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(72) Inventors:
• **ANIM-MENSAH, Alexander R.**
Glenview, Illinois, 60025 (US)
• **WATSON, Michael T.**
Glenview, Illinois, 60025 (US)
• **ASHWORTH, Thomas J.**
Glenview, Illinois, 60025 (US)
• **PAULUS, Mary E.**
Glenview, Illinois, 60025 (US)

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(71) Applicant: **Illinois Tool Works, Inc.**
Glenview, Illinois 60025 (US)

(74) Representative: **Trinks, Ole**
Meissner Bolte Patentanwälte
Rechtsanwälte Partnerschaft mbB
Postfach 10 26 05
86016 Augsburg (DE)

(54) **WAREWASHER WITH AIR ASSISTED WASHING AND/OR RINSING**

(57) A warewash machine (10) for cleaning wares, comprising a chamber (14) for receiving wares, the chamber (14) having at least one spray zone (20); a rinse system associated with the spray zone (20) and including

one or more spray nozzles (28) and a feed system (30) connected to the spray nozzles, wherein the feed system (30) includes both a rinse liquid line (32) and a compressed air line (34).

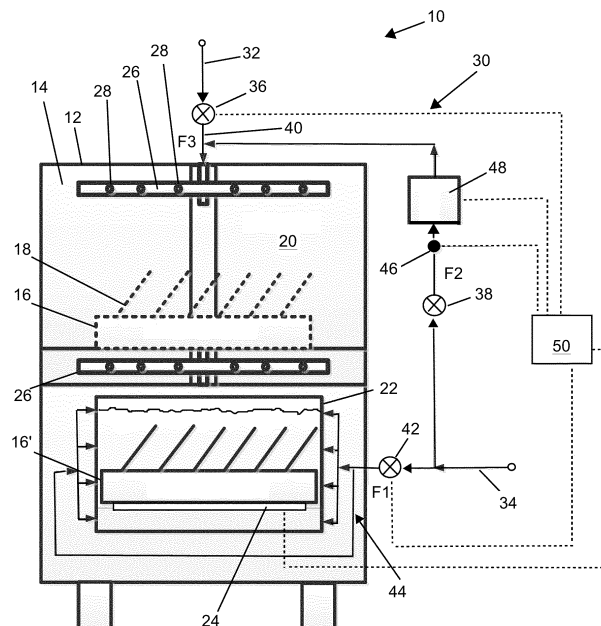


FIG. 1

Description

[0001] This application relates generally to warewashers such as those used in commercial applications such as cafeterias and restaurants and, more particularly, to systems and methods to utilize air for ware cleaning in such warewashers.

BACKGROUND

[0002] Commercial warewashers commonly include a housing which defines one or more internal washing and rinsing zones for dishes, pots pans and other wares. In conveyor-type machines wares are moved through multiple different spray zones within the housing for cleaning (e.g., pre-wash, wash, post-wash (aka power rinse) and a rinse zone or zones). One or more of the zones include a tank in which liquid to be sprayed on wares is heated in order to achieve desired cleaning. In batch-type machines wares are typically manually moved into a generally stationary location within a chamber for cleaning, and then manually removed from the machine upon completion of all operations/steps of the cleaning cycle.

[0003] Reduced water consumption is becoming more important in certain areas in view of the growing demands for water as well as an increase in the number of drought stricken areas.

[0004] It would be desirable to provide a warewasher system and method that reduces water consumption.

SUMMARY

[0005] In one aspect, a warewash machine for cleaning wares includes a chamber for receiving wares, the chamber having at least one spray zone. A rinse system associated with the spray zone includes one or more spray nozzles and a feed system connected to the spray nozzles. The feed system includes both a rinse liquid line and a compressed air line.

[0006] In one implementation of the foregoing aspect, the feed system is operable to feed a combination of the rinse liquid and the compressed air to the spray nozzles during at least part of a rinsing operation carried during a ware cleaning cycle.

[0007] In one instance of the foregoing implementation, a ratio of rinse liquid flow to compressed air flow that is fed to the spray nozzles is variable by adjustment of one or more flow control devices.

[0008] In another implementation of the foregoing aspect, the feed system includes a first flow control device for selectively controlling flow of rinse liquid from the rinse liquid line to the spray nozzles and a second flow control device for selectively controlling flow of compressed air from the compressed air line to the spray nozzles. A controller is operatively connected to control both the first flow control device and the second flow control device. The controller is configured to control the first flow control device and the second flow control device so as to feed

a combination of the rinse liquid and the compressed air to the spray nozzles during at least part of a rinsing operation of a ware cleaning cycle.

[0009] In one instance of the immediately preceding implementation, the first flow control device comprises a first valve and the second flow control device comprises a second valve.

