another portion 208 is disposed below the central portion 207 and comprises another membrane 209 (referred to as bottom membrane) closing the capsule through which the extracted or dissolved substance is released.

Figure 3 is a schematic perspective view of a heating unit according to one aspect. Shown is heating unit 100, e.g. for a beverage preparation machine (not shown; see e.g. 1 in **figure 1**), comprising a casing or housing 103 (forth only denoted housing), a heating element 104, a pre-heating tube 101 for receiving a fluid, preferably a liquid like water, e.g. a pumped from a fluid reservoir (not shown; see e.g. 2 in **figure 1**). The pre-heating tube comprises a tube inlet 102 and a tube outlet 107 terminating in or connecting with a heating chamber 108 in the housing 103. At least a part of the heating element 104 (i.e. the active part) is located in the heating chamber 108 and is adapted to heat a liquid therein. The housing 103 further comprises a liquid outlet 105 connected to the heating chamber 108 where the liquids exits the housing 103 after being heated by the heating element 104. The housing 103 further comprises a central hole or opening 106 in a housing part 109. The pre-heating tube 101 is located at least partly within the housing 103 and in such a way that the heating element 104 will heat a liquid inside the pre-heating tube 101 when the liquid passes through the pre-heating tube 101 from the tube inlet 102 to the tube outlet 107.

In this way, a liquid is effectively heated at two stages using the same heating element 104; firstly when moving via the pre-heating tube 101 after entering the heating unit 100 and then again a second time when the liquid is received in the heating chamber 108 and passing through to the liquid outlet 105. This provides a very efficient way of heating the liquid. Furthermore, the issue of mixing hot and cold liquid or water within the same mass of liquid or water, as e.g. is done in current boiler type heaters, is avoided as the liquid or water will be heated before arriving in the heating chamber 108. Additionally, the start-up time necessary for providing adequately heated water is also reduced.

The pre-heating tube 101 may be an otherwise regular tube but is designated so since it provides initial- or pre-heating of the liquid or water before it enters the heating chamber 108.

In a further embodiment (as shown in **figure 3**), at least a part of the pre-heating tube ~~102~~ 101 has a generally cylindrical coil shape. In the same manner, at least a part of the heating element 104 also has a generally cylindrical coil shape and at least a part of the heating element 104 is located inside the cylindrical coil shape of the pre-heating tube ~~102~~101.

In a particular embodiment (as shown in **figure 3**), an outer diameter of the generally cylindrical coil shape of the heating element 104 is smaller than an inner diameter of the generally cylindrical coil shape of the pre-heating tube ~~102~~ 101 to an extent so that the

cylindrical coil shape of the heating element 104 fits closely within the generally cylindrical coil shape of the pre-heating tube ~~102~~101. Alternatively, the configuration illustrated in the figure 3 can be reversed so that the fluid-conveying pre-heating coiled tube 102 has a smaller diameter than the coiled heating element 104, such that the latter is located in the inside with the heating coil located all around on the outside of said pre-heating tube ~~102~~101. **In other words, a**t least a part of the generally cylindrical coil shape of the pre-heating tube ~~102~~ 101 is located inside the generally cylindrical coil shape of the heating element 104. This may be beneficial as in some embodiments of a heating element there may be minimal bending radius for an effective heating element 104 and this enables the heating element to have the bigger radius while still providing a compact heating unit 100.

This provides a very compact heating unit 100 and also an effective heating of the liquid or water in the pre-heating tube ~~102~~101. It is to be understood that the difference of diameters may be larger in certain embodiments. The housing 103 may also have a generally cylindrical shape adding to the compactness of the heating unit 100. Control of the temperature may e.g. be provided using a temperature sensor arranged e.g. in close proximity to the liquid outlet 105 where the heating effect of the heating element 104 may be regulated in response to output from the temperature sensor and input in the form of required or preferred temperature received from a control system or the like.

Figure 4 is a schematic exploded view of the heating unit of **figure 3**. Shown is a heating unit 100 with its elements separated in an exploded view. The elements correspond to the ones shown and explained e.g. in connection with **figure 3**. The housing part 109 is in this figure shown more clearly. The housing part 109 forms the top piece of the housing 103 and has various cut-outs or holes to accommodate parts of the elements that protrude outside the housing 103, e.g. like the tube inlet 102 and parts of the heating element 104.

