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

(72) Inventor: **BERZAGHI, Claudio**
37139 Verona (IT)

(74) Representative: **Sidel Group**
c/o Gebo Packaging Solutions France
5-7 Rue du Commerce
ZI - CS 73445 Reichstett
67455 Mundolsheim Cedex (FR)

(54) METHOD FOR HEATING A WASHING LIQUID IN A MACHINE FOR WASHING CONTAINERS, AND WASHING MACHINE FOR CARRYING OUT SUCH A METHOD

(57) In a machine (1) for washing containers (2), a conveyor device (4) advances a plurality of containers (2) along a washing path (P) through an inlet station, an outlet station (O) and a cleaning zone (C1, C2) arranged downstream of the inlet station and upstream of the outlet station; at this cleaning zone, the containers (2) are dipped into a bath of washing liquid; the washing liquid is heated inside the bath, by at least one heating conduit (201) channelling steam, and is delivered from the bath along a circulation line (150); condensate is separated from the steam in the heating conduit (201) so as to form a discharged fluid having heat that is transferred to the washing liquid in the circulation line (150).

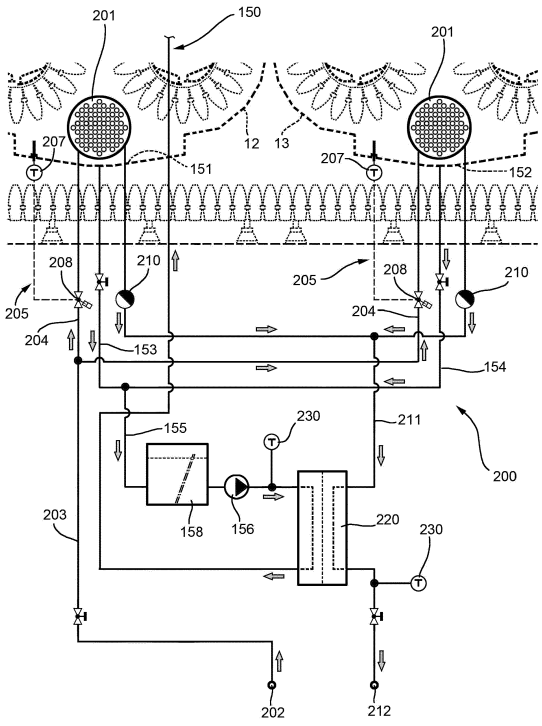

FIG. 2

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Description

[0001] The invention relates to a method for heating a washing liquid in a machine for washing containers.

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

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

[0004] Known washing machines essentially comprise:

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

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

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

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

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

[0009] In the meantime, such a washing liquid is heated by a heating system, generally comprising a plurality of hot conduits extending through the above mentioned baths and channelling a steam flow under pressure. The heating system further comprises condensate separators, that separate condensate from steam in the conduits and discharge the separated condensate. In the conduits, upstream of such separators, the steam and the corresponding condensate are at a pressurized condition, i.e. at a pressure higher than the atmospheric one (e.g. about four bars). Therefore, the condensate is formed at a boiling temperature that is higher than the usual boiling temperature of the water at atmospheric conditions, i.e. formed at a temperature higher than 100° C (e.g. at about 120 °C). Downstream of the separators, on the other hand, the separated condensate is channelled in a discharge line at the atmospheric pressure. In other words, the condensate undergoes a pressure reduction when discharged into the discharge line. Because of this pressure reduction, the boiling temperature decreases. Therefore, part of the discharged condensate undergoes a change of phase, i.e. it becomes again steam. This steam part coming from the separators is usually discharged into the atmosphere.

[0010] In respect to these known solutions, a need is felt within this field for improving the heating system for heating the washing liquid, so as to limit possible loss of energy.

[0011] It is an object of the invention to provide a method for heating a washing liquid in a machine for washing containers, which allows for meeting the abovementioned need in a simple and economic manner.

