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(73) Patent holder: **BSH Bosch und Siemens Hausgeräte GmbH**
81739 Munich (DE)

(72) Inventors:

- **AIGNER, Andreas**
83313 Siegsdorf (DE)

- **MAGG, Johann**
83368 St. Georgen (DE)
- **OSTERMAIER, Albert**
83371 Stein a. d. Traun (DE)
- **STADLER, Stefan**
83376 Truchtlaching (DE)
- **STEFFL, Michael**
83250 Marquartstein (DE)

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Description

[0001] The present invention relates to a hot beverage preparation device, to a coffee pad machine which is equipped with a water container, a heating device and a brewing chamber, which are connected to one another by a liquid pipe. The first section of which is located between the water container and the heating device and the second section of which is located between the heating device and the brewing chamber. The device also comprises a return pipe, in or at the inlet of which a return valve is arranged. For the sake of simplicity, but without limiting the scope of protection of the invention to this, the following refers exclusively to coffee machines instead of hot beverage preparation devices.

[0002] Patent EP 0 345 521 B1 relates to a corresponding device for the production of beverages, in which the return pipe, with a valve arranged therein, subsequently branches off from a liquid pipe upstream of a thermoblock and is returned to the water container. It is utilized to vent the water pipe upstream of the thermoblock in order to achieve constant cup filling

[0003] WO 02/100 227 A1 describes a coffee machine with a return pipe arranged downstream of the heating device. A valve controls, depending on the prevailing conditions, whether the heated water is fed to the brewing device or back to the water reservoir via the return pipe. EP 0 797 945 A1 describes a filter coffee machine with a fresh water tank and at least one heating element for heating water. Water is fed back into a water reservoir via a pipe.

[0004] The object of the present invention is to provide a device in which the first cup tapped already has the desired beverage temperature.

[0005] This task is solved in that, in the device mentioned at the beginning, the return pipe downstream of the heating device connects the second section to the first section of the liquid pipe via the return valve, so that the water heated by the heating device can be returned from the second to the first section of the liquid pipe, and in that a control valve is arranged in the first section of the liquid pipe, which is connected to an outlet of the return pipe. The water is therefore not always released into the brewing chamber after the heating device, but can be returned to the inlet of the heating system. Water that has already been insufficiently heated once can thus be sent through the heating device one or more times until it has reached the desired temperature. Only then does the recirculation valve interrupt the recirculation and the sufficiently heated water is fed to the brewing chamber. With the device according to the invention, it is therefore possible to reach the water temperature required for the brewing process more quickly. Since preheated water is supplied to the heating device, less time is required to heat the water to brewing temperature. The return valve only opens the return pipe until the required brewing temperature is reached at the outlet of the heating device.

[0006] In principle, the movement of the water in the liquid pipes is based on the principle of

gravity. It can happen that the water does not move reliably or at a predeterminable, defined flow rate, but instead moves uncontrollably through the liquid pipes in surges. According to an advantageous embodiment of the invention, a pump is therefore arranged in the first section of the liquid pipe between the inlet of the return pipe into the first section and the heating device. This allows a specific flow rate and a specific pressure in the water-carrying system to be set via the output of the pump.

[0007] The pump can be operated continuously or discontinuously. Its discontinuous operation is divided into operating intervals and pause intervals. Depending on the amount of water to be heated or the water temperature to be reached, i.e. depending on the required pressure and flow rate, the pump can be operated with different operating/pause interval ratios. For example, if the water is to be heated to brewing temperature, an operating/pause ratio of 1:2 is advantageous, e.g. with the pump running for 10 seconds followed by a 20 second pause. With this ratio, the brewing temperature is reached most quickly.

[0008] With the device according to the invention, it is also possible to generate steam, e.g. with an operating/pause ratio of the pump of about 0.5:2.

[0009] The pump can be controlled by a control unit which controls the operation of the pump depending on different default values. Default values can be values entered by the user, values determined by sensors or programmed values.

[0010] In order to achieve the necessary brewing temperature in a very short time even when the appliance is cold, a control valve is arranged in the first section of the liquid pipe at the outlet of the return pipe. The control valve can control the merging of the preheated water coming from the return pipe with the cold water from the water tank. As soon as the control valve shuts off the water supply from the water tank, the water only circulates in a return circuit between the control valve, heating device, return valve and return pipe. The arrangement of the pump between the control valve and the heating device in the first section also proves to be advantageous here because the pump is then located within the circuit. As only preheated water is pumped through the heating device after the cold water pipe has been shut off by the control valve, the brewing temperature can be reached in a shorter time. The dimensioning of the device can be designed so that the amount of water circulating in the return circuit is sufficient for one brewing process.