The central hole or opening 106 of the housing part 109 has in this embodiment a cross-section shaped like a drop. The presence of the central hole or opening 106 may be used to optimise the volume of liquid in the heating chamber in relation to the provided heating element, i.e. so the effect of the heating element is adjusted to the volume of liquid thereby ensuring increased heating efficiency and/or reduced heating time. Furthermore, the specific shape of the central hole or opening 106 may also optimise the heating capabilities of the heating element, e.g. by governing the distance between fluid at various places in the heating chamber and various parts of the heating element. Such a central hole or opening 106 works well especially in connection with a heating element and/or pre-heating tube of a generally cylindrical coil shape as the coil shape(s) can ‘go around’ the hole or opening. As can be seen from the figure, the drop like shape enables –

Claims

1. A heating unit (100) for a beverage preparation machine (1) said machine (1) being suitable for preparing a beverage by mixing a beverage ingredient with a fluid, said machine comprising a pump for circulating said beverage preparation fluid through said machine at least from a fluid source to said heating unit, the heating unit (100) being suitable for heating said fluid and comprising:

(i) a housing (103) defining a fluid heating chamber (108), and

(ii) a heating element (104) located inside said housing (103) and being adapted to heat said fluid therein,

~~characterized in that~~ wherein

- the heating unit (100) further comprises a pre-heating tube (101) for conveying said fluid received from said pump through said heating unit (100), the pre-heating tube (101) comprising a tube inlet (102) and a tube outlet (107), the tube outlet (107) connecting with the heating chamber (108), and
- wherein the pre-heating tube (101) is located at least partly within the housing (103) in such a way that that the heating element (104) will at least partially heat said fluid in said pre-heating tube (101) before said pre-heated fluid is released into the heating chamber (108) through said outlet (107)~~.~~;

characterized in that

at least a part of the pre-heating tube (101) has a generally cylindrical coil shape.

~~**2.** The heating unit (100) according to claim 1, wherein at least a part of the pre-heating tube (102) has a generally cylindrical coil shape.~~

~~3.~~2. The heating unit (100) according to ~~any one of claims 1 – 2~~claim 1, wherein at least a part of the heating element (104) has a generally cylindrical coil shape.

~~4.~~3. The heating unit (100) according to any one of claims ~~2 – 3~~1 - 2, wherein at least a part of the heating element (104) is located inside the cylindrical coil shape of the pre-heating tube (~~102~~101).

~~5.~~4. The heating unit (100) according to any one of claims ~~3 – 4~~ 2 - 3, wherein an outer diameter of the generally cylindrical coil shape of the heating element

(104) is smaller than an inner diameter of the generally cylindrical coil shape of the pre-heating tube (~~102~~101).

~~6.~~5. The heating unit (100) according to claim ~~5~~4, wherein the outer diameter of the generally cylindrical coil shape of the heating element (104) is smaller than the inner diameter of the generally cylindrical coil shape of the pre-heating tube (~~102~~101) to an extent so that the cylindrical coil shape of the heating element (104) fits closely within the generally cylindrical coil shape of the pre-heating tube (~~102~~101).

~~7.~~6. The heating unit (100) according claim ~~3~~2, wherein at least a part of the pre-heating tube (~~102~~101) is located inside the cylindrical coil shape of the heating element (104).

~~8.~~7. The heating unit (100) according to any one of claims ~~3~~ 2 or ~~7~~6, wherein an outer diameter of the generally cylindrical coil shape of the pre-heating tube (~~102~~101) is smaller than an inner diameter of the generally cylindrical coil shape of the heating element (104).

~~9.~~8. The heating unit (100) according to claim ~~8~~7, wherein the outer diameter of the generally cylindrical coil shape of the pre-heating tube (~~102~~101) is smaller than the inner diameter of the generally cylindrical coil shape of the heating element (104) to an extent so that the cylindrical coil shape of the pre-heating tube (~~102~~101) fits closely within the generally cylindrical coil shape of the heating element (104).

~~10.~~9. The heating unit (100) according to any one of claims 1 – ~~10~~8, wherein the housing (103) further comprises a central opening (106), wherein the volume and/or shape of the central opening (106) enables optimisation of a volume of fluid in the heating chamber (108) in relation to the heating element (104).

~~11.~~10. The heating unit (100) according to claim ~~10~~9, wherein the central opening (106) has a cross-section that is substantially circular at at least one predetermined location.

~~12.~~11. The heating unit (100) according to any one of the preceding claims, wherein said pre-heating tube (~~102~~101) is located at a distance from said heating

element (104) that is less than 10mm, preferably less than 5mm, more preferably less than 1mm.

~~13.~~12. A beverage preparation machine (1) comprising:

(iii) a reservoir (2) for a fluid,

(iv) a brewing head (3) adapted to receive at least one beverage preparation ingredient (204),

(v) a pump for pumping a predetermined volume of said fluid from said reservoir (2) to said brewing head (3), such that said fluid can be injected into said brewing head (3), to mix with said ingredient (204) under pressure and produce a predetermined volume of beverage,

(vi) a heating unit (100) for optionally heating said fluid pumped from said reservoir (2) before it enters the brewing head,

characterized in that the heating unit (100) is a heating unit (100) according to any one of claims 1 – ~~12~~11.

~~14.~~13. A beverage preparation machine (1) according to claim ~~13~~12, wherein the brewing head is adapted to receive at least one ingredient capsule (200) comprising the least one beverage preparation ingredient (204) and to inject the fluid into said capsule (200), when received by said brewing head (3).

~~15.~~14. A beverage preparation machine (1) according to claims ~~13~~ 12 or ~~14~~13, wherein the pump to inject the fluid into said brewing head (3) under pressure.