(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 3 015 180 A1

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
04.05.2016 Bulletin 2016/18

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

(21) Application number: **14190820.2**

(22) Date of filing: **29.10.2014**

(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

(71) Applicant: **Gebo Packaging Solutions Italy SRL**
43126 Parma (IT)

(72) Inventors:
- **Sterzi, Andrea**
  37139 VERONA (IT)
- **Berzaghi, Claudio**
  37139 VERONA (IT)

(74) Representative: **Eltzer, Thomas**
Gebo Packaging Solutions France
IP Central
5-7 rue du Commerce
ZI - CS 73445 REICHSTETT
67455 Mundolsheim Cedex (FR)

(54) **Washing unit for empty containers and corresponding method**

(57) Washing unit (1) and method for washing empty containers (2), the unit comprising a washing tunnel (3) in which the containers (2) are conveyed, said washing tunnel (3) having a washing zone (6), and having also a final rinsing zone (7), disposed after the washing zone (6) and where a rinsing liquid like water is used to rinse the containers (2), a sprinkling means (8) for sprinkling said rinsing liquid on containers (2) in said final rinsing zone (7), and a control unit (9) for controlling the operation of at least the sprinkling means (8). Said washing unit is characterized in that it comprises at least one sensing unit (10) measuring the thermal effect of the sprinkling means (8) on the containers (2) and sending a corresponding information to the control unit (9).

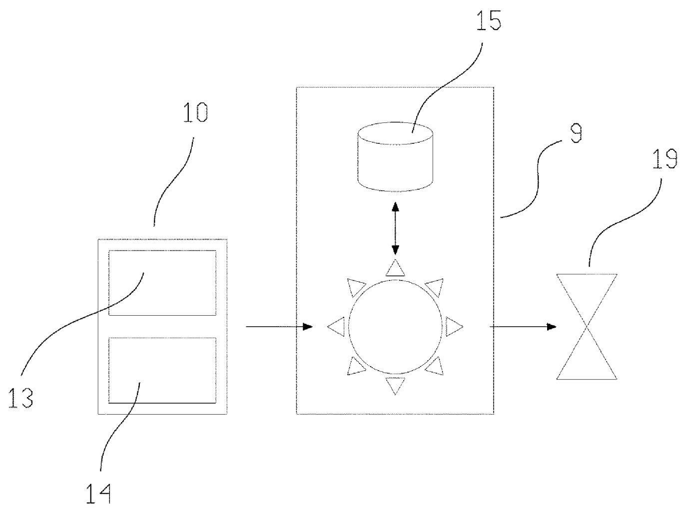

Fig. 3

EP 3 015 180 A1

Description

[0001] The current invention belongs to the domain of washing units for empty containers comprising a washing tunnel in which the containers are conveyed through treatment zones, said containers being organized in successive lines perpendicular to the movement direction. The object of the present invention is a washing unit and a method for controlling such a washing unit.

[0002] In standard washing units, the containers move in the washing tunnel through a plurality of successive treatment zones: a prewash zone, then a first cleaning zone, a second cleaning zone, and a final rinsing zone. Each of these treatments is mainly based on liquid and chemical agents if necessary, sprayed on the containers or as baths in which the containers are brought. The rinsing phase normally uses sprinklers, for sprinkling water on and in the containers.

[0003] The containers move in the washing tunnel thanks to a closed loop conveyor, comprising pockets in which the containers can be inserted. Containers are charged on this conveyor at the level of an input zone, and discharged at the level of an output zone, between which said treatment zones are located.

[0004] This internal conveyor moves in the washing tunnel in a certain direction. In this internal conveyor, the containers are arranged in parallel lines, perpendicular to this movement direction, in order to treat simultaneously each container of the line. Many lines are treated simultaneously in the washing tunnel.

[0005] Such a washing unit is for example disclosed in EP2727660. The global consumption of treating liquids is an important feature of the overall efficiency of such a washing unit. In the usual practice, the flow of rinsing liquid is fixed at a constant value corresponding to the worst possible working conditions, in terms of liquid temperature, outside temperature, size of container, etc. This leads to an over consumption at any less demanding working condition. The object of this invention is to reduce the consumption of fresh water for the rinsing phase.

[0006] Simply reducing the flow of sprinkled water is not an acceptable solution. In fact, in some situations, the containers go through the subsequent process step right after having left the washing unit, in particular for being poured with beverage. The temperature of the container at this subsequent process step can be of a critical importance. For instance, the temperature of a beer when poured is around 3°C. If the container is too hot, the thermal shock can simply break the container breakage. The quality of the beverage is also substantially altered if the container is too hot. In this kind of situation, the temperature of the containers as they come out of the washing tunnel directly depends on the operation of the rinsing means. Simply reducing the liquid flow in the final rinsing zone would then lead to hot containers and to problems at this kind of subsequent process steps.

[0007] Therefore, the invention aims at proposing a new washing unit with a more efficient rinsing phase, saving rinsing liquid, but still simple, easy to control and able to provide containers at the desired temperature.

[0008] In order to reach this, the invention proposes to regulate the rinsing phase operation based on the thermal effect it creates on the containers, said thermal effect corresponding to the resulting container temperature. The washing unit detects this thermal effect, for example in term of temperature of the containers after they have been rinsed, and adjust the operating condition of the rinsing device.

[0009] According to the invention, there is provided a washing unit for washing empty containers for liquid like bottles or flasks, comprising a washing tunnel in which the containers are conveyed line by line by an internal conveying means for being cleaned and further rinsed, said washing tunnel having a washing zone where liquids with detergent or cleaning agents are used to clean the containers, and having also a final rinsing zone, disposed after the washing zone and where a rinsing liquid like water is used to rinse the containers, a sprinkling means for sprinkling said rinsing liquid on containers in said final rinsing zone, and a control unit for controlling the operation of at least the sprinkling means.

[0010] This washing unit is characterized in that it also comprises at least one sensing unit for measuring the thermal effect of the sprinkling means on the containers and sending a corresponding information to the control unit, so that said information can be taken into account by said control unit to pilot the operation of the sprinkling means.

[0011] There is also provided a corresponding method for controlling a washing unit in which unit containers are cleaned, and further rinsed in a final rinsing phase by a sprinkling means acting in a final rinsing zone of a washing tunnel of said washing unit, the containers being organized in lines progressing successively in said washing tunnel, said method comprising

- measuring the thermal effect of the final rinsing phase on the containers, and
- adjusting the operation of the sprinkling means based on said measured thermal effect.

[0012] Further features and advantages of the present invention will be better understood from the description of preferred embodiments, which is given below by way of a non-limiting illustration, with reference to the accompanying drawings, in which :

- figure 1 shows a global view of a washing unit;
- figure 2 is a more detailed view of the output zone of the washing tunnel;
- figure 3 is a diagram showing the interactions in the method;
- figure 4 shows a possible location of the sensing unit at the level of the output zone, and
- figure 5 is a chart showing the status of the sprinkling means and the related temperature.

