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(71) Applicant: **Whirlpool Corporation**

Benton Harbor, MI 49022 (US)

(72) Inventor: **Czarnecki, Philip J.**

21024 Cassinetta di Biandronno (VA) (IT)

(74) Representative: **Spina, Alessandro**

Whirlpool Management EMEA S.R.L.

Via Carlo Pisacane, 1

20016 Pero (MI) (IT)

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(54) **DISH TREATING APPLIANCE WITH A DRYING SYSTEM AND METHOD OF OPERATION**

(57) A dishwasher (10) includes a tub (14) at least partially defining a treating chamber (16), with an access opening. The dishwasher (10) further includes a closure (20) movable between closed and opened positions to

selectively close and open the access opening. A method (300) of drying dishes within the dishwasher (10) includes moving the closure (20) to a partially open position between the closed and opened positions.

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Description**TECHNICAL FIELD**

[0001] The present disclosure generally relates to a dishwasher and method of drying dishes in the dishwasher.

BACKGROUND

[0002] Contemporary automatic dish treating appliances for use in a typical household include a cabinet with an access opening and a tub that can have an open front and at least partially defines a treating chamber into which items, such as kitchenware, glassware, and the like, can be placed to undergo a treating operation, such as washing. At least one rack or basket for supporting soiled dishes can be provided within the tub. A silverware or utensil basket for holding utensils, silverware, cutlery, and the like, may also be provided and is generally removably mounted to the door or within the dish rack. The treating cycle of operation for the dishes can include a drying cycle for drying the dishes. Traditional drying cycles utilize various methods for drying dishes, examples of which include closed loop drying methods, such as by the use of a condenser, or fan-assisted drying methods, which can be implemented with or without the use of a heater. However, after the completion of such drying methods, residual moisture within the dish treating appliance may re-condense on the dishes before a user removes the clean dishes.

[0003] The dishwasher can be further provided with a door assembly, which can be hingedly mounted to the tub or to the cabinet for pivoting movement about a pivot axis between closed and opened positions to selectively close and open the open front and the access opening. The door can include a latch or a closure to selectively retain the door in the closed position. A door opener can be included to selectively bias the door toward the opened position, or toward a partially open position. Such door openers can be operated, for example, as part of a drying cycle of operation to move the door to the partially open position to improve performance of drying dishes within the treating chamber.

BRIEF DESCRIPTION

[0004] An aspect of the present disclosure relates to a method of drying dishes within a dishwasher having a tub at least partially defining a treating chamber, with an access opening, and a closure movable between opened and closed positions to selectively open/close the access opening, the method comprising forcing heated air through the treating chamber, and moving the closure to a partially open position between the closed and opened positions while forcing heated air through the treating chamber.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] In the drawings:

FIG. 1 is a right-side perspective view of an automatic dish treating appliance having multiple systems for implementing an automatic cycle of operation, including a drying system according to an aspect of the present disclosure.

FIG. 2 is a schematic view of the dish treating appliance of FIG. 1 and illustrating at least some of the plumbing and electrical connections between at least some of systems.

FIG. 3 is a schematic view of a controller of the dish treating appliance of FIGS. 1 and 2.

FIG. 4 is a rear view of a door assembly for use with the dish treating appliance of FIGS. 1 and 2 and including the drying system of FIG. 1.

FIG. 5 is a partially exploded front perspective view of the door assembly with the drying system of FIG. 4.

FIG. 6 is a flow chart illustrating a method of drying dishes for use with the door assembly with the drying system of FIG. 4.

