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(54) **A WASHING MACHINE AND A PROCESS FOR TREATING CONTAINERS THEREWITH**

(57) A washing machine (1) includes a conveyor device (4) for advancing containers (2) along a washing path (P) having a first and a second treatment branch (P1S; R1S), of which the second treatment branch (P1S; R1S) is arranged downstream of the first treatment branch (P1S; R1S), a first treatment station (P1F; R1F, R1P, R1U) arranged along the first treatment branch (P1S; R1S) and provided with a first delivering unit (77F, 77P, 77U) that delivers a treating agent to the containers (2) and with a first collecting unit (80F, 80P, 80U) to collect the delivered treating agent, and a second treatment station (P1L; R1P, R1U, R1L) arranged along the second treatment branch (P1S; R1S) and provided with a second delivering unit (77PL; 77P, 77U, 77RL) that delivers the treating agent to the containers (2) and with a second collecting unit (80P, 80U, 80L) to collect the delivered treating agent; the first delivering unit (77) is fluidly connected to the second collecting unit (80P, 80U, 80L 80) for being supplied with the treating agent and fluidly isolated from the first collecting means (80F, 80P, 80U) .

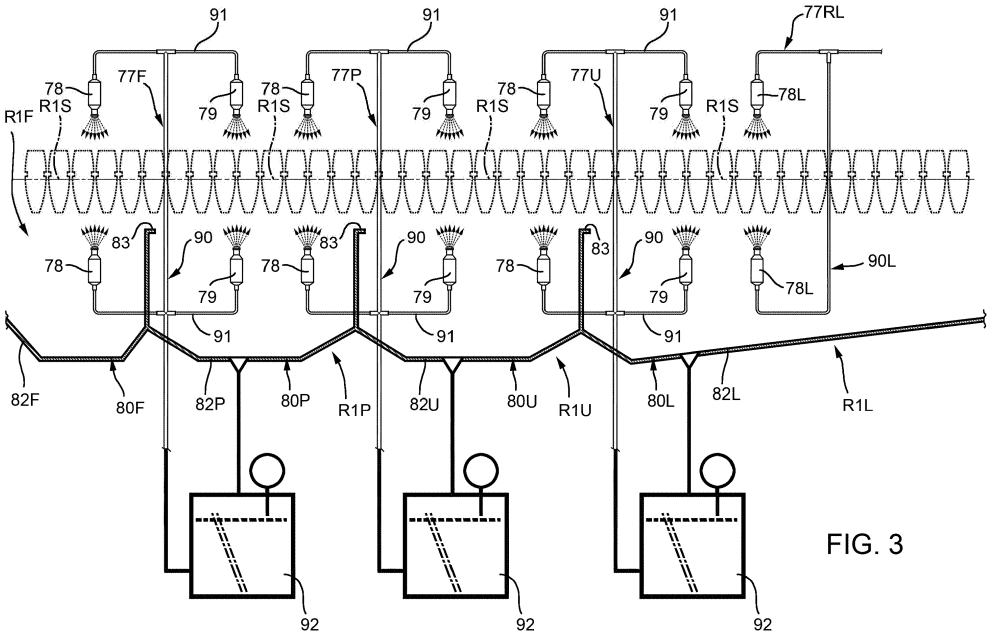

FIG. 3

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Description

[0001] The invention relates to a washing machine and to a process for treating containers through the same washing machine.

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

[0008] The first and the second cleaning station usually comprise respective cleaning baths, which are filled with a high-temperature cleaning agent and are arranged to receive and soak the advancing containers.

[0009] On the other hand, each prewash station and each rinsing station comprise, respectively:

- a corresponding plurality of ejecting devices to direct a prewashing agent towards the containers; and
- a corresponding plurality of ejecting devices to direct a rinsing agent towards the containers.

[0010] Although having different purposes, the prewashing agent and the rinsing agent both define respective treating agents for the containers. In particular, the prewashing agent is used for softening encrusted dirt deposits onto the containers, whereas the rinsing agent is used for diluting the residuals of cleaning agent onto the containers after their immersion in the cleaning baths.

[0011] Furthermore, each prewash or rinsing station comprises a corresponding basin, which collects the ejected treating agent dripping from the advancing containers and supplies the corresponding ejecting devices with the collected treating agent, which, therefore, is recirculated within the same station.

[0012] The basins of the last prewash station and of the last rinsing station, according to the advancing direction of the containers, respectively receive also fresh treating agent from corresponding tanks included in the washing machine.

[0013] On the other hand, each of all the other basins receive recycled treating agent from spillways, which are obtained onto the basin of the immediately downstream station, according to the advancing direction of the containers.

[0014] While the containers are sequentially conveyed through the consecutive prewash stations and, respectively, the consecutive rinsing stations, the percentage concentration of dirt and cleaning agent onto the same containers gradually reaches decreasing values.

[0015] More in particular, thanks to the recirculation of the prewashing agent, the containers advancing through a specific prewash station carry a concentration of dirt, which is the same of that carried by the recirculated prewashing agent within the specific prewash station.

[0016] Analogously, thanks to the recirculation of the rinsing agent, the containers advancing through a specific rinsing station carry a concentration of cleaning agent, which is the same of that carried by the recirculated rinsing agent within the specific rinsing station.

[0017] However, although the previously described recirculation, the overall quantities of fresh prewash agent and of fresh rinsing agent that are used within the known washing machines for treating the containers are still significant.

[0018] This aspect introduces an issue regarding the energetic and environmental impact of the known washing machines, as well as the costs related to high consumption of treating agents.

[0019] In view of that, a need is to reduce the amount of treating agents in respect to known solutions, without losing cleaning or rinsing performances of the washing machine itself.

[0020] It is an object of the invention to provide a washing machine, which allows meeting the abovementioned need in a simple and economic manner.

[0021] This object is achieved by the invention as it relates to a washing machine, as claimed in claim 1.

[0022] The invention further relates to a process for treating containers through a washing machine, as claimed in claim 11.

[0023] 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 represents schematically a lateral view of a washing machine for treating containers, according to the invention; and

- Figures 2 and 3 show respective enlarged schemes of distinct portions of the washing machine of Figure 1.

[0024] 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.