[0013] A first object of the present invention is a washing unit 1 for washing empty containers 2 for liquid like bottles or flasks, comprising

- a washing tunnel 3 in which the containers 2 are conveyed line 4 by line 4 by an internal conveying means 5 for being cleaned and further rinsed, said washing tunnel 3 having a washing zone 6 where liquids with detergent or cleaning agents are used to clean the containers 2, and having also a final rinsing zone 7, disposed after the washing zone 6 and where a rinsing liquid like water is used to rinse the containers 2,
- a sprinkling means 8 for sprinkling said rinsing liquid on containers 2 in said final rinsing zone 7, and
- a control unit 9 for controlling the operation of at least the sprinkling means 8.

[0014] In the washing zone 6, the containers 2 normally go through a plurality of baths or showers. In the rinsing zone 7, a rinsing liquid like water is used to remove the chemical agents used during the washing step. The rinsing liquid is sprayed on and/or in the containers 2, and then collected again. The rinsing liquid can then be recycled, and reused again. The rinsing liquid used in this rinsing phase is therefore either fresh or recycled. For the purposes of the present invention, which aims at reducing the consumption of water, the sprinkling means 8 is mainly limited to the means working with fresh rinsing liquid. The flow of rinsing liquid used by the sprinkling means 8 is controlled by at least one valve 19, the opening of which can be tuned between two end positions in a continuous manner.

[0015] According to the present invention, the washing unit 1 also comprises at least one sensing unit 10 for measuring the thermal effect of the sprinkling means 8 on the containers 2 and sending a corresponding information to the control unit 9, so that said information can be taken into account by said control unit 9 to pilot the operation of the sprinkling means 8, in particular by changing the opening status of the at least one valve 19 of said sprinkling means 8.

[0016] As will be further described hereunder, the thermal effect of the rinsing liquid mainly consists in a cooling down of the containers 2, and can therefore be measured with any corresponding parameter, among which: the temperature of the container 2, the temperature of the used rinsing liquid, etc. As said earlier, according to the present invention, it is mainly proposed to introduce a regulation of the working condition of the sprinkling means 8 consuming fresh rinsing liquid, said regulation being based on the thermal effect created by the rinsing phase on the containers 2. In fact, the flow of rinsing liquid sprayed by the sprinkling means 8 is increased or decreased based on the resulting temperature of the containers 2.

[0017] According to a possible additional feature, the at least one sensing unit 10 measures the temperature of the rinsing liquid after it has been sprinkled on the containers 2, in particular by measuring the temperature of the rinsing liquid in a collection tank 16 of the washing tunnel 3 located in the final rinsing zone 7. This is one possibility for measuring the thermal effect of the rinsing phase on the container 2.

[0018] According to another possible additional feature corresponding to another possibility for measuring the thermal effect of the rinsing phase on the containers 2, the at least one sensing unit 10 directly measures the temperature of the containers 2 after the action of the rinsing liquid, in or after the final rinsing zone 7. The sensing unit 10 is then located and oriented in the washing unit 1 so as to measure the temperature of a certain fixed detection zone in which at least one container 2 is supposed to arrive at least once after having been rinsed. As the movement of the internal conveying means 5 is monitored, it is possible to know exactly when a container 2 is supposed to arrive in this detection zone.

[0019] In some embodiments, the at least one sensing unit 10 is located at an output zone 11 of the washing tunnel 3, after the final rinsing zone 7, where the containers 2 are withdrawn the internal conveying device 5. The containers 2 are conveyed through the washing tunnel 3 thanks to an internal conveying device 5. They are loaded on the internal conveying device 5 at the input zone 18, and taken off at the output zone 11. In said output zone 11, the containers 2 are brought on an external conveying means 12. It is proposed to locate and orient the sensing unit 10 so that the measuring zone arrives in this output zone 11, preferably at the level of the transition between the internal conveying means 5 and the external conveying means 12.

[0020] According to a possible additional feature, the at least one sensing unit 10 is mounted at a side of the washing tunnel 3, so as to be able to measure the temperature of a container 2 located at an end of a line 4. As containers 2 are normally conveyed in lines 4 through the washing tunnel 3, it is simply proposed to locate and orient the sensing unit 10 so that the sensing zone corresponds to an end of the line 4. Such a location is easy to implement also for existing washing units 1, as the sensing unit 10 can be directly fixed for example on the external walls of the washing tunnel 3. Also, a direct access to the end of the line 4 is possible in a lot of existing washing tunnel 3.

[0021] According to another possible feature, the washing unit 1 comprises an external conveying means 12 for conveying the containers 2 in one or more rows between the washing tunnel 3 and the subsequent processing step, like filling, and the at least one sensing unit 10 is mounted at the level of said external conveying means 12, so as to be able to measure the temperature of a container 2 outside and after the washing tunnel 3. This makes the implementation on existing washing unit 1 even easier. The external conveying means 12 can move in a direction which is perpendicular or parallel to the internal conveying means 5. In said external conveying means 12, containers 2 can be conveyed in one single row or in a plurality of rows parallel to the movement of the external conveying means 12. The sensing unit 10 can for example be located above the external conveying means 12, and oriented top down so as to measure the temperature of containers 2 in a central row, for example.

[0022] As already mentioned, the position of the containers 2 in the washing unit 1 is always known, either on the internal conveying means 5 or on the external conveying means 12. It is therefore possible to synchronize the position of the containers 2 and the temperature measurement: the temperature measured by the sensing unit 10 is taken into account in the regulation loop only when a container 2 is supposed to be in the detection zone of the sensing unit 10. This helps to deal with the fact that the sensing unit 10 might work continuously.

[0023] However, it is possible that the line 4 is not completely full and that no container 2 arrives in the detection zone when expected. This would create an irregularity in the regulation loop. Therefore, in some embodiments, the at least one sensing unit 10 comprises: a temperature measuring probe 13, like an infrared based probe, and a container detector 14, for detecting the absence or presence of a container 2, so as to be able to verify that the temperature measured by the sensing unit 10 is the temperature of a container 2. Then, thanks to the synchronization, it is possible to identify more precisely the moments when the temperature must be taken into account. In these embodiments, it is further possible to avoid taking into account temperatures measured when the containers 2 are missing.

[0024] According to another possible additional feature, the control unit 9 comprises a memory unit 15 for storing the information received from the sensing unit 10. As will be explained later in more details, this allows storing the measured temperature, when corresponding to a real container 2, in order to reuse this value for the regulation loop in case of absence of container 2. Also, this memory unit 15 can be used for auto-tuning purposes, and mainly to store an information linking the status of the sprinkling means 8 and the resulting thermal effect on the containers 2.

[0025] A second object of the present invention is a method for controlling a washing unit 1 in which unit containers 2 are cleaned, and further rinsed in a final rinsing phase by a sprinkling means 8 acting in a final rinsing zone 7 of a washing tunnel 3 of said washing unit 1, the containers 2 being organized in lines 4 progressing successively in said washing tunnel 3.

