A device for heating process water for a water-carrying household appliance is provided. The device stores thermal energy surrounding the device and transfers the thermal energy to the process water. The device is a latent heat energy store having a heat exchanger with a storage medium and a working medium. The storage medium stores the thermal energy and the temperature of a phase transition of the working medium is set between 20°C and 22°C.
DEVICE FOR HEATING PROCESS WATER FOR A WATER-CARRYING HOUSEHOLD APPLIANCE FOR THE CARE OF LAUNDRY ITEMS, AND HOUSEHOLD APPLIANCE HAVING SUCH A DEVICE

[0001] The present invention relates to a device for heating process water for a water-carrying household appliance, particularly a household appliance for the care of laundry items. In washing machines, the water flowing in from a supply network, which is also referred to hereinbelow as process water, is heated with the aid of an electrical heating device from the inflow temperature up to the set washing temperature. The energy needed for this constitutes a major part of the energy needed for a wash cycle. The temperature of the inflowing process water is typically significantly lower than the temperature of the space in which the household appliance is installed. Thus, in Berlin, for example, the process water supplied to consumers typically has a temperature at the water meter of between 13°C and 15°C. Washing appliances are frequently installed in a room inside apartments and buildings. The temperature of interior rooms lies typically between 20°C and 25°C and in summer may sometimes lie significantly above that, and, in particular, even reach up to 30°C. In an extended period of non-use, all parts assume the temperature of the room in which they are installed.

[0002] A washing machine or dishwasher having a latent heat store which is designed for heating supplied fresh water is known from DE 44 03 737 A1. The latent heat store is connected to a heat exchanger, the primary circuit of which is composed of a line carrying waste water and the secondary circuit of which is composed of the line for the fresh water to be supplied, such that heat from the waste water is transferred to the latent heat store and can be fed again to the fresh water to be supplied. A further such water-carrying household appliance is disclosed in DE 199 60 812 A1.

[0004] The object of the present invention is to create an alternative device and/or a household appliance with which the heating of process water for a water-carrying household appliance can be carried out in an energy-efficient and cost-effective manner.

[0005] This object is achieved in a device having the features as claimed in claim 1 and in a household appliance according to claim 17.

[0006] An inventive device for heating process water for a water-carrying household appliance which preferably a household appliance for the care of laundry items is designed for storing thermal energy in the surroundings of the device and for transferring the thermal energy to the process water. The device can thus achieve an energy-efficient heating of the process water for the household appliance, as the temperature in the surroundings of the device and also of the household appliance, which temperature is normally higher than that of the process water is absorbed and transferred to the process water. In an ongoing washing process, the temperature of the process water in the household appliance has therefore to be raised only by a significantly smaller temperature value than is the case in conventional household appliances. Thermal energy from the air in the space surrounding the device is preferably fed to the device for thermal storage. In this way, the process water supplied to the household appliance can be heated to ambient temperature in a simple manner. The device can be constructed very simply and cost-effectively since, for example, no secondary circuit of a heat exchanger known from the prior art is required.

[0007] The device is preferably designed as a latent heat energy store. This is particularly advantageous since the thermal energy absorbed can also be stored in the device and can be transferred as required. In this way, the energy-efficiency can be increased still further.

[0008] The device is preferably connected to the water supply network and connected to the household appliance. Provision is made in this way for the device to be integrated into the inflow facility, and no additional external further devices thus have to be provided. The device can thus be integrated into the entire feed system with a minimum of components and in an optimum position.

[0009] The device is designed, in particular, for accommodating a quantity of process water required for a wash and/or rinse program, in particular at least 101. This is a particularly advantageous embodiment since in this respect a quantity of water such as is subsequently necessary for a chosen wash and/or rinse program can be thermally subjected to the stored heat energy. In this way, even very large quantities of process water can be heated by the device, so that this also impacts advantageously on subsequent full use during a washing process.

[0010] The device is also designed not least with the objectives of being able to apply thermal energy efficiently specifically to such large quantities of process water and thus also of enabling a relatively large increase in the temperature of such large quantities of process water to be achieved by the device.

[0011] In particular, the device is designed to transfer the absorbed thermal energy to the process water in a deactivated phase of the household appliance. This energy store is thus loaded in the non-use phase of the household appliance and brought to the temperature in the surroundings of the device, in particular in a space in which the household appliance is installed. When water flows in, the absorbed energy is transferred to the inflowing process water.

