substantially recessed part on the downstream side. This configuration has high mixing and agitation effects with less pressure loss. Thus, it is possible to make the temperature of warm water uniform with smaller temperature non-uniformity. At the same time, the heat exchange flow path and the temperature buffer part can be integrated to achieve further downsizing.

[0048] Although, in the present exemplary embodiment, there has been described an example in which, as illustrated in FIG. 2D, the number of mixing ribs is one or more and equal to the number of through holes, and each mixing rib is disposed corresponding to each through hole at the side facing the outlet port, the present invention is not limited to this configuration. For example, the number of mixing ribs may not be equal to the number of through holes. Further, each mixing rib is not necessarily disposed corresponding to each through hole at the side facing the outlet port. Each mixing rib may be disposed at any position that enables the mixing rib to effectively obstruct a water flow to effectively mix water having temperature nonuniformity inside the temperature buffer part.

[0049] As described above, in the present exemplary embodiment, the temperature buffer part is placed inside the housing, and the through hole which allows the heat exchange flow path and the temperature buffer part to communicate with each other is formed. This configuration makes it possible to make the temperature of warm water flowing into the temperature buffer part uniform. Further, a space occupied by the temperature buffer part can be reduced as much as possible. Thus, the heating device that is provided with both the heat exchange flow path and the temperature buffer part can be easily downsized.

SECOND EXEMPLARY EMBODIMENT

[0050] Hereinbelow, equipment according to a second exemplary embodiment of the present invention will be described with reference to FIG. 8.

[0051] The equipment of the present exemplary embodiment is, for example, a sanitary washing device, a washstand, a bathing device such as a bathtub, an instantaneous water heater, or a water server provided with the heating device described in the above first exemplary embodiment. Further, the equipment includes equipment that requires providing fluid having a stable temperature.

[0052] Hereinbelow, a sanitary washing device will be described in detail as an example of the equipment.

[0053] The sanitary washing device in the present ex-

emplary embodiment is an instantaneous sanitary washing device which heats flowing water to generate warm water and differs from a storage type sanitary washing device which stores warm water in a tank. An instantaneous sanitary washing device typically has a water flow amount of approximately 400 to 500 ml per one minute and generates warm water by a heating device to wash the human private parts.

[0054] FIG. 8 is a perspective view of the sanitary washing device according to the second exemplary embodiment of the present invention to which the heating device is attached.

[0055] As illustrated in FIG. 8, sanitary washing device 100 of the present exemplary embodiment includes at least toilet seat body 101, a water feeder (not illustrated), operation part 104, nozzle 105, and the like. Toilet seat body 101 is pivotably connected to seating part 102 to allow seating part 102 to pivot on toilet seat body 101. Toilet seat body 101 is mounted on Western-style toilet bowl 103. Heating device 1 described in the first exemplary embodiment is disposed inside toilet seat body 101. In this case, heating device 1 is disposed in such a manner that the flat heater of a heat exchanger vertically stands inside toilet seat body 101. Accordingly, inlet port 11 of heating device 1 is located on a lower side of heat exchange flow path 24, and outlet port 12 is located on an upper side of heat exchange flow path 24.

[0056] Next, operation of the sanitary washing device according to the present exemplary embodiment will be described.

[0057] When washing is performed using sanitary washing device 100, a user first operates operation part 104. Accordingly, the water feeder feeds water to heating device 1 from a water feed source.

[0058] The water fed to heating device 1 flows into heating device 1 through inlet port 11 located on the lower side and flows up in heat exchange flow path 24 along the heating surface which vertically stands while being heated by efficient heat exchange by forced convection and natural convection functions. Then, as described above, water flows are joined on the upper end of heater 23 and heated to have a uniform temperature by heat exchange flow path 24 and temperature buffer part 25 which communicate with each other through through hole 21. Then, warm water having a uniform temperature, which is instantaneously heated by heating device 1 is jetted from nozzle 105 of sanitary washing device 100. In this manner, washing to the human body is performed.

[0059] The present exemplary embodiment makes it possible to further downsize equipment such as sanitary washing device 100 by incorporating heating device 1 having a small size. Further, it is possible to generate water having a uniform temperature with less temperature nonuniformity by heating device 1 and jet the generated water from nozzle 105. Accordingly, it is possible to achieve equipment such as sanitary washing device 100 having an excellent feeling of use. Typically, a sanitary washing device has both a used state and an unused

state. Thus, water is not continuously circulated through the sanitary washing device. Therefore, it is necessary to eject warm water having an optimal temperature when needed. In view of this, it is possible to instantaneously generate warm water for washing the human body having less temperature nonuniformity by the heat exchanger of the present invention to achieve a comfortable feeling of use.