[0025] 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.

[0026] 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.

[0027] 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.

[0028] 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.

[0029] Specifically, each beam 16 comprises a row of pockets 17 aligned orthogonally to path P and adapted to receive corresponding containers 2.

[0030] 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.

[0031] 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 and horizontal, in use.

[0032] 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.

[0033] 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.

[0034] The operation and construction of the sequencing device 105 in known as such and, therefore, not described further in detail.

[0035] In the embodiment shown, direction F is horizontal and orthogonal to axes A of containers 2 fed along the same direction F.

[0036] Washing machine 1 further comprises an outfeed conveyor 14, which receives rows of cleaned containers 2 from chain conveyor 4 at an outlet station O of washing tunnel 3.

[0037] In view of the above, path P comprises:

- a transport branch T, 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 through which beams 16 return towards inlet station I without containers 2.

[0038] Furthermore, according to the advancing direction of the same containers 2, washing machine 1 comprises in sequence, along transport branch T, the following treatment stations:

- an earlier prewash station P0;
- two consecutive prewash stations P1F, P1L;
- a first cleaning station C1;
- a second cleaning station C2;
- an earlier rinsing station R0; and
- four consecutive rinsing stations R1F, R1P, R1U, R1L.

[0039] In the foregoing of the present disclosure, for the sake of clarity, terms like "upstream" and "downstream", as well as like "first", "last", "consecutive", "preceding", "following", etc., are to be intended throughout the whole description with reference to the advancing direction of the containers 2 along path P.

[0040] Earlier prewash station P0 is arranged along a prewash branch K and is provided with a bath 11 filled with a prewashing agent, preferably a basic solution, in particular with concentration of NaOH greater than 0.4%, having a temperature between 45 °C and 60 °C, so that the encrusted dirt onto containers 2 that advances through the same bath 11 starts to soften.

[0041] Similarly, first and second cleaning station C1, C2 are arranged along respective washing branches Q of path P and comprises respective baths 12, 13 filled with a cleaning agent, preferably a basic solution, in particular with concentration of NaOH greater than 1.2%, having a temperature between 65° and 80°, so that the containers 2 advancing through baths 12, 13 are deeply washed and dirt thereon is completely removed.

[0042] More precisely, the basic solutions contained in baths 11, 12, 13 are all aqueous solutions comprising

sodium hydroxide.

[0043] Earlier rinsing station R0 is arranged along a rinsing branch Q1 and is provided with a bath 69 filled with a rinsing agent, which is suitable for diluting the cleaning agent contained within bath 13. In particular, the rinsing agent comprises water and has a temperature lower than that of the cleaning agent within bath 13, precisely between 45° and 65°.

[0044] In such a manner, the containers 2 advancing through bath 69 are partially cooled down and deprived of respective portions of the cleaning agent remained thereon after immersion within bath 13.

[0045] Therefore, the rinsing agent within bath 69 is a basic solution because of the portions of the cleaning agent herein released by the incoming containers 2.

[0046] The two sequences of treatment stations defined by prewash stations P1F, P1L and, respectively, by rinsing stations R1F, R1P, R1U, R1L are each arranged along a corresponding plurality of consecutive treatment branches, which are indicated in Figure 1 by reference symbol P1S or R1S based on what sequence they actually refer to.

[0047] Each one of treatment stations P0, P1F, P1L, C1, C2, R0, R1F, R1P, R1U, R1L carries out, in use, a respective treatment on containers 2 advancing along a corresponding one of treatment branches K, P1S, Q, Q1, R1S.

[0048] As shown in Figure 1, treatment branches P1S and treatment branches R1S are respectively placed upstream and downstream of washing branches Q.

[0049] With reference to Figure 2, prewash stations P1F, P1L respectively comprise two delivering apparatus 77F, 77PL, which are configured to deliver a treating agent to the containers 2 advancing through the relative treatment branches P1S.

[0050] Prewash stations P1F, P1L further comprise respective collecting apparatus 80F, 80P, which are each configured to collect at least one portion of the treating agent delivered at the corresponding treatment branch P1S.

[0051] Similarly, with reference to Figure 3, rinsing stations R1F, R1P, R1U, R1L respectively comprise delivering apparatus 77F, 77P, 77U, 77L for respectively treating, with a further treating agent, the containers 2 advancing through the relative treatment branches R1S.

[0052] Rinsing stations R1F, R1P, R1U, R1L respectively comprise, moreover, collecting apparatus 80F, 80P, 80U, 80L for collecting at least portions of the treating agent delivered at the corresponding treatment branches R1S.

[0053] Based on the specific sequence of treatment stations, i.e. the sequence of prewash stations P1F, P1L or the sequence of rinsing stations R1F, R1P, R1U, R1L, the delivered treating agent carries out a peculiar function.

[0054] In particular, the treating agent delivered at prewash stations P1F, P1L carries out the function of softening encrusted dirt onto containers 2, raising the temperature of the latter, and favouring the detachment of possible labels thereon.

[0055] On the other hand, the treatment agent delivered at rinsing stations R1F, R1P, R1U, R1L carries out the function of cooling down the containers 2 and of diluting or removing the residual cleaning agent thereon.

[0056] Advantageously, delivering apparatus 77F at rinsing station R1F is fluidly connected to collecting apparatus 80P at rinsing station R1P, for being supplied with the treating agent collected by the same collecting apparatus 80P, and is fluidly isolated from collecting apparatus 80F at rinsing station R1F.

[0057] Moreover, in a similar manner, delivering apparatus 77F at prewash station P1F is connected to collecting apparatus 80P at prewash station P1L and is fluidly isolated from collecting apparatus 80F at prewash station P1F.

[0058] Furthermore, delivering apparatus 77P, 77U at rinsing stations R1P and R1U are fluidly connected, respectively, to collecting apparatus 80U, 80L at rinsing stations R1U, R1L and are fluidly isolated, respectively, from collecting apparatus 80P, 80U at rinsing stations R1P, R1U.

[0059] Thus, in the embodiment shown, prewash station P1F and rinsing stations R1F, R1P, R1U have respective individual sources of collected treating agent that has been already delivered to containers 2.

