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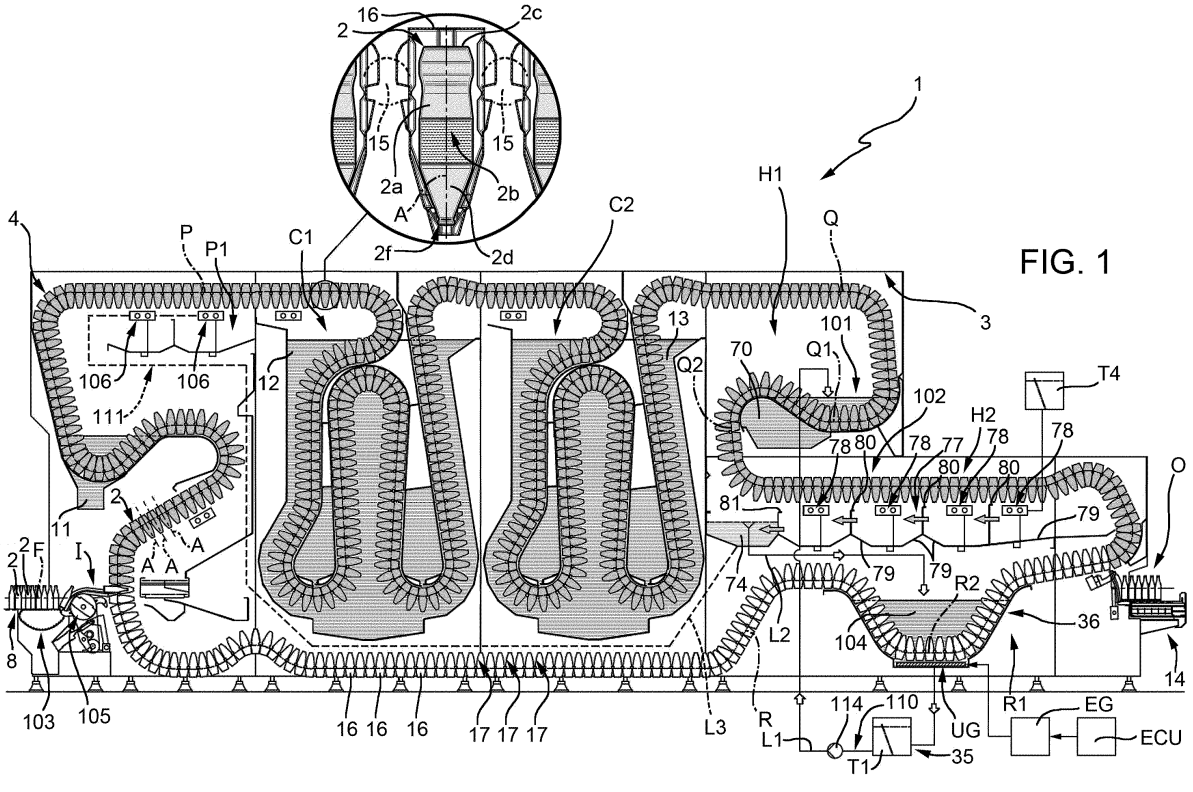
(54) A WASHING MACHINE FOR WASHING EMPTY CONTAINERS AND AN OPERATING METHOD THEREOF

(57) A washing machine (1) for washing empty containers (2) includes a plurality of beams (16) cyclically movable along a closed-loop path (P) for carrying and advancing a plurality of containers (2) along the path (P), an inlet and an outlet station (I, O) arranged along the path (P) to respectively allow the beams (16) to withdraw and discharge the containers (2), a return zone (R1) arranged along the path (P) downstream of the outlet station (O), and cleaning means arranged within the return zone (R1) to clean the beams (16), while the latter are advanced through the basin (104).



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Description

[0001] The invention relates to a washing machine for washing empty containers and to an operating method thereof.

[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 beams, which are fed at the inlet station by the feeding system with respective rows of containers.

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

[0007] Each beam is discharged of the respective washed containers at the outlet station and then is returned to the inlet station, where it receives new empty containers to be washed.