[0026] According to the invention, the method comprises

- measuring the thermal effect of the final rinsing phase on the containers 2, and
- adjusting the operation of the sprinkling means 8 based on said measured thermal effect, in particular increasing the flow of the sprinkling means 8 if the thermal effect on the container 2 is detected as being insufficient, or decreasing said flow if the thermal effect on the container 2 is detected as being too high.

[0027] Adjusting the operation of the sprinkling means 8 mainly consists in changing the opening of the at least one control valve 19. It should be noted that the adjustment of the rinsing liquid flow could be done only for the fresh water circuit, and/or for the used water circuit.

[0028] As said earlier, the thermal effect can be assessed by measuring the temperature of the container 2 directly, or by measuring the temperature of the used rinsing liquid, for example. Therefore, in some embodiments, measuring the thermal effect of the final rinsing phase on the containers 2 is achieved by measuring the temperature of the rinsing liquid after its action on the containers 2, in particular by measuring the temperature of the used rinsing liquid collected in a collection tank 16 collecting said rinsing liquid after its action.

[0029] According to an additional or to an alternative feature, measuring the thermal effect of the final rinsing phase on the containers 2 is achieved by measuring the temperature of the containers 2 after the action of the rinsing liquid, either in the final rinsing zone 7, or in the output zone 11 of the washing tunnel 3 or even at the level of external conveying means 12 of the washing unit 1 conveying containers 2 after said output zone 11, in one or more rows.

[0030] In some specific embodiments, measuring the temperature of the containers 2 is done after they have left the final rinsing zone 7, and the period of time needed for a container 2 to move from the final rinsing zone 7 to the zone where its temperature is measured is taken into account for ajusting the operation of the sprinkling means 8, in particular by associating the instantaneous operation of the sprinkling means 8 with the temperature measured only after said period of time has lapsed. Due to the time needed for a container 2 to move from the sprinkling means 8 action zone to the sensing unit 10 action zone, associating the temperature at a certain moment to the status of the sprinkling means 8 at the same moment would lead to an erroneous regulation loop.

[0031] As said before, the movement of the internal conveying means 5 as well as the movement of the external conveying means 12 are constantly monitored, which makes it possible to monitor and take into account the time between the sprinkling and the measuring. Therefore, according to another possible feature, the period of time needed for a container 2 to move from the final rinsing zone 7 to the zone where its temperature is measured is calculated based on the speed of the conveying means moving the containers 2 between these two zones: the internal conveying means 5 alone, or both the internal conveying means 5 and the external conveying means 12.

[0032] In order to handle situations where no container 2 is present in the sensing zone of the sensing unit 10 when expected, and according to another possible feature, the method comprises

- detecting the absence or presence of container 2, and,
- in case of detected presence of container 2, using the measured thermal effect to control the operation of the sprinkling means 8 and storing the measured value in a memory unit 15, and,
- in case of absence of container 2, recalling the previously stored measured value for controlling the operation of the sprinkling means 8.

[0033] According to another possible feature of the present method, it comprises monitoring the relation between the operation status of the sprinkling means 8 and the resulting thermal effect on the containers 2, said relation being eventually further taken into account when controlling the operation of the sprinkling means 8 based on a targeted thermal effect, in particular a targeted temperature of the containers 2.

[0034] In fact, the regulation of the sprinkling means 8 can be based on the following principle: increasing the rinsing flow step by step until the temperature of the containers 2 decreases to the targeted range, or decreasing said rinsing flow until said temperature increases to the target range. One of the advantages of this working principle is that it can be used even if there is no model of the thermal reaction itself happening in the final rinsing zone. Another principle would be to use a predictive model of the thermal reaction, in which the working status of the sprinkling means 8 is directly linked to the thermal effect on the containers 2. However, it is difficult to build a reliable predictive model, mainly because parameters to be taken into account are quite numerous. In some embodiments of the present method, it is therefore proposed to build such a model by collecting data both about the working status of the sprinkling means 8 and the resulting thermal effect on the containers 2. Such a model can then be used to reduce the time needed to reach the optimal working status of the sprinkling means 8 for the target container's 2 temperature.

[0035] In the embodiment shown in the attached drawings, the washing unit 1 treats containers 2 for beverages or other liquids. The containers 2 can be made of plastic of glass, for example.

[0036] The containers 2 move in the washing unit 1 from the left to the right of figure 1. The washing unit 1 has a washing tunnel 3 in which the containers 2 are cleaned. Dirty containers 2 enter the washing tunnel 3 at the input zone 18 of said tunnel 3 and are moved to the output zone 11 by an internal conveying device 5. This internal conveying device 5 receives containers 2 at the level of pockets 17 having a corresponding shape and in which the containers 2 can be inserted and further maintained during the washing process in the washing tunnel 3.

[0037] A plurality of containers 2 is treated simultaneously, as the internal conveying device 5 has a plurality of pockets 17 arranged next to each other in a line 4 which is perpendicular to the movement of the internal conveying device 5. The containers 2 are therefore organized in the washing tunnel 3 in many parallel lines 4 which are perpendicular to the movement of the internal conveying device 5.

[0038] In the washing tunnel 3, the containers 2 are moved through a plurality of zones, in which the containers 2 are treated. In particular, as shown on figure 1, the containers 2 are brought by the internal conveying device 5 in a series of tanks filled with liquids comprising chemical agents. Figure 1 shows two treatment tanks in the washing zone 6, one after the other, to achieve prewashing and then a final washing.

[0039] As said before, in some cases, due to the temperature of the liquid in the tank or to the chemical activity, the containers 2 are heated up by these bathes. This can be problematic at later stages of the process, requiring a container 2 with a temperature in a certain range, for example the stage in which the container 2 is poured or filled with gaseous liquid like beer. Furthermore, in some cases, the containers 2 are further dedicated to contain beverages or special chemical products. It is therefore necessary to arrange a further step of rinsing, in which the chemical agents of the cleaning liquids are withdrawn from the containers 2 for hygienic, sanitary and/or chemical purposes.

[0040] For these reasons, the washing tunnel 1 also has a final rinsing zone 7, mainly dedicated to removing the chemical cleaning agents out of the container 2 and to cooling it down. A sprinkling means 8 is mounted in this rinsing zone 7 and sprays a rinsing liquid on and/or in the containers 2. The sprinkling means 8 can have a plurality of sprinklers acting one after the other on a container 2. The rinsing liquid can be sprayed up in the container 2 oriented upside down in the internal conveying device 5.

[0041] Water is preferably used as rinsing liquid. The rinsing liquid has a thermal effect on the containers 2 which basically corresponds to the change in the container's 2 temperature caused by the rinsing liquid, sprayed and flowing on it. The thermal effect of the rinsing normally mainly consists in a cooling down of the temperature of the container 2.