[0012] This object is achieved by the invention, as it relates to a method for heating a washing liquid in a machine for washing containers, as defined in claim 1.

[0013] The invention further relates to a washing machine, as defined in claim 5.

[0014] One preferred embodiment is hereinafter disclosed for a better understanding of the present invention, by way of non-limitative example and with reference to the accompanying drawings, in which:

- Figure 1 is a lateral and schematic view of a machine for washing empty containers by means of a washing liquid, which is heated according to a preferred embodiment of the method of the present invention; and
- Figure 2 is a schematic view, in an enlarged scale, of the components for carrying out the preferred embodiment of the method of the present invention.

[0015] With reference to Figure 1, reference numeral 1 indicates a washing machine for washing containers 2, in particular empty bottles intended to be filled with a pourable product.

[0016] As shown in the enlarged window of figure 1, each container 2 has a first 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. The neck portion 2d is provided, along axis A, with an inlet opening 2f, which allows for the filling of the inner volume 2b of the corresponding container 2.

[0017] Washing machine 1 comprises:

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

[0018] 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.

[0019] Specifically, each beam 16 comprises a row of pockets 17 aligned orthogonally to path P and adapted to receive respective containers 2. 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.

[0020] Still with reference to figure 1, washing machine 1 further comprises 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.

[0021] 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 load the received row onto the chain conveyor 4 at inlet station I.

[0022] In particular, the containers 2 of the most forward 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.

[0023] The operation and construction of the sequencing device 105 in known as such and, therefore, not described further in detail.

[0024] In the embodiment shown, direction F is horizontal and orthogonal to axes A of containers 2 fed along the same direction F.

[0025] Washing machine 1 further comprises an outfeed conveyor 14, which receives rows of cleaned containers 2 from chain conveyor 4 at an outlet station 0 of washing tunnel 3.

[0026] In view of the above, path P comprises:

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

[0027] Furthermore, according to the advancing direction of the containers 2, and in sequence along washing branch Q, washing machine 1 comprises:

- a prewash zone P1;
- a first cleaning zone C1;
- a second cleaning zone C2;
- a first cooling zone H1; and
- a second cooling zone H2.

[0028] This scheme is given just as an example, as the present invention applies to washing machines having other possible arrangements and/or a different number of prewash, cleaning and cooling zones.

[0029] Within prewash zone P1, first cleaning zone C1 and second cleaning zone C2, washing machine 1 comprises respective tubs or basins 11, 12, 13 filled with a washing liquid including a cleaning agent, so as to form respective baths into which containers 2 are dipped during advancement along washing branch Q. The washing liquid is defined, by way of example, by a basic aqueous solution comprising sodium hydroxide.

[0030] Moreover, at prewash zone P1 and at cleaning zones C1 and C2, washing machine 1 comprises respective nozzles 106, 107 and 108 which are arranged along washing branch Q to deliver, in use, sprays of the washing liquid, preferably directed towards first surfaces 2a and inner volumes 2b of containers 2, while the latter are advanced along washing branch Q.

[0031] As mentioned above, in prewash zone P1 and in cleaning zones C1 and C2, conveyor 4 travels into the baths of basins 11, 12 and 13, so as to dip the containers 2 into the washing liquid of such baths during advancement along washing branch Q.

[0032] The washing liquid in basin 11 and/or the washing liquid ejected by nozzles 106 are brought to a relatively high temperature, for instance between 45 °C and 60 °C, so that the encrusted dirt on containers 2 starts to dissolve as containers 2 themselves advance through prewash zone P1.

[0033] On the other hand, the washing liquid ejected by nozzles 107 and 108 and/or the washing liquid in basins 12 and 13 are brought to a higher temperature, for instance between 65 °C and 80 °C, thanks to a heating system 200 (schematically shown in figure 2) that will be described later on, so that in cleaning zones C1 and C2 dirt on advancing containers 2 is fully removed together with possible labels arranged thereon.