[0008] 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.

[0009] 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.

[0010] 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.

[0011] 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.

[0012] As the containers are sequentially conveyed through the treatment zones, also the conveying beams are exposed to the washing chemical agent and then to the rinsing liquid.

[0013] Therefore, the beams tend to show limescale deposits after many washing cycles, such that the same beams need periodical treatments in order to be recovered to the initial operating conditions.

[0014] Moreover, after a deep using of the washing machine, the beams may also show encrusted dirt deposit, including for instance rust, which should be removed to avoid corrosion of the beams themselves or contaminations in general.

[0015] Generally, the beams are one by one disassembled from the washing machine and are separately restored in a manual manner or even replaced, if conditions thereof are particularly critic.

[0016] The above general approach, however, results scarcely satisfactorily due to the significant operation time taken for disassembling and reassembling each beam, as well as due to the inherent risks of assembling errors, which could lead to inconvenient downtimes.

[0017] In view of that, a need is felt within the sector for a washing machine integrating both the function of washing the empty containers and of periodically restoring the beams without stops of the washing machine operation.

[0018] It is an object of the invention to provide a washing machine for washing empty containers, which allows meeting the abovementioned need in a simple, economic and energy efficient manner.

[0019] This object is achieved by the invention as it relates to a washing machine for washing empty containers, as claimed in claim 1.

[0020] The invention further relates to an operating method of a washing machine for washing empty containers, as claimed in claim 10.

[0021] 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, 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.

[0022] 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.

[0023] 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.

[0024] 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.

[0025] 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.

[0026] 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.

[0027] Specifically, each beam 16 comprises a row of pockets 17 aligned orthogonally to path P and adapted to receive corresponding containers 2.

[0028] 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.

[0029] 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.

[0030] 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.

[0031] 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.

[0032] The operation and construction of the sequencing device 105 in known as such and, therefore, not described further in detail.

[0033] In the embodiment shown, direction F is horizontal and orthogonal to axes A of containers 2 fed along the same direction F.

[0034] Washing machine 1 further comprises an outfeed conveyor 14, which receives rows of cleaned containers 2 from chain conveyor 4 at an outlet station 0 of washing tunnel 3.

[0035] In view of the above, path P comprises:

- a washing branch Q, which extends from inlet station I to outlet station 0 and along which containers 2 are advanced by chain conveyor 4; and
- a return branch R, which extends from outlet station 0 to inlet station I and defines a return zone R1, through which beams 16 return towards inlet station I without containers 2.

[0036] 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.

[0037] 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.

[0038] 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.

[0039] Moreover, within prewash zone P1, washing machine 1 comprises also a plurality of sprinkling devices 106 arranged in sequence along washing branch Q.

[0040] 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.

[0041] 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.

[0042] 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.

[0043] 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 0.

[0044] 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.

[0045] 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.

[0046] 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.

[0047] In this manner, the cleaning agent remaining onto containers 2 and onto beams 16 is gradually removed therefrom, as well as dissolved in the rinsing medium.

[0048] 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.

[0049] 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.

[0050] 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.

[0051] 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.

[0052] 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.

[0053] 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.

[0054] 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.

[0055] 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.

[0056] 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°.

[0057] 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.

[0058] 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.

[0059] 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.

[0060] 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.

[0061] 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.

[0062] 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.

[0063] 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.

[0064] 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.

[0065] The last basin 79 in the respective sequence gathers the 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.

[0066] 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.

[0067] 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, comprises at the top a corresponding spillway 80 toward the immediately upstream basin 79.

[0068] 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.

[0069] 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 correspond-

ing sprinkling device 78; the other basins 79 are completely filled in succession according to a direction opposite to the advancing direction of containers 2.

[0070] 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.

[0071] 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.

[0072] 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.

[0073] Advantageously, washing machine 1 further comprises a cleaning device, which is arranged within return zone (R1) and is configured to clean beams 16, while the latter advance through the return zone (R1).

[0074] With greater detail, the cleaning device comprises a basin 104 arranged so as to allow therein a recovering bath treatment for beams 16.

