

[001] WASHING DEVICE AND WASTE HEAT RECOVERY SYSTEM THEREOF

[002] Technical Field

- 5 [003] The present disclosure relates to a cleaning device, and more particularly to a cleaning device having a heat recovery unit / system.

[004] Background Art

[005] There are various commercially available cleaning apparatuses,
10 such as dishwashers, which typically heat the water of room temperature (about 25 °C) up to 70 to 95 °C with a heater for washing and/or rinsing the dishes. Due to the relatively long heating time and relatively high heating cost, there is a need in the field for an improved dishwasher which can reduce the heating time and cost for a long time.

15 [006] Referring particularly to Figures 1-2, which depict a prior art sealing type two-stage cleaning machine / apparatus 1 for cleaning tableware 50 (such as bowls, dishes, plates, chopsticks, spoons, knives, forks, and/or cups, or the like), comprising: a housing 60 having an input end and an output end and usually being in a substantially sealed state;
20 an automatic conveying mechanism 40 having an input end 401 and an output end 402, comprising a belt conveying mechanism, which extends through the Input and output ends of the cleaning apparatus so that the tableware 50 placed thereon can be conveyed therebetween; and a two-stage cleaning arrangement of two cleaning devices 10, 20 connected in
25 series or in cascade and having a substantially identical configuration, each of which comprises: a water inlet unit 101, 201 for inputting water of a first temperature (such as 25 ° C); a heater unit 102, 202 for

connecting with the water inlet unit and heating or adjusting the water from the water inlet unit to hot water of a third temperature (such as 70/85 °C); a water outlet unit 103, 203 for connecting with the heater unit and outputting the hot water of the third temperature for cleaning operation; a waste water treatment unit 104, 204 in fluid communication with the water outlet unit and adapted for processing waste water used for cleaning the tableware and output from the water outlet unit; and a steam processing unit 30 located above the cleaning devices 10, 20.

[007] In operation, the tableware 50 is conveyed from the input end 401 to the output end 402 via the automatic conveying mechanism, and the input end of the cleaning device 10 will be opened and sealed accordingly when the tableware is entered from the input end 401 and passed through the first cleaning device 10. During the period, the water coming from the water inlet unit 101 and having a lower or first temperature (about 25 °C) is heated by the heater unit 102 and converted to hot water having a relatively high temperature (about 70 °C), which can then be optionally mixed with a detergent and applied to the tableware by means of a nozzle or other similar devices with a pressurizer, so as to clean, wash, and/or rinse the tableware, while the waste water that has been used for cleaning the tableware during the period can be discharged concurrently from the drainage of the automatic conveying mechanism via the waste water treatment unit 104. When the operation in the first cleaning device 10 is completed, the tableware will be conveyed from the first cleaning device 10 into the second cleaning device 20. Similarly, the water inputting from the water inlet unit 201 and having a lower or first temperature (about 25 °C) is heated by the heater unit 202 to hot water having a relatively high temperature (about 85 °C), which is then output from the water outlet unit 203 via a nozzle or other similar device having the pressurizing

capability, so as to effect second stage of cleaning, washing, and/or rinsing of the tableware, while the waste water that has been used for cleaning the tableware will then be discharged accordingly via the waste water treatment unit 204. When the operation in the second cleaning device 20 is completed, the tableware will be conveyed from the second cleaning device 20 to the output end 402. The steam generated during the entire cleaning operation as described above is discharged concurrently from the steam processing unit 30.

[008] Obviously, the waste water discharged directly after the cleaning of the tableware still contain a considerable amount of heat, such that several equipment have been developed to utilize the waste heat of the waste water. For example, CN204562057U discloses a heat recovery energy-saving system for dishwasher, which includes a waste water heat recovery pump, a heat recovery storage tank, a heat exchange coil, a waste hot water valve, a preheated water inlet valve, so that the heat of the waste water could be used to preheat the inlet water via the heat exchange coil, whereby reducing the heating time and energy consumption. Such a dishwasher requires a larger or much larger waste water container than the conventional dishwasher to store all of the waste water generated during the entire dishwashing operation, so that all of the waste water could be transferred to the heat recovery storage tank (its space requirement is equivalent to that of the waste water container) to preheat the inlet water after the use of the dishwasher, and the next dishwashing cycle could be started only after the preheating operation is completed. Although such a dishwasher can utilize the thermal energy of the waste water to a certain extent, it requires additional space for storing and transferring the waste water and also additional time for preheating, so its advantages on the overall cost, operating time / efficiency and performance are limited.