[0060] On the other hand, prewash station P1L and prewash station R1L, which are the last of the respective sequences, according to the advancing direction of containers 2, may each have one or more different sources of treating agent.

[0061] For instance, the delivering apparatus 77RL is, in the embodiment shown, supplied only with fresh treating agent incoming to the washing machine 1.

[0062] Each of the delivering apparatus 77F, 77P, 77U comprises a corresponding plurality of sprinkling devices 78, 79 for directing sprinkles of the treating agent to the advancing containers 2.

[0063] In particular, each of the delivering apparatus 77F, 77P, 77U comprises two sprinkling devices 78 and two sprinkling devices 79 comprising, respectively, two couples of nozzles each consisting of an upper and a lower nozzle, which correspondingly direct the sprinkles of the treating agent toward the external surfaces 2a and the inner volumes 2b of containers 2.

[0064] Preferably, the upper and the lower nozzle are vertically aligned in such a manner to be placed, in use and at a specific instant, respectively above and below a same one of the advancing containers 2.

[0065] Moreover, delivering apparatus 77F, 77P, 77U comprise respective supply lines 90 that respectively connect the corresponding sprinkling devices 78 to collecting apparatus 80P, 80U, 80L, and respective line branches 91 extending from the corresponding supply line 90 to the corresponding sprinkling devices 79, which therefore result connected to the same supply line 90.

[0066] On one hand, sprinkling devices 78 of delivering

apparatus 77F, 77P, 77U respectively deliver the treating agent to containers 2 advancing above collecting apparatus 80F, 80P, 80U.

[0067] On the other hand, sprinkling devices 79 of delivering apparatus 77F, 77P, 77U respectively deliver the treating agent to containers 2 advancing above collecting apparatus 80P, 80U, 80L.

[0068] Therefore, each of the collecting apparatus 80P, 80U, 80L collects at least part of the treating agent withdrawn from the same corresponding collecting apparatus 80P, 80U, 80L.

[0069] As shown in figures 2 and 3, each of the delivering apparatus 77PL, 77RL comprises a corresponding plurality of sprinkling devices 78L, which are identical to sprinkling devices 78, and a corresponding supply line 90L for connecting sprinkling devices 78L to a corresponding source of treating agent (not shown in Figures 2 and 3).

[0070] Preferably, collecting apparatus 80P, 80U, 80L comprise respective basins 82P, 82U, 82L arranged in such a manner to receive the delivered treating agent, which respectively drips from the containers 2 advancing above the same basins 82P, 82U, 82L.

[0071] In particular, the basins 82P, 82U, 82L at the rinsing stations R1P, R1U, R1L are arranged in close sequence with one another along the advancing direction of containers 2, so that the same basin 82P is adjacent to the same basin 82U, which is in turn adjacent to the same basin 82L.

[0072] Furthermore, each of the collecting apparatus 80P, 80U, 80L comprises a corresponding tank 92 connected to the corresponding one of basins 82P, 82U, 82L for collecting the received treating agent.

[0073] As shown in Figures 2 and 3, each tank 92 is connected to one corresponding supply line 90. Additionally but not necessarily, tanks 92 may communicate one with the other.

[0074] As shown in Figures 2 and 3, both collecting apparatus 80F, respectively at prewash station P1F and at rinsing station R1F, comprise respective basins 82F arranged in such a manner to receive the delivered rinsing agent, which drips from the containers 2 advancing above the same basins 82F.

[0075] In particular, as shown in Figures 2 and 3, each basin 82F is arranged adjacent to a corresponding basin 82P, so as to immediately precede the latter according to the advancing direction of containers 2.

[0076] As shown in Figures 2 and 3, basins 82P can respectively supply, in use, the adjacent basins 82F. Furthermore, as shown in Figure 3, basins 82U, 82L can respectively supply, in use, the adjacent basins 82P, 82U.

[0077] In detail, basins 82P respectively comprise at the top respective spillways 83 toward the respective adjacent basins 82F. Furthermore, basins 82U, 82L respectively comprise other respective spillways 83 toward the adjacent basins 82P, 82U.

[0078] Therefore, when one of the basins 82P, 82U, 82L is completely filled with treating agent, a superficial portion of such treating agent falls from the same one of the basins 82P, 82U, 82L by means of the included spillway 83.

[0079] In the following, details of the specific sequence of rinsing stations R1F, R1P, R1U, R1L will be disclosed with reference to Figure 1.

[0080] The treating agent delivered to containers 2 is a rinsing agent, in particular comprising water, which is brought in contact with containers 2 and beams 16, while the latter are advanced through the treatment branches R1S of rinsing stations R1.

[0081] 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 agent.

[0082] The delivering apparatus 77RL of the last rinsing station R1L is supplied by a source of fresh rinsing agent; specifically washing machine 1 comprises a tank 94 defining the above source of rinsing agent; accordingly, supply line 90L at rinsing station R1L connects the corresponding sprinkling devices 78L to tank 94.

[0083] As shown in Figure 1, tank 94 supplies only the delivering apparatus 77RL.

[0084] Preferably, again with reference to Figure 1 and immediately downstream of rinsing branch Q1, path P comprises a dripping branch Q2 along which containers 2 are advanced with their axes A inclined with respect to a vertical direction.

[0085] In other words, each container 2 advancing along dripping branch 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.

[0086] More in detail, while advancing throughout the whole dripping branch 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.

[0087] In particular, containers 2 are conveyed through dripping branch Q2 with respective axes A that progressively form angles with the vertical direction between 30° and 140°, more in particular between 60° and 120°.

[0088] In such a manner, containers 2 and beams 16, which advance through bath 69, push a portion of the rinsing agent herein contained toward dripping branch Q2, where the same portion falls down from containers 2 and beams 16 themselves due to gravity action.

[0089] The basin 82F at rinsing station R1F is arranged immediately below dripping branch Q2, so as to receive and gather the portion of the rinsing agent fallen down from containers 2 and beams 16.

[0090] In the following, details of the specific sequence of prewash stations P1F, P1L will be disclosed with reference to Figure 1.

[0091] The treating agent delivered to containers 2 is a prewashing agent, which is brought in contact with con-

tainers 2 that come out from bath 11, with the purpose of partially dissolving, in a gradual manner, the dirt thereon.