[0012] It is particularly advantageous specifically in this phase to apply the thermal energy to the process water accordingly, as it is then available for subsequent use in a wash program at a significantly higher temperature and can be fed to the water-carrying household appliance, in particular the washing appliance or the household appliance for the care of laundry items.

[0013] The device preferably comprises a heat exchanger having a storage medium for thermal energy. The device may, in particular, be a latent heat store having such a heat exchanger. The temperature of the phase transition of the working medium of the heat exchanger is preferably set to a temperature between 20°C and 22°C. In the phase of non-use of the household appliance the storage medium of the heat exchanger is liquefied through absorption of energy from the installation space. When water flows in, a phase transition of this storage medium occurs, and the storage medium transfers its latent stored energy to the process water and/or the inflowing water. A latent heat store of such a design is capable of storing large quantities of energy in a small storage volume.

[0014] In a particularly advantageous manner, the storage medium of a heat exchanger of this type is the inflowing process water itself. The device is thus in a particularly advan-
tageous manner designed such that, with regard to this design, the process water itself forms the storage medium with regard to this absorption of energy.

[0015] The device for heating process water preferably has a container for accommodating the process water, which container is designed for absorbing the thermal energy. This design enables direct contact to be achieved between the process water and the container walls, providing a direct thermal coupling via which a particularly effective transfer of the stored thermal energy from the container to the process water can be effected.

[0016] In particular, the device is designed such that a container of this type is arranged externally in relation to the household appliance, in particular arranged in a built-in furniture unit, in particular integrated therein. It has proven to be particularly advantageous for a container of this type to be built into and integrated in a worktop, the household appliance preferably being located beneath this worktop. In this way a device of this kind can be arranged and provided in a manner optimally suited to the installation space.

[0017] Alternatively, the device for heating process water is encompassed by the water-carrying household appliance itself. It has proven to be particularly favorable for the device to be integrated in the worktop of the household appliance.

[0018] A wound, in particular serpentine, flow channel is preferably embodied in the container. This design enables the guiding of the process water flowing into the container to be arranged particularly effectively such that it comes into contact as much and as often as possible with the container walls, in which the thermal energy is stored through increase in the temperature of the heat of the container. The flow channel can be embodied as a tubular structure in the built-in furniture component, in particular the worktop. This flow channel is preferably dimensioned so as to accommodate as great as possible a volume of water.

[0019] A particularly advantageous embodiment is produced if the flow channel is formed and/or delimited by the inner walls of the container and by additional separate dividing walls in the container. Virtually the entire interior volume of the container can thus be designed for accommodating the process water and for forming the flow channel. It is precisely such a design that on the one hand makes it possible for a large quantity of process water, for example even as much as 151 or more, to be accommodated and on the other nonetheless provides this in a particularly compact and minimally-sized container design.

[0020] It is preferably provided that blocking elements, in particular valves, are arranged at the inlet and/or at the outlet of the device, in particular at the inlet and/or at the outlet of the container. Such valves for controlling the water inflow and the water outflow can thus be arranged upstream of or downstream of the storage device. If the valve is located upstream of the storage device, it is preferably provided that it be ensured through an appropriate arrangement of the storage device or a special outflow protection that the process water located in the energy storage device, in particular the container, is not carried further in an undesired manner or does not flow out in an undesired manner after termination of the filling process.

[0021] The design of a flow channel in the container prevents the relatively cold inflowing process water from mixing to an undesirable extent with the previously heated process water located in the container. The inlets and the outlets of the device, in particular of the container, as well as the flow channel, are preferably arranged and designed such that the inflowing relatively cold process water expels or forces the previously heated process water out of the container. As a consequence, this previously heated process water then exhibits no undesired cooling by the inflowing process water.

[0022] In the event that the device is arranged externally in relation to the household appliance, a thermal insulation facility is preferably embodied on a side of the device facing the household appliance. It may in particular be provided that the facility has a thermal insulation layer arranged on the inside of the container. Such a design can prevent a transfer of heat from the interior of the household appliance to the device and an associated condensation of ambient air humidity on the inside. This would extract part of the stored thermal energy again, thereby reducing again the effective transfer of heat for heating the process water in the device.

[0023] Such thermal insulation facilities may also be provided accordingly on the device for heating the process water, which device is encompassed by the household appliance.