[0060] In the above, the present invention has been described based on the specific exemplary embodiments. However, all the exemplary embodiments described above are merely examples and do not limit the protection range of the present invention. It is needless to say that various modifications and corrections added to the present invention based on the gist and the principle of the present invention are also included in the range of the present invention.

[0061] As described above, the heating device of the present invention is provided with a housing which has an inlet port for allowing fluid to flow in and an outlet port for allowing the fluid to flow out, a heat exchange flow path which is placed inside the housing and communicates with the inlet port, and a heater which heats the fluid inside the heat exchange flow path. The heating device is further provided with a temperature buffer part which is placed inside the housing and communicates with the outlet port and one or more through holes which are formed between the heat exchange flow path and the temperature buffer part, and communicating between the heat exchange flow path and the temperature buffer part. The heat exchange flow path may guide the fluid flowing in through the inlet port and allow the fluid after being heated to flow into the temperature buffer part through the one or more through holes, and the temperature buffer part may guide the fluid flowing in through the one or more through holes to the outlet port.

[0062] In this configuration, the temperature buffer part is placed, and the heat exchange flow path and the temperature buffer part communicate with each other through the one or more through holes. This configuration makes it possible to allow water to more uniformly flow into the temperature buffer part through the through hole(s). As a result, the temperature of warm water flowing into the temperature buffer part from the heat exchange flow path can be made uniform in the temperature buffer part. Further, a space occupied by the temperature buffer part can be reduced. As a result, it is possible to achieve the heating device in which the temperature of warm water is made uniform, and the heat exchange flow path and the temperature buffer part are integrated to downsize the heating device.

[0063] In the heating device of the present invention, the temperature buffer part may further include a mixing rib. In this configuration, the flow of warm water flowing inside the temperature buffer part is obstructed by the mixing rib. At this time, warm water flowing into the temperature buffer part through the through hole(s) and flowing inside the temperature buffer part is further mixed in

a gap between the mixing rib and an inner wall of the temperature buffer part and in a part of the temperature buffer part having no mixing rib. Accordingly, it is possible to allow warm water having a more uniform temperature to flow out through the outlet port.

[0064] In the heating device of the present invention, the mixing rib may be disposed at a position between the outlet port and at least one of the through hole(s) located farthest from the outlet port. This configuration makes it possible to further effectively obstruct the flow direction of warm water flowing inside the temperature buffer part. As a result, warm water having temperature nonuniformity can be further mixed to be uniform.

[0065] In the heating device of the present invention, the heater may be disposed inside the heat exchange flow path at a position that is not in contact with a wall surface of the heat exchange flow path. This configuration makes it possible to heat water by both faces of the heater. As a result, it is possible to increase the speed of heating to instantaneously supply warm water.

[0066] In the heating device of the present invention, the inlet port and the outlet port of the housing may be disposed at positions that make a flow direction of the fluid flowing into the heat exchange flow path through the inlet port to be opposite to a flow direction of the fluid flowing out to the outlet port from the temperature buffer part. This configuration makes it possible to maintain a balance between the fluid flowing into the temperature buffer part through the through hole(s) and the fluid flowing out of the temperature buffer part. As a result, it is possible to allow warm water to efficiently flow into the temperature buffer part without causing stagnation of fluid inside the heat exchange flow path.

[0067] In the heating device of the present invention, a flow direction of the fluid flowing into the temperature buffer part through the through hole(s) may intersect a flow direction of the fluid inside the temperature buffer part. This configuration makes it possible to gradually mix the fluid flowing inside the temperature buffer part with the fluid flowing into the temperature buffer part through the through hole(s). As a result, the temperature of water can be made uniform when the water flows out through the outlet port.

[0068] The sanitary washing device of the present invention may include a toilet seat body which is mounted on a Western style toilet bowl and pivotably connected to a seating part to allow the seating part to pivot on the toilet seat body, the above heating device which is disposed inside the toilet seat body, a water feeder which feeds water from a water feed source to the heating device, and a nozzle which washes a human body using warm water heated by the heating device.

[0069] This configuration makes it possible to jet warm water having a uniform temperature generated by the heating device from the nozzle. Further, downsizing of the sanitary washing device can be achieved by incorporating the heating device having a small size.

[0070] Equipment of the present invention may be pro-

vided with the above heating device.

[0071] This configuration makes it possible to jet warm water having a uniform temperature generated by the heating device from the equipment. Further, downsizing of the equipment can be achieved by incorporating the heating device having a small size.