[0011] Depending on the design of the brewing chamber, its heat capacity can vary. As a result, water heated to brewing temperature, for example, can cool down too much. As a result, the coffee temperature may be too low, especially with small quantities of coffee. To avoid this, the return pipe can be routed through the brewing chamber in another advantageous embodiment of the invention. Heated water in the return pipe then gives off heat to the brewing chamber. The return pipe can thus be used to preheat the brewing chamber. This shortens the time until the first

brewing process.

[0012] In an advantageous embodiment of the invention, channels are arranged in the brewing chamber as part of the return pipe. In the case of a cylindrical brewing chamber, for example, the channels can run in a spiral within the outer surface of the brewing chamber. For good heat transfer, the channels have a thin wall thickness and/or are made of materials with high thermal conductivity.

[0013] To ensure that the return valve does not open the return pipe for longer than necessary and/or the control valve optimally supplies cold water, a temperature sensor for measuring the water and/or steam temperature can be arranged according to the invention at least at the outlet of the heating device. It is also possible to arrange several temperature sensors, for example one each at the outlet of the heating device, close to where the return pipe joins the first section and/or at or in the brewing chamber. The control unit, as the link between the sensors and the valves and the pump, evaluates the signals transmitted by the sensors and then causes the return valve, the control valve and/or the pump to be adjusted.

[0014] For coffee preparation, it is advantageous if there is a separate extraction point for steam, in particular for frothing milk. In a further advantageous embodiment of the invention, a switching valve is arranged in the second section of the liquid pipe for this purpose, which is connected to a milk frothing nozzle. The switching valve is preferably arranged between the return valve and the brewing chamber, because the maximum brewing or steam temperature is only available there. After the switching valve, the second section of the liquid pipe is divided into an inner section that leads to the brewing chamber and an outer section that leads to the nozzle. The switching valve can also be controlled by the control unit. A user of the coffee machine can use the coffee machine's control elements to select whether they require scalding hot water for a brewing process or steam, for example for frothing milk. Depending on the selection, the water is heated by the heating device until the temperature sensor at the output of the heating device measures the corresponding water or steam temperature. Depending on the temperature, the control unit switches the switching valve to the passage to the brewing chamber or frothing nozzle.

[0015] The passage of water vapor through the liquid pipes can result in disturbing noise. To at least reduce this, a sound-absorbing element can be arranged in the return pipe in an advantageous embodiment of the invention. It can, for example, be designed in the form of a chamber with a labyrinth arranged therein. In addition to the sound-absorbing effect, passing the vapor through the labyrinth also has the effect that the water vapor is partially condensed and can be fed to the first section of the liquid pipe in the form of warm water.

[0016] In the following, embodiments of the are explained in more detail with reference to

schematic figures. They show:

Figure 1 a first embodiment of the device;

Figure 2 a second embodiment of the device;

Figure 2a a modification of the embodiment shown in Figure 2;

Figure 3 an embodiment of the device according to the invention;

Figure 4 a further embodiment of the device according to the invention.

[0017] Figure 1 shows the basic structure of a pad coffee machine 10 as an example of a hot beverage preparation device. The main components of the pad coffee machine 10 are a water tank 12, an instantaneous water heater 14 as a heating device and a brewing chamber 16. The water tank 12 is connected to the instantaneous water heater 14 via a water pipe 18. A pump 20 is arranged in the water pipe 18. A water pipe 22 connects the instantaneous water heater 14 to the brewing chamber 16. A return pipe 24 branches off from the pipe 22 shortly after the instantaneous water heater 14. The branching point forms a T-piece 26. Part of the return pipe 24 is a shut-off valve 28. The return pipe 24 opens into a T-piece 30 in the pipe 18. The T-piece 26 forms an inlet and the T-piece 30 an outlet of the return pipe 24. A temperature sensor 32 is located at the outlet of the instantaneous water heater 14 upstream of the T-piece 26. It is connected to a control unit 34, which is also connected to the pump 22 and the return valve 28 via control pipes (shown in dashed pipes).