[0034] Containers 2 come out from the bath of basin 13 cleaned and heated up to a temperature likely between 60 °C and 70 °C, so that the same containers 2 needs to be cooled down to environmental temperature before being discharged at outlet station O.

[0035] In view of that, washing machine 1 comprises a cooling apparatus 101, not described in detail, arranged within cooling zones H1 and H2. By way of example, such cooling apparatus 101 allows containers 2 and beams 16 to come in thermal contact with a cooling medium having a temperature lower than that of the washing liquid, such that the same containers 2 and beams 16 are cooled while the cooling medium is heated.

[0036] Washing machine 1 further comprises at least one circulation line 150, which connects the lowest areas 151,152 of the basins 12 and 13 to the nozzles 107 and

108 and is external in respect to the cleaning zones C1 and C2. According to a variant, not shown, each cleaning zone C1 and C2 may be provided with a dedicated respective circulation line 150.

[0037] As shown in figure 2, circulation line 150 comprises two branches 153,154, which are connected respectively to the areas 151,152 and join together at a branch 155. Circulation line 150 further comprises a pump 156, that is arranged along branch 155, sucks flows of washing liquid from areas 151,152 via branches 153,154 and delivers such flows towards the nozzles 107 and 108. In particular, nozzles 107 and 108 are connected separately to branch 155 by respective valves. Preferably, circulation line 150 further comprises a filter 158, arranged along branch 155 upstream of pump 156 (considering the flow direction of the washing liquid delivered towards the nozzles 107 and 108).

[0038] As far as the above mentioned heating system 200 is concerned, such heating system 200 exploits steam to heat the washing liquid defining the baths in basins 12 and 13. For each of the cleaning zones C1 and C2, heating system 200 comprises at least one heating conduit 201, which extends in such cleaning zone C1,C2 through the bath of basins 12,13.

[0039] The heating conduits 201 communicate with a steam source 202 via a supply line 203. By way of example, the steam source 202 is defined by a connector suitable to be connected to a steam generator (not shown), e.g. to a boiler. According to the preferred embodiment that is schematically shown in figure 2, the heating conduit 201 arranged in cleaning zone C1 and the heating conduit 201 arranged in cleaning zone C2 are supplied with steam as parallel branches 204 by the same supply line 203.

[0040] As the steam is generally supplied under pressure, the steam pressure in the heating conduits 201 is higher than the atmospheric pressure, e.g. it is at about four bars.

[0041] Preferably, the steam is kept separated from the washing liquid, by means of watertight conduits (in particular, to avoid a change in the percentage of the cleaning agent in the washing solution).

[0042] By way of example, the heating conduit 201 of each cleaning zone C1, C2 is defined by a bundle of heating pipes.

[0043] The branches 204 are controlled independently by respective temperature control devices 205, each comprising a temperature sensor 207 for detecting the temperature of the washing liquid, in particular the bath temperature in the basins 12,13. Each device 205 further comprises a control valve 208 operated in response to the detected temperature, so as to adjust the quantity or flowrate of steam supplied by the supply line 203 to the corresponding heating conduit 201. In particular, the temperature control device 205 has the function of a thermostat, for switching on and switching off the supply of steam to the heating conduit 201, so as to adjust the temperature in the bath of the basin 12,13 to a predetermined setpoint.

[0044] Besides, for each of the cleaning zones C1 and C2, heating system 200 further comprises at least one condensate separator 210, which communicates with the corresponding heating conduit 201 and is configured to separate the condensate normally forming in such heating conduit 201 and to discharge the separated condensate into a discharge line 211.

[0045] At an end opposite to the separators 210, the discharge line 211 comprises an outlet 212, that is generally at the atmospheric pressure.