[0042] The rinsing liquid is sprayed on the containers 2 in the final rinsing zone 7. The final rinsing zone 7 also has a collection tank 16, located under the internal conveying device 5, for collecting the rinsing liquid after it has been sprayed on the containers 2. As the rinsing liquid has a cooling thermal effect on the container 2, it is therefore heated up and the temperature of the rinsing liquid collected in the collection tank 16 in the final rinsing zone 7 is higher than the temperature of the rinsing liquid not yet sprayed on the containers 2. Therefore, it is possible to evaluate the thermal effect of the rinsing liquid on the containers 2 by measuring the temperature of the used rinsing liquid collected in the collection tank 16, and to compare it with the temperature of the rinsing liquid before it is sprayed.

[0043] Of course, it is also possible to evaluate the thermal effect of the rinsing phase by directly measuring the temperature of the containers 2 itself.

[0044] In order to optimize the use of rinsing liquid, it is proposed to adjust the operational status of the sprinkling means 8 based on the thermal effect on the container 2, said thermal effect being assessed for example either by measuring the temperature of the containers 2 itself, or by measuring the temperature of the used rinsing liquid in the collection tank. Preferably, the minimum rinsing liquid flow is more than zero: reducing the flow of rinsing liquid cannot be done to zero and is rather stopped at a certain minimum value, in order to guarantee that rinsing liquid always flows somehow in any working condition of the washing unit 1.

[0045] In order to do so, the washing unit 1 comprises at least one sensing unit 10 for measuring this thermal effect, which mainly leads to assess whether the treated containers 2 are too hot, or too cold or in a targeted predefined range. This measurement is sent to a control unit 9 of the washing unit 1, which will compare it with the target and adjust the behavior of the sprinkling means 8 accordingly, especially of the sprinkling means 8 consuming fresh rinsing liquid. Therefore, this sensing unit 10 is preferably able to measure the temperature of the container 2, or another linked feature like the temperature of the used rinsing liquid. This sensing unit 10 is therefore able to measure the thermal effect of the rinsing phase on the containers 2, either by measuring the heating of the rinsing liquid or by measuring the cooling of the containers 2.

[0046] The sprinkling means 8 usually comprises more than one sprinklers acting one after the other on the containers 2. For water saving purposes, only the last sprinklers use clean and fresh water, and the other ones use recycled rinsing liquid. In such a case, the consumption of fresh rinsing liquid only depends on the working conditions of these last sprinklers. Therefore, preferably, adjusting the working condition of the sprinkling means 8 is mainly done by adjusting the working condition of only those elements of said sprinkling means 8 using fresh rinsing liquid, in particular said last sprinklers.

[0047] In cases where the thermal effect is measured by measuring the temperature of the containers 2, the corresponding sensing unit 10 can be placed so as to be able to measure this thermal effect directly in the final rinsing zone 7, or even after in the process line, like in the output zone 11 of the washing tunnel 3, or at the level of external conveying means 12 moving the containers 2 from the washing tunnel 3 to the subsequent processing machine.

[0048] As said before, the containers 2 are normally conveyed in the washing tunnel 3 as parallel lines 4 which are perpendicular to the movement of the internal conveying device 5. Therefore, the instantaneous treatment of each container 2 of one specific line 4 is normally the same. In some cases, the at least one sensing unit 10 measures the temperature of a single container 2 and adjusts the flow of rinsing liquid for the whole line.

[0049] However, the pocket 17 which is targeted by the sensing unit 10 can be empty, for example at the beginning of the process batch, if a container 2 has fallen, or even if some containers 2 were missing at the input zone 18. Even in such cases of missing container 2, the sensing unit 10 will still generate a signal corresponding to a measured temperature, which then corresponds to the temperature of something else than a container 2: the pocket 17, the internal conveying device 5, or even another internal element of the washing tunnel 3 present in the detection zone. Such a measurement must not be taken into account in the regulation process of the rinsing phase, as it does not show the thermal effect of the rinsing liquid.

[0050] In order to solve this problem, it is proposed to implement a detection step, to detect whether or not a container 2 is present when the thermal effect is evaluated by a sensing unit 10 able to measure the temperature of the container 2. For this, the sensing unit 10 can also comprise a container detector 14. In such cases, the signal sent by the sensing unit 10 to the control unit 9 comprises an information linked to the temperature of the container 2, which normally directly corresponds to the thermal effect of the rinsing phase, and also comprises an information linked to the presence or absence of container 2 in the temperature detection zone of the sensing unit 10. The treatment of the information about temperature by the control unit 9 will then depend on the signal corresponding to the absence or presence of container 2.

[0051] It should be noted here that during the washing process, containers 2 are treated line 4 by line 4. Also, the sensing unit 10 is normally static and mounted so as to measure the temperature in a predefined zone through which containers 2 move. Therefore, the first temperature detected by the sensing unit 10 corresponds to a container 2 in a certain place in the first line 4, then the second temperature corresponds to the container 2 in the same place of the subsequent line 4, and so on. The sensing unit 10 normally detects the temperature of containers 2 belonging to successive lines 4. The absence of a container 2 in the sequence of lines 4 can then lead to an erroneous adjustment of the sprinkling means 8 working conditions. It is therefore proposed to add a memory unit 15 in which measurements can be stored and recalled as described hereunder.

[0052] If the sensing unit 10 detects that a container 2 is present when the temperature is measured, then said temperature is used by the control unit 9 to adjust the working condition of the sprinkling means 8, if necessary. This value is also stored in the memory unit 15, possibly by resetting the currently stored value. If the sensing unit 10 detects that no container 2 is present when the temperature is measured, then the regulation loop simply takes into account the value stored in the memory unit 15.

[0053] As containers 2 are treated line 4 by line 4, it is possible to synchronize the temperature measurement, the containers 2 detection, and the calculation of the resulting needed adjustment with the speed of the movement of the internal conveying device 5. By taking into account the movement of the internal conveying device 5, it is possible to know exactly when a container 2 is supposed to reach the measurement zone of the sensing unit 10. For this exact moment, the temperature sensed by the sensing unit 10 and the detection of the container detector 14 are treated as explained before.

[0054] Using a container detector 14 is especially useful for embodiments where the thermal effect of the rinsing phase is normally measured directly by measuring the temperature of the container 2 located in a predefined place in the line 4. However, using a container detector 14 can also be useful for embodiments where the thermal effect is measured by measuring the temperature of the rinsing liquid collected in the collection tank 16. For such embodiments, it is then possible, for example, to identify working conditions where the line 4 is completely empty, meaning that the temperature of the liquid in the collection tank 16 should not be taken into account to adjust the working condition of the sprinkling means 8.

[0055] Figure 4 focuses on the output zone 11 of an embodiment where the sensing unit 10 is located at the level of said output zone 11, where containers 2 are taken out of the internal conveying device 5 and put on the external conveying device 12. In this embodiment, the sensing unit 10 has the form of a subassembly in which both a temperature measuring probe 13 and a container detector 14 are integrated, for example one above the other. The sensing unit 10 is mounted at a side of the output zone 11, to detect the output of the pocket 17 located at the end of the line 4. The wall guiding the container 2 as it goes out of the pocket 17 and which is located between the sensing unit 10 and the first container 2 has an opening through which the temperature can be measured and the container 2 can be detected, in a direction corresponding to the direction of a line 4. Such an embodiment is very easy to implement and has only very little impact on the design of the rest of the washing unit 1.