[0092] Conveniently, the delivering apparatus 77PL at prewash station P1L is supplied by the collecting apparatus 80F at rinsing station R1F through the included supply line 90L.

[0093] Indeed, the rinsing agent collected by collecting apparatus 80F at rinsing station R1F is significantly rich of residuals of cleaning agent and defines, therefore, a prewashing agent.

[0094] The above holds because the latter collected rinsing agent is brought in contact with containers 2 that have undergone only a single rinsing stage through the earlier rinsing station R0, i.e. that have only been advanced through bath 69.

[0095] Moreover, the rinsing agent collected by collecting apparatus 80F at rinsing station R1F results already delivered to containers 2 at all the rinsing stations R1F, R1P, R1U, R1L.

[0096] In practice, the fresh rinsing agent coming from tank 94 is moved according to an opposite direction to the advancing direction of containers 2, thanks to delivering apparatus 77F, 77P, 77U, 77RL and collecting apparatus 80F, 80P, 80U, 80L at rinsing stations R1F, R1P, R1U, R1L.

[0097] As the rinsing agent is moved oppositely to the advancing direction of container 2, the same rinsing agent is enriched of dissolved cleaning agent residuals.

[0098] Therefore, the rinsing agent collected by the collecting apparatus 80F at rinsing station R1F comprises the maximum possible quantity of dissolved cleaning agent.

[0099] Furthermore, the temperature of the collected rinsing agent at rinsing station R1F is sufficiently high for prewashing containers 2 coming out from bath 11, since such temperature is almost equal to that of the rinsing agent that fills bath 69.

[0100] In the embodiment shown, supply line 90L of delivering apparatus 77PL is connected directly to basin 82F at rinsing station R1F.

[0101] The operation of washing machine 1 is described in detail in the following.

[0102] Feeding system 8 advances a plurality of rows of containers 2 to be washed through conveyor 103 in a parallel manner to direction F.

[0103] 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.

[0104] 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 transport branch T, discharge rows of cleaned containers 2 at outlet station O onto outfeed conveyor 14, and return along return branch R without containers 2.

[0105] In detail, containers 2 of each row are first carried by pockets 17 through earlier prewash station P0, where containers 2 are preliminary washed and heated through immersion within bath 11.

[0106] Then, containers 2 advance through the sequence of prewash stations P1F, P1L, so that a process takes place for treating the same containers 2.

[0107] Here, when containers 2 advance through the first prewash station P1F, the same containers 2 receive prewashing agent coming from the immediately downstream prewash station P1L.

[0108] Since delivering apparatus 77F is fluidly isolated from collecting apparatus 80F, the prewashing agent collected at prewash station P1L by collecting apparatus 80P is advantageously delivered separately from the prewashing agent collected at prewash station P1F by collecting apparatus 80F.

[0109] In particular, the prewashing agent received by containers 2 was only collected by collecting apparatus 80P at prewash station P1L.

[0110] At the last prewash station P1L, containers 2 receive, by means of delivering apparatus 77PL, the rinsing agent collected by collecting apparatus 80F at rinsing station R1F.

[0111] As containers 2 advance through prewash stations P1F, P1L the same containers 2 become cleaner and cleaner while the delivered prewashing agent becomes dirtier and dirtier according to the direction opposite to the advancing direction of containers 2.

[0112] After the end of this treating process, the same containers 2 are conveyed through following baths 12, 13, respectively at cleaning stations C1, C2, so that containers 2 are completely cleaned and deprived of any labels attached thereon.

[0113] Here, containers 2 are also heated by the cleaning agent within baths 12, 13 up to reach high temperatures, for instance between 60 °C and 70° C.

[0114] At this point, containers 2 are advanced through bath 69, where the same containers 2 are immersed into a cooler rinsing agent so as to establish a thermal equilibrium with the latter and reach intermediate temperatures, for instance between 45 °C and 60 °C.

[0115] Furthermore, part of the cleaning agent remained onto containers 2 after the immersion into bath 13 is dissolved within the rinsing agent contained within bath 69.

[0116] In the meantime, the advancing containers 2 drag out from bath 69 some of the rinsing agent contained therein and let such dragged rinsing agent to fall down within the basin 82F at rinsing station R1F.

[0117] The rinsing agent gathered within basin 82F at rinsing station R1F has a temperature essentially equal to that of the dragged out rinsing agent; then, part of the gathered rinsing agent is conveyed through delivering apparatus 77PL, in particular through the corresponding supply line 90L.

[0118] Then, containers 2 advance through the sequence of rinsing stations R1F, R1P, R1U, R1L so that another process takes place for treating the same containers 2.

[0119] Here, when containers 2 advance through each

one of the rinsing stations R1F, R1P, R1U, the same containers 2 receive rinsing agent that respectively comes from the immediately downstream rinsing stations R1P, R1U, R1L.

[0120] Since delivering apparatus 77F, 77P, 77U are fluidly isolated from collecting apparatus 80F, 80P, 80U, respectively, the rinsing agent collected at rinsing stations R1P, R1U, R1L is advantageously delivered separately from the rinsing agent collected at rinsing stations R1F, R1P, R1U, respectively.

[0121] In particular, at rinsing stations R1P, R1U, R1L, the rinsing agent collected at the same rinsing stations R1P, R1U, R1L is respectively delivered through sprinkling devices 79, whereas the rinsing agent collected at the immediately upstream rinsing stations R1U, R1L and contained in tank 94 is respectively delivered through sprinkling devices 78.

[0122] At rinsing station R1F, the rinsing agent received by containers 2 was only collected by collecting apparatus 80P at rinsing station R1P.

[0123] The rinsing agent delivered at rinsing station R1F has less concentration of cleaning agent residuals than that delivered at the earlier rinsing station R0. In the same way, the rinsing agent delivered at rinsing station R1P has less concentration of cleaning agent residuals than that delivered at rinsing station R1F. Analogously, the rinsing agent delivered at rinsing station R1U has less concentration than that delivered at rinsing station R1P.

[0124] At the last rinsing station R1L, containers 2 receive, by means of delivering apparatus 77RL, the fresh rinsing agent contained in tank 94.

