



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
17.06.2020 Bulletin 2020/25

(51) Int Cl.:
B08B 9/20 (2006.01) B08B 9/30 (2006.01)

(21) Application number: **18212340.6**

(22) Date of filing: **13.12.2018**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
 Designated Extension States:
BA ME
 Designated Validation States:
KH MA MD TN

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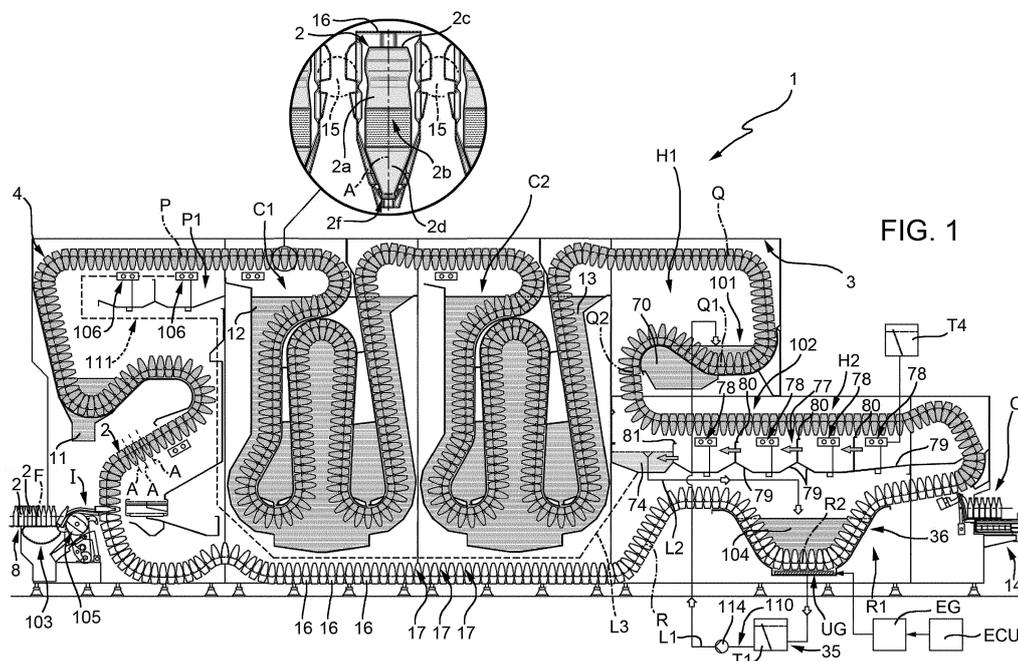
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(54) **A COOLING PROCESS FOR COOLING HOT WASHED CONTAINERS IN A WASHING MACHINE AND WASHING MACHINE CARRYING OUT THE SAME PROCESS**

(57) A cooling process for cooling hot washed containers (2) in a washing machine (1) includes the steps of advancing hot washed containers and a member (16) of a conveyor (4) along a path (P) that crosses an outlet station (O); sequentially cooling the member (16) and the containers (2) for a first and a second time by putting the member (16) in thermal contact with first and second heat transfer medium, respectively at a first and a second heat exchange zone (H1, H2), which are arranged in sequence along path (P) upstream of the outlet station (O);

discharging the containers (2) at the outlet station (O); circulating the first heat transfer medium between the first heat exchange zone (H1) and a return zone (R1) that is arranged along path (P) downstream of the outlet station (O); heating the member (16) by putting the latter in thermal contact with the first heat transfer medium at the return zone (R1); and returning the cooled first heat transfer medium to the first heat exchange zone (H1) for cooling the containers (2).



Description

[0001] The invention relates to a cooling process for cooling hot washed containers in a washing machine and to a washing machine that carries out the same process.

[0002] In general, washing machines are known with the purpose of cleaning the empty containers upstream of a filling and a labelling station, in which the containers are respectively filled with a pourable product and labelled with respective labels.

[0003] An example of washing machine is known, e.g. from EP2727660 in the name of the same Applicant.

[0004] Known washing machines essentially comprise:

- a feeding system;
- a washing tunnel;
- a looped chain conveyor advancing the containers along a closed washing path and extending inside the washing tunnel from an inlet station to an outlet station; and
- a plurality of sequential treatment zones arranged between the inlet station and the outlet station, and through which the chain conveyor advances the containers.

[0005] In detail, the chain conveyor comprises a plurality of bars, which are fed at the inlet station by the feeding system with respective rows of containers.

[0006] In particular, each bar comprises a plurality of aligned pockets, which receive, convey and outlet the respective washed containers.

[0007] According to the advancing direction of containers along the washing tunnel, the treatment zones comprise, in sequence, a prewash zone, a first cleaning zone, a second cleaning zone and a plurality of consecutive rinsing zones.

[0008] The prewash zone, the first cleaning zone, and the second cleaning zone comprise respective cleaning baths, which are filled with a washing chemical agent at high temperature and through which the containers are advanced.