[0024] It may in particular be provided that, for example, at a temperature of the inflowing process water of approximately 15°C and a temperature of the surroundings of the device of approximately 23°C, a water quantity of approximately 151 can be heated such that in a care process of the household appliance, in particular in a washing process, the heating time of the supplied process water can be reduced by about four minutes. This leads to a reduction in energy consumption of approximately 0.14 kWh. Such a use of a device for heating the process water can also achieve improved dissolving of the detergent during the care process in the household appliance.

[0025] The process water heated by the device and flowing into a container of the household appliance, in particular into an outer tub or dishwasher cavity, has substantially the temperature of the surroundings of the device, and consequently less energy and less time are required for further heating of the water in the household appliance during the execution of a care process.

[0026] Exemplary embodiments of the invention will be described in greater detail hereinbelow with the aid of schematic drawings, in which:

[0027] FIG. 1 shows a schematic representation of a household appliance and of a device for heating process water;

[0028] FIG. 2 shows a schematic plan view of an exemplary embodiment of a device according to the invention; and

[0029] FIG. 3 shows a longitudinal sectional representation of the device according to FIG. 2.

[0030] Identical or functionally identical elements are labeled in the drawings with the same reference characters.

[0031] FIG. 1 shows in a schematic front view a household appliance for the care of laundry items, which is embodied as a washing machine 1. The washing machine 1 comprises a drum 2 which is mounted rotatably about an axis A oriented perpendicularly to the plane of the drawing. The drum 2 is designed for accommodating laundry items. The washing machine 1 additionally comprises an 3 which surrounds the drum 2 circumferentially and into which water and/or a washing liquor is introduced when a washing process is executed.

[0032] FIG. 1 additionally shows a built-in furniture unit which comprises a worktop 4. The worktop 4 is arranged in a vertical direction (y direction) above the washing machine 1, the washing machine 1 being installed in an installation space below the worktop 4.
The embodiment also shows a device 5 for heating process water 8 which flows in via a supply network 9. The device 5 comprises a container 6 which is integrated in the workstation 4. The container 6 has an input or inlet 7 which is connected to a hose connection, the process water 8 flowing into the container 6 via this hose and the inlet 7. On the opposite side viewed in a horizontal direction (x-direction) the container 6 comprises an output or outlet 10 which is likewise connected to a hose 11 which leads into the washing machine 1 such that the process water flowing out from the container 6 can be routed via the hose 11 and optionally via further components into the outer tub 3.

The device 5 comprising the container 6 is designed for storing thermal energy (Fig. 2). The walls of the container 6 heating up in this respect to the temperature of the surroundings of the container 6 and thus to the temperature in the installation space of the washing machine 1, this thermal energy then being transferred in particular via the walls of the container 6 to the process water 8 located in the container 6.

The device 5 comprising the container 6 is designed in particular as a latent heat energy store.

Fig. 2 shows a plan view of the workstation 4 and thus also of the device 5 comprising the container 6. The container 6 has an interior space which enables it to accommodate a quantity of water of, for example, 151. In the interior of the container 6 a flow channel 17 is embodied which is preferably delimited on the one hand by the inner wall 12 of the container 6 and on the other by further dividing walls 13. According to the embodiment shown in Fig. 2, the dividing walls 13 are oriented parallel to one another and are arranged on the inner walls 12 in such a way that a meandering and thus also serpentine winding of the flow channel 17 through the container 6 is produced. The relatively cold process water 8 flowing in via the inflow or inlet 7, which water is colder in temperature than the ambient temperature in the installation space of the washing machine 1, is thus guided, so to speak, through the flow channel 17, absorbing the stored thermal energy 14 and being heated as it does so. In particular, the process water 8 in the container 6 then has a temperature which corresponds to the temperature of the surroundings of the washing machine 1. The washing machine 1 is thus connected to an energy store and/or a device 5 which heats the inflowing water. In particular, this device 5 is loaded in a phase of non-use of the washing machine 1 and brought to the temperature of the installation space. When water flows in, the thermal energy absorbed is transferred to the process water 8. The process water 8 flowing via the outlet 10 to the outer tub 3 has as a result the temperature of the installation space, and less energy and less time are needed for further heating of the water in the washing machine 1.

Thus, in the embodiment shown, a latent heat energy store is shown in which the storage medium is the process water 8 itself. In the phase of non-use of the washing machine 1, the container 6 is completely filled with inflowing process water 8 and then both the inlet 7 and outlet 10 are closed by means of valves (not shown in detail). The process water 8 then located in the container 6 absorbs the stored thermal energy.