[0046] Because of the difference in pressure between the environment within heating conduits 201 and the environment within discharge line 211, the boiling temperature of the condensate discharged by the separators 210 decreases. As the temperature of the condensate discharged by the separators 210 is usually at about 120 °C, i.e. above the boiling temperature at atmospheric pressure, a part of such condensate undergoes a change of phase within the discharge line 211, just past the separators 210, and becomes again steam. In particular, the fluid channelled by the discharge line 211 towards the outlet 212 is defined by a liquid part and a steam part.

[0047] According to the present invention, such fluid (at a temperature of about 100-120 °C) is exploited as heating fluid to transfer heat to, and increase temperature of, the washing liquid. According to the preferred embodiment of the present invention, heat is transferred from this fluid channelled by the discharge line 211 to the washing liquid that is delivered in the circulation line 150, by means of an appropriate heat exchanger 220 (schematically shown). Preferably, along the circulation line 150, heat exchanger 220 is arranged downstream of pump 156 (i.e. along branch 155 between pump 156 and nozzles 107,108).

[0048] Preferably, the fluid discharged along discharge line 211 and the washing liquid are kept separated, e.g. by fluidtight passages in the heat exchanger 220. In other words, the condensate is not mixed with the washing liquid.

[0049] Preferably, heating system 200 further comprises one or more temperature sensors 230 to detect and therefore check the temperatures of the washing liquid and/or the fluid in the discharge line 211, upstream and/or downstream of heat exchanger 220. By way of example, the detected temperatures can be used to check the amount of heat transferred to the washing liquid. In particular, a one of the temperature sensors 230 is arranged along the discharge line 211 between heat exchanger 220 and outlet 212, so as to check if the fluid channelled towards outlet 212 has a temperature below 100 °C (i.e. it is all in the liquid phase).

[0050] Thanks to this heat transfer, the part of washing liquid circulated towards the nozzles 107,108 in the branch 155 is furtherly heated and afterwards injected into the cleaning zones C1 and C2. In such cleaning zones C1 and C2, the ejected washing liquid automatically returns into the baths of basins 12 and 13.

[0051] The operation of washing machine 1 is briefly described in the following.

[0052] Feeding system 8 advances a plurality of rows of containers 2 to be washed through conveyor 103 in a parallel manner to direction F.

[0053] 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.

[0054] Beams 16 of chain conveyor 4 withdraw respective rows of containers 2 at inlet station I from sequencing device 105, advance containers 2 inside washing tunnel 3 along the washing branch Q, discharge rows of cleaned containers 2 at outlet station 0 onto outfeed conveyor 14, and return along return branch R without containers 2.

[0055] In detail, containers 2 of each row are first carried by pockets 17 through prewash zone P1, where containers 2 are preliminary washed and heated through immersion within bath 11 and by means of nozzles 106.

[0056] Hence, containers 2 are conveyed also along nozzles 107 and 108 and through baths of basins 12 and 13, respectively at cleaning zones C1, C2, so that containers 2 are completely cleaned and deprived of any labels attached thereon.

[0057] Here, both containers 2 and beams 16 continue to receive heat from the washing liquid sprayed by nozzles 107 and 108 and from the washing liquid defining the baths of basis 12 and 13, up to reach elevated temperatures, for instance between 60 °C and 70° C.

[0058] Afterwards, a cooling process is carried out for cooling the hot washed containers 2 before the same containers 2 are discharged at outlet station O.

[0059] In the meantime, heating system 200 provides for heating the washing liquid, either in the baths of basins 12 and 13, by means of the conduits 201, or in the circulation line 150, by means of heat exchanger 220.

[0060] The latter heat exchanger 220 aids to increase the temperature of the washing liquid by recovering energy, i.e. heat, of the fluid discharged by the separators 210.

[0061] It is therefore apparent the advantages of the heating system 200 provided in the washing machine 1 according to the present invention.

[0062] First of all, thanks to the recovery of the heat from the fluid discharged by the separators 210, the heating system 200 and the machine 1 are more efficient, from the energetic point of view. Besides, it is possible to completely recover also the water at the outlet 212 (without loss of possible steam).