[0009] Each rinsing zone comprises a corresponding rinsing bath filled with rinsing liquid and/or ejecting devices for directing sprinkles of rinsing liquid toward the containers.

[0010] The rinsing liquid delivered to the containers has both the function of removing therefrom any residuals of washing chemical agent and of cooling down the same containers after being conveyed out from the cooling baths.

[0011] As the containers are sequentially conveyed through the consecutive rinsing zones of the washing machine, the same containers are cooled more and more and the temperatures of the rinsing liquid in each of the rinsing zones reach respective values decreasing according to the advancing direction of the containers.

[0012] According to known processes for cooling con-

tainers, the overall quantity of rinsing liquid that needs to be used for bringing the containers at room temperature is generally significant.

[0013] Such remark introduces an issue regarding the energetic and environmental impact of the known cooling processes, and the costs related to an increased consumption of rinsing liquid.

[0014] In view of that, a need is felt within the sector for a cooling process using a reduced amount of rinsing liquid in respect to known solutions, without losing cooling performances.

[0015] It is an object of the invention to provide a process for cooling hot washed containers in a washing machine, which allows meeting the abovementioned need in a simple and economic manner.

[0016] This object is achieved by the invention as it relates to a cooling process for cooling hot washed containers in a washing machine, as claimed in claim 1.

[0017] The invention further relates to a washing machine, as claimed in claim 7.

[0018] One preferred embodiment is hereinafter disclosed for a better understanding of the present invention, by way of non-limitative example and with reference to the accompanying drawings, in which:

- Figure 1 is a lateral view of a washing machine for washing empty containers and for carrying out a process for cooling hot washed containers, according to the invention; and
- Figure 2 is a lateral view in an enlarged scale of some components of the washing machine of Figure 1.

[0019] With reference to Figure 1, numeral 1 indicates a washing machine for washing containers 2, in particular empty bottles intended to be filled with a pourable product.

[0020] Each container 2 has an external surface 2a delimiting an inner volume 2b adapted to receive the pourable product and extends along an axis A (lying on a vertical plane, in the embodiment shown) from a base portion 2c to a neck portion 2d.

[0021] The neck portion 2d is provided with an inlet opening 2f about axis A, which allow the filling of the inner volume 2b of the corresponding container 2.

[0022] Washing machine 1 comprises:

- a washing tunnel 3, in which empty containers 2 are fed and accordingly washed; and
- a chain conveyor 4 for advancing containers 2 inside washing tunnel 3 along a closed loop path P, in particular lying on a vertical plane.

[0023] In detail, chain conveyor 4 comprises:

- a pair of chains 15 elongated parallel to path P and parallel to one another; and
- a plurality of subsequent conveying beams 16, which extend between chains 15 in a transversal and, more

in detail, orthogonal manner to chains 15 and path P.

[0024] Specifically, each beam 16 comprises a row of pockets 17 aligned orthogonally to path P and adapted to receive corresponding containers 2.

[0025] In such a manner, containers 2 carried by a corresponding beam 16 are aligned orthogonally to path P and housed inside the respective pockets 17.

[0026] Washing machine 1 comprises also a feeding system 8 for feeding a sequence of empty containers 2 along a direction F and at an inlet station I of washing tunnel 3. In particular, containers 2 fed along direction F are arranged in rows orthogonal to path P.

[0027] Feeding system 8 comprises:

- a plurality of endless conveyors 103 (of which only one is schematically shown) configured to convey the rows of containers 2 towards the inlet station I;
- a motor (not shown), which drives conveyors 103; and
- a sequencing device 105, arranged between inlet station I and endless conveyors 103 and configured to receive a row of containers 2 at a time from conveyors 103 and to feed the received row to the chain conveyor 4 at inlet station I.

[0028] In particular, the most forward containers 2 of each row of containers 2 are transferred by sequencing device 105 to the respective pockets 17 of the beam 16 that is travelling at inlet station I.

[0029] The operation and construction of the sequencing device 105 is known as such and, therefore, not described further in detail.

[0030] In the embodiment shown, direction F is horizontal and orthogonal to axes A of containers 2 fed along the same direction F.

[0031] Washing machine 1 further comprises an out-feed conveyor 14, which receives rows of cleaned containers 2 from chain conveyor 4 at an outlet station O of washing tunnel 3.

[0032] In view of the above, path P comprises:

- a washing branch Q, which extends from inlet station I to outlet station O and along which containers 2 are advanced by chain conveyor 4; and
- a return branch R, which extends from outlet station O to inlet station I and defines a return zone R1, through which beams 16 return towards inlet station I without containers 2.

[0033] Furthermore, according to the advancing direction of the same containers 2, washing machine 1 comprises in sequence along washing branch Q:

- a prewash zone P1;
- a first cleaning zone C1;
- a second cleaning zone C2;
- a first heat exchange zone H1; and

- a second heat exchange zone H2.

[0034] In the foregoing of the present disclosure, for the sake of clarity, terms like "upstream of" and "downstream of" are to be intended throughout the whole description with reference to such advancing direction of the containers 2 along path P.