[009] Brief Summary of Invention

[0010] The present disclosure discloses a cleaning device having a heat recovery unit, comprising:

5 [0011] a water inlet unit for inputting water of a first temperature;

[0012] a heater unit for connecting with the water inlet unit and heating or adjusting the water from the water inlet unit to hot water of a third temperature;

10 [0013] a water outlet unit for connecting with the heater unit and outputting the hot water of the third temperature for cleaning operation; and

[0014] a heat recovery unit in fluid communication with the hot water from the water outlet unit and/or steam generated therefrom for receiving, storing, transferring, and/or regulating heat or waste heat from the hot
15 water and/or the steam;

[0015] wherein the water inlet unit connects at least partly with the heat recovery unit to receive heat or waste heat from the heat recovery unit and/or the hot water and/or the steam, by which heat or waste heat the water in the water inlet unit is regulated to be of a second
20 temperature before heated by the heater unit.

[0016] Preferably, the cleaning device further comprises a waste water treatment unit in fluid communication with the water outlet unit and adapted for processing waste water used for cleaning operation and output from the water outlet unit; and/or a condensate treatment unit
25 adapted for being in fluid communication with the steam generated by the water outlet unit for treating condensed water from the steam.

[0017] In some embodiments, the heat recovery unit and/or the water inlet unit are further connected to the waste water treatment unit to receive the waste heat from the waste water so that the water in the water inlet unit is preheated or adjusted to the second temperature
5 before being heated by the heater unit.

[0018] In some embodiments, the heat recovery unit and/or the water inlet unit are further connected to the condensate treatment unit to receive the condensed water and/or the heat from the condensed water, so that the water in the water inlet unit is preheated or adjusted to the
10 second temperature before being heated by the heater unit.

[0019] In some embodiments, longitudinal axes of the water inlet unit, the water outlet unit, the heat recovery unit, the condensate treatment unit and/or the waste water treatment unit are aligned with each other.

15 [0020] In some embodiments, at least a portion of the water inlet unit and/or the waste water treatment unit and/or the condensate treatment unit is arranged in a manner of surrounding a longitudinal axis of the heat recovery unit, comprising a manner of surrounding concentrically a longitudinal axis of the heat recovery unit.

20 [0021] In some embodiments, the first temperature comprises 25 °C, 45-57 °C or 5-57 °C; and/or the second temperature comprises 45-57 °C or 35-65 °C; and/or the third temperature comprises 70-85 °C or 70-95 °C.

[0022] The present disclosure also discloses a cleaning apparatus
25 for cleaning tableware comprising at least one of the cleaning device, and further comprising:

[0023] an automatic conveying mechanism including a belt conveyor mechanism extended through an input end and an output end

of the cleaning apparatus so that the tableware, comprising a bowl, a dish, a disk, and/or a cup, can be conveyed therebetween;

[0024] wherein at least one cleaning device is arranged between the input end and the output end to clean the tableware passing therethrough and conveyed therebetween;

[0025] wherein in a configuration of the cleaning apparatus comprising a plurality of cleaning devices, the cleaning devices are arranged in series or in cascade between the input end and the output end to sequentially clean the tableware conveyed therebetween; and the water inlet unit, the heat recovery unit, the condensate treatment unit, and/or the waste water treatment unit of one of the plurality of cleaning devices are respectively connected with the water inlet unit, the heat recovery unit, the condensate treatment unit, and/or the waste water treatment unit of other one or more of the cleaning devices, so as to facilitate the water in one or more of the water inlet unit to be preheated or adjusted to the second temperature before being heated by respective heater units.

[0026] In addition, the present disclosure further discloses a cleaning apparatus for cleaning tableware comprising two cleaning device as described above and further comprising:

[0027] an automatic conveying mechanism including a belt conveyor mechanism extended through an input end and an output end of the cleaning apparatus so that the tableware, comprising a bowl, a dish, a disk, and/or a cup, can be conveyed therebetween;

[0028] wherein the two cleaning devices are arranged between the input end and the output end to clean the tableware passing therethrough and conveyed therebetween;

[0029] wherein the two cleaning devices are arranged in series or in cascade between the input end and the output end to sequentially clean the tableware conveyed therebetween; and the water inlet unit, the heat recovery unit, the condensate treatment unit, and/or the waste water treatment unit of one of the plurality of cleaning devices are respectively connected with the water inlet unit, the heat recovery unit, the condensate treatment unit, and/or the waste water treatment unit of the other one of the cleaning devices, so as to facilitate the water in each of the water inlet units to be preheated or adjusted to the second temperature before being heated by respective heater units.