INDUSTRIAL APPLICABILITY

[0072] The present invention is useful in the fields of such as a heating device that is small and requires generation of warm water having a uniform temperature, and a sanitary washing device and equipment provided with the same.

REFERENCE MARKS IN THE DRAWINGS

[0073]

- 1: heating device
- 11: inlet port
- 12: outlet port
- 13: housing
- 21, 21a, 21b, 21c, 21d: through hole
- 22, 22a, 22b, 22c, 22d: mixing rib
- 23: heater
- 23a: heating surface
- 24: heat exchange flow path
- 24c, 24d, 24e: region
- 25: temperature buffer part
- 26a, 26b: wall surface
- 100: sanitary washing device
- 101: toilet seat body
- 102: seating part
- 103: Western-style toilet bowl
- 104: operation part
- 105: nozzle

Claims

1. A heating device comprising:

- a housing having an inlet port for allowing fluid to flow in and an outlet port for allowing the fluid to flow out;
- a heat exchange flow path placed inside the housing, the heat exchange flow path communicating with the inlet port;
- a heater for heating the fluid inside the heat exchange flow path;
- a temperature buffer part placed inside the housing, the temperature buffer part communicating with the outlet port; and
- one or more through holes formed between the heat exchange flow path and the temperature buffer part, and communicating between the heat exchange flow path and the temperature

- buffer part,
 wherein the heat exchange flow path guides the fluid flowing in through the inlet port and allows the fluid after being heated to flow into the temperature buffer part through the through holes, and
 the temperature buffer part guides the fluid flowing in through the through holes to the outlet port. 5
2. The heating device according to claim 1, wherein the temperature buffer part further includes a mixing rib. 10
3. The heating device according to claim 2, wherein the mixing rib is disposed at a position between the outlet port and at least one of the through holes located farthest from the outlet port. 15
4. The heating device according to claim 1, wherein the heater is disposed inside the heat exchange flow path at a position that is not in contact with a wall surface of the heat exchange flow path. 20
5. The heating device according to claim 1, wherein the inlet port and the outlet port of the housing are disposed at positions that make a flow direction of the fluid flowing into the heat exchange flow path through the inlet port to be opposite to a flow direction of the fluid flowing out to the outlet port from the temperature buffer part. 25
6. The heating device according to claim 1, wherein a flow direction of the fluid flowing into the temperature buffer part through the through holes intersects a flow direction of the fluid inside the temperature buffer part. 30
7. A sanitary washing device comprising:
 a toilet seat body mounted on a Western style toilet bowl and pivotably connected to a seating part to allow the seating part to pivot on the toilet seat body; 40
 the heating device according to any one of claims 1 to 6 disposed inside the toilet seat body; 45
 a water feeder for feeding water from a water feed source to the heating device; and
 a nozzle for washing a human body using warm water heated by the heating device.
8. Equipment comprising the heating device according to any one of claims 1 to 6. 50
- Amended claims under Art. 19.1 PCT** 55
1. (Amended) A heating device comprising:
 a housing having an inlet port for allowing fluid to flow in and an outlet port for allowing the fluid to flow out;
 a heat exchange flow path placed inside the housing, the heat exchange flow path communicating with the inlet port;
 a heater for heating the fluid inside the heat exchange flow path;
 a temperature buffer part placed inside the housing, the temperature buffer part communicating with the outlet port;
 a plurality of through holes formed between the heat exchange flow path and the temperature buffer part, and communicating between the heat exchange flow path and the temperature buffer part; and
 a mixing rib disposed in the temperature buffer part at a position between the through holes and the outlet port, the mixing rib narrowing a flow path inside the temperature buffer part from the through holes to the outlet port,
 wherein the heat exchange flow path guides the fluid flowing in through the inlet port and allows the fluid after being heated to flow into the temperature buffer part through the through holes, and
 the temperature buffer part guides the fluid flowing in through the through holes to the outlet port.
2. (Amended) The heating device according to claim 1, wherein the mixing rib comprises a same number of mixing ribs as the through holes.
3. (Amended) The heating device according to claim 1, wherein the mixing rib has a projecting shape with an upstream side rounded into a substantially crescent cross section.
4. The heating device according to claim 1, wherein the heater is disposed inside the heat exchange flow path at a position that is not in contact with a wall surface of the heat exchange flow path.
5. The heating device according to claim 1, wherein the inlet port and the outlet port of the housing are disposed at positions that make a flow direction of the fluid flowing into the heat exchange flow path through the inlet port to be opposite to a flow direction of the fluid flowing out to the outlet port from the temperature buffer part.
6. The heating device according to claim 1, wherein a flow direction of the fluid flowing into the temperature buffer part through the through holes intersects a flow direction of the fluid inside the temperature buffer part.
7. A sanitary washing device comprising:

a toilet seat body mounted on a Western style toilet bowl and pivotably connected to a seating part to allow the seating part to pivot on the toilet seat body;

the heating device according to any one of claims 1 to 6 disposed inside the toilet seat body; a water feeder for feeding water from a water feed source to the heating device; and a nozzle for washing a human body using warm water heated by the heating device.