[0075] In other words, path P extends through the basin 104 itself.

[0076] Preferably, heating apparatus 36 comprises the basin 104, which is also suitable for holding heat transfer medium.

[0077] 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.

[0078] 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.

[0079] 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.

[0080] 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.

[0081] 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.

[0082] 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.

[0083] Basin 74 is arranged above basin 104, such that the first portion is conveyed by fluidic line L2 due to gravity action, without the needing of any pump.

[0084] 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.

[0085] In particular, fluidic circuit 111 comprises a fluidic 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.

[0086] Preferably, the aforementioned cleaning device 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 may receive an ultrasonic cleaning treatment while advancing through basin 104.

[0087] 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.

[0088] 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.

[0089] 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.

[0090] 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.

[0091] While beams 16 advances through stretch R2, the same beams 16 have respective portions facing ultrasonic transducers 90 in close proximity.

[0092] Stretch R2 is preferably rectilinear and, more preferably horizontal. Moreover, stretch R2 conveniently has a length between 0.5 m and 2 m.

[0093] 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.

[0094] Washing machine 1 further comprises:

- an electric power generator EG connected to ultra-

sonic 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.

[0095] 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.

[0096] 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.

[0097] During the depressurized state, air dissolved within the heat transfer medium tends to form many microbubbles, which implode when pressure increases, so as to release energy towards beams 16 that are advanced through basin 104.

[0098] Such energy is useful to disaggregate possible tough calcium deposit or encrusted dirt on the beams 16 themselves.

[0099] The operation of washing machine 1 is described in detail in the following.

[0100] Feeding system 8 advances a plurality of rows of containers 2 to be washed through conveyor 103 in a parallel manner to direction F.

[0101] 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.

[0102] 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 0 onto outfeed conveyor 14, and return along return branch R without containers 2.

[0103] 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.

[0104] 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.

[0105] 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.

[0106] 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 0.

[0107] 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 the 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.

[0108] 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.

[0109] The dragged part falls down within basin 74 while the same containers 2 and the same beams 16 advance through the stretch Q2.

[0110] 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.

[0111] 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.

[0112] Then, cooled beams 16 advance through the return branch R whereas containers 2 at the above low temperatures are discharged at outlet station 0.

[0113] 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.

[0114] During heat exchange, beams 16 receive a complete ultrasonic cleaning treatment by means of ultrasonic wave generator UG, with above described modes.

[0115] After such heat exchange, beams 16 are warmed and conveyed toward inlet station I, whereas the heat transfer medium is cooled down.

[0116] 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.

[0117] From an analysis of the features of washing machine 1 and of the method according to the invention, the advantages they allow to obtain are apparent.

[0118] Return zone R1, which, in the known solutions, is only aimed to allow the return of beams 16 to inlet station I, is here provided with cleaning means to allow removal of limescale or encrusted dirt deposits during the operation of washing machine 1.

[0119] Thanks to that, stops of washing machine 1 for disassembling beams 16 are totally avoided. In the same way, manual maintenance operations on beams 16 are unnecessary and any related assembling errors waived.

[0120] In particular, the waves generated by ultrasonic generator UG through basin 104 reveals significantly effective in restoring beams 16.

[0121] The flattened shape of ultrasonic transducers

90 allows a simple and compact arrangement of ultrasonic wave generator UG within basin 104 under the advancing beams 16 through stretch R2.

[0122] In particular, the reduced spacing between ultrasonic transducers 90 and beams 16 optimizes the effectiveness of the cleaning treatment of beams 16 themselves, since an increased amount of energy affects the limescale or encrusted dirt deposits thereon.

[0123] The energetic impact of the operation of ultrasonic wave generator UG is particularly limited thanks to the intelligent control performed by electronic control unit ECU, which selectively activate each ultrasonic transducer 90 according to a predetermined optimized period.

[0124] The relatively high temperature of the heat transfer medium, which enables the ultrasonic wave transmission, enhances the cleaning performances of the transmitted ultrasonic waves.

[0125] Finally, the length of stretch R2 is chosen according to an optimized compromise between energetic expenditure and cleaning performances, as demonstrated by several experiments accomplished by the Applicant.