[0125] As containers 2 advance through the rinsing stations R1F, R1P, R1U, R1L, the same containers 2 carry less and less residuals of cleaning agent while the delivered rinsing agent becomes more and more rich of the above residuals, according to the direction opposite to the advancing direction of containers 2.

[0126] In such a manner, downstream of the treatment branch R1S of the last rinsing station R1L, no more residuals of cleaning agent substantially remain onto containers 2. Moreover, during their advancement through the sequence of rinsing stations R1F, R1P, R1U, R1L, containers 2 are also cooled down to the ambient temperature.

[0127] Then, after the end of the other treating process, beams 16 advance through the return branch R whereas rinsed containers 2 are discharged at outlet station O.

[0128] From an analysis of the features of the washing machine 1 and of the disclosed processes for treating the containers 2, the advantages they allow to obtain are apparent.

[0129] Delivering apparatus 77F at prewash station P1F are fluidly connected to collecting apparatus 80P and fluidly isolated from collecting apparatus 80F.

[0130] In other words, delivering apparatus 77F delivers prewashing agent collected by collecting apparatus 80P separately from the dirtier prewashing agent collected by collecting apparatus 80F.

[0131] In this way, differently from known washing machines, when containers 2 advance through any one of prewash stations P1F, P1L, the same containers 2 receive a prewashing agent that is less contaminated by dirt with respect to that collected within the same one of prewash stations P1F, P1L.

[0132] Indeed, the prewashing agent delivered at prewash station P1F is only withdrawn from prewash station P1L and the prewashing agent delivered at prewash station P1L is only withdrawn from rinsing station R1F.

[0133] On the contrary, according to known washing machines, the containers advancing through a specific prewashing station receive a prewashing agent that is directly withdrawn within the same specific prewash station.

[0134] Therefore, due to the higher cleaning power of the delivered prewashing agent, the sequence of prewash stations P1F, P1L is more effective than the known sequences of prewash stations.

[0135] Hence, a reduced quantity of prewashing agent may be used, without performance losses.

[0136] Similarly, delivering apparatus 77F, 77P, 77U at rinsing stations R1F, R1P, R1U are fluidly connected, respectively, to collecting apparatus 80P, 80U, 80L and fluidly isolated from collecting apparatus 80F, 80P, 80U.

[0137] In other words, delivering apparatus 77F, 77P, 77U deliver rinsing agent respectively collected by collecting apparatus 80P, 80U, 80L separately from the enriched rinsing agent respectively collected by collecting apparatus 80F, 80P, 80U.

[0138] In this way, when containers 2 advance through any one of rinsing stations R1F, R1P, R1U, R1L, the same containers 2 receive a rinsing agent having a reduced concentration of cleaning agent with respect to that collected within the same one of rinsing stations R1F, R1P, R1U, R1L.

[0139] Indeed, for instance, the rinsing agent delivered at rinsing station R1F is only withdrawn from rinsing station R1P.

[0140] On the contrary, according to known washing machines, the containers advancing through a specific rinsing station receive a rinsing agent that is directly withdrawn within the same specific rinsing station.

[0141] Therefore, due to the higher rinsing power of the delivered rinsing agent, the sequence of rinsing stations R1F, R1P, R1U, R1L is more efficient than known sequences of rinsing stations.

[0142] Hence, a reduced quantity of rinsing agent may be used, without performance losses.

[0143] Thanks to the connection between the delivering apparatus 77PL and the collecting apparatus 80F at rinsing station R1F, the fresh rinsing agent is supplied just only to the delivering apparatus 77RL.

[0144] Therefore, the usage of treating agents is reduced at the minimum necessary, so that costs and environmental impact of washing machine 1 are cut down.

[0145] Clearly, changes may be made to the washing

machine 1, and the processes for treating containers 2, as described and illustrated herein without, however, departing from the scope of protection as defined in the accompanying claims.

[0146] For instance, delivering apparatus 77PL may be supplied also or exclusively by a tank containing the prewashing agent.

[0147] Moreover, one or more of the delivering apparatus 77F, 77P, 77U, 77PL, 77RL may be replaced by corresponding delivering apparatus having different constructive components but having the same function.

[0148] Clearly, the same applies for one or more of the collecting apparatus 80F, 80P, 80U, 80L.

[0149] Eventually, any one of the delivering apparatus 77F, 77P, 77U may be further supplied by a respective auxiliary tank.

Claims

1. A washing machine (1) comprising a conveyor device (4) for advancing a plurality of containers (2) along a washing path (P) according to an advancing direction;
the washing path (P) comprising a first and a second treatment branch (P1S; R1S), wherein the second treatment branch (P1S; R1S) is arranged downstream of said first treatment branch (P1S; R1S), according to said advancing direction;
said washing machine (1) further comprising:

- a first treatment station (P1F; R1F, R1P, R1U) arranged along said first treatment branch (P1S; R1S) and comprising, in turn:

  first delivering means (77F, 77P, 77U) configured to deliver a treating agent to the containers (2) advancing through said first treatment branch (P1S; R1S); and
  first collecting means (80F, 80P, 80U) arranged at said first treatment branch (P1S; R1S) and configured to collect at least one portion of the treating agent delivered by the first delivering means (77F, 77P, 77U) ; and

- a second treatment station (P1L; R1P, R1U, R1L) arranged along said second treatment branch (P1S; R1S) and comprising, in turn:

  second delivering means (77PL; 77P, 77U, 77RL) configured to deliver the treating agent to the containers (2) advancing through said second treatment branch (P1S; R1S); and
  second collecting means (80P, 80U, 80L) arranged at said second treatment branch (P1S; R1S) and configured to collect at least one portion of the treating agent delivered by the second delivering means (77PL; 77P, 77U, 77RL);

characterized in that said first delivering means (77F, 77P, 77U) are fluidly connected to said second collecting means (80P, 80U, 80L) for being supplied with said treating agent by said second collecting means (80P, 80U, 80L);
said first delivering means (77F, 77P, 77U) being fluidly isolated from said first collecting means (80F, 80P, 80U) .

2. The washing machine of claim 1, wherein said second treatment branch (R1S, P1S) is arranged immediately downstream of said first treatment branch (R1S, P1S).