[0035] Within prewash zone P1, first cleaning zone C1, and second cleaning zone C2, washing machine 1 comprises respective baths 11, 12, 13 filled with a cleaning agent, preferably a basic aqueous solution comprising sodium hydroxide.

[0036] Moreover, within prewash zone P1, washing machine 1 comprises also a plurality of sprinkling devices 106 arranged in sequence along washing branch Q.

[0037] Sprinkling devices 106 deliver, in use, sprinkles of the above cleaning agent to external surfaces 2a and inner volumes 2b of containers 2, while the latter are advanced through the prewash zone P1 itself.

[0038] The cleaning agent within bath 11 and the cleaning agent ejected by sprinkling devices 106 are brought to a relatively high temperature, for instance between 45 °C and 60 °C, so that the encrusted dirt on containers 2 starts to dissolve as containers 2 themselves advance through prewash zone P1.

[0039] On the other hand, the cleaning agent within baths 12, 13 is brought to a higher temperature, for instance between 65 °C and 80 °C, so that dirt on advancing containers 2 is fully removed together with possible labels arranged thereon.

[0040] Therefore, containers 2 come out from bath 13 cleaned and heated up to a temperature likely between 60 °C and 70 °C, so that the same containers 2 needs to be cooled down to environmental temperature before being discharged at outlet station O.

[0041] In view of that, washing machine 1 comprises a cooling apparatus 101, which is arranged within heat exchange zone H1 and allows containers 2 and beams 16 to come in thermal contact with heat transfer medium having a temperature lower than that of the cleaning agent within bath 13, such that the same containers 2 and beams 16 are cooled for a first time while the corresponding heat transfer medium is heated.

[0042] Moreover, washing machine 1 comprises another cooling apparatus 102, which is arranged within heat exchange zone H2 and allows containers 2 and beams 16 to come in thermal contact with further heat transfer medium having a lower temperature, such that the same containers 2 and beams 16 are cooled for a second time while the corresponding heat transfer medium is heated.

[0043] In detail, each mentioned heat transfer medium comprises a rinsing medium, in particular water, which is brought in contact with containers 2 and beams 16, while the latter are advanced through heat exchange zones H1, H2.

[0044] In this manner, the cleaning agent remaining onto containers 2 and onto beams 16 is gradually re-

moved therefrom, as well as dissolved in the rinsing medium.

[0045] In particular, the equilibrium temperatures respectively reached by containers 2, beams 16 and the heat transfer medium at heat exchange zone are between 45 °C and 60 °C, while the equilibrium temperatures respectively reached by containers 2, beams 16 and the heat transfer medium at heat exchange zone H2 is between 25 °C and 35 °C.

[0046] In the embodiment shown, cooling apparatus 101 comprises a basin 70 suitable for holding heat transfer medium and arranged within heat exchange zone H1, in particular along a stretch Q1 of washing branch Q.

[0047] Basin 70 is filled with heat transfer medium and is arranged in a position such that beams 16 are conveyed by chains 15 through the same basin 70.

[0048] In such a manner, beams 16 and external surfaces 2a of containers 2 advancing through the basin 70 are fully in contact with such heat transfer medium and, in particular, immersed therein.

[0049] Since the above heat transfer medium comprises a rinsing medium, basin 70 may be considered part of a rinsing apparatus aimed to remove cleaning agent from containers 2 and from beams 16 by delivering rinsing medium to the containers 2 and beams 16 themselves.

[0050] Immediately downstream of stretch Q1, washing branch Q comprises a stretch Q2 within heat exchange zone H1 and along which containers 2 are advanced with their axes A inclined with respect to a vertical direction.

[0051] In other words, each container 2 advancing along stretch Q2 has a corresponding orientation that is intermediate in respect of two extremal orientations, according to which axis A is vertical and inlet opening 2f is respectively above and below the base portion 2c.

[0052] More in detail, while advancing throughout the whole stretch Q2, each container 2 assumes a plurality of progressive orientations, among which at least one is distinguished by that the corresponding axis A is horizontal.

[0053] In particular, containers 2 are conveyed through stretch Q2 with respective axes A that progressively form angles with the vertical direction between 30° and 140°, more in particular between 60° and 120°.

[0054] In such a manner, containers 2 and beams 16, which advance through basin 70 push a portion of the heat transfer medium toward stretch Q2, at which the same portion falls down from containers 2 and beams 16 themselves due to gravity action.

[0055] Moreover, still with reference to the embodiment shown, washing machine 1 comprises a basin 74 that is suitable for holding heat transfer medium and is arranged in heat exchange zone H1 below stretch Q2, so as to receive and gather the portion of the heat transfer medium fallen down from containers 2 and beams 16.

[0056] Furthermore, cooling apparatus 102 comprises a rinsing apparatus arranged within heat exchange zone

H2, and configured to deliver a rinsing medium onto containers 2 and beams 16, while the latter are advanced through heat exchange zone H2.