[0010] In another instance of the immediately preceding implementation, the controller is configured to control the first flow control device and the second flow control device to feed only compressed air to the spray nozzles during a ware drying step of the ware cleaning cycle. Alternatively, or in addition, the controller is configured to control the first flow control device and the second flow control device to feed only rinse liquid to the spray nozzles during at least part of the rinsing operation.

[0011] In another implementation of the foregoing aspect, the chamber includes a wash tank below the spray zone, and a mechanism from moving wares from the spray zone down into the wash tank for a washing operation and back up to the spray zone for a rinsing operation. In such a case, the wash tank holds wash liquid in which the wares are submerged during the washing operation, and the compressed air line is selectively connectable to delivered compressed air into the wash liquid during at least part of the washing operation.

[0012] In another implementation of the foregoing aspect, the chamber includes a wash tank and an associated recirculation system for recirculating wash liquid from the wash tank for spraying the wash liquid in the spray zone onto wares during a washing operation. The compressed air line is selectively connectable to the recirculation system for delivering a combined spray of wash liquid and compressed air onto the wares during the washing operation.

[0013] In another aspect, a warewash machine for cleaning wares includes a chamber for receiving wares, the chamber having at least one spray zone, wherein the chamber includes a wash tank below the spray zone and at least one of: (i) a mechanism from moving wares from the spray zone down into the wash tank for a washing operation and back up to the spray zone for a rinsing operation, wherein the wash tank holds wash liquid in which the wares are submerged during the washing operation, and a compressed air line is connected to deliver compressed air into the wash liquid during at least part of the washing operation, or (ii) a recirculation system for recirculating wash liquid from the wash tank to spray nozzles of the spray zone for spraying the wash liquid onto wares during a washing operation, and a compressed air line is connected to the recirculation system to deliver a combined spray of wash liquid and compressed air from the spray nozzles onto the wares during the washing operation.

[0014] In implementations of the immediately preceding aspect, in the case of either (i) or (ii), the compressed air line is selectively connectable to one or more rinse spray nozzles of the warewash machine such that a com-

binized spray of rinse liquid and compressed air is delivered to the rinse spray nozzles during at least part of a rinsing operation of a ware cleaning cycle.

[0015] In a further aspect, a method is provided for cleaning wares in a warewash machine that includes a chamber for receiving wares, the chamber having at least one spray zone. The method involves carrying out at least one of the following steps: (i) delivering both compressed air and rinse liquid to a plurality of wash spray nozzles of the warewash machine and spraying a combination of the compressed air and the wash liquid from the rinse spray nozzle onto the wares during at least part of a washing operation of a ware cleaning cycle, wherein the wash liquid is recirculated from a wash tank below the spray zone; or (ii) lowering wares from the spray zone into a wash tank below the spray zone to submerged the wares within wash liquid of the wash tank and delivering compressed air into the wash tank during at least part of a washing operation of a ware cleaning cycle, and thereafter raising the wares back up into the spray zone for a rinsing operation; or (iii) delivering both compressed air and rinse liquid to a plurality of rinse spray nozzles of the warewash machine and spraying a combination of the compressed air and the rinse liquid from the rinse spray nozzle onto the wares during at least part of a rinsing operation of a ware cleaning cycle.

[0016] In one implementation of the immediately preceding aspect, both steps (i) and (iii) are carried out during a common ware cleaning cycle.

[0017] In another implementation of the immediately preceding aspect, both steps (ii) and (iii) are carried out during a common ware cleaning cycle.

[0018] The details of one or more embodiments are set forth in the accompanying drawings and the description below. Other features, objects, and advantages will be apparent from the description and drawings, and from the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019]

Fig. 1 is a schematic side elevation of one embodiment of a warewasher; and

Fig. 2 is a flow chart of exemplary process/logic for the warewasher of Fig. 1;

Fig. 3 is a schematic side elevation of another embodiment of a warewasher; and

Fig. 4 is a flow chart of exemplary process/logic for the warewasher of Fig. 3.

DETAILED DESCRIPTION

[0020] Referring to Fig. 1, an exemplary warewash machine 10 is shown, with a housing 12 and an internal

chamber 14 with a spray zone 20 that can receive a rack 16 (or racks) of soiled wares 18 for cleaning (e.g., through an access opening closeable by a door or hood or, in some cases, through an access opening without a door).

The machine includes a wash tank 22 below the spray zone. A mechanism 24 for lowering wares from the spray zone 20 down into the wash tank 22, and raising the wares from the wash tank 22 back up into the spray zone 20 is shown schematically. By way of example, the mechanism 24 could be a lift platform (e.g., open wire frame type) that is raised or lowered by way of a motor and belt or chain drive, or by way of one or more linear actuators. However, other mechanism configurations are possible.