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8. Equipment comprising the heating device according to any one of claims 1 to 6.

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FIG. 1

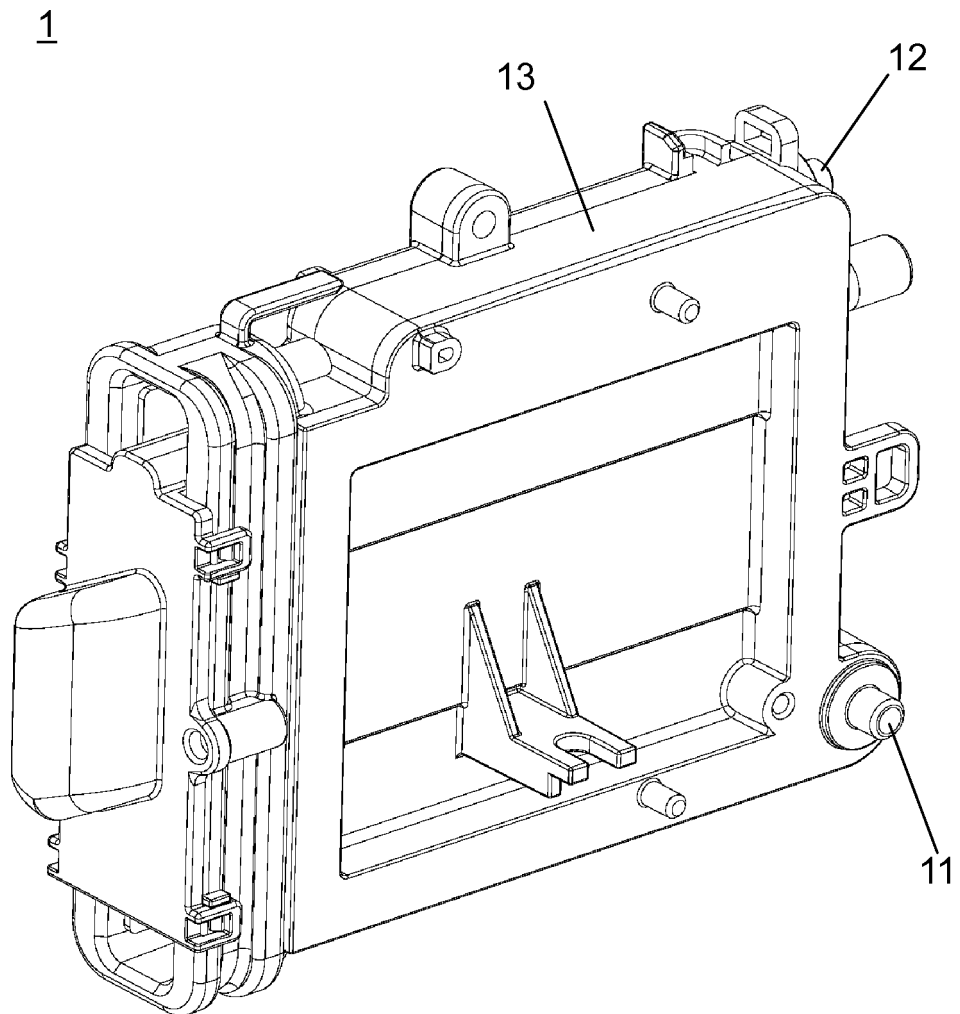


FIG. 2A

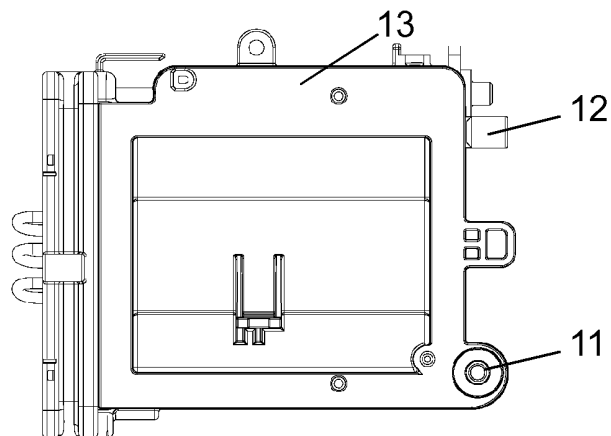


FIG. 2B

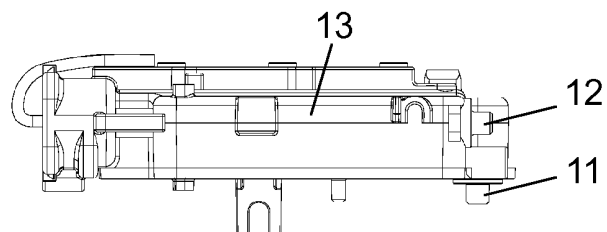


FIG. 2C

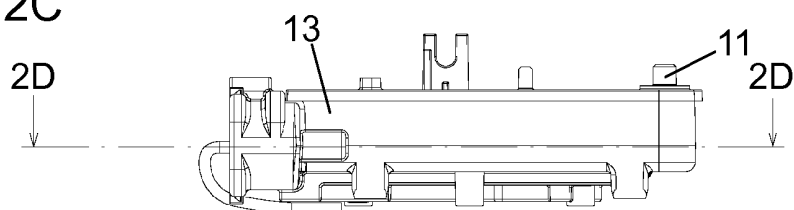


FIG. 2E

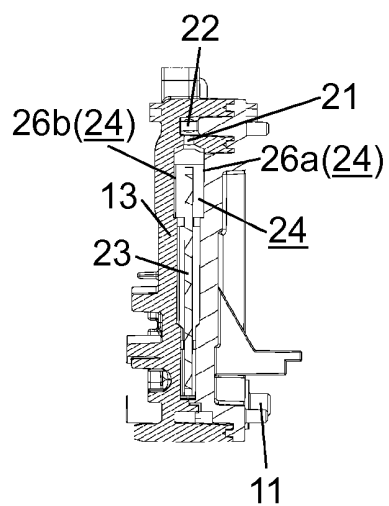


FIG. 2D

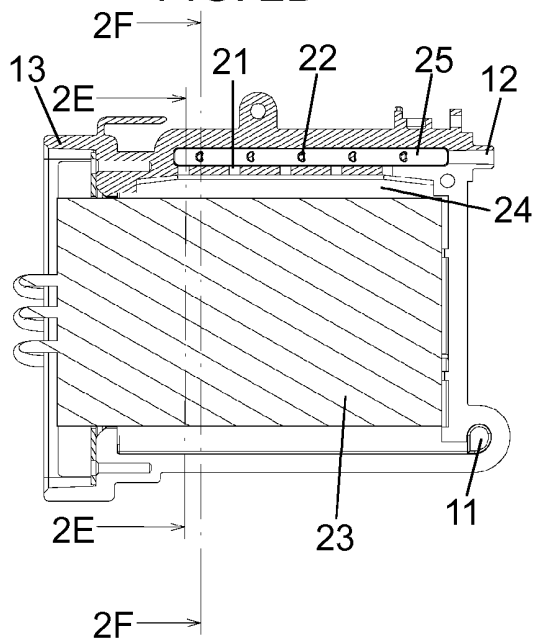


FIG. 2F

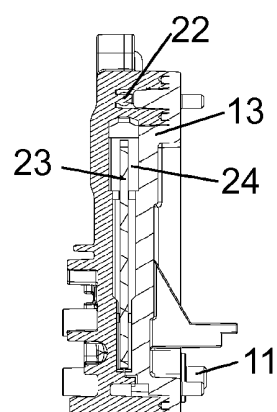


FIG. 3