3. The washing machine of claim 1 or 2, comprising a source of a fresh treating agent (94); the second delivering means (77RL) being connected to said source (94) for being supplied with said fresh treating agent.

4. The washing machine of claim 3, wherein said second treatment station (P1L; R1P, R1U, R1L) is the last treatment station (P1L, R1L) of a corresponding sequence, according to said advancing direction.

5. The washing machine of any one of the foregoing claims, wherein at least one of said first and second delivering means (77F, 77P, 77U, 77PL, 77RL) comprises:

- an ejection device (78, 78L) configured to direct sprinkles of said treating agent toward the containers (2) advancing through the corresponding one of said first and second treatment branch (R1S, P1S); and
- a supply line (90, 90L) connected to said ejection device (78, 78L) to supply the ejection device (78, 78L) itself with said treating agent.

6. The washing machine of claim 5, wherein said first delivering means (77F, 77P, 77U) comprises said ejection device (78) and said supply line (90); said first delivering means (77F, 77P, 77U) further comprising:

- a further ejection device (79) configured to direct sprinkles of said treating agent toward the containers (2) advancing through said second treatment branch (P1S; R1S); and
- a line branch (91) connected to both said supply line (90) and said further ejection device (79) to supply the further ejection device (79) itself with said treating agent.

7. The washing machine of any one of the foregoing

claims, wherein said first and second collecting means (80F, 80P, 80U, 80L) respectively comprise a first and a second collecting basin (82F, 82P, 82U, 82L) adapted to receive, in use, said treating agent dripping from said advancing containers.

8. The washing machine of claim 7, wherein said second collecting basin (82P, 82U, 82L) has a spillway (83) toward said first collecting basin (82F, 82P, 82U).

9. The washing machine of any one of the foregoing claims, further comprising a washing station (C1, C2) arranged along a washing branch (Q) of said path (P) and configured to allow a cleaning agent coming into contact with the containers advancing through said washing branch (Q) ;
wherein said first treatment branch (R1S) is arranged downstream of said washing branch (Q), according to said advancing direction, and wherein said treating agent is defined by a rinsing agent suitable for diluting said cleaning agent.

10. The washing machine of claim 9, comprising:

- a third treatment station (P1F) arranged along a third treatment branch (P1S) of said path (P) and comprising, in turn:

  third delivering means (77F) configured to deliver a prewashing agent to the containers (2) advancing through said third treatment branch (P1S); and
  third collecting means (80F) arranged at said third treatment branch (P1S) and configured to collect at least one portion of the prewashing agent delivered by the third delivering means (77F); and

- a fourth treatment station (P1L) arranged along a fourth treatment branch (P1S) of said path (P) and comprising, in turn:

  fourth delivering means (77PL) configured to deliver the prewashing agent to the containers (2) advancing through said fourth treatment branch (P1S); and
  fourth collecting means (80P) arranged at said fourth treatment branch (P1S) and configured to collect at least one portion of the prewashing agent delivered by the fourth delivering means (77PL);

wherein said fourth treatment branch (P1S) is respectively arranged downstream of said third treatment branch (P1S) and upstream of said washing branch (Q), according to said advancing direction;
wherein said third delivering means (77F) are fluidly connected to said fourth collecting means (80P) for being supplied with said prewashing agent by said fourth collecting means (80P); said third delivering means (77F) being fluidly isolated from said third collecting means (80F);
wherein said fourth delivering means (77PL) are fluidly connected to said first collecting means (80F) for being supplied with said prewashing agent by said first collecting means (80F).

11. A process for treating containers (2) through a washing machine (1), the process comprising the steps of:

i) advancing, according to an advancing direction, a plurality of containers (2) along a washing path (P) through:

- a first treatment station (P1F; R1F, R1P, R1U), arranged along a first treatment branch (P1S; R1S) of said path (P); and
- a second treatment station (P1L; R1P, R1U, R1L), arranged along a second treatment branch of said path (P), downstream of said first treatment branch (P1S; R1S), according to said advancing direction;

ii) delivering a treating agent at said first treatment station (P1F; R1F, R1P, R1U) to the containers (2) advancing through said first treatment branch (P1S; R1S);
iii) collecting at said first treatment station (P1F; R1F, R1P, R1U), at least one portion of the treating agent delivered at said first treatment branch (P1S; R1S);
iv) delivering the treating agent at said second treatment station (P1L; R1P, R1U, R1L) to the containers (2) advancing through said second treatment branch (P1S; R1S); and
v) collecting at said second treatment station (P1L; R1P, R1U, R1L), at least one portion of the treating agent delivered at said second treatment branch (P1S; R1S);

characterized in that the step ii) comprises the step of:
vi) delivering at least part of the treating agent collected at said second treatment station (P1L; R1P, R1U, R1L) separately from the treating agent collected at said first treatment station (P1F; R1F, R1P, R1U).

12. The process of claim 11, wherein the step iv) comprises the step of:
vii) delivering fresh treating agent at said second treatment station (P1L; R1P, R1U, R1L).

13. The process of claim 11 or 12, wherein the step ii) further comprises the step of:

viii) delivering at least part of the treating agent collected at said first treatment station (P1F; R1F, R1P, R1U) separately from the treating agent collected at said second treatment station (P1L; R1P, R1U, R1L).

14. The process of any one of claims from 11 to 13, further comprising the step of:
ix) washing the containers (2) advancing through a washing branch (Q) of said path (P) by allowing contact of the containers (2) themselves with a cleaning agent;
wherein said first treatment branch is arranged downstream of said washing branch (Q), according to said advancing direction, and wherein said treating agent is defined by a rinsing agent suitable for diluting said cleaning agent.

15. The process of claim 14, further comprising the step of:

x) delivering a prewashing agent at a third treatment station (P1F), arranged along a third treatment branch (P1S) of said path (P), to the containers (2) advancing through said third treatment branch (P1S);
xi) collecting at said third treatment station (P1F), at least one portion of the prewashing agent delivered at said third treatment branch (P1S);
xii) delivering the prewashing agent at a fourth treatment station (P1L), arranged along a fourth treatment branch (P1S) of said path (P), to the containers (2) advancing through said fourth treatment branch (P1S);
xiii) collecting at said fourth treatment station (P1L), at least one portion of the prewashing agent delivered at said fourth treatment branch (P1S);

wherein said fourth treatment branch (P1S) is respectively arranged downstream of said third treatment branch (P1S) and upstream of said washing branch (Q), according to said advancing direction;
wherein the step x) comprises the step of:
xiv) delivering at least part of the prewashing agent collected at said fourth treatment station (P1L) separately from the prewashing agent collected at said third treatment station (P1F);
wherein the step xii) comprises the step of:
xv) delivering at least part of the collected treating agent at said first treatment station (R1F), as said prewashing agent.