[0021] The spray zone 20 includes one or more rinse arms 26 (stationary and/or moving depending upon machine type) with associated spray nozzles 28 for spraying rinse liquid onto wares when the wares are up in the spray zone 20. A feed system 30 feeds to the spray arms 26 and includes a rinse liquid line 32 and a compressed air line 34, each of which is connected, or selectively connectable, by a respective valve 36 and 38 to the rinse arm input path 40. The rinse liquid could, for example, come from a hot water booster and may or may not include a rinse agent. The compressed air could come from an external source as a standalone unit, from the facility utility or from a compressor installed on the machine. The compressed air line 34 is also connected, or selectively connectable, to the wash tank 22 by a valve 42 and feed path 44, where the feed path 44 includes multiple inputs to the wash tank 22. A controller 50 is operatively connected to each of the valves 36, 38, 42, the mechanism 24, an air sensor 46 (e.g., temperature and/or humidity and/or other air quality characteristics) and an air heater 48 (e.g., an electric heater). As used herein, the term controller is intended to broadly encompass any circuit (e.g., solid state, application specific integrated circuit (ASIC), an electronic circuit, a combinational logic circuit, a field programmable gate array (FPGA)), processor(s) (e.g., shared, dedicated, or group - including hardware or software that executes code), software, firmware and/or other components, or a combination of some or all of the above, that carries out the control functions of the machine or the control functions of any component thereof.

[0022] Referring to the schematic machine 10 of Fig. 1 and the process flow diagram 60 of Fig. 2, in an automatic mode, the wash tank 22 is filled with the required volume of wash liquid (e.g., water with detergent either predosed or dosed at the beginning of a cleaning cycle). The valves 36, 38 and 42 are all closed at this time. Per step 62, the machine 10 receives rack(s) in the upper position in the spray zone per dashed line form of rack 16, and a door of machine is closed at step 64 to activate a switch/sensor to initiate cleaning. Alternatively, or in addition to door closure, a user interface button could be manually pressed to initiate cleaning. The rack transport/shift mechanism 24 then operates to submerge the rack(s) into the wash tank water per solid line form of

rack 16'. When the rack is moved to submerged position (e.g., as determined by an activated switch or sensor of the mechanism 24) per step 66, the controller 50 initiates the wash operation of the cleaning cycle at step 68, which includes opening valve 42 to deliver compressed air from line 34 into the washing liquid for washing for a predetermined time (while valves 36 and 38 remain closed). The compressed air may be introduced directly into the volume of water in which the wares are submerged as suggested, and may be introduced during the entire washing operation of the cleaning cycle or during only part of the washing operation. The introduction of the compressed air aids in cleaning by creating turbulent conditions in the washing tank.

[0023] At the end of the washing operation of the cycle (e.g., after a set time period or after a sensor indicates sufficient washing) per step 70, the rack transport/shift mechanism 24 moves the rack back into the upper position in the spray zone 20 per step 72 for rinsing (e.g., via sprays from nozzles 28 in the one or more rinse arms 26). Per step 74, for purpose of rinsing, valve 42 is closed and valves 38 and 36 are opened to deliver a combined rinse water and compressed air mixture that is directed onto the wares through the spray nozzles 28, such as a combined flow through the same nozzle(s) 28 for rinsing for a predetermined time (e.g., which predetermined time can be set or varied). The compressed air may be introduced during the entire rinsing operation of the cleaning cycle or during only part of the rinsing operation.

[0024] At the end of the rinsing operation of the cleaning cycle as determined at step 76, the valve 42 remains closed and valve 36 is also closed such that compressed air is delivered into the ware chamber (without any water) through the spray nozzles 28 for a drying operation (e.g., for a predetermined time for a time as determined by a sensor that detects how dry the wares are) per step 78. The heater 48 may be activated or otherwise controlled during the drying period based on air temperature and air quality factors/conditions such as humidity, moisture, etc. as indicated by the sensor(s) 46. Moreover, the flow-rate or amount of compressed air for drying may be controlled or set based upon, for example, the type of ware, shape, weight, etc. The valves 36, 38 and 42 (or other flow control devices) can be regulated/controlled (e.g., by the controller 50) to achieve various compressed air flows F1 and F2 and various rinse water flows F3 to achieve different water-to-air ratios and flows (e.g., F1 only for the wash, F3/F2 for rinsing and F2 for drying, where the level of each of F1, F2 and F3 can be controlled) as necessary for desired wash, rinse and drying of the various wares types, such as heavy or light duty loads.

[0025] While the above description primarily contemplates and automated machine 10, in a manual machine or mode of the Fig. 1 machine manual button presses may be used for initiating rack submersion, raising the rack back into the upper position, starting the rinsing, starting the drying, etc. Moreover, the valves 36, 38 and

42 could be controlled manually as well.