[0057] Specifically, the above rinsing apparatus is defined by an ejection assembly 77 and the rinsing medium comprises a liquid defining the heat transfer medium within heat exchange zone H2.

[0058] Ejection assembly 77 comprises a plurality of sprinkling devices 78 arranged in sequence along washing branch Q for delivering sprinkles of the rinsing medium to external surfaces 2a and inner volumes 2b of containers 2, as well as to beams 16 carrying the same containers 2.

[0059] At least one of the sprinkling devices 78 is supplied by a source of rinsing medium; specifically washing machine 1 comprises a tank T4 defining the above source of rinsing medium.

[0060] In the embodiment shown, tank T4 supplies only the last sprinkling device 78 of the respective sequence, according to the advancing direction of containers 2.

[0061] To supply all the other sprinkling devices 78, ejection assembly 77 comprises also a plurality of basins 79 respectively arranged in sequence below sprinkling devices 78 and fluidly connected thereto.

[0062] The last basin 79 in the respective sequence gather rinsing medium that is ejected by the corresponding sprinkling device 78, since the same ejected rinsing medium falls down from containers 2 and beams 16 that advance above the same last basin 79.

[0063] As it will be explained in the foregoing of the disclosure, the previously referred last basin 79 supplies, in use, all the other basins 79, which in turn supply the corresponding sprinkling devices 78.

[0064] In detail, as schematically illustrated in Figure 1 and according to the advancing direction of containers 2, each basin 79, with exception of the first of the respective sequence, comprise at the top a corresponding spillway 80 toward the immediately upstream basin 79.

[0065] Therefore, when a basin 79 (excluded the first one of the respective sequence) is completely filled with rinsing medium, a superficial portion of the latter falls by means of the spillway 80 into the immediately upstream basin 79.

[0066] The last basin 79 in the respective sequence is the first one that is completely filled since indirectly receiving rinsing medium from tank T4 via the corresponding sprinkling device 78; the other basins 79 are completely filled in succession according to a direction opposite to the advancing direction of containers 2.

[0067] In the embodiment shown, the first basin 79 of the respective sequence is adjacent to basin 74 and comprises at the top a spillway 81 toward the same basin 74.

[0068] Advantageously, washing machine 1 further comprises:

- a circulation system 35 for circulating heat transfer medium between first heat exchange zone H1 and return zone R1; and

- a heating apparatus 36 for heating beams 16 at return zone R1 by allowing thermal contact between the same beams 16 and the circulated heat transfer medium, such that the same heat transfer medium is cooled by transferring part of the heat absorbed at first heat exchange zone H1 to the beams 16 themselves before being returned to first heat exchange zone H1 for cooling containers 2.

[0069] In particular, the equilibrium temperatures respectively reached by beams 16 and heat transfer medium at return zone R1 are between 25 °C and 35 °C.

[0070] Heating apparatus 36 comprises a basin 104, which is suitable for holding heat transfer medium and is arranged within return zone R1 in a position such that beams 16 passes through the same basin 104, while the beams 16 themselves are conveyed by chains 15 along return branch R.

[0071] In use, basin 104 is filled with heat transfer medium, such that beams 16 advanced through basin 104 result fully in contact with the heat transfer medium itself and, in particular, immersed therein.

[0072] Circulation system 35 comprises a fluidic circuit 110, which:

- withdraws a first portion of heat transfer medium heated at heat exchange zone H1 to supply the same first portion to the basin 104; and
- withdraws a second portion of heat transfer medium cooled within the basin 104 to convey the same second portion back to heat exchange zone H1.

[0073] In particular, fluidic circuit 110 comprises a fluidic line L1, which fluidly connects the basin 104 to the basin 70 so as to allow flowing of the above second portion from basin 104 to basin 70.

[0074] More in particular, fluidic line L1 is provided with a tank T1, which is filled with the heat transfer medium at the same temperature of the second portion, is arranged below basin 104, and is connected to basin 104 for receiving the second portion.

[0075] Moreover, fluidic circuit 110 is provided also with a pump 114 arranged along fluidic line L1 for pumping the second portion from tank T1 to basin 70, which is arranged above both tank T1 and basin 104.

[0076] Fluidic circuit 110 further comprises another fluidic line L2, which fluidly connects basin 104 to basin 74 so as to allow transport of the above first portion from basin 74 to basin 104.

[0077] Basin 74 is arranged above basin 104, such that the first portion is conveyed by fluidic line L2 due to gravity action, without the need of any pump.

[0078] Furthermore, washing machine 1 comprises another fluidic circuit 111, which withdraws a further portion of the heat transfer medium heated at heat exchange zone H1 to convey the same further portion to prewash zone P1.

[0079] In particular, fluidic circuit 111 comprises a flu-

idic line L3, which fluidly connects basin 74 with sprinkling devices 106, so as to supply the same sprinkling devices 106 with the above further portion of the heat transfer medium.