[0056] The external conveying means 12 convey the containers 2 from the output zone 11 of the washing tunnel 3 to the subsequent processing machine, like a filler, for example. The movement of the external conveying means 12 can be parallel or perpendicular to the movement of the internal conveying means 5. Usually, during this conveying stage, the containers 2 are conveyed in one single row, parallel to the movement of the external conveying means 12.

[0057] It is also possible to install the sensing unit 10 so that it measures the temperature of the containers 2 as they are moved on the external conveying means 12. This makes it easier to work with a container 2 which would normally be located in the middle of the line 4 in the washing tunnel 3, for example.

[0058] The regulation of the sprinkling means 8 will now be explained. The sprinkling means 8 mainly consists in a set of sprinklers projecting and spraying the rinsing liquid in or on the containers 2. The control unit 9 uses the observed thermal effect as an input to adjust the flow of rinsing liquid. If the thermal effect is too high, which corresponds to a temperature of the containers 2 which is under a predefined target, then the flow of rinsing liquid is reduced, preferably of a predefined value. In the other situation, if the thermal effect is too low, which corresponds to a temperature of the containers 2 which is higher than a predefined target, then the flow of rinsing liquid is increased, preferably of a predefined value. Of course, when the thermal effect is in the targeted range, the flow of rinsing liquid is not adjusted but simply maintained. Comparing the measured thermal effect with the targeted range is preferably synchronized with the movement of the containers 2, and done each time a new line 4 arrives and is analyzed. Also, it is preferable that the minimum flow of rinsing liquid is more than zero, and that at least this little flow of rinsing liquid stays. This ensures the removal of the detergent from inside the container 2 in any condition.

[0059] With such a working principle, the flow of rinsing liquid is adjusted step by step until the target is reached. It is therefore possible to reach an optimal flow of rinsing liquid even if the relation between the rinsing flow and the resulting temperature of the containers 2 is not known.

[0060] As said above, in some embodiments, measuring the thermal effect of the sprinkling means 8 is only done after the containers 2 have left the final rinsing zone 7. Therefore, the temperature of the container 2 does not correspond to the simultaneous working status of the sprinkling means 8. As a consequence, adjusting the flow of rinsing liquid at a certain moment cannot be based on the thermal effect measured at the same moment: the temperature of the containers 2 cannot be used for adjusting the simultaneous flow of rinsing liquid.

[0061] In order to solve this problem, it is proposed that the control unit 9 takes into account the time duration needed for a container 2 to move from the final rinsing zone 7 to the place where the temperature is measured.

[0062] For the purpose of the following explanation, this duration is defined as "D". Let us name "M" the moment when the operational status of the sprinkling means 8 is adjusted by the control unit 9. The containers 2, subject to this specific operational status, will only be measured after time D has lapsed, starting from moment M, so at moment M+D. So the feedback loop of the control unit 9 advantageously takes the time D into consideration and, when adjusting the status of the sprinkling means 8 at moment M, said feedback loop analyses the consequence of this adjustment only at moment M+D, i.e. once the containers 2 which have been rinsed by the sprinkling means 8 with this specific operational status have reached the temperature measurement zone of the at least one sensing unit 10.

[0063] Therefore, after a change in the operation status of the sprinkling means 8, which mainly consists in the flow of rinsing liquid, said status can be kept unchanged during a period of time corresponding to the duration of time D needed for the container to move between the two aforementioned zones.

[0064] As described before, in some embodiments, the control unit 9 changes the operation of the sprinkling means 8 based on a predefined increment and on the measured thermal effect, until the target is reached. However, when doing so, finding the status corresponding to the targeted thermal effect on the containers 2 can be long. In order to reduce the time needed to reach the target, it is possible to benefit from the measures already done. The chart in figure 5 shows three columns: the one at the left corresponds to the instantaneous status of the sprinkling means 8; the central column corresponds to the temperature of the line of containers 2 which is simultaneously measured; the right column shows the information that can be built with these two values. Each line corresponds to a time increment, which means that each line corresponds to the moment when a line 4 arrives in the measurement zone of the sensing unit 10.

[0065] In this schematic view, the final rinsing zone 7 and the measurement area are separated by three containers 2, and the process works as follows:

- At moment 1, the status of the sprinkling means is S1, and so on for moment 2 with status S2 and moment 3 with status S3;
- At moment 4, the status of the sprinkling means is S4, and the containers 2 subjected to S1 can now be measured, which leads to T1. The control unit 9 can then conclude that if the status of the sprinkling means 8 is S1, then the temperature will be T1;
- At moment 5, the status of the sprinkling means 8 is S5, and the containers subjected to S2 can now be measured, which leads to T2. The relation between S2 and T2 can be stored;
- At moment 6, the status is S6. The temperature measurement is done for containers 2 which were in the final rinsing zone when the status was S3, bringing the information that S3 leads to T3, and so on.

[0066] Therefore, by changing the operation of the sprinkling means 8, the control unit 9 can, step by step, gather later some data to be used as a predictive model, linking the status of the sprinkling means 8 to the generated thermal effect. In order to gather more rapidly such predictive data, it is possible to change the status of the sprinkling means 8 even during the time duration D when the control unit 9 waits for the container 2.

[0067] This principle of building a predictive model can also be adapted to embodiments where the thermal effect measurement and the rinsing are simultaneous, and also where the sensing unit 10 measures the temperature of the rinsing liquid collected in the collection tank 16.

[0068] The control unit 9 can use the memory unit 15 to store such predictive data about the link between the status of the sprinkling means 8 and the resulting thermal effect on the container 2. This data can later be used to control to operation of the sprinkling means 8 based on a targeted thermal effect, and to reach this target more rapidly than by adjusting the status step by step.

[0069] Thanks to this description, it can be understood that, according to the invention, the rinsing phase is regulated based on the thermal effect it creates on the containers 2 in terms of container temperature. This can directly bring precious savings in term of fresh rinsing liquid, in a very simple way, because the thermal effect is directly used as the input of the feedback loop, rather than, for example, the temperature of the fresh rinsing liquid, the temperature of the container 2 before rinsing, pH conditions, etc.

[0070] Of course, from a general point of view, a regulation of the sprinkling flow of the sprinkling means 8 could also be based only on the detection of container 2 absence or presence, without any temperature measurement: if no container 2 is detected, the flow of rinsing liquid is set to its minimum value; if a container 2 is detected, the flow is set to its standard value.

[0071] While specific embodiments of the invention have been described in detail, it will be appreciated by those skilled in the art that various modifications and alternatives to those details, in addition to those discussed above, could be developed in light of the overall teachings of the disclosure. Accordingly, the particular arrangements disclosed are meant to be illustrative only, and not limiting as to the scope of the invention which is to be given the full breadth of the claims appended in any and all equivalents thereof, including any combination of their features.