[0026] Referring to Fig. 3, another exemplary ware-wash machine 100 is shown, where similar features/components to machine 10 are shown with similar number designations. Here, compressed air line 34 is connected through a valve 102 to the rinse input path 40, which can also form part of the wash liquid path as shown. However, it is recognized that separate wash arms 104 with wash nozzles 106 may also be provided, in which case an additional valve 108 may be provided so that separate compressed air flows to the wash path and the rinse path are possible. The wash tank 22 includes a recirculation system with pump 110, line 112 and valve 114 which can feed to the spray nozzles 28 in one embodiment, or could feed to the spray nozzles 106 in an embodiment with separate wash arm(s) 104. The machine may be a rack-type machine or may be a conveyor-type with a conveyance mechanism for moving wares through various spray zones of the machine. A controller 150 is operatively connected to each of the valves 36, 102, 108, 114, and the pump 110, air sensor(s) 46 and heater 48.

[0027] Referring to the schematic machine 100 of Fig. 3 and the process flow diagram 160 of Fig. 4, in an automatic mode, the wash tank 22' is filled with the required volume of water with detergent either predosed or dosed at the beginning of washing. The valves 36, 102, 108 and 114 are all closed at this time, and the pump 110 is off. Per step 162, the machine 10 receives rack(s) in the chamber, and a door of machine is closed at step 164 to activate a switch/sensor to initiate cleaning. Alternatively, or in addition to door closure, a user interface button could be manually pressed to initiate cleaning per step 166. At step 168, the valve 114 is opened and the pump 110 is then operated to circulate the wash fluid from the tank 22' up to the spray arms/nozzles 26/28 or 104/106 of the spray zone 20, while valves 36 and 102 (and if applicable 108) are closed. In some cases valve 102 (or 108 if applicable) could also be opened during washing operation, or part of the washing operation, to deliver a combination of compressed air and washing liquid through the spray nozzles during the washing operation.

[0028] At the end of the washing operation as determined at step 170, per step 172 the pump 110 stops and the valve 114 is closed, and the valves 102 and 36 are opened for the rinse operation. The open state of valves 102 and 36 allow a water and compressed air mixture to be delivered onto the wares (e.g., combined flow through the same nozzle(s) for rinsing for a predetermined time (e.g., which predetermined time can be set or varied). The compressed air may be introduced during the entire rinsing operation of the cleaning cycle or during only part of the rinsing operation.

[0029] At the end of the rinsing as determined at step 174, valve 36 is closed and valve 102 remains open so that compressed air (without any water) for drying is directed onto the wares for a drying operation of the cleaning cycle (e.g., for a predetermined time for a time as determined by a sensor that detects how dry the wares

are) per step 176. The heater 48 may be activated or otherwise controlled during the drying period based on air temperature and air quality factors/conditions such as humidity, moisture, etc. as indicated by the sensor(s) 46. Moreover, the flowrate or amount of compressed air for drying may be controlled or set based upon, for example, the type of ware, shape, weight, etc. The valves 36, 114, 102 (and 108 if applicable) can be regulated/controlled (e.g., by the controller 150) to achieve various compressed air flows F5 and/or F5', various wash liquid flows F4 and various rinse water flows F6 to achieve different water-to-air ratios and flows as necessary for desired wash, rinse and drying of the various wares types, such as heavy or light duty loads.

[0030] While the above description primarily contemplates and automated machine 100, in a manual machine or mode of the Fig. 3 machine manual button presses may be used for initiating rack cleaning and/or any of initiating washing, starting the rinsing, starting the drying, etc. Moreover, the valves 36, 114, 102 (and 108 if applicable) could be controlled manually as well.

[0031] It is to be clearly understood that the above description is intended by way of illustration and example only and is not intended to be taken by way of limitation, and that changes and modifications are possible. Accordingly, other embodiments are contemplated and modifications and changes could be made without departing from the scope of this application.

Claims

1. A warewash machine for cleaning wares, comprising:
 - a chamber for receiving wares, the chamber having at least one spray zone;
 - a rinse system associated with the spray zone and including one or more spray nozzles and a feed system connected to the spray nozzles, wherein the feed system includes both a rinse liquid line and a compressed air line.
2. The warewash machine of claim 1, wherein the feed system is operable to feed a combination of the rinse liquid and the compressed air to the spray nozzles during at least part of a rinsing operation carried during a ware cleaning cycle.
3. The warewash machine of claim 2, wherein a ratio of rinse liquid flow to compressed air flow that is fed to the spray nozzles is variable by adjustment of one or more flow control devices.
4. The warewash machine of one of the preceding claims, wherein the feed system includes a first flow control device for selectively controlling flow of rinse liquid

from the rinse liquid line to the spray nozzles and a second flow control device for selectively controlling flow of compressed air from the compressed air line to the spray nozzles, and a controller operatively connected to control both the first flow control device and the second flow control device, the controller configured to control the first flow control device and the second flow control device so as to feed a combination of the rinse liquid and the compressed air to the spray nozzles during at least part of a rinsing operation of a ware cleaning cycle.