[0063] In addition, the arrangement of heating exchanger 220 along circulation line 150 allows for having a simple solution, as there is no need to provide further and dedicated pumps and/or filters and/or pipes, as such solution exploits components that are already provided in known washing machines for handling the flow of the washing liquid.

[0064] Clearly, changes may be made to the method for heating the washing liquid and washing machine 1 as described and illustrated herein without, however, departing from the scope of protection as defined in the accompanying claims.

[0065] In particular, in principle the fluid discharged by separators 210 could be used to heat the washing liquid in areas different from the circulation line 150 (by way of example, at the basins 11,12,13 and/or at the nozzles 106, 107, 108).

[0066] Moreover, washing machine 1 may comprise a different number of heat exchanging zones for heating the washing liquid and/or a different number of baths for washing containers 2.

Claims

1. A method for heating a washing liquid in a machine (1) for washing containers (2), the method comprising the steps of:

   - advancing a plurality of containers (2) along a washing path (P) through an inlet station (I), an outlet station (0) and at least one cleaning zone (C1,C2), which is arranged downstream of said inlet station and upstream of said outlet station;
   - washing said containers (2) at said cleaning zone (C1, C2) by dipping said containers (2) into at least one bath defined by a washing liquid;
   - delivering a part of the washing liquid from said bath along a circulation line (150);
   - heating said bath by at least one heating conduit (201), in which steam flows;
   - separating condesate from said steam; the separated condensate forming a discharged fluid;

   characterized by further comprising the step of transferring heat from said discharged fluid to at least a part of said washing liquid.

2. The method according to claim 1, **characterized in that** heat is transferred from said discharged fluid to washing liquid flowing in said circulation line (150).

3. The method according to claim 1 o 2, **characterized in that** said discharged fluid and the washing liquid are kept separated.

4. The method according to anyone of the previous claims, **characterized in that** said circulation line (150) circulates washing liquid from said bath to at least one nozzle (107,108), which ejects the circulated washing liquid towards containers advancing along the washing path.

5. A washing machine (1) for carrying out the method of anyone of the previous claims, the machine comprising:

- an inlet station, an outlet station and at least one cleaning zone (C1,C2) arranged downstream of said inlet station and upstream of said outlet station;
- a conveyor device (4) operable to advance a plurality of containers (2) along a washing path (P) trough said inlet station, outlet station and cleaning zone (C1,C2);
- at least one basin (12,13) arranged in said cleaning zone (C1,C2) and suitable to receive a washing liquid so as to form a bath into which said containers (2) are dipped during the advancement along said washing path (P);
- a circulation line (150) communicating with said basin (12, 13) to deliver a part of washing liquid from said bath;
- at least one heating conduit (201) suitable to receive steam and arranged in said basin (12,13)
- at least one condensate separator (210) communicating with said heating conduit (201) for separating condensate from said steam;
- a discharge line (211) communicating with said condensate separator (210) for channelling a discharged fluid formed by said condensate;

characterized by further comprising at least one heat exchanger (220) to transfer heat from said discharged fluid to at least a part of said washing liquid.

6. The washing machine according to claim 5, **characterized in that** said heat exchanger (220) is arranged so as to transfer heat from said discharge line (211) to said circulation line (150).

7. The washing machine according to claim 6, **characterized in that** said circulation line (150) comprises a pump (156); the heat exchanger (220) being arranged downstream of said pump (156).

8. The washing liquid according to claim 6 or 7, **characterized in that** said circulation line (150) comprises a pump (156) and connects said basin to at least one nozzle (107,108) which is arranged so as to eject washing liquid towards containers advancing along the washing path (P).