[0030] In some embodiments, in the configuration of the cleaning apparatus comprising a plurality of cleaning devices, one of the plurality of cleaning devices and the other one or more of the plurality of the cleaning devices are configured to share one or more of the heat recovery units; and/or the condensate treatment unit and/or the waste water treatment unit of one of the plurality of cleaning devices are respectively in connection with the water inlet unit, the heat recovery unit, the condensate treatment unit, and/or the waste water treatment unit of other one or more of the cleaning devices; and/or the condensate treatment unit of one of the plurality of cleaning devices are respectively in fluid communication with the water inlet unit, the heat recovery unit, and/or the condensate treatment unit of other one or more of the cleaning devices; wherein the connection and/or the fluid communication facilitate the water in one or more of the water inlet unit to be preheated or adjusted to the second temperature before being heated by respective heater units.

[0031] Brief Description of Drawings

[0032] The present disclosure will be described in details below with reference to the accompanying drawings, in which:

[0033] Figure 1 is a schematic view of a prior art sealing type cleaning apparatus for cleaning tableware;

5 [0034] Figure 2 is a schematic perspective view of the cleaning apparatus of Figure 1;

[0035] Figure 3 is a schematic perspective view of a cleaning device having a heat recovery unit according to an exemplary embodiment of the present disclosure; and

10 [0036] Figure 4 is a perspective and cross-sectional view of an exemplary heat recovery unit according to another embodiment of the present disclosure.

[0037] Detailed Description of Invention

15 [0038] Some preferred embodiments of the present disclosure are set forth below in conjunction with the accompanying drawings, so as to illustrate in details the technical solutions of the present disclosure.

[0039] Referring to Fig. 3, a schematic perspective view of a cleaning apparatus 2 having a heat recovery unit according to an exemplary embodiment of the present disclosure is shown. The structure and arrangement of the cleaning device 2 are substantially identical to the prior art cleaning device 1 as described above, and it comprises a two-stage cleaning arrangement of two cleaning devices 10, 20 connected in series or in cascade, but it further comprises a heat recovery unit 300 and water inlet units 101', 201' being correspondingly and adaptively modified; and/or other units / components, etc., so as to

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recycle and reuse substantially the heat generated by the cleaning apparatus 2.

[0040] The heat recovery unit 300 may be a thermal block of a heat storage material, a heat sink stack, and/or a heat exchanger, which has a good thermal conductivity and a selective shape for efficient storage and transfer of thermal energy. As shown in the figure, the heat recovery unit 300 may selectively be provided as a part of the steam processing unit 30. Preferably, it may be arranged right above the output portion of the water outlet unit 203 and/or the input or storage portion of the waste water treatment unit 205, such that the hot water output from the water outlet unit 203 and/or the steam generated from the waste water entering into the waste water treatment unit 205 during the operation process could reach and pass through the heat recovery unit 300 for heat recovery and reuse in a relatively fast manner.

[0041] For the sake of clarity, only one shared heat recovery unit 300 is shown in the figure. In some embodiments, a plurality of heat recovery units may be provided corresponding to the number of cleaning devices 10, 20. For example, one or more heat recovery units may be provided right above the output portion of the water outlet unit 103 and/or the input or storage portion of the waste water treatment unit 105 of the cleaning device 10.

[0042] In some embodiments of the present disclosure, the heat recovery unit 300 may be configured to be in connection and/or fluid communication with all of other units or portions (e.g., the waste water treatment unit, or the like) of the cleaning apparatus 2 capable of generating thermal energy or carrying waste heat (e.g., the steam, condensate, waste water, or the like), so as to recover or utilize the heat energy thereof for preheating the water in the water inlet units 101', 201' connected thereto.

[0043] According to some embodiments of the present disclosure, the cleaning apparatus 2 further comprises at least one condensate treatment unit 210 configured for being in fluid communication with the steam generated by the cleaning device to process the condensate /
5 condensed water from the steam. The condensate has a considerable amount of heat and is relatively clean, so that both itself and its heat can be recovered and reused by the cleaning apparatus 2. According to the present embodiment, the condensate treatment unit comprises a storage device 211 (such as a water collector as shown in the figure) and an
10 output device 212 (such as a pipe shown in the figure, which is depicted by a dashed line, indicating that the arrangements of its position and connection are optional), and the output device is selectively connected to the heat recovery unit 300 through a connecting device, such as a pumping mechanism 230 or the like, such that the condensed water in
15 the storage device and its heat can be transferred to the heat recovery unit 300.