5. The warewash machine of claim 3 or 4, wherein the first flow control device comprises a first valve and the second flow control device comprises a second valve.
6. The warewash machine of claim 4 or 5, wherein the controller is configured to control the first flow control device and the second flow control device to feed only compressed air to the spray nozzles during a ware drying step of the ware cleaning cycle.
7. The warewash machine of one of claims 4 to 6, wherein the controller is configured to control the first flow control device and the second flow control device to feed only rinse liquid to the spray nozzles during at least part of the rinsing operation.
8. The warewash machine of one of the preceding claims, wherein the chamber includes a wash tank below the spray zone, and a mechanism from moving wares from the spray zone down into the wash tank for a washing operation and back up to the spray zone for a rinsing operation.
9. The warewash machine of claim 8, wherein the wash tank holds wash liquid in which the wares are submerged during the washing operation, and the compressed air line is selectively connectable to deliver compressed air into the wash liquid during at least part of the washing operation.
10. The warewash machine of one of the preceding claims, wherein the chamber includes a wash tank and an associated recirculation system for recirculating wash liquid from the wash tank for spraying the wash liquid in the spray zone onto wares during a washing operation, wherein the compressed air line is selectively connectable to the recirculation system for delivering a combined spray of wash liquid and compressed air onto the wares during the washing operation.
11. The warewash machine of one of the preceding claims,

wherein the compressed air line is selectively connectable to one or more rinse spray nozzles of the warewash machine such that a combined spray of rinse liquid and compressed air is delivered to the rinse spray nozzles during at least part of a rinsing operation of a ware cleaning cycle. 5

12. A method of cleaning wares in a warewash machine that includes a chamber for receiving wares, the chamber having at least one spray zone, the method comprising: carrying out at least one of the following steps: 10

(i) delivering both compressed air and rinse liquid to a plurality of wash spray nozzles of the warewash machine and spraying a combination of the compressed air and the wash liquid from the rinse spray nozzle onto the wares during at least part of a washing operation of a ware cleaning cycle, wherein the wash liquid is recirculated from a wash tank below the spray zone; or 15 20

(ii) lowering wares from the spray zone into a wash tank below the spray zone to submerge the wares within wash liquid of the wash tank and delivering compressed air into the wash tank during at least part of a washing operation of a ware cleaning cycle, and thereafter raising the wares back up into the spray zone for a rinsing operation; or 25

(iii) delivering both compressed air and rinse liquid to a plurality of rinse spray nozzles of the warewash machine and spraying a combination of the compressed air and the rinse liquid from the rinse spray nozzle onto the wares during at least part of a rinsing operation of a ware cleaning cycle. 30 35

13. The method of claim 12, wherein both steps (i) and (iii) are carried out during a common ware cleaning cycle. 40

14. The method of claim 12 or 13, wherein both steps (ii) and (iii) are carried out during a common ware cleaning cycle. 45