16. The process of any one of claims from 11 to 15, wherein the step ii) is carried out by means of first delivering means (77F, 77P, 77U) and wherein the steps iii), v) are respectively carried out by means of first collecting means (80F, 80P, 80U) and second collecting means (80P, 80U, 80L); the process further comprising the steps of:

xvi) fluidly connecting said first delivering means (77F, 77P, 77U) to said second collecting means (80P, 80U, 80L) ; and
xvii) fluidly isolating said first delivering means (77F, 77P, 77U) from said first collecting means (80F, 80P, 80U) .

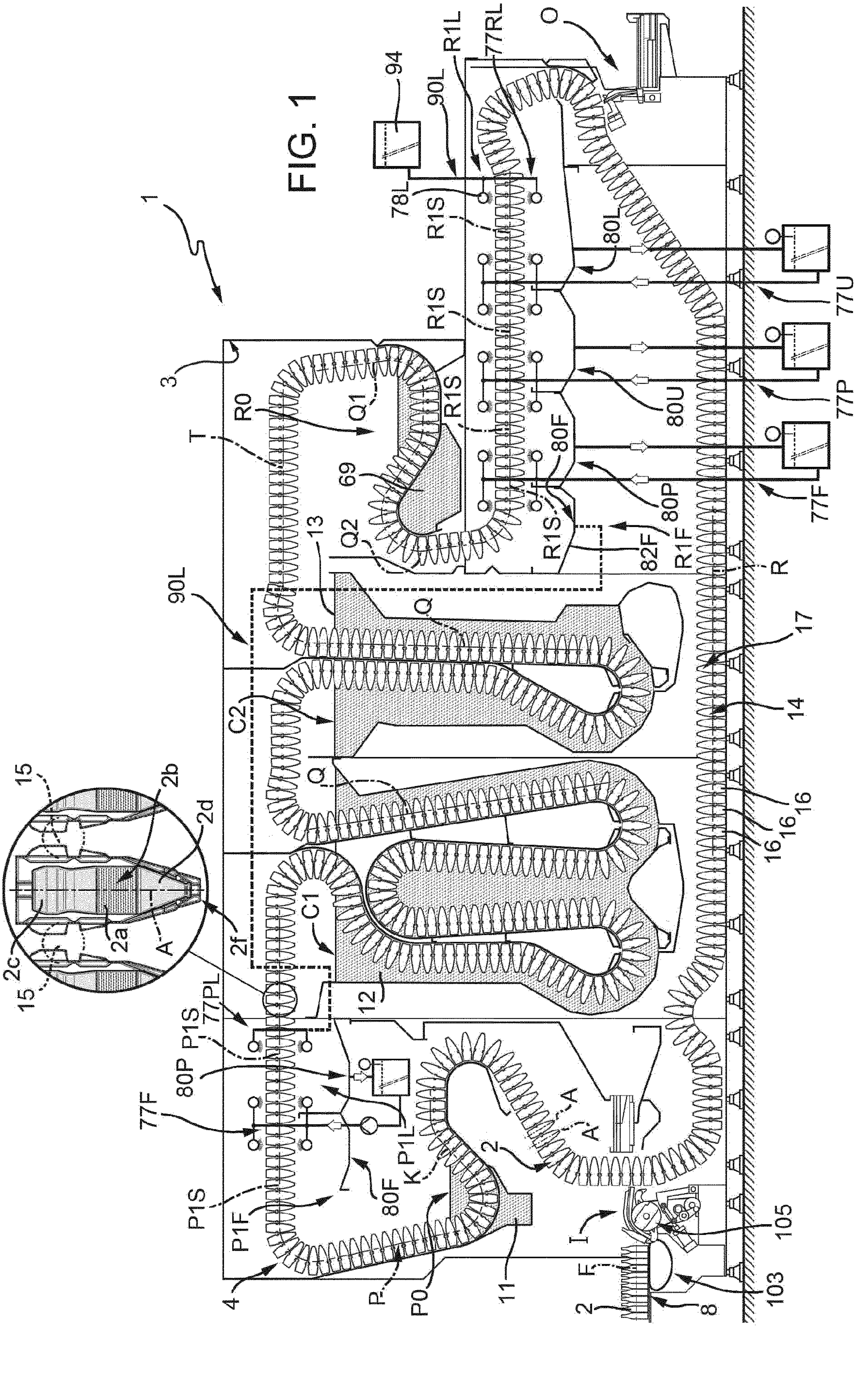
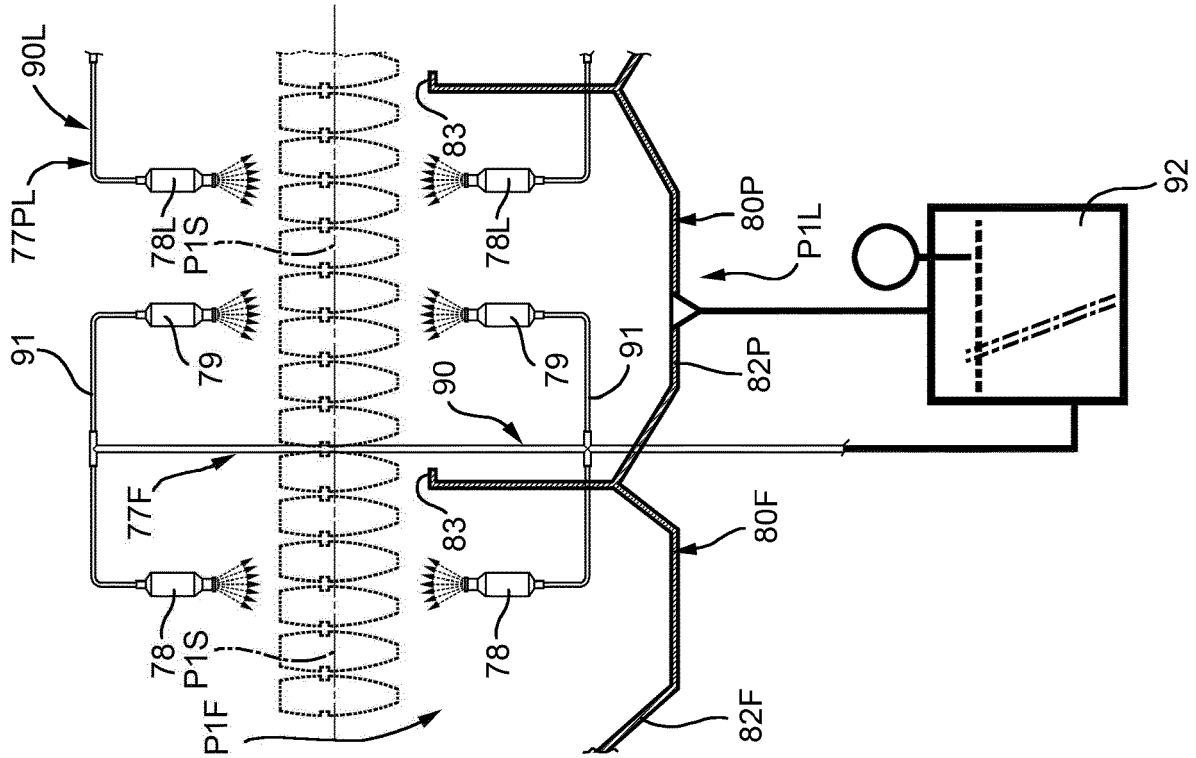