[0044] In some embodiments, the condensate treatment unit may be in fluid communication with the water inlet units 101', 201', such that the condensed water may be used directly for the cleaning operation.

20 [0045] As shown in Fig. 3, the water inlet unit 201' in the present embodiment basically comprises a water pipe having a straight portion connected to the water source and/or the heater unit 202, and a meandering portion connected to or made contact with the heat recovery unit 300 and extended back and forth along the width and/or height of at
25 least a portion of the heat recovery unit, and the meandering portion is configured to preferably maximize the contact area between the water inlet unit and the heat recovery unit to facilitate heat transfer with the heat recovery unit. In some embodiments, the portion of the water inlet unit 201' connected to the heater unit 202 may be connected to the

water inlet unit 101' of the cleaning device 10 or directly acted / used as the water inlet unit 101' of the cleaning device 10 (which is depicted by a dashed line in the figure, indicating that the arrangements of its position and connection are optional).

5 [0046] According to some embodiments of the present disclosure, the waste water treatment unit and/or the condensate treatment unit may be configured to comprise also a meandering portion connected to or made contact with the heat recovery unit 300 and extended back and forth along the width and/or height of at least a portion of the heat
10 recovery unit, and the storage device and the output device of the waste water treatment unit and/or the condensate treatment unit are selectively connected to the heat recovery unit 300 by the pumping mechanism 230, such that the heat of the waste water and/or condensate in the storage device may be transferred to the heat recovery unit 300.

15 [0047] According to some embodiments of the present disclosure, the longitudinal axes of the water inlet unit 201', the water outlet unit 202, the heat recovery unit 300, the condensate treatment unit 210, and/or the waste water treatment unit 204 might be aligned with each other.

[0048] According to other embodiments of the present disclosure, at
20 least a portion of the water inlet unit and/or the waste water treatment unit and/or the condensate treatment unit, such as the foregoing meandering portion, is arranged in a manner of surrounding the longitudinal axis of the heat recovery unit 300, for example, in a manner of surrounding concentrically the longitudinal axis of the heat recovery
25 unit.

[0049] In some embodiments, the heat recovery unit 300 may be disposed in the lower part of the cleaning device, namely to be near or adjacent to the waste water treatment units 105, 205 to receive waste

heat from the waste water, and in such a configuration, at least a portion of the water inlet unit and/or the condensate treatment unit, such as the foregoing meandering portion, is arranged in a similar manner of surrounding the heat recovery unit 300, and the steam generated in the cleaning device may be oriented to the heat recovery unit via an additional conduit or guiding device (not shown), such that the heat recovery unit located in the lower part of the cleaning device can also receive the heat of the steam generated in the middle or upper part of the cleaning device.

[0050] Referring to Fig. 4, a perspective and cross-sectional view of an exemplary heat recovery unit according to another embodiment of the present disclosure is shown. The heat recovery unit 300' is a thermal block of a heat storage material and in a substantially cylindrical form, a heat sink stack, and/or a heat exchanger, among which a plurality of heat sink elements and/or heat exchanging elements spaced apart from each other might be arranged to enable the steam to flow therethrough; and two inner and outer annular conduits 410, 420 arranged preferably in a concentric manner and connected with and located outside the heat sink elements and/or heat exchanging elements are provided to receive the heat from the steam and the heat sink elements and/or heat exchanging elements, so as to preheat the water therein. The lower part of the heat recovery unit 300' is provided with a condensate treatment unit 210 for processing the condensed water generated by the heat recovery unit. The storage device 211 of the condensate treatment unit may be located in a position that is in contact with the heat recovery unit but being departed from and not interfering with the steam channel / duct. According to the present embodiment, the inner annular pipe 420 is the meandering portion of the water inlet unit, the temperature of the water at its input end 421 is about 25 °C, and after being heated by the heat

recovery unit, the temperature of the water at its output end 422 may be about 45-57°C. The outer annular conduit 420 may be the meandering portion of the condensate treatment unit, or the waste water treatment unit, or the water inlet unit or the condensate treatment unit or the waste
5 water treatment unit of other cleaning devices. In some embodiments, the heat recovery unit may be provided with two or more layers of annular conduit, such that the heat recovery unit might be connected with all of other units or portions of the cleaning apparatus capable of generating thermal energy or carrying waste heat.