[0080] Preferably, the washing machine 1 comprises an ultrasonic wave generator UG, which is coupled to the basin 104 and is configured to propagate ultrasonic waves through the heat transfer medium within basin 104 itself, such that beams 16 receive an ultrasonic cleaning treatment while advancing through basin 104.

[0081] More in detail, the ultrasonic wave generator comprises a plurality of ultrasonic transducers 90 (Figure 2), which are conveniently plate-shaped, configured to convert electric power into ultrasounds, and sequentially arranged adjacent and parallel to each other along a stretch R2, which is part of return branch R and is placed within basin 104.

[0082] Ultrasonic transducers 90 preferably emit ultrasonic waves having an action range of at least 350 mm and a frequency between 25 kHz and 28 kHz.

[0083] Specifically, ultrasonic transducers 90 are parallel to stretch R2 and fixed with respect to basin 104, so as to be placed immediately below the advancing beams 16.

[0084] In particular, ultrasonic transducers 90 have a maximum clearance from beams 16 that is equal to 10 mm, according to a direction orthogonal to stretch R2.

[0085] While beams 16 advances through stretch R2, the same beams 16 have respective lower portions facing ultrasonic transducers 90 in close proximity.

[0086] Stretch R2 is preferably rectilinear and, more preferably horizontal. Moreover, stretch R2 conveniently has a length between 0.5 m and 2 m.

[0087] Preferably, beams 16 are advanced throughout the whole stretch R2 during a time interval between 20 s and 60 s, in order to have optimal performances of the ultrasonic cleaning treatment.

[0088] Washing machine 1 further comprises:

- an electric power generator EG connected to ultrasonic transducers 90; and
- a control unit ECU connected to the electric power generator EG and configured to control power supply of each ultrasonic transducer 90 by operating electric power generator EG.

[0089] In particular, control unit ECU controls the activation of ultrasonic transducers 90 in a periodic or discontinuous manner, e.g. for a duration of 30 s after each period of 420 working hours of the washing machine 1.

[0090] Ultrasonic waves generated by ultrasonic wave generator UG have a relative periodic motion with respect to the heat transfer medium in which the same waves propagate; therefore, local micro-zones within the heat transfer medium pass periodically from a depressurized to a pressurized state.

[0091] During the depressurized state, air dissolved within the heat transfer medium tends to form many mi-

crobbles, which implode when pressure increases, so as to release energy towards beams 16 that are advanced through basin 104.

[0092] Such energy is useful to disaggregate possible tough calcium deposit or encrusted dirt on the beams 16 themselves.

[0093] The operation of washing machine 1 is described in detail in the following.

[0094] Feeding system 8 advances a plurality of rows of containers 2 to be washed through conveyor 103 in a parallel manner to direction F.

[0095] The properly positioned containers 2 are arranged with respective axes A orthogonal to path P and with respective base portions 2c lying on conveyor 103.

[0096] Beams 16 of chain conveyor 4 withdraw respective rows of containers 2 at inlet station I from sequencing device 105, advance containers 2 inside washing tunnel 3 along the washing branch Q, discharge rows of cleaned containers 2 at outlet station O onto outfeed conveyor 14, and return along return branch R without containers 2.

[0097] In detail, containers 2 of each row are first carried by pockets 17 through prewash zone P1, where containers 2 are preliminary washed and heated through immersion within bath 11 and by means of sprinkling devices 106.

[0098] Hence, the same containers 2 are conveyed also through following baths 12, 13, respectively at cleaning zones C1, C2, so that containers 2 are completely cleaned and deprived of any labels attached thereon.

[0099] Here, both containers 2 and beams 16 continue to receive heat from cleaning agent within baths 12, 13 up to reach elevated temperatures, for instance between 60 °C and 70 °C.

[0100] At this point, a cooling process is carried out for cooling the hot washed containers 2 before the same containers 2 are discharged at outlet station O.

[0101] In particular, containers 2 and beams 16 are advanced through basin 70 within heat exchange zone H1, where the containers 2 and the beams 16 themselves are immersed into heat transfer medium and establish a thermal equilibrium with the latter, so as to reach intermediate temperatures, for instance between 45 °C and 60 °C.

[0102] Here, part of the heated heat transfer medium, at a similar temperature to the above intermediate temperatures, is dragged out from basin 70 by containers 2 and beams 16, while the latter are conveyed out from the basin 70 itself.

[0103] The dragged part falls down within basin 74 while the same containers 2 and the same beams 16 advance through the stretch Q2.

[0104] The entire heat transfer medium gathered within basin 74 has a temperature essentially equal to that of the above part; then, two different further parts of the heat transfer medium within the same basin 74 are split to be respectively supplied to sprinkling devices 106 via fluidic line L3 and transported to basin 104 via fluidic line L2.

[0105] When containers 2 and beams 16 reach the heat exchange zone H2, the containers 2 and beams 16 themselves receive the heat transfer medium by means of sprinkling devices 78, so as to be further cooled down to low temperatures, for instance between 25 °C and 35 °C.