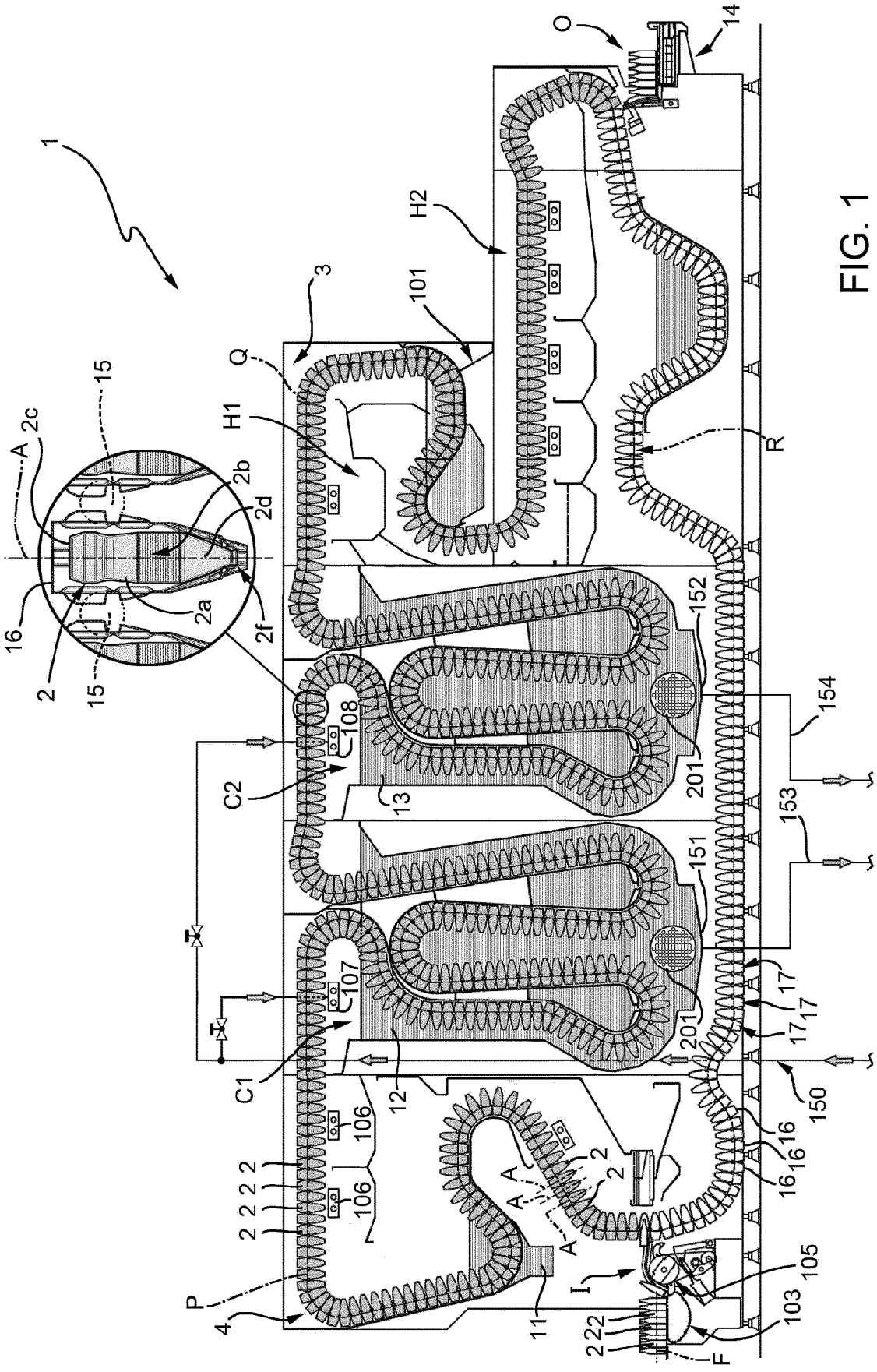
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FIG. 1