[0126] Clearly, changes may be made to washing machine 1 and to the method as described and illustrated herein without, however, departing from the scope of protection as defined in the accompanying claims.

[0127] In particular, the shape and arrangement of each ultrasonic transducer 90 may be different from what described and illustrated in the above disclosure.

[0128] Moreover, ultrasonic wave generator UG may even be lacking and basin 104 may be filled, for instance, with an acid solution suitable for descaling beams 16. Clearly, in the latter case, circulation system 36 would not be present and basin 104 would be isolated from heat exchange zones H1, H2.

Claims

1. A washing machine (1) for washing empty containers (2), the washing machine comprising:

- a plurality of beams (16) cyclically movable along a closed-loop path (P) for carrying and advancing a plurality of containers (2) along said path (P); said path (P) comprising:
- an inlet and an outlet station (I, 0) respectively configured to allow said beams (16) to withdraw and discharge said containers (2); and
- a return zone (R1) arranged downstream of said outlet station (0), according to an advancing direction of said beams (16);

characterized by further comprising cleaning means arranged within said return zone (R1) and configured to clean said beams (16) during their advancement through said return zone (R1).

2. The washing machine of claim 1, **characterized in that** said cleaning means comprise:

- a basin (104) arranged within said return zone (R1) and suitable for allowing therein a recovering bath treatment for said beams (16); said path (P) extending through said basin (104); and
- an ultrasonic wave generator (UG) coupled to said basin (104) and configured to propagate ultrasonic waves through a wave transmission medium filling said basin (104), such that said beams (16) can receive an ultrasonic cleaning treatment during their advancement through said basin (104);

3. The washing machine of claim 2, wherein said ultrasonic wave generator (UG) comprises at least one ultrasonic transducer (90) being plate-shaped, configured to convert electric power into ultrasounds, and arranged within said basin (104) in such a manner to face respective portions of said beams (16) in close proximity during the advancement of said beams (16) through said basin (104).

4. The washing machine of claim 3, further comprising a control unit (ECU) connected to said ultrasonic transducer (90) and configured to control power supply of said ultrasonic transducer (90).

5. The washing machine of claim 4, wherein said control unit (ECU) is configured to activate said ultrasonic transducer (90) according to a predetermined period and for a predetermined activation duration; said predetermined period and duration being, in particular, selected in view of an advancing velocity of said beams (16) to guarantee an optimized balance between cleaning performance of said ultrasonic cleaning treatment and energy expenditure.

6. The washing machine of any one of claims from 2 to 5, wherein said ultrasonic wave generator (UG) comprises a plurality of ultrasonic transducers (90) being plate-shaped, configured to convert electric power into ultrasounds, and sequentially arranged adjacent and parallel to each other along a stretch (R2) of said path (P); said stretch (R2) extending within said basin (104).

7. The washing machine of claim 6, wherein said ultrasonic transducers (90) are arranged in such a manner to be placed, in use, below said beams (16) during their advancement through said basin (104).

8. The washing machine of claim 6 or 7, wherein said stretch (R2) has a length between 0.5 m and 2 m.

9. The washing machine of claim 1, wherein said cleaning means comprise a basin (104) suitable for hold-

ing a descaling agent, in particular an acid solution; said path (P) extending through said basin (104).

10. An operating method of a washing machine (1) for washing empty containers, the method comprising the steps of:

- cyclically advancing a plurality of beams (16) along a closed loop path (P) comprising an inlet and an outlet station (I, 0), and a return zone (R1) arranged downstream of said outlet station (0), according to an advancing direction of said beams (16);
- charging said beams (16) with a plurality of containers (2) at said inlet station (I);
- discharging said containers (2) from said beams (16) at said outlet station (0);

characterized by further comprising the step of cleaning said beams (16) during their advancement through said return zone (R1).