[0106] Then, cooled beams 16 advance through the return branch R whereas containers 2 at the above low temperatures are discharged at outlet station O.

[0107] Cooled beams 16 are immersed within basin 104 while advancing through the return branch R; here, a heat exchange occur between the heat transfer medium within basin 104 and the cooled beams 16.

[0108] During heat exchange, beams 16 receive a complete ultrasonic cleaning treatment by means of ultrasonic wave generator UG, with above described modes.

[0109] After such heat exchange, beams 16 are warmed and conveyed toward inlet station I, whereas the heat transfer medium is cooled down.

[0110] Then, part of the cooled down heat transfer medium is transported to basin 70, so as to be re-used for cooling other containers 2 and beams 16, which advance through basin 70 itself.

[0111] From an analysis of the features of the cooling process and washing machine 1 according to the invention, the advantages they allow to obtain are apparent.

[0112] Basin 70 is supplied with recycled heat transfer medium from basin 104, which is maintained at low temperatures by beams 16 cooled at heat exchange zone H2 and passing through basin 104 itself.

[0113] Thanks to that, there is no need of supplying basin 70 with fresh heat transfer medium at low temperatures; in other words, the amount of heat transfer medium circulated by circulation system 35 is sufficient to guarantee effective cooling of containers 2.

[0114] Fresh heat transfer medium is supplied just only to one sprinkling device 78; thanks to the peculiar arrangement of basins 79, all the other sprinkling devices 78 are effectively supplied with recycled heat transfer medium.

[0115] Therefore, the usage of fresh heat transfer medium is reduced at the minimum necessary, so that costs and environmental impact of washing machine 1 are cut down.

[0116] Besides, part of the heat accumulated by heat transfer medium within heat exchange zone H1 is conveniently exploited at the prewash zone P1 thanks to fluidic circuit 111.

[0117] Clearly, changes may be made to the process for cooling hot washed containers 2 and washing machine 1 as described and illustrated herein without, however, departing from the scope of protection as defined in the accompanying claims.

[0118] In particular, instead of being supplied with heat transfer medium gathered into basin 74, basin 104 may be supplied by exploiting other collecting means, possibly suitable for actively withdrawing heat transfer medium

from heat exchange zone H1, such as pumping systems that trap heat transfer medium from basin 70.

[0119] Many kinds of cooling or heating apparatus may be used to allow heat transfers between beams 16 and heat transfer media at heat exchange zones H1, H2, and at return zone R1, including heat exchangers, fans, nebulizers, and the like.

[0120] In view of that, basin 70 may be placed within heat exchange zone H2 whereas ejection assembly 77 may be placed within heat exchange zone H1, as well as heat exchange zones H1, H2 may be provided with rinsing apparatus including further basins and/or ejection assemblies.

[0121] Moreover, washing machine 1 may comprise many more heat exchange zones between cleaning zone C2 and outlet station O. Possibly, some of such heat exchange zones may be placed between heat exchange zones H1, H2.

[0122] Eventually, fluidic circuit 111 may connect heat exchange zone H1 also or only with bath 11.

Claims

1. A cooling process for cooling hot washed containers (2) in a washing machine (1), the method comprising the steps of:

- advancing, by means of a conveyor device (4), a plurality of said hot washed containers (2) and at least one member (16) of said conveyor (4) along a washing path (P) with an outlet station (0) and a return zone (R1) downstream of said outlet station (0), according to an advancing direction of said member (16) along said path (P);
- sequentially cooling said member (16) and said containers (2) for a first and a second time by putting said member (16) in thermal contact respectively with a first and a second heat transfer medium, respectively at a first and a second heat exchange zone (H1, H2) arranged in sequence along said path (P) and upstream of said outlet station (0) according said advancing direction, such that said first heat transfer medium is heated up to a temperature higher than that of said second heat transfer medium;
- discharging said containers (2) at said outlet station (0) ;

characterized by further comprising the steps of:

- circulating said first heat transfer medium between said first heat exchange zone (H1) and said return zone (R1);
- heating said member (16) and cooling said first heat transfer medium by putting said member (16) in thermal contact with said first heat transfer medium at said return zone (R1); and

- returning the cooled said first heat transfer medium to said first heat exchange zone (H1) for cooling said containers (2) .