Claims

1. Washing unit (1) for washing empty containers (2) for liquid like bottles or flasks, comprising
a washing tunnel (3) in which the containers (2) are conveyed line (4) by line (4) by an internal conveying means (5) for being cleaned and further rinsed, said washing tunnel (3) having a washing zone (6) where liquids with detergent or cleaning agents are used to clean the containers (2), and having also a final rinsing zone (7), disposed after the washing zone (6) and where a rinsing liquid like water is used to rinse the containers (2),
a sprinkling means (8) for sprinkling said rinsing liquid on containers (2) in said final rinsing zone (7), and
a control unit (9) for controlling the operation of at least the sprinkling means (8),
washing unit (1) **characterized in that**
it also comprises at least one sensing unit (10) for measuring the thermal effect of the sprinkling means (8) on the containers (2) and sending a corresponding information to the control unit (9), so that said information can be taken into account by said control unit (9) to pilot the operation of the sprinkling means (8).

2. Washing unit (1) according to claim 1, wherein the at least one sensing unit (10) measures the temperature of the rinsing liquid after it has been sprinkled on the containers (2).

3. Washing unit (1) according to any of claims 1 or 2, wherein the at least one sensing unit (10) directly measures the temperature of the containers (2) after the action of the rinsing liquid, in or after the final rinsing zone (7).

4. Washing unit (1) according to claim 3, wherein the at least one sensing unit (10) is located at an output zone (11) of the washing tunnel (3), after the final rinsing zone (7), where the containers (2) are withdrawn the internal conveying device (5).

5. Washing unit (1) according to any of claims 3 or 4, wherein the at least one sensing unit (10) is mounted at a side of the washing tunnel (3), so as to be able to measure the temperature of a container (2) located at an end of a line (4).

6. Washing unit (1) according to any of claim 3 or 4, wherein the washing unit (1) comprises an external conveying means (12) for conveying the containers (2) in one or more rows between the washing tunnel (3) and the subsequent processing step, like filling, and the at least one sensing unit (10) is mounted at the level of said external conveying means (12), so as to be able to measure the temperature of a container (2) outside and after the washing tunnel (3).

7. Washing unit (1) according to any of claims 1 to 6, wherein the at least one sensing unit (10) comprises: a temperature measuring probe (13), like an infrared based probe, and a container detector (14), for detecting the absence or presence of a container (2), so as to be able to verify that the temperature measured by the sensing unit (10) is the temperature of a container (2).

8. Washing unit (1) according to any of claims 1 to 7, wherein the control unit (9) comprises a memory unit (15) for storing the information received from the sensing unit (10).

9. Method for controlling a washing unit (1) in which unit containers (2) are cleaned, and further rinsed in a final rinsing phase by a sprinkling means (8) acting in a final rinsing zone (7) of a washing tunnel (3) of said washing unit (1), the containers (2) being organized in lines (4) progressing successively in said washing tunnel (3),
said method comprising

- measuring the thermal effect of the final rinsing phase on the containers (2), and
- adjusting the operation of the sprinkling means (8) based on said measured thermal effect.

10. Method according to claim 9, wherein measuring the thermal effect of the final rinsing phase on the containers (2) is achieved by measuring the temperature of the rinsing liquid after its action on the containers (2).

11. Method according to claim 9 or 10, wherein measuring the thermal effect of the final rinsing phase on the containers (2) is achieved by measuring the temperature of the containers (2) after the action of the rinsing liquid.

12. Method according to claim 11 wherein measuring the temperature of the containers (2) is done after they have left the final rinsing zone (7), and the period of time needed for a container (2) to move from the final rinsing zone (7) to the zone where its temperature is measured is taken into account for ajusting the operation of the sprinkling means (8).

13. Method according to claim 12, wherein the period of time needed for a container (2) to move from the final rinsing zone (7) to the zone where its temperature is measured is calculated based on the speed of the conveying means moving the containers (2) between these two zones.

14. Method according to any of claims 9 to 13, further comprising

- detecting the absence or presence of container (2), and,
- in case of detected presence of container (2), using the measured thermal effect to control the operation of the sprinkling means (8) and storing the measured value in a memory unit (15), and,
- in case of absence of container (2), recalling the previously stored measured value for controlling the operation of the sprinkling means (8).

15. Method according to any of claims 9 to 14, further comprising monitoring the relation between the operation status of the sprinkling means (8) and the resulting thermal effect on the containers (2).