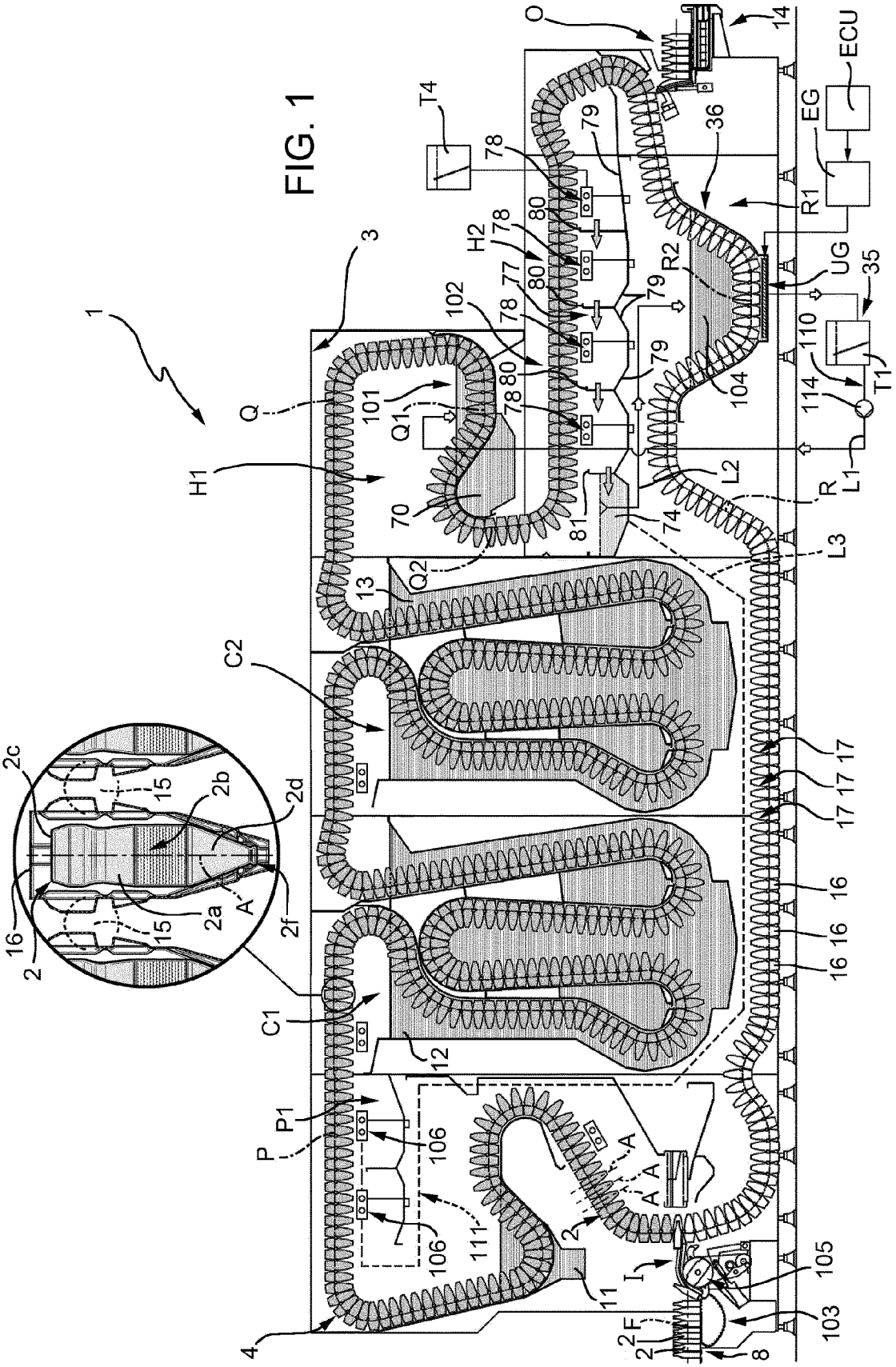
11. The operating method of claim 10, wherein said step of cleaning said beams (16) comprises the steps of:

- filling a basin (104) arranged within said return zone (R1) with a wave transmission medium; said path (P) extending through said basin (104); and
- propagating ultrasonic waves through said wave transmission medium during the advancement of said beams (16) through said basin (104), such that said beams (16) receive an ultrasonic cleaning treatment.