2. The process of claim 1, wherein said step of circulating said first heat exchange medium comprises the step of filling a first basin (104) within said return zone (R1) with a first portion of the first heat transfer medium heated at said first heat exchange zone (H1);
- the process further comprising the step of advancing said member (16) through said first basin (104) to come in thermal contact with said first portion.
3. The process of claim 2, further comprising the step of propagating ultrasonic waves through said first portion, such that said member (16) receives an ultrasonic cleaning treatment while advancing through said first basin (104).
4. The process of any one of the foregoing claims, wherein said step of circulating said first heat transfer medium comprises the step of filling a second basin (70) within said first heat exchange zone (H1) with a second portion of the first heat transfer medium cooled at said return zone (R1);
- the process further comprising the step of advancing said member (16) through said second basin (70) to come in thermal contact with said second portion.
5. The process of any one of the foregoing claims, wherein said step of circulating said first heat transfer medium comprises the steps of:
- gathering into a third basin (74) within said first heat exchange zone (H1) a third portion of the first heat transfer medium heated at said first heat exchange zone (H1) by said member (16) and said containers (2) during said step of advancing through said first heat exchange zone (H1); and
 - transporting a fourth portion of said first heat transfer medium from said third basin (74) to said return zone (R1).
6. The process of any one of the foregoing claims, further comprising the steps of:
- washing said containers (2) through a washing zone (P1) arranged along said path (P) upstream of said first heat exchange zone (H1), according to said advancing direction;
 - advancing said member (16) through said washing zone (P1); and
 - transporting a fifth portion of the first heat transfer medium heated at said first heat exchange zone (H1) to said washing zone (P1) for heating said containers (2) during said step of advancing

said member (16) through said washing zone (P1).

7. A washing machine (1) comprising:

- a conveyor device (4) for advancing a plurality of containers (2) along a washing path (P) and comprising at least one member (16) movable along said path (P);
- an outlet station (0) arranged along said path (P) and configured to allow discharging of said containers (2);
- a first and a second heat exchange zone (H1, H2) arranged in sequence along said path (P) and upstream of said outlet station (0), according to an advancing direction of said containers (2);
- cooling means (101, 102) operable for sequentially cooling said member (16) and said containers (2) for a first and a second time, respectively at said first and second heat exchange zone (H1, H2), by allowing thermal contact between said member (16) and, respectively, a first and a second heat transfer medium, such that said first heat transfer medium is heated up to a temperature higher than that of said second heat transfer medium; and
- a return zone (R1) arranged along said path (P) downstream of said outlet station (0), according to said advancing direction;

characterized by further comprising:

- circulation means (35) operable for circulating said first heat transfer medium between said first heat exchange zone (H1) and said return zone (R1); and
- heating means (36) operable for heating said member (16) at said return zone (R1) by allowing thermal contact between said member (16) and said first heat transfer medium, such that said first heat transfer medium is, in use, cooled by transferring part of the heat absorbed at said first heat exchange zone (H1) to said member (16) before being returned to said first heat exchange zone (H1) for cooling said containers (2).

8. The washing machine of claim 7, wherein:

- said heating means (36) comprise a first basin (104) arranged within said return zone (R1) and suitable for holding said first heat transfer medium; and
- said circulation means (35) comprise a fluidic circuit (110) for moving a first portion of the first heat transfer medium heated at said first heat exchange zone (H1) to said first basin (104) and a second portion of the first heat transfer medi-

um cooled within said first basin (104) to said first heat exchange zone (104);

said path (P) extending through said first basin (104), such that said member (16) comes in thermal contact with said first portion.

9. The washing machine of claim 8, wherein:

- said cooling means (35) further comprise a second basin (70) arranged within said first heat exchange zone (H1) and suitable for holding said first heat transfer medium; and
- said fluidic circuit (110) comprises a first fluidic line (L1) fluidly connecting said second basin (70) with said first basin (104), such that said second basin (70) is supplied with said second portion;

said path (P) extending through said second basin (70), such that said member (16) comes in thermal contact with said second portion; and/or wherein said fluidic circuit (110) comprises a pump (114) arranged along said first fluidic line (L1) between a first branch of said first fluidic line (L1), in which said second portion flows due to gravity action, and a second branch of said first fluidic line (L1), in which said second portion is pushed by said pump (114) to said second basin (70).

10. The washing machine of claim 8 or 9, further comprising a third basin (74) arranged within said first heat exchange zone (H1) and configured to receive and gather a third portion of the first heat transfer medium heated at said first heat exchange zone (H1);

wherein said fluidic circuit (110) comprises a second fluidic line (L2) fluidly connecting said third basin (74) with said first basin (104), such that said first basin (104) is supplied with said first portion.

11. The washing machine of claim 10, further comprising:

- a prewash zone (P1) arranged along said path (P) upstream of said first heat exchange zone (H1), according to said advancing direction;
- a prewashing apparatus (106, 11) arranged along said path (P) within said prewash zone (P1) and configured to wash said containers (2); and
- a third fluidic line (L3) fluidly connecting said third basin (74) with said prewashing apparatus (106, 11), such that said prewashing apparatus (106, 11) is supplied with a fifth portion of said first heat transfer medium withdrawn from said third basin (74).