10 [0051] Referring again to Figs. 1-2, each of the shown prior art two-stage cleaning arrangement of two cleaning devices 10, 20 respectively comprises separate water inlet units 101 and 201, heater units 102 and 202, water outlet units 103 and 203, and waste water treatment units 104 and 204. In order to recover and reuse the heat generated by the
15 cleaning apparatus 2 to the greatest extent, the present disclosure has adaptively modified their configuration and connection such that they could cooperate with the heat recovery unit 300 in a preferred manner.

[0052] In some embodiments, the cleaning apparatus comprises only one cleaning device for effecting one or more cleaning operations.
20 In other embodiments, the cleaning apparatus comprises a plurality of cleaning devices 10, 20 arranged in series or in cascade between the input end and the output end of the cleaning apparatus to sequentially clean the tableware conveyed therebetween; and the water inlet unit, the heat recovery unit, the condensate treatment unit, and/or the waste
25 water treatment unit of one of the plurality of cleaning devices might be connected with each other and might be also respectively connected with the water inlet unit, the heat recovery unit, the condensate treatment unit, and/or the waste water treatment unit of other one or more of the cleaning devices, so as to facilitate the water in one or more

of the water inlet unit to be preheated or adjusted to a relatively high temperature before being heated by respective heater units. For example, to be more specific, the water inlet unit of the cleaning device 10 might be not only in corresponding connection to make use of the waste heat of the cleaning device 10, but also in connection respectively with the water inlet unit, the heat recovery unit, the condensate treatment unit, and/or the waste water treatment unit of the cleaning device 20, and in fluid communication with the steam or fluid generated in the cleaning device 20 to utilize the thermal heat or waste heat of the respective units of the cleaning device 20.

[0053] In some embodiments, one of the plurality of cleaning devices and the other one or more of the plurality of the cleaning devices included by the cleaning apparatus might be configured to share one or more of the heat recovery units to simplify the configuration thereof. Alternatively, the condensate treatment unit and/or the waste water treatment unit of one of the plurality of cleaning devices might be respectively in connection with the water inlet unit, the heat recovery unit, the condensate treatment unit, and/or the waste water treatment unit of other one or more of the cleaning devices to mutually transfer and receive the waste heat therein. Preferably, the condensate treatment unit of one of the plurality of cleaning devices might be respectively in fluid communication with the steam, the water inlet unit, the heat recovery unit, and/or the condensate treatment unit of other one or more of the cleaning devices, such that both the condensed water itself and its heat could be completely recycled and reused. According to the present disclosure, the connection and/or the fluid communication facilitate the water having a first temperature (such as 25 °C / 45-57 °C / 5-57 °C) in one or more of the water inlet unit to be preheated or adjusted to the second temperature (such as the preferred 45-57 °C or 35-65 °C) before

being heated by respective heater units to a desired working temperature (such as the preferred 70/85 °C or 70-95 °C).

[0054] The heat recovery unit according to the present disclosure is used to be in connection with and/or in fluid communication with those
5 various units of the cleaning apparatus capable of generating waste heat and/or the high temperature steam, wherein the heat recovery unit might be of various configurations, and might be arranged at multiple locations and might be in various connections with other units to receive, store, transfer and reuse the waste heat therein. The various exemplary heat
10 recovery units as described above are for illustrative rather than exhaustive purposes.

[0055] Obviously, the heat recovery unit of the present disclosure preheats the inlet water of the cleaning device by recovering the heat of the waste water and the steam generated during the cleaning process,
15 thereby reducing the heating time and the energy consumption. The heat recovery unit of the present disclosure may be arranged in the conventional cleaning device without the need for any additional space or container for storing the waste water generated during the entire dishwashing operation, and the preheating operation is continuous and
20 almost no delay or latency in time. In addition, the present disclosure could be easily employed in the existing conventional cleaning equipment without making significant changes to the prior art cleaning equipment, such the present disclosure has significant advantages in terms of the overall cost, operating time / efficiency, and performance
25 thereof.

[0056] The description of the foregoing embodiments has been provided for illustrative and descriptive purposes. But the embodiments are not intended to be exhaustive or limitative to the present disclosure. The individual components or features of a particular embodiment are

generally not limited to such particular embodiment, but are interchangeable with and adoptable in other selected embodiments when appropriate, even if not being specifically shown or described hereinbefore. The individual components or features may also be varied
5 and modified in many ways. Such variations and modifications are not to be regarded as a departure from the present disclosure, and all such variations and modifications are intended to be included within the scope of the invention.