FIG. 1


90L
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78L
P1S
91
79
77F
78
P1S
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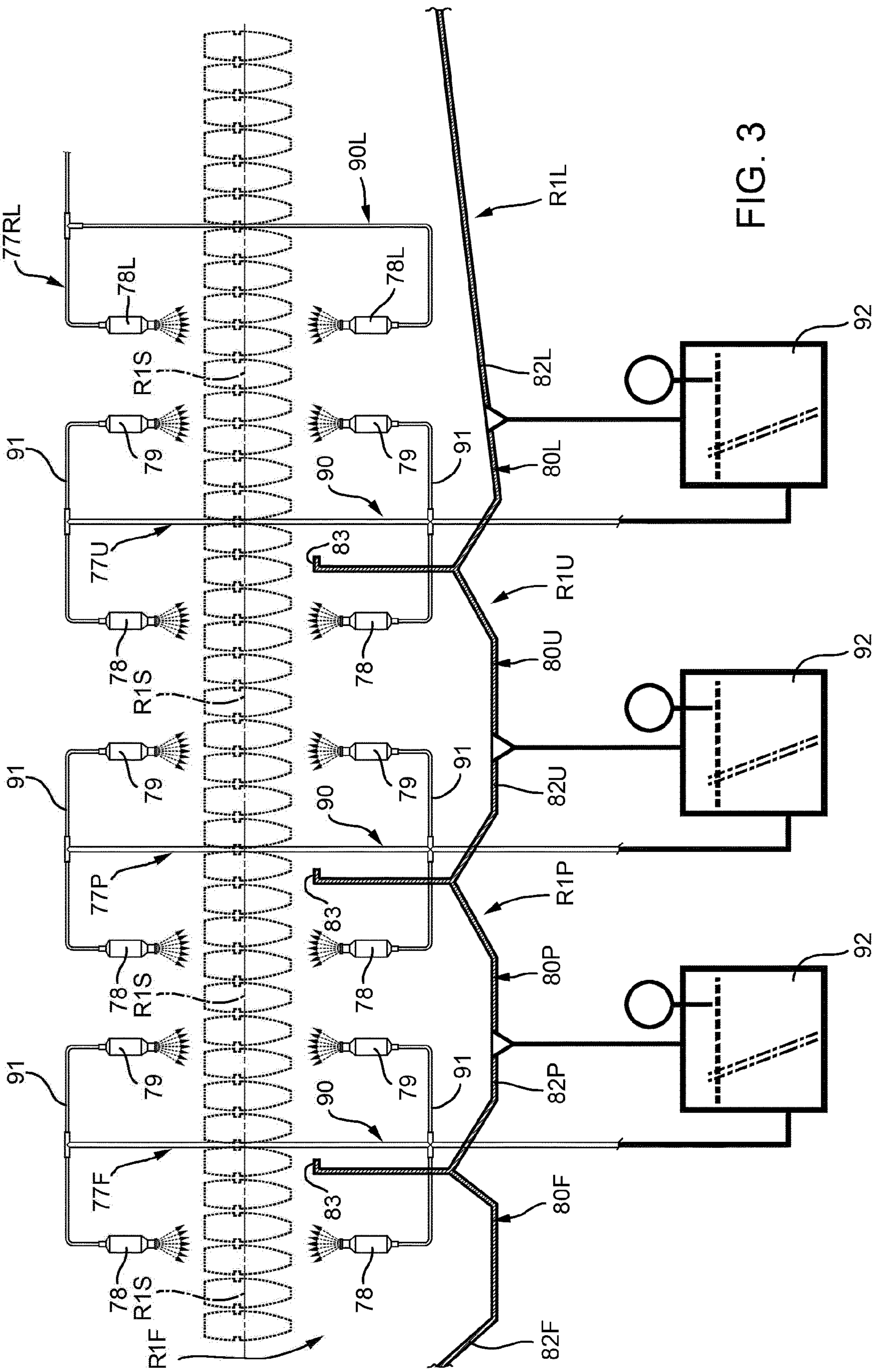
80P
P1L
82P
80F
82F
92

FIG. 2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90L
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78L
R1L
R1S
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79
82L
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92
90
77U
83
R1U
78
80U
82U
77P
R1P
80P
82P
77F
80F
82F
R1F

FIG. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 19 17 5713

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	14 November 2019	Cassiat, Clément

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EUROPEAN SEARCH REPORT

Application Number
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