[0018] During operation of the pad coffee machine 10, the pump 22 pumps water from the water tank 12 through the water pipe 18 into the instantaneous water heater 14, where the water is heated and conveyed through the pipe 22 to the brewing chamber 16. At the start of a brewing process, the return valve 28 is open, so that the water heated by the instantaneous water heater 14 is pumped both into the water pipe 22 and back into the water pipe 18 through the return pipe 24. At this point, there is already a coffee pad in the brewing chamber 16 (not shown in Figure 1). The coffee pad represents a certain resistance for the water. The resistance of the coffee pad in the brewing chamber 16 causes the main part of the hot water coming from the instantaneous water heater 14 to travel along the path with the lower resistance, namely through the return pipe 24 back into the water pipe 18. There it mixes with the cold water coming from the water tank 12, so that the pump 20 supplies the instantaneous water heater 14 with already preheated water in a second cycle.

[0019] The hot water that reaches the brewing chamber 16 despite the higher resistance there is used to moisten the coffee pod. An already moistened coffee pad leads to an even better development of the aromatic substances during the brewing process. The hot water also preheats the brewing chamber 16.

[0020] As soon as the temperature sensor 32 at the outlet of the instantaneous water heater 14 measures the required brewing temperature, the control unit 34 closes the return valve 28 and

feeds the brewing-hot water directly to the brewing chamber 16. In the already preheated brewing chamber 16, the hot brewing water can now no longer cool down so much that the resulting coffee temperature in the cup would be too low.

[0021] The control unit 34 has the function of converting the signals transmitted by the temperature sensor 32 into corresponding switching or actuating functions and of effecting the opening and closing of the return valve 28. It can operate the pump 20 in intermittent mode if required. It controls its performance, for example by operating it in an operating/pause cycle.

[0022] At the start of a brewing process, in particular after long periods of standstill or if the temperature of the pad coffee machine is too low, the water heated by the instantaneous water heater 14 is fed back upstream of the instantaneous water heater 14 in a circuit during a so-called recirculation phase. This takes place until the water has reached the brewing temperature, during which time the liquid-carrying parts of the coffee machine up to the brewing chamber 16 are preheated with the water circulating in the circuit. This ensures that the resulting water temperature in the cup is always sufficiently high right from the start, especially when the appliance is cold.

[0023] Figure 2 shows the structure of the pad coffee machine 10 already known from Figure 1. In contrast to Figure 1, a 2-way valve 36 is used here for the return valve 28 there. It is not arranged in the return pipe 24 like the return valve 28, but instead of the T-piece 26 (see Figure 1) in the water pipe 22. It therefore also forms the inlet of the return pipe 24. In all other respects, identical parts have been given the same reference symbols. This also applies to the following figures.

[0024] Depending on the switching position of the 2-way valve 36, the water can now flow either into the water pipe 22 or into the return pipe 24. A corresponding control ensures that no hot water enters the brewing chamber 16 as long as there is no coffee pod in the brewing chamber 16. The risk of scalding a user as a result of hot water escaping from the brewing chamber 16 is thus avoided. For this purpose, a sensor arranged in the brewing chamber 16 (not shown in Figure 2) detects the presence of a coffee pod in the brewing chamber 16. The control unit 34, which is connected to the sensor, can briefly switch the 2-way valve 36 so that the brewing chamber 16 is also preheated in this arrangement and a coffee pad arranged therein is moistened.

[0025] At the start of a brewing process, the hot water coming from the instantaneous water heater 14 flows back, at least for the most part, through the return pipe 24 into the water pipe 18 upstream of the instantaneous water heater 14. The switching position of the 2-way valve is maintained until the temperature sensor 32 transmits a corresponding signal to the control unit 34 that a predetermined water temperature has been reached. The 2-way valve 36 then switches over

so that the entire volume of water coming from the instantaneous water heater 14 flows through the water pipe 22 into the brewing chamber 16. The return pipe 24 should be short so that the hot water loses as little heat as possible during the return phase.

[0026] Figure 2a shows the embodiment of the pad coffee machine 10 already known from Figure 2, with the difference that the return pipe 24 is routed through the brewing chamber 16. The water heated by the instantaneous water heater 14 flows through channels (symbolized in Figure 2a by a dotted pipe in the brewing chamber 16) in the brewing chamber 16 back to the water pipe 18. This preheats the brewing chamber 16.