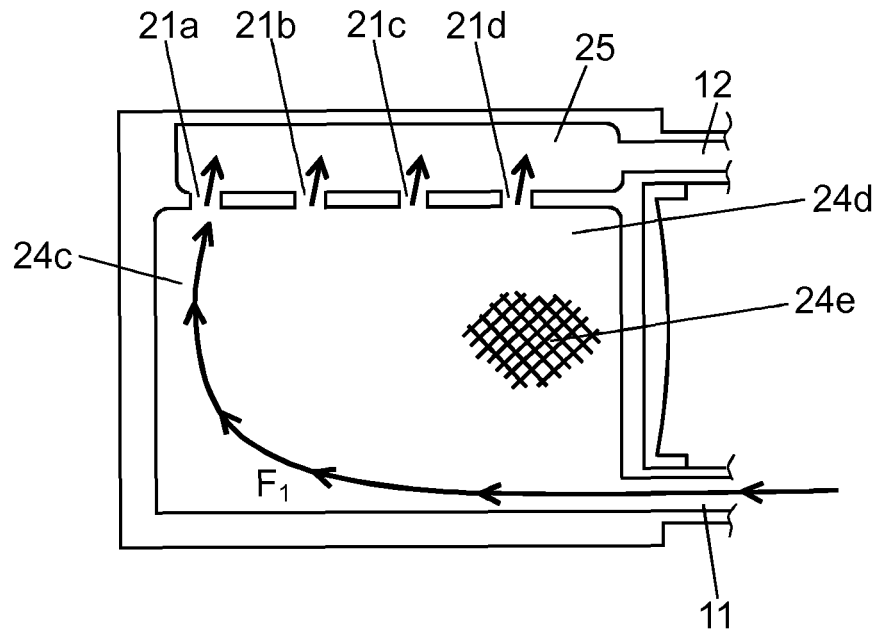


FIG. 4

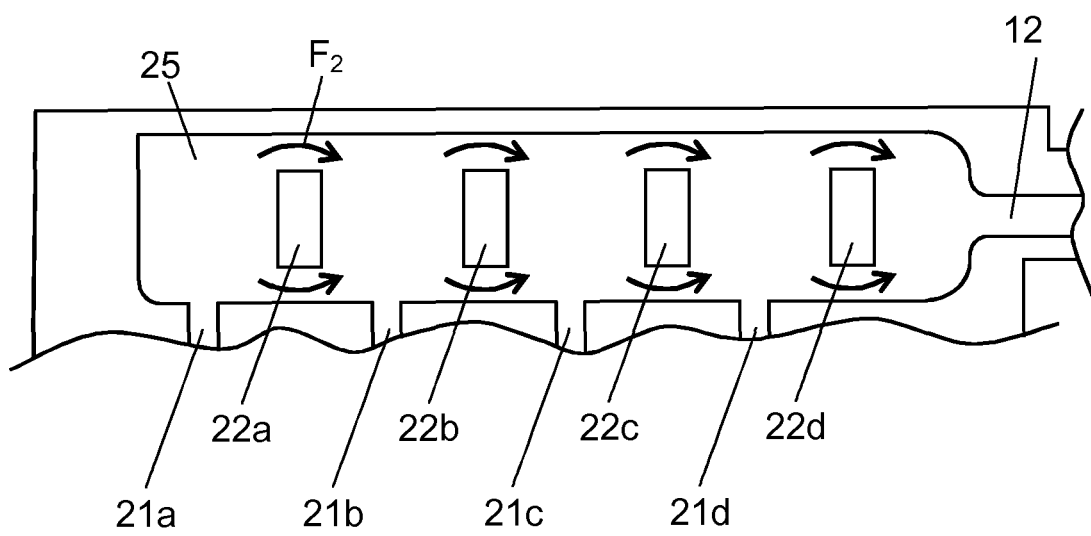


FIG. 5

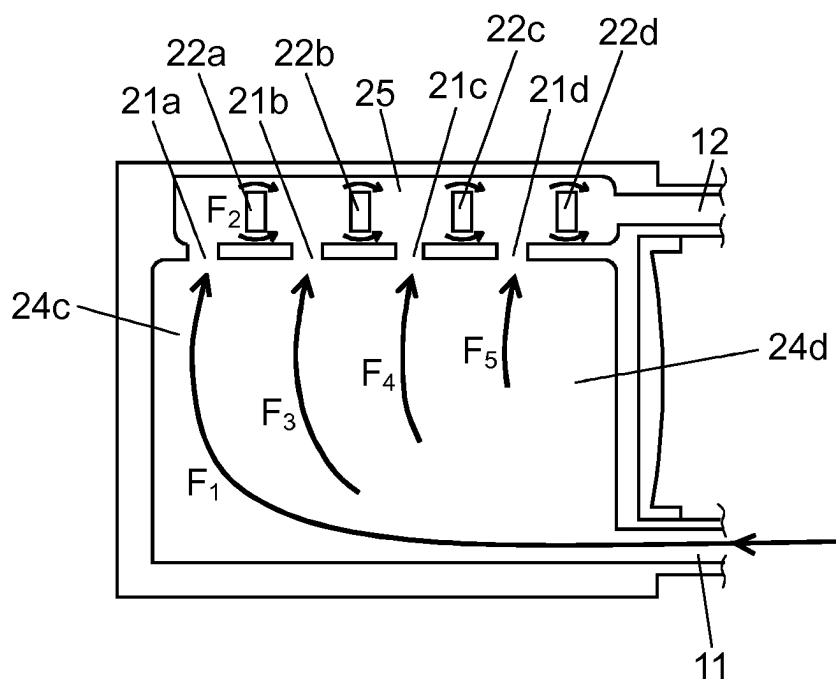


FIG. 6A

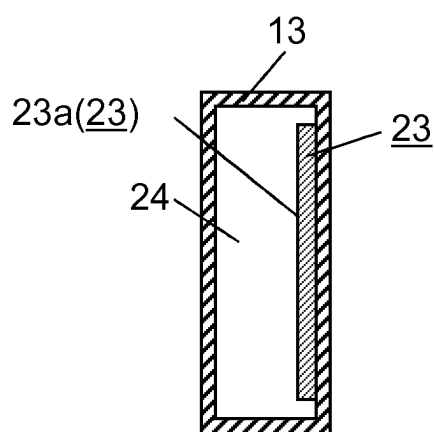


FIG. 6B

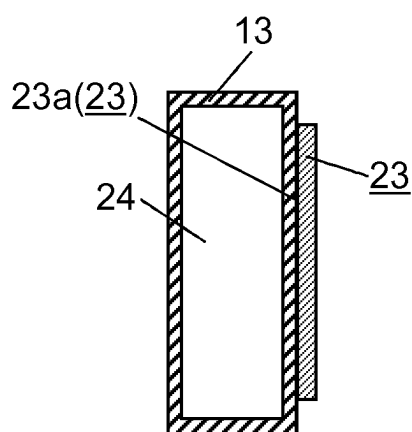


FIG. 6C

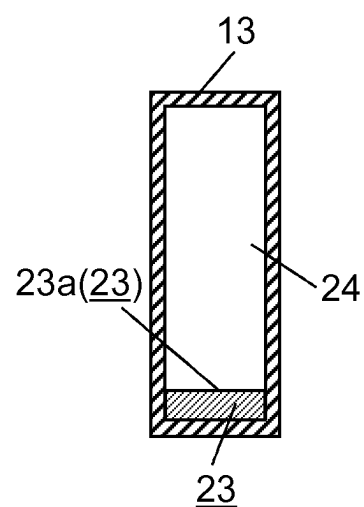


FIG. 7A

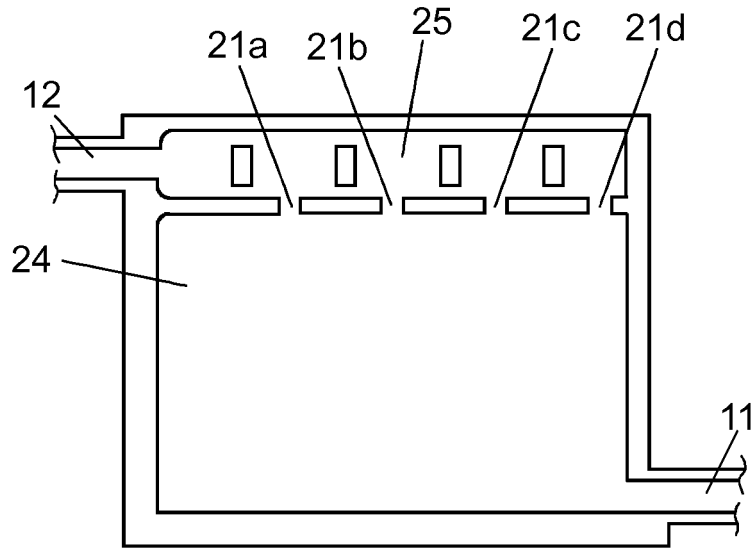


FIG. 7B

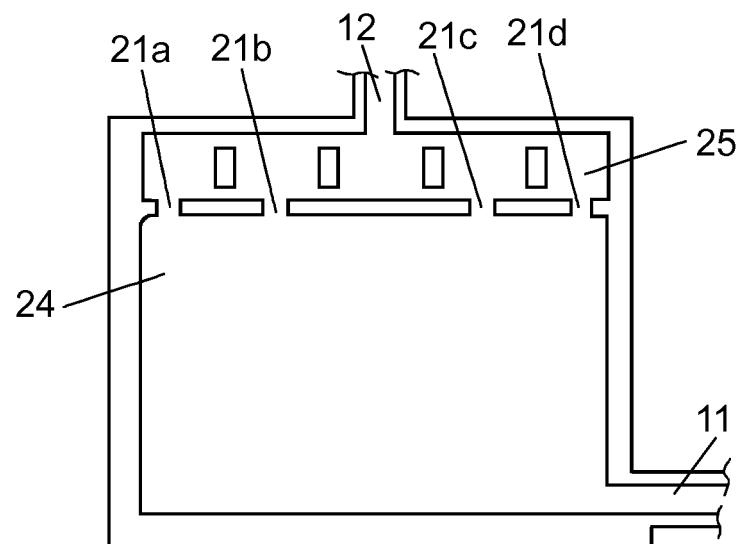
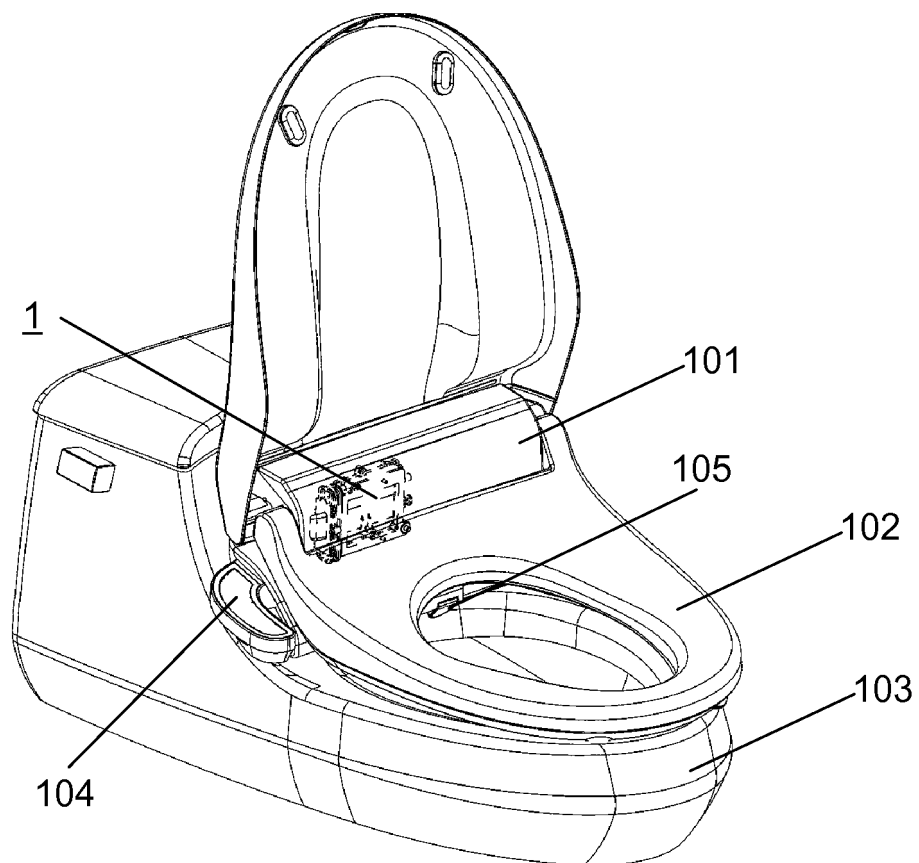


FIG. 8

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2014/003296

A. CLASSIFICATION OF SUBJECT MATTER