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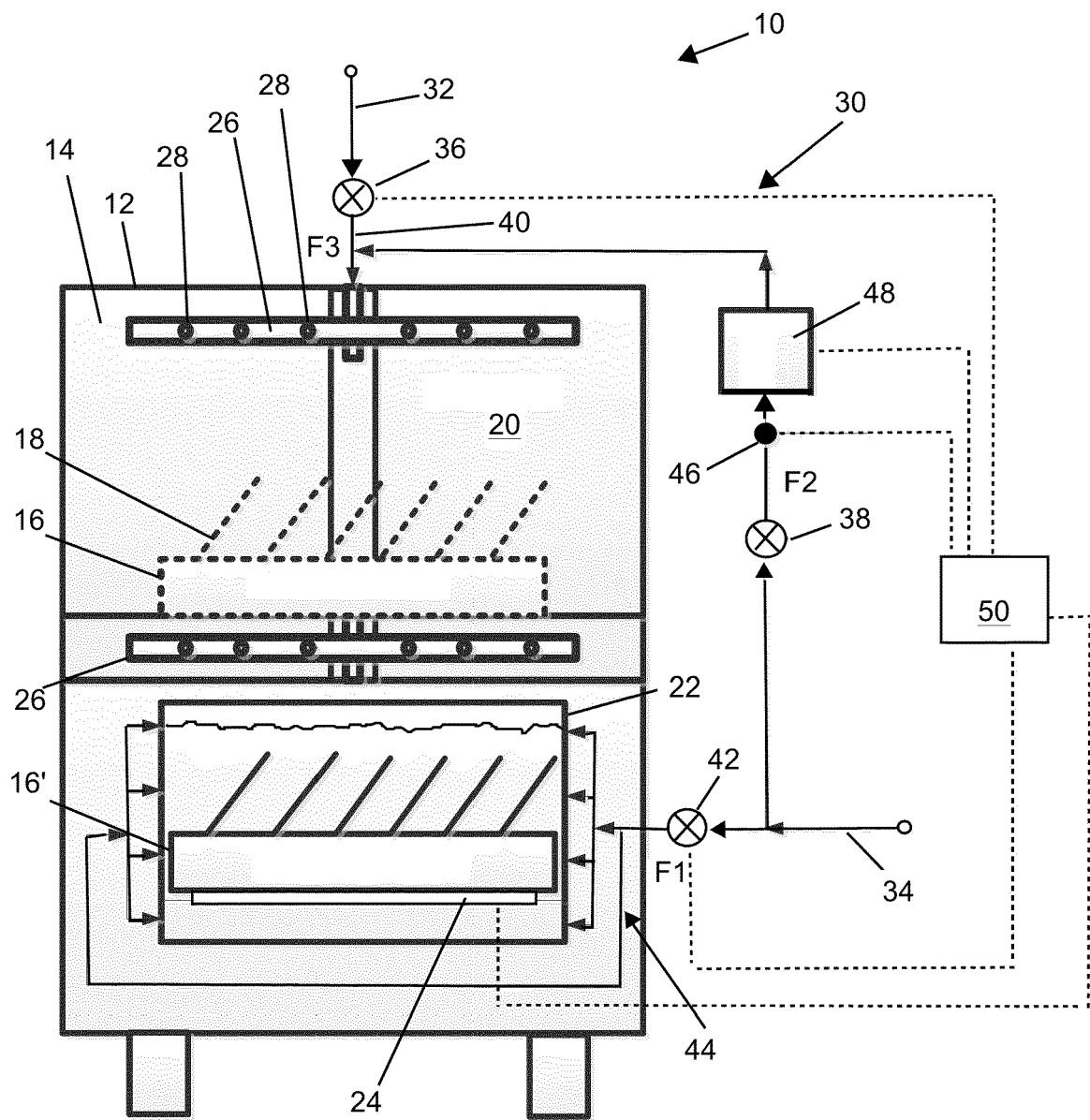