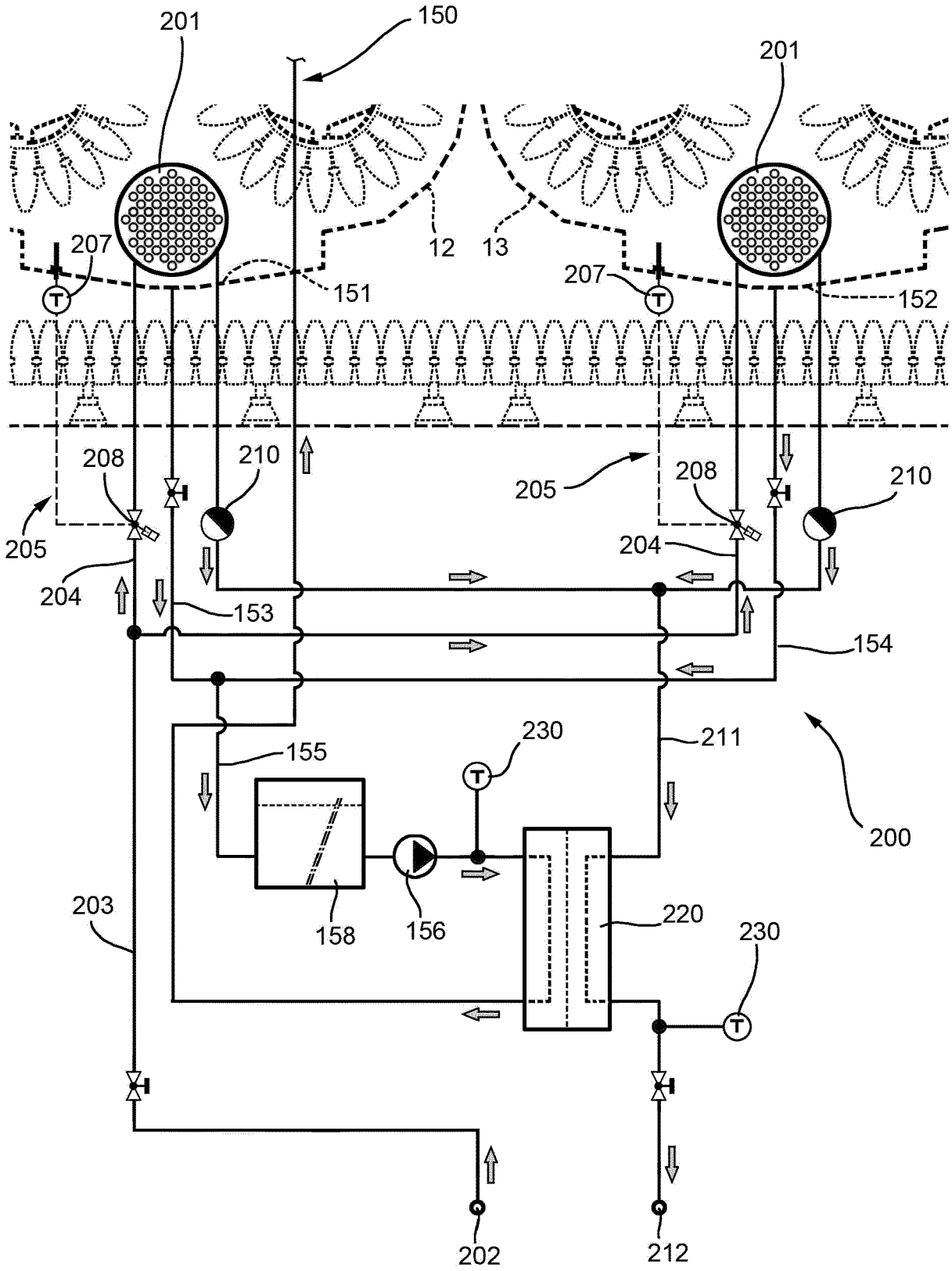
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FIG. 2

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EUROPEAN SEARCH REPORT

Application Number
EP 18 21 2666

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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
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CATEGORY OF CITED DOCUMENTS

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