12. The washing machine of any one of claims from 8 to 11, further comprising an ultrasonic wave generator (UG) coupled to said first basin (104) for propagating ultrasonic waves through said first portion, such that said member (16) receives an ultrasonic cleaning treatment while advancing through said first basin (104). 5

13. The washing machine of any one of claims from 7 to 12, further comprising a rinsing apparatus (70; 77) arranged within at least one of said first and second heat exchange zone (H1, H2) and configured to deliver a rinsing medium toward said containers (2) and, preferably, to said member (16); said rinsing medium being correspondingly part of one of said first and second heat transfer medium. 10 15

14. The washing machine of claim 13, when dependent on claims from 9 to 12, wherein said rinsing apparatus (70; 77) comprises: 20

- said second basin (70) for holding said rinsing medium and arranged along said path (P), such that said member (16) advances, in use, through said second basin (70) coming into contact with said rinsing medium; and/or 25

- at least one ejection assembly (77) configured to direct sprinkles of said rinsing medium toward said containers (2) and said member (16); 30

said ejection assembly (77) comprising, in particular, a plurality of sprinkling devices (78) and a respective plurality of fourth basins (79) arranged below the corresponding said sprinkling devices, fluidly connected to the corresponding said sprinkling devices, and being fluidly communicating with one another through spillways (80). 35

15. The washing machine of any one of claims from 7 to 14, wherein said conveyor (4) comprises: 40

- a plurality of beams (16) suitable for carrying respective rows of said containers (2) and extending transversally to said path (P); and 45
- a conveying chain (15) extending parallel to said path (P) and configured to convey said beams (16) along said path (P);

said beams (16) defining a respective plurality of said members (16) for exchanging heat with said first and second heat transfer medium. 50

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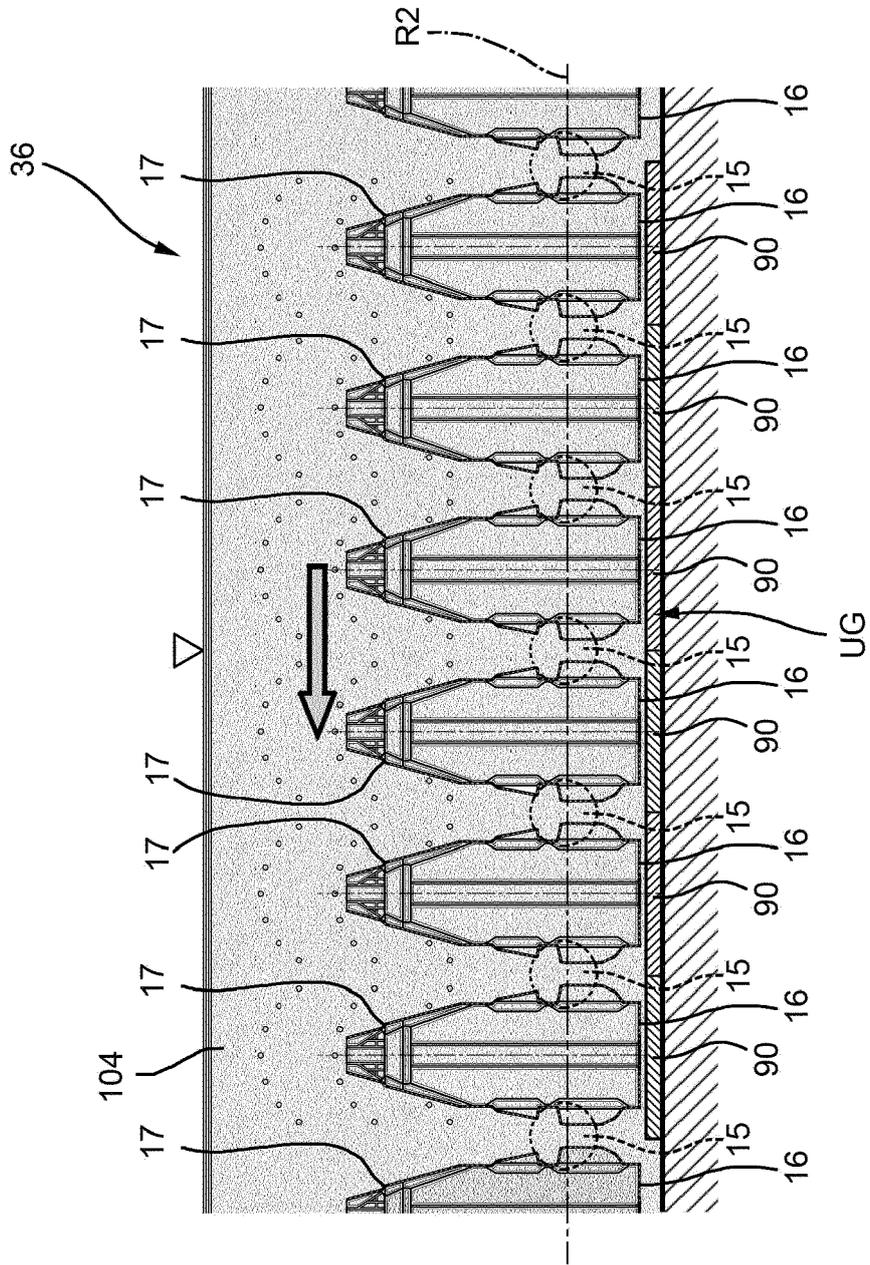


FIG. 2



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