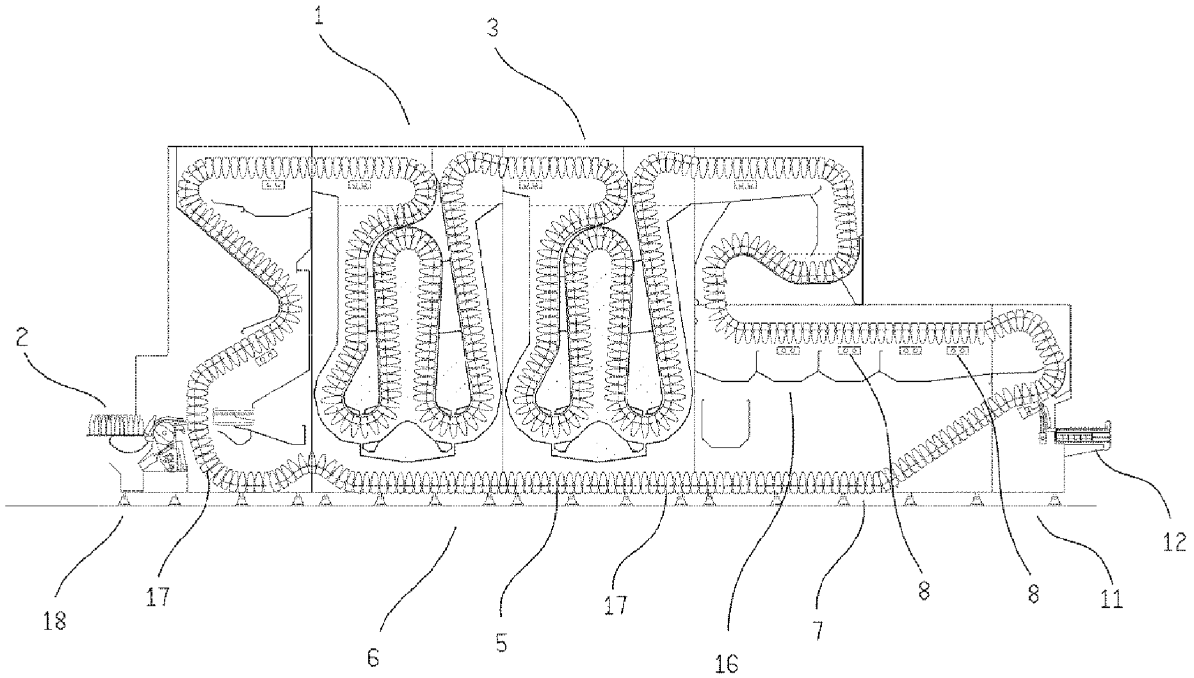

Fig. 1

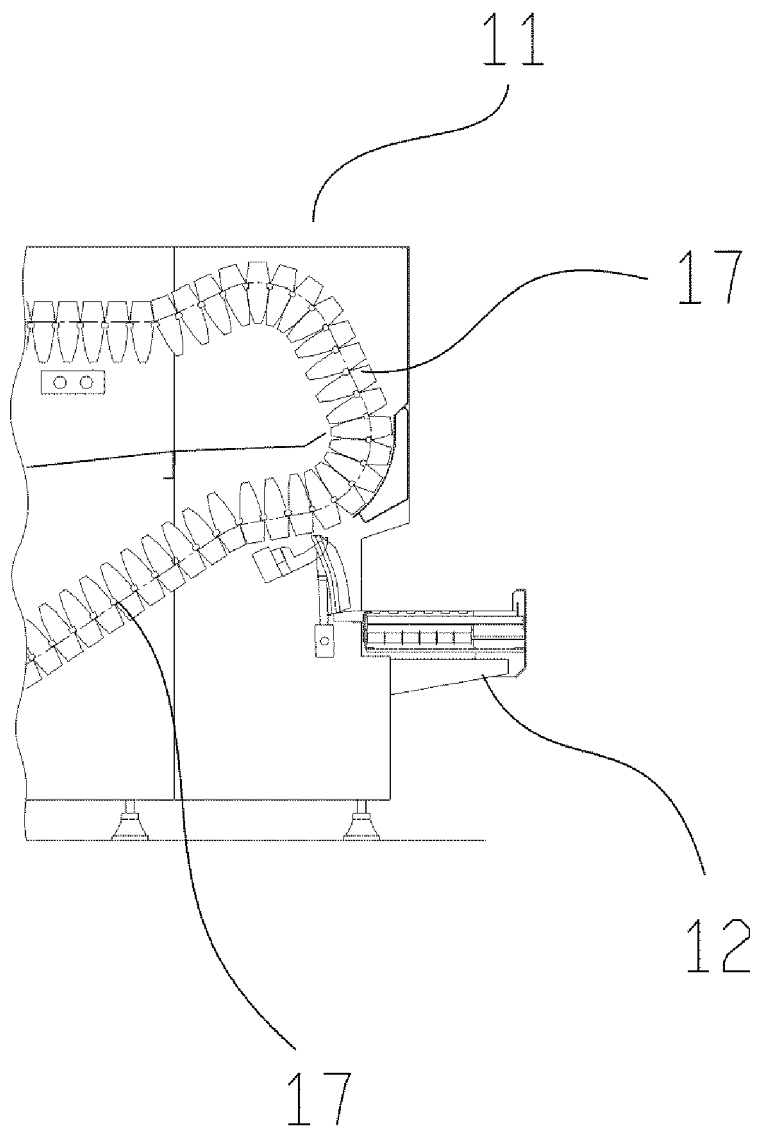

Fig. 2

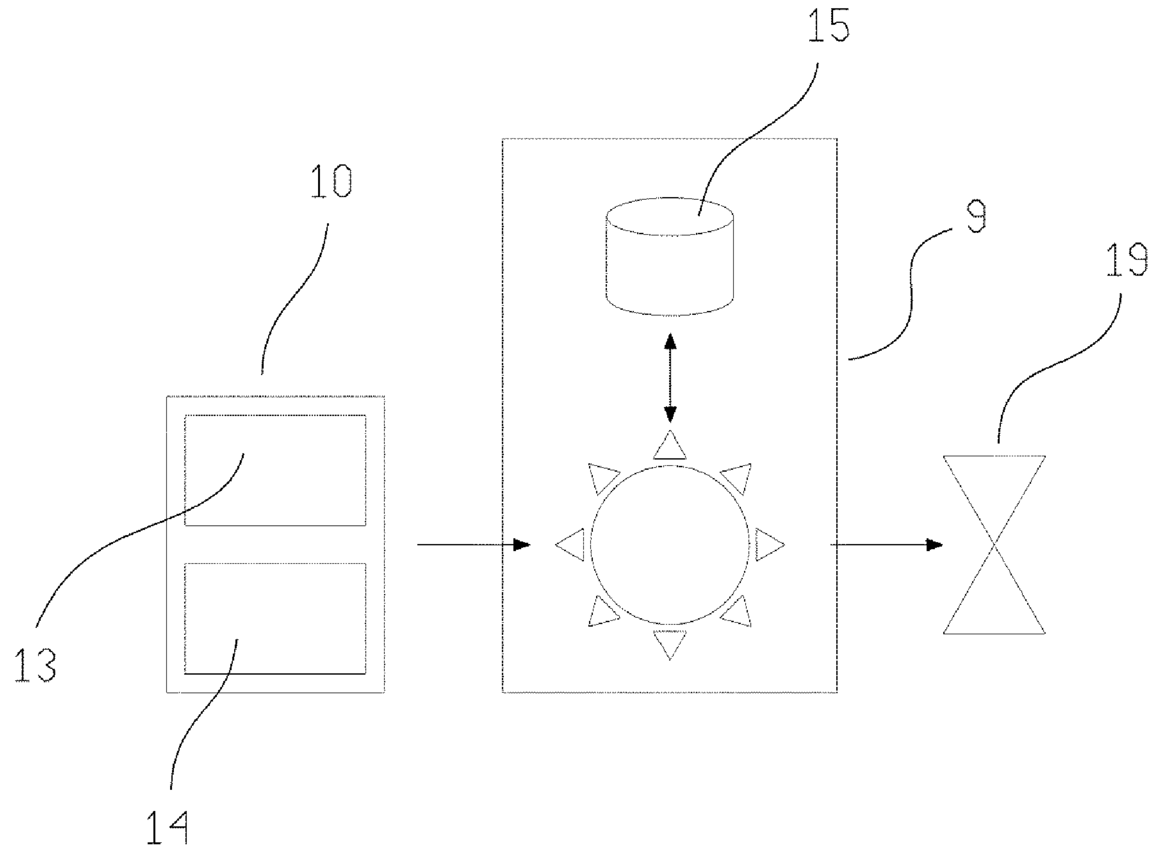

Fig. 3

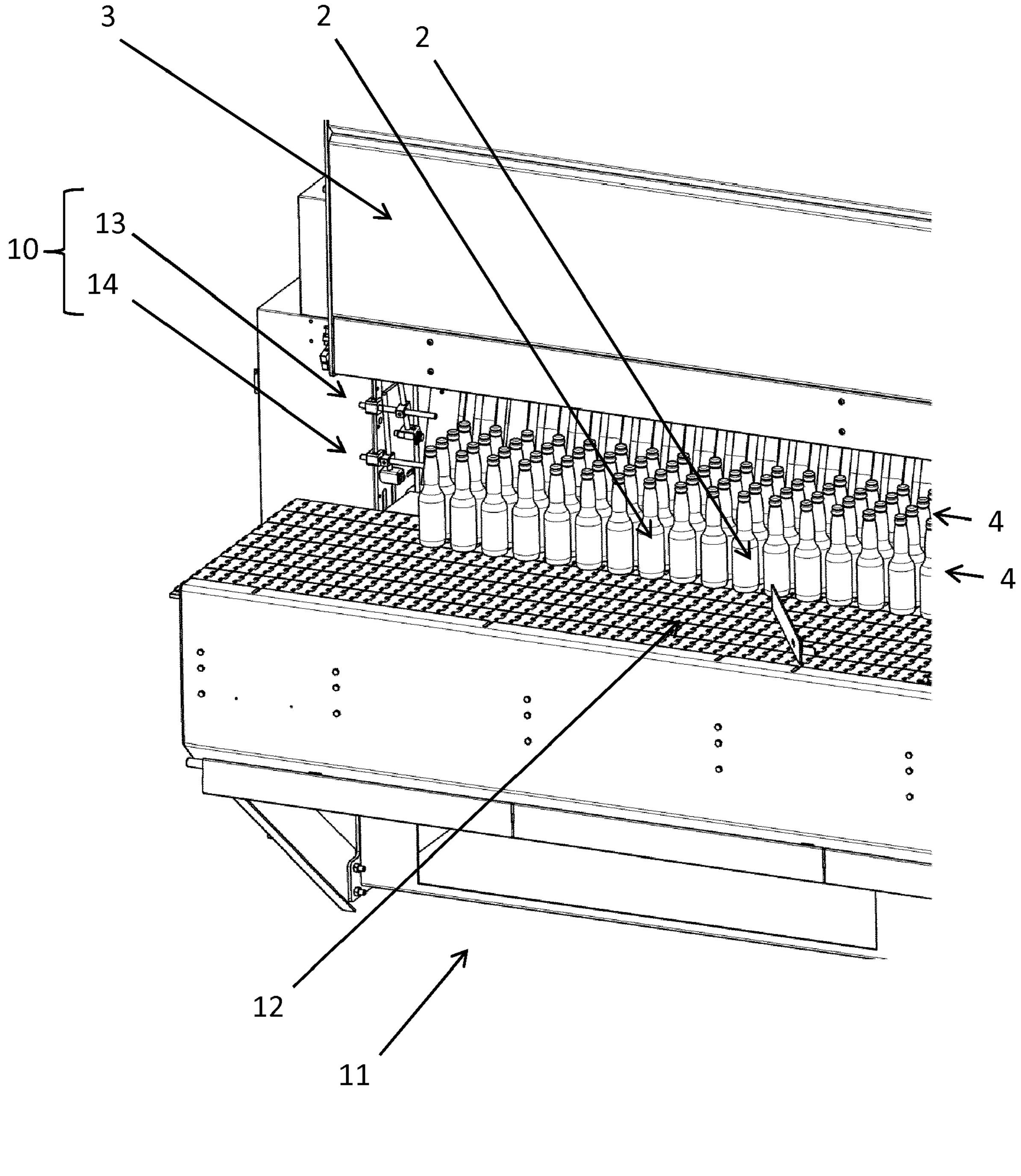

Fig. 4

S1	/	/
S2	/	/
S3	/	/
S4	T1	S4=>T1
S5	T2	S5=>T2
S6	T3	S6=>T3
S7	T4	S7=>T4
S8	T5	S8=>T5

Fig. 5

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 14 19 0820

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y	DE 10 2005 018382 A1 (KRONES AG [DE]) 26 October 2006 (2006-10-26) * paragraph [0007] - paragraph [0011] * * paragraph [0023] * * paragraph [0034] - paragraph [0036] * * paragraph [0040] - paragraph [0041] * * figures 1-3 * -----	1,3-9, 11,12, 14,15 2,10,13	INV. B08B9/30
X A	US 2010/276028 A1 (SANGI DARYOUSH [DE] ET AL) 4 November 2010 (2010-11-04) * paragraph [0086] * -----	9,11,12 1-8	
A	EP 1 281 446 A1 (HAFFMANS BV [NL]) 5 February 2003 (2003-02-05) * paragraph [0006]; figure 1 * -----	1-15	
A	DE 10 2007 020458 A1 (KHS AG [DE]) 30 October 2008 (2008-10-30) * claims 1,2 * -----	1	
Y	DE 41 26 167 A1 (URCOLA ANTONIO MARIA [AR]) 26 March 1992 (1992-03-26) * column 1, line 32 - line 39 * -----	2,10	TECHNICAL FIELDS SEARCHED (IPC) B08B
Y	DE 10 2006 023764 A1 (KHS AG [DE]) 22 November 2007 (2007-11-22) * claims 1,2 * -----	13	
A	DE 10 2006 017407 A1 (KHS AG [DE]) 18 October 2007 (2007-10-18) * paragraph [0029] - paragraph [0030] * -----	14	

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