F24H1/10(2006.01)i, E03D9/08(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F24H1/10, E03D9/08

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2014
Kokai Jitsuyo Shinan Koho	1971-2014	Toroku Jitsuyo Shinan Koho	1994-2014

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	JP 2-311632 A (Matsushita Electric Works, Ltd.), 27 December 1990 (27.12.1990), page 2, lower left column to page 4, upper left column; fig. 1, 2 (Family: none)	1, 5-6, 8 2-4, 7
Y	JP 2000-154938 A (Toto Ltd.), 06 June 2000 (06.06.2000), claim 18; paragraph [0038]; fig. 4, 8 (Family: none)	2-4
Y	JP 4-278142 A (Hitachi AIC Inc.), 02 October 1992 (02.10.1992), paragraphs [0022] to [0023]; fig. 4 to 6 (Family: none)	2-3



Further documents are listed in the continuation of Box C.



See patent family annex.

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

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later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&"

document member of the same patent family

Date of the actual completion of the international search
11 September, 2014 (11.09.14)Date of mailing of the international search report
22 September, 2014 (22.09.14)Name and mailing address of the ISA/
Japanese Patent Office

Authorized officer

Facsimile No.

Telephone No.

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2014/003296

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 56-57420 A (Toto Ltd.), 19 May 1981 (19.05.1981), entire text; all drawings (Family: none)	7

Form PCT/ISA/210 (continuation of second sheet) (July 2009)

REFERENCES CITED IN THE DESCRIPTION

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- JP 3714060 B [0008]
- JP 2000001896 A [0008]
- JP 2009235792 A [0008]