12. The operating method of claim 10, wherein said step of cleaning said beams (16) comprises the step of:

- filling a basin (104) arranged within said return zone (R1) with a descaling agent, in particular an acid solution; said path (P) extending through said basin (104), such that said beams (16) come in contact with said descaling agent during their advancement through said basin (104).

FIG. 1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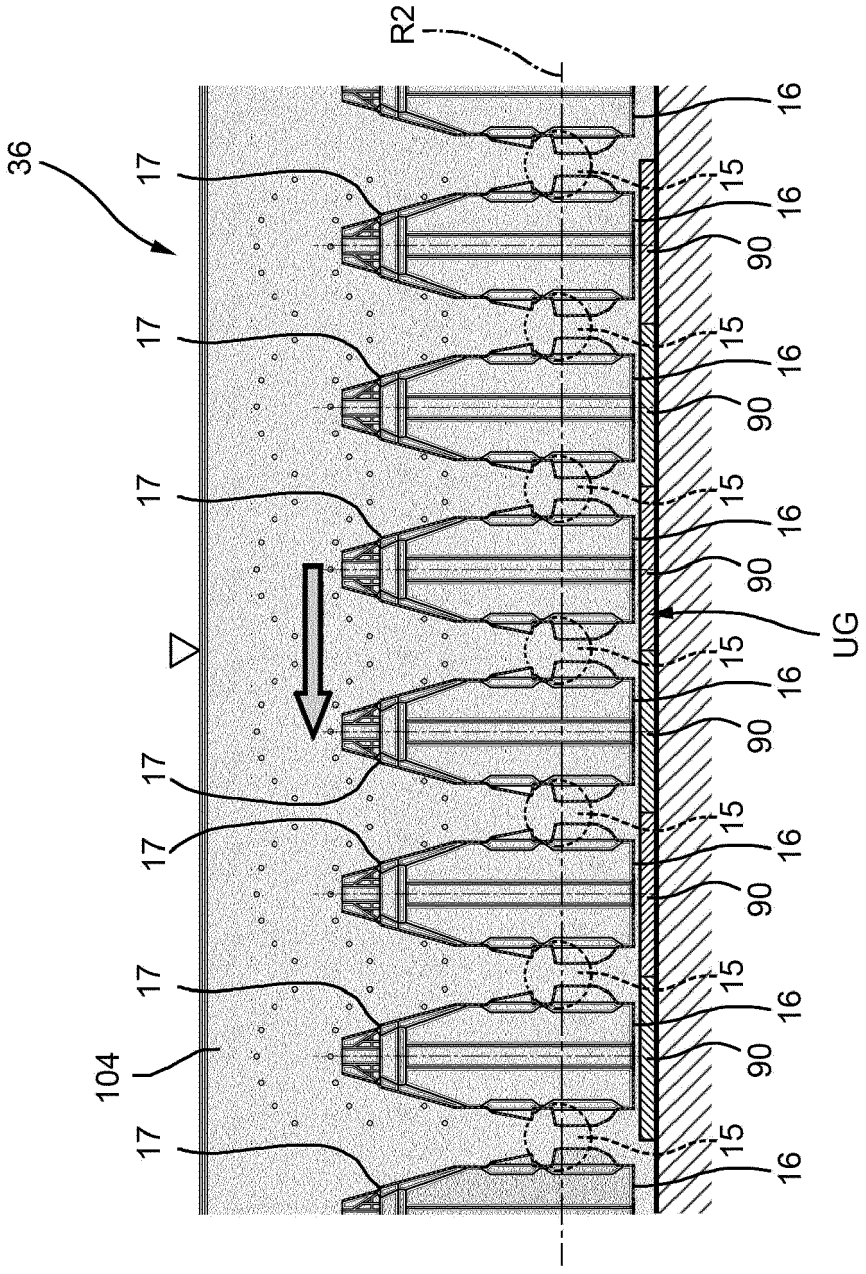

FIG. 2

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EUROPEAN SEARCH REPORT

Application Number
EP 18 21 2342

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