DETAILED DESCRIPTION

[0006] FIG. 1 illustrates an automatic dish treating appliance 10, illustrated herein as a dishwasher 10, capable of implementing an automatic cycle of operation to treat dishes. As used in this description, the term "dish(es)" is intended to be generic to any item, single or plural, that can be treated in the dishwasher 10, including, without limitation, dishes, plates, pots, bowls, pans, glassware, silverware, and other utensils. As illustrated, the dishwasher 10 is a built-in dishwasher implementation, which is designed for mounting under a countertop. However, this description is applicable to other dishwasher implementations such as a standalone, multi-tub-type, drawer-type, or a sink-type, for example, as well as dishwashers having varying widths, sizes, and capacities. The dishwasher 10 shares many features of a conventional automatic dishwasher, which may not be described in detail herein except as necessary for a complete understanding of aspects of the disclosure.

[0007] The dishwasher 10 has a variety of systems, some of which are controllable, to implement the automatic cycle of operation. A chassis or cabinet is provided to support the variety of systems needed to implement the automatic cycle of operation and defines an interior. As illustrated, for a built-in implementation, the chassis or cabinet includes a frame in the form of a base 12 on which is supported an open-faced tub 14, which at least partially defines a treating chamber 16, having an access opening, illustrated herein as an open face 18, for receiving the dishes.

[0008] A closure in the form of a door 20 or door assembly 20 can be hingedly or pivotally mounted to the base 12, or to any other suitable portion of the cabinet

or chassis or of the tub 14, for pivoting movement about a pivot axis and relative to the tub 14 between opened and closed positions to selectively open and close the open face 18 of the tub 14. In the opened position, a user can access the treating chamber 16, as shown in FIG. 1, while, in the closed position (not shown), the door assembly 20 covers or closes the open face 18 of the treating chamber 16. Thus, the door assembly 20 provides selective accessibility to the treating chamber 16 for the loading and unloading of dishes or other items. A closure or latch assembly (not shown) can be provided to selectively retain the door assembly 20 in the closed position.

[0009] A door opening assembly 140, illustrated herein as a door opener 140, is provided with the dishwasher 10 to selectively bias the door assembly 20 toward the opened position. It is further contemplated that the door opener 140 can selectively bias and move the door assembly 20 into a partially open position (not shown) between the closed and opened positions. The partially open position can be defined by the angle of rotation of the door assembly 20 relative to the open face 18. By way of non-limiting example, the door opener 140 can be selectively actuated to move the door assembly 20 into the partially open position wherein the door assembly 20 is rotated at least 5 degrees away from the open face 18, further wherein the door assembly 20 is rotated at least 8 degrees away from the open face 18, further yet wherein the door assembly 20 is rotated about 10 degrees away from the open face 18. The door opener 140 can be provided at any suitable location within the dishwasher 10, such as coupled to or mounted to the tub 14 or to another portion of the chassis or cabinet or the dishwasher 10. The door opener 140 comprises an actuating mechanism 142 that is operably coupled with an opening pin 144 to selectively actuate the opening pin 144 to move from a non-actuated or retracted position to an actuated or extended position wherein the opening pin 144 contacts and bears against the door assembly 20 to bias and to move the door assembly 20 toward and into the partially open position.

[0010] The chassis or cabinet, as in the case of the built-in dishwasher implementation, can be formed by other parts of the dishwasher 10, like the tub 14 and the door assembly 20, in addition to a dedicated frame structure, like the base 12, with them all collectively forming a uni-body frame by which the variety of systems are supported. In other implementations, like the drawer-type dishwasher, the chassis can be a tub that is slidable relative to a frame, with the closure being a part of the chassis or the countertop of the surrounding cabinetry. In a sink-type implementation, the sink forms the tub and the cover closing the open top of the sink forms the closure. Sink-type implementations are more commonly found in recreational vehicles.

[0011] The systems supported by the chassis, while essentially limitless, can include a dish holding system 30, spray system 40, recirculation system 50, drain system 60, water supply system 70, first drying system 80,

heating system 90, filter system 100, and second drying system 200. These systems are used to implement one or more treating cycles of operation for the dishes, for which there are many, one of which includes a traditional automatic wash cycle.