[0057] Claims

1. A cleaning device having a heat recovery unit, comprising:
a water inlet unit for inputting water of a first temperature;
a heater unit for connecting with the water inlet unit and heating or
5 adjusting the water from the water inlet unit to hot water of a third
temperature;
a water outlet unit for connecting with the heater unit and
outputting the hot water of the third temperature for cleaning
operation; and
10 a heat recovery unit in fluid communication with the hot water from
the water outlet unit and/or steam generated therefrom for
receiving, storing, transferring, and/or regulating heat or waste
heat from the hot water and/or the steam;
wherein the water inlet unit connects at least partly with the heat
15 recovery unit to receive heat or waste heat from the heat recovery
unit and/or the hot water and/or the steam, by which heat or waste
heat the water in the water inlet unit is regulated to be of a second
temperature before heated by the heater unit.
2. The cleaning device according to Claim 1, further comprising a
20 waste water treatment unit in fluid communication with the water
outlet unit and adapted for processing waste water used for
cleaning operation and output from the water outlet unit.
3. The cleaning device according to claim 2, wherein the heat
recovery unit and/or the water inlet unit are further connected to
25 the waste water treatment unit to receive the waste heat from the
waste water so that the water in the water inlet unit is preheated
or adjusted to the second temperature before being heated by

the heater unit.

4. The cleaning device according to anyone of the preceding claims, further comprising a condensate treatment unit adapted for being in fluid communication with the steam generated by the water outlet unit for treating condensed water from the steam.
5. The cleaning device according to claim 4, wherein the heat recovery unit and/or the water inlet unit are further connected to the condensate treatment unit to receive the condensed water and/or the heat from the condensed water, so that the water in the water inlet unit is preheated or adjusted to the second temperature before being heated by the heater unit.
6. The cleaning device according to anyone of the preceding claims, wherein longitudinal axes of the water inlet unit, the water outlet unit, the heat recovery unit, the condensate treatment unit and/or the waste water treatment unit are aligned with each other.
7. The cleaning device according to anyone of the preceding claims, wherein at least a portion of the water inlet unit and/or the waste water treatment unit and/or the condensate treatment unit is arranged in a manner of surrounding a longitudinal axis of the heat recovery unit, comprising a manner of surrounding concentrically a longitudinal axis of the heat recovery unit.
8. The cleaning device according to anyone of the preceding claims, wherein the first temperature comprises 25 °C, 45-57 °C or 5-57 °C; and/or the second temperature comprises 45-57 °C or 35-65 °C; and/or the third temperature comprises 70-85 °C or 70-95 °C.
9. A cleaning apparatus for cleaning tableware comprising a cleaning device as claimed in any one of the preceding claims, and further comprising:

an automatic conveying mechanism including a belt conveyor mechanism extended through an input end and an output end of the cleaning apparatus so that the tableware, comprising a bowl, a dish, a disk, and/or a cup, can be conveyed therebetween;

5 wherein at least one cleaning device is arranged between the input end and the output end to clean the tableware passing therethrough and conveyed therebetween;

10 wherein in a configuration of the cleaning apparatus comprising a plurality of cleaning devices, the cleaning devices are arranged in series or in cascade between the input end and the output end to sequentially clean the tableware conveyed therebetween; and the water inlet unit, the heat recovery unit, the condensate treatment unit, and/or the waste water treatment unit of one of the plurality of cleaning devices are respectively connected with the water inlet unit, the heat recovery unit, the condensate treatment unit, and/or the waste water treatment unit of other one or more of the cleaning devices, so as to facilitate the water in one or more of the water inlet unit to be preheated or adjusted to the second temperature before being heated by respective heater units.

20 10. The cleaning apparatus as claimed in claim 9, wherein in the configuration of the cleaning apparatus comprising a plurality of cleaning devices, one of the plurality of cleaning devices and the other one or more of the plurality of the cleaning devices are configured to share one or more of the heat recovery units; and/or the condensate treatment unit and/or the waste water treatment unit of one of the plurality of cleaning devices are respectively in connection with the water inlet unit, the heat recovery unit, the condensate treatment unit, and/or the waste

water treatment unit of other one or more of the cleaning devices;
and/or the condensate treatment unit of one of the plurality of
cleaning devices are respectively in fluid communication with the
water inlet unit, the heat recovery unit, and/or the condensate
treatment unit of other one or more of the cleaning devices;
wherein the connection and/or the fluid communication facilitate
the water in one or more of the water inlet unit to be preheated or
adjusted to the second temperature before being heated by
respective heater units.