The Hague	23 December 2014	Appelt, Lothar

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 14 19 0820

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

23-12-2014

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 102005018382 A1	26-10-2006	NONE	
US 2010276028 A1	04-11-2010	US 2010276028 A1	04-11-2010
		US 2010276029 A1	04-11-2010
EP 1281446 A1	05-02-2003	AT 434495 T	15-07-2009
		EP 1281446 A1	05-02-2003
		NL 1018707 C2	04-02-2003
DE 102007020458 A1	30-10-2008	DE 102007020458 A1	30-10-2008
		EP 2144636 A1	20-01-2010
		PL 2144636 T3	30-11-2012
		WO 2008135132 A1	13-11-2008
DE 4126167 A1	26-03-1992	AR 245021 A1	30-12-1993
		BR 9005022 A	10-09-1991
		DE 4126167 A1	26-03-1992
		US 5190063 A	02-03-1993
DE 102006023764 A1	22-11-2007	BR PI0711213 A2	23-08-2011
		CN 101448728 A	03-06-2009
		DE 102006023764 A1	22-11-2007
		EP 2027056 A2	25-02-2009
		JP 5253389 B2	31-07-2013
		JP 2009537412 A	29-10-2009
		US 2009130268 A1	21-05-2009
		WO 2007134803 A2	29-11-2007
DE 102006017407 A1	18-10-2007	AT 542611 T	15-02-2012
		CN 101421055 A	29-04-2009
		DE 102006017407 A1	18-10-2007
		EP 2012941 A2	14-01-2009
		ES 2376535 T3	14-03-2012
		JP 5331676 B2	30-10-2013
		JP 2009533210 A	17-09-2009
		PL 2012941 T3	31-07-2012
		RU 2008144718 A	20-05-2010
		US 2009255603 A1	15-10-2009
		WO 2007118606 A2	25-10-2007

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- EP 2727660 A **[0005]**