[0012] A basic traditional automatic cycle of operation for the dishwasher 10 has a wash phase, where a detergent/water mixture is recirculated and then drained, which is then followed by a rinse phase where water alone or with a rinse agent is recirculated and then drained. An optional drying phase can follow the rinse phase. More commonly, the automatic wash cycle has multiple wash phases and multiple rinse phases. The multiple wash phases can include a pre-wash phase where water, with or without detergent, is sprayed or recirculated on the dishes, and can include a dwell or soaking phase. There can be more than one pre-wash phases. A wash phase, where water with detergent is recirculated on the dishes, follows the pre-wash phases. There can be more than one wash phase; the number of which can be sensor controlled based on the amount of sensed soils in the wash liquid. One or more rinse phases will follow the wash phase(s), and, in some cases, come between wash phases. The number of wash phases can also be sensor controlled based on the amount of sensed soils in the rinse liquid. The amounts of water, treating chemistry, and/or rinse aid used during each of the multiple wash or rinse steps can be varied. The wash phases and rinse phases can include the heating of the water, even to the point of one or more of the phases being hot enough for long enough to sanitize the dishes. A drying phase can follow the rinse phase(s). The drying phase can include a drip dry, a non-heated drying step (so-called "air only"), heated dry, condensing dry, air dry or any combination. These multiple phases or steps can also be performed by the dishwasher 10 in any desired combination.

[0013] A controller 22 can also be included in the dishwasher 10 and operably couples with and controls the various components of the dishwasher 10 to implement the cycles of operation. The controller 22 can be located within the door assembly 20 as illustrated, or it can alternatively be located somewhere within the chassis. The controller 22 can also be operably coupled with a control panel or user interface 24 for receiving user-selected inputs and communicating information to the user. The user interface 24 can provide an input and output function for the controller 22.

[0014] The user interface 24 can include operational controls such as one or more knobs, dials, lights, switches, displays, touch screens and the like for communicating with the user, such as enabling a user to input commands, such as a cycle of operation, to the controller 22 and to receive information, for example about the selected cycle of operation. For example, the displays can include any suitable communication technology including that of a liquid crystal display (LCD), a light-emitting diode (LED) array, or any suitable display that can convey a message to the user. The user can enter different types

of information including, without limitation, cycle selection and cycle parameters, such as cycle options. Other communications paths and methods can also be included in the dishwasher 10 and can allow the controller 22 to communicate with the user in a variety of ways. For example, the controller 22 can be configured to send a text message to the user, send an electronic mail to the user, or provide audio information to the user either through the dishwasher 10 or utilizing another device such as a mobile phone.

[0015] The controller 22 can include the machine controller and any additional controllers provided for controlling any of the components of the dishwasher 10. For example, the controller 22 can include the machine controller and a motor controller. Many known types of controllers can be used for the controller 22. It is contemplated that the controller is a microprocessor-based controller that implements control software and sends/receives one or more electrical signals to/from each of the various working components to effect the control software. As an example, proportional control (P), proportional integral control (PI), and proportional derivative control (PD), or a combination thereof, a proportional integral derivative control (PID control), can be used to control the various components.

[0016] The dish holding system 30 can include any suitable structure for receiving or holding dishes within the treating chamber 16. Exemplary dish holders are illustrated in the form of an upper dish rack 32 and lower dish rack 34, commonly referred to as "racks", which are located within the treating chamber 16. The upper dish rack 32 and the lower dish rack 34 each define an interior and are typically mounted for slidable movement in and out of the treating chamber 16 through the open face 18 for ease of loading and unloading. Drawer guides/slides/rails 36 are typically used to slidably mount the upper dish rack 32 to the tub 14. The lower dish rack 34 typically has wheels or rollers 38 that roll along rails 39 formed in sidewalls of the tub 14 and onto the door assembly 20, when the door assembly 20 is in the opened position.

[0017] Dedicated dish holders can also be provided. One such dedicated dish holder is a third level rack 28 located above the upper dish rack 32. Like the upper dish rack 32, the third level rack 28 is slidably mounted to the tub 14 with drawer guides