FIG. 1

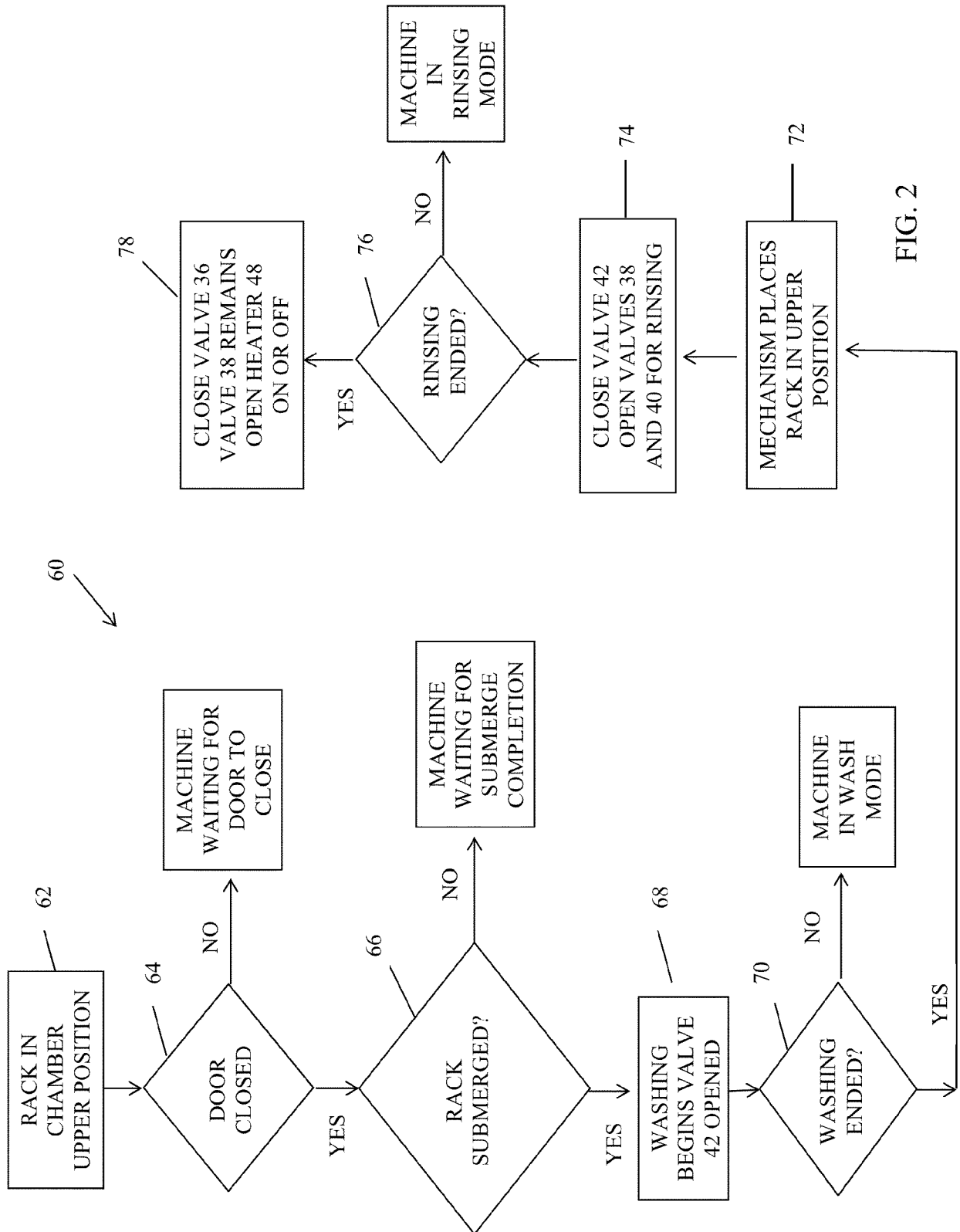


FIG. 2

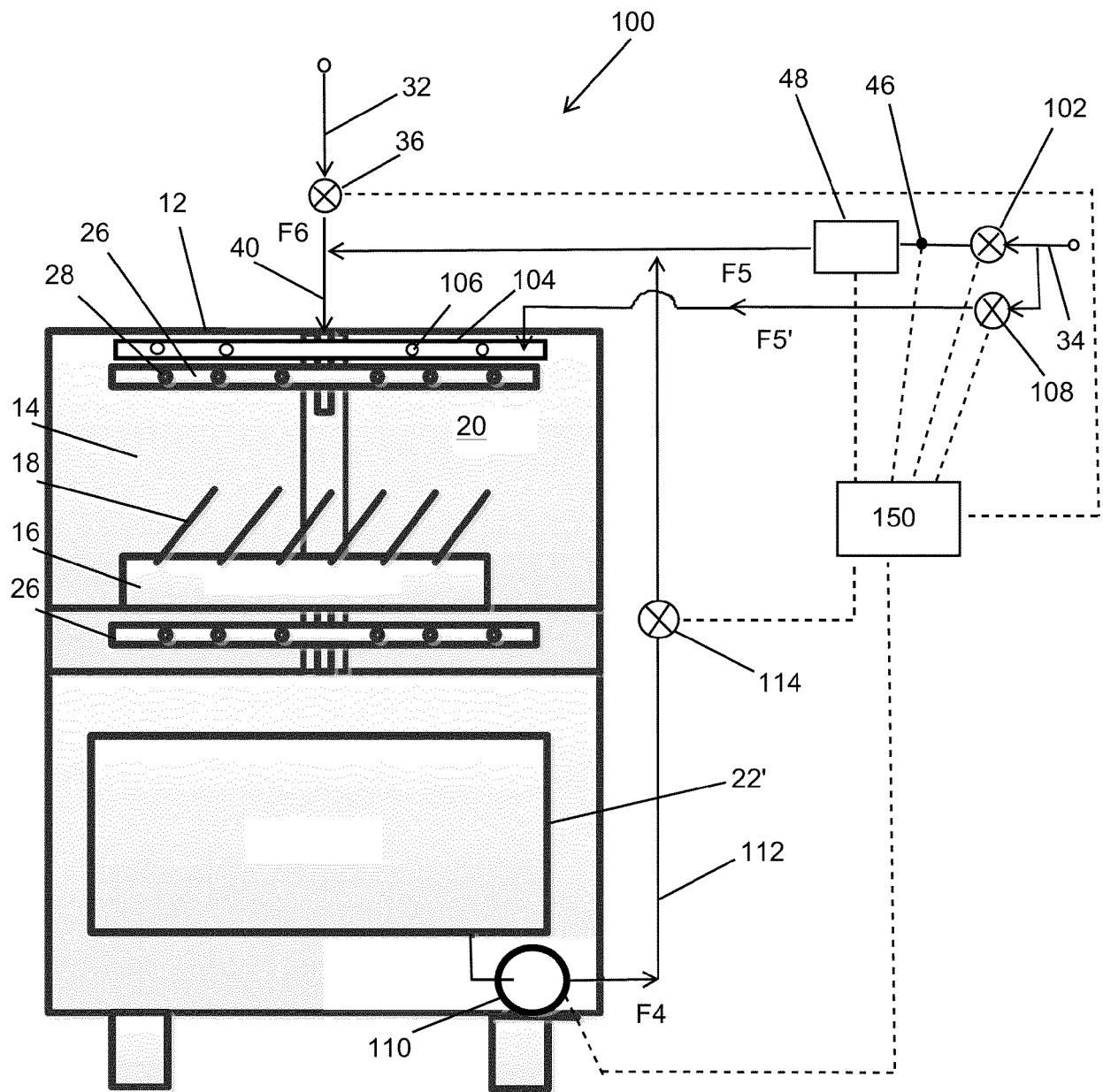


FIG. 3

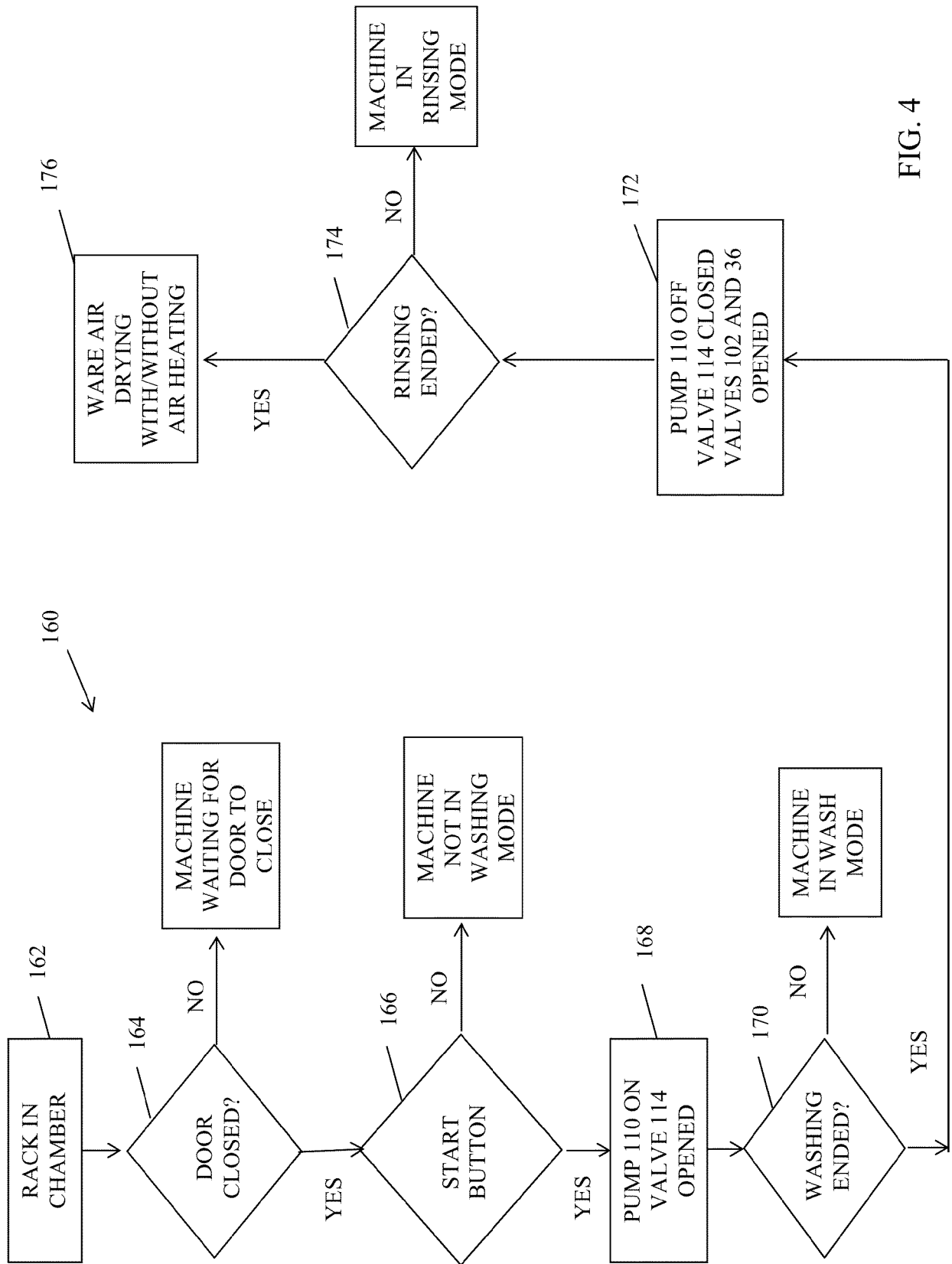


FIG. 4



EUROPEAN SEARCH REPORT

Application Number
EP 17 17 5850

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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 30 October 2017	Examiner Beckman, Anja
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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