If this process water 8 is subsequently needed for a washing process, the valve on the outlet 10 and also the valve on the inlet 7 are preferably opened and the heated process water 8 located in the container 6 is forced through the flow channel 17 by the relatively cold process water 8 flowing in via the inlet 7 and is correspondingly displaced and expelled from the outlet 10. The flow channel 17 not only generates the greatest possible degree of contact between the process water 8 flowing in the container 6 and the inner wall 12 but also prevents a relatively large quantity of heated process water 8 in the container 6 mixing with the relatively cold inflowing process water 8 and thus can also prevent an undesired intense cooling of a relatively large quantity of previously heated process water 8 in the container 6.

Fig. 3 shows a schematic longitudinal sectional representation along the section AA of the device 5 according to Fig. 2. It can be seen that a thermal insulation facility 15 is embodied over the entire surface of the base of the container 6, the side 16 facing the washing machine 1 thus being thermally insulated. A transfer of heat from the interior of the washing machine 1 to the device 5 and thus a possible associated condensation of ambient air humidity on the inside of the container 6 can thereby be prevented, as a result of which an extraction of heat from the heated process water 8 located in the container 6 can also be prevented.

In an alternative embodiment, the workstation 4 shown in Fig. 1 is not an integral part of a built-in furniture unit but an integral component of the washing machine 1, i.e. the workstation 4 comprising the device 5 is rigidly connected to the washing machine 1.

The above-mentioned exemplary embodiments of the device for a washing machine and of the washing machine itself also apply mutatis mutandis to dishwashers.

1.18. (canceled)

19. A device for heating process water for a water-carrying household appliance, the device to store thermal energy surrounding the device and to transfer the thermal energy to the process water, wherein the device is a latent heat energy store comprising a heat exchanger with a storage medium and a working medium, wherein the storage medium stores the thermal energy, and wherein a temperature of a phase transition of the working medium is set between 20°C and 22°C.

20. The device of claim 19, wherein the water-carrying household appliance is a household appliance for care of laundry items.

21. The device of claim 19, wherein the device is connected to a water supply network and to the water-carrying household appliance.

22. The device of claim 19, wherein the device accommodates a quantity of the process water that is necessary for at least one of a wash program and a rinse program.

23. The device of claim 22, wherein the quantity of the process water is at least 10 liters.

24. The device of claim 19, wherein the device transfers absorbed thermal energy to the process water in a deactivated phase of the water-carrying household appliance.

25. The device of claim 19, further comprising a container to accommodate the process water and to absorb the thermal energy.

26. The device of claim 25, wherein the container has a wound flow channel.

27. The device of claim 26, wherein the wound flow channel is a serpentine flow channel.

28. The device of claim 26, wherein the container has an inner wall and a plurality of dividing walls that form the flow channel.

29. The device of claim 19, further comprising an inlet and an outlet, wherein a plurality of valves are arranged at at least one of the inlet and the outlet of the device.
30. The device of claim 25, wherein the container has an inlet and an outlet, and wherein a plurality of valves are arranged at at least one of the inlet and the outlet of the container.

31. The device of claim 19, wherein one side of the device has a thermal insulator.

32. The device of claim 31, further comprising a container to accommodate the process water and to absorb the thermal energy, and wherein the thermal insulator has a thermal insulation layer on the inside of the container.

33. The device of claim 25, wherein the device is external in relation to the water-carrying household appliance.

34. The device of claim 25, wherein the container is external in relation to the water-carrying household appliance.

35. The device of claim 33, wherein the device is in a built-in furniture unit.

36. The device of claim 35, wherein the device is integrated in the built-in furniture unit.

37. The device of claim 33, wherein the thermal insulator is on a side facing the household appliance.

38. The device of claim 19, wherein the device is integrated in a worktop, and wherein the household appliance is installed below the worktop.

39. A water-carrying household appliance, comprising a device for heating process water, the device to store thermal energy surrounding the device and to transfer the thermal energy to the process water, wherein the device is a latent heat energy store having a heat exchanger with a storage medium and a working medium, wherein the storage medium stores the thermal energy, and wherein a temperature of a phase transition of the working medium is set between 20°C and 22°C.

40. The water-carrying household appliance of claim 39, further comprising a worktop, wherein the device is integrated in the worktop.

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