[0027] Figure 3 shows an embodiment of the pad coffee machine 10 according to the invention in which, in contrast to Figures 1, 2 and 2a, a 2-way valve 38 is also arranged at the outlet of the return pipe 24 in the water pipe 18. The 2-way valve 38 controls the merging of the water conveyed through the return pipe 24 with the cold water from the water tank 12. The control unit 34 switches the 2-way valve 38 so that the supply of cold water is completely or partially blocked during the return phase. During the return phase, the pump 20 pumps the water through the instantaneous water heater 14 into the water pipe 22 to the 2-way valve 36 and back to the 2-way valve 38 via the return pipe 24. If the cold water supply from the water tank 12 is blocked by the 2-way valve 38, the water circulates exclusively in the return phase circuit symbolized by the arrow A. This continues until the temperature of the water tank 12 is reached. This continues until the temperature sensor 32 signals the control unit 34 that a predetermined water temperature has been reached and the latter switches the 2-way valve 36 so that the water coming from the instantaneous water heater 14 is completely conveyed through the water pipe 22 into the brewing chamber 16. Conveniently, the amount of water circulating in circuit A corresponds exactly to the amount of water required to brew a cup of coffee. This ensures that the first cup of coffee is available at the desired high coffee temperature after a very short time, even after long downtimes of the coffee machine.

[0028] In addition to the structure of the pad coffee machine 10 shown in Figure 3, Figure 4 shows a 2-way valve 40 in the water pipe 22 between the 2-way valve 36 and the brewing chamber 16. A steam pipe 42 branches off from the 2-way valve 40, the outlet of which is connected to a steam nozzle 44. In principle, steam is generated in the same way as scalding hot water. In contrast, the water for steam passes through the recirculation phase until the desired steam temperature is measured at temperature sensor 32. Once this is reached, the control unit 34 switches the 2-way valve 36 so that the steam is completely directed to the steam nozzle 44.

[0029] A silencer 46 is arranged in the return pipe 24. During steam operation, it serves to reduce noise caused by almost boiling water as it passes through the return pipe 24. It functions according to the principle of a labyrinth and, in addition to noise reduction, also causes the water in the silencer to condense at least in part and can be fed to the first section of the liquid pipe in

the form of hot water.

[0030] Since the preceding pad coffee machines 10 described in detail are examples of embodiments, they can be modified to a wide extent in the usual manner by the skilled person without leaving the scope of the invention. In particular, the actual course of the return pipe 24 can be in a different form to that described here. Similarly, the arrangement or design of the valves 28, 36, 38, 40 and the T-pieces 26 and 30 can be in a different form if this is necessary for reasons of space or design. Furthermore, the use of the indefinite articles "a" or "one" does not exclude the possibility that the relevant features may also be present more than once.

List of reference signs

[0031]

10 : - Pad coffee machine
12 : - water tank
14 : - Heating device, instantaneous water heater
16 : - Brewing chamber
18,22 : - Water pipes
20 : - Pump
24 : - Return pipe
26, 30 : - T-pieces
28 : - Recirculation valve
32 : - Temperature sensor
34 : - Control unit
36, 38, 40 : - 2-way valves
42 : - Steam pipe
44 : - Steam nozzle
46 : - Silencer

Claims

1. Hot drink preparation device (10), particularly sachet coffee machine, with a water container (12), a heating device (14) and a brewing chamber (16), which are connected together by a liquid duct (18, 22), the first section (18) of which lies between the water container (12) and the heating device (14) and the second section (22) of which lies between the heating device (14) and the brewing chamber (16), and with a return duct (24), in which or at the inlet of which a return valve (28, 36) is arranged, and which behind the heating device connects the second section (18) via the return valve (28; 36) with the first section (22) of the liquid duct, characterized in that a control valve (38) connected with an outlet of the return duct (24) is arranged in the first section (18) of the liquid duct.
2. hot drink preparation device (10) according to claim 1, characterized in that the return valve is a two-way valve (36).
3. hot drink preparation device (10) according to claim 1 with a pump (20) in the first section (18) of the liquid duct.
4. hot drink preparation device (10) according to any one of the preceding claims, characterized in that the return duct (24) is led through the brewing chamber (16).
5. hot drink preparation device (10) according to claim 4, characterized in that channels which are part of the return duct (24) are arranged in the brewing chamber (16).
6. hot drink preparation device (10) according to any one of the preceding claims, characterized in that a temperature sensor (32) for measuring the water and/or steam temperature is arranged at the outlet of the heating device (14).
7. hot drink preparation device (10) according to any one of the preceding claims, characterized in that a sound-damping element (46) is arranged in the return duct (24).
8. hot drink preparation device (10) according to any one of the preceding claims with a water and/or steam nozzle (44), characterized in that a switching valve (40), by which the liquid duct (22) is separable into a liquid duct (42) connected with the brewing chamber (16) and a liquid duct (42) connected with the nozzle (44), is arranged in the second section (22) of the liquid duct.
9. hot drink preparation device (10) according to any one of claims 6 to 8, characterized in that a control device (34) controls the valves (28; 36; 38; 40) and/or the pump (20) in dependence on signals of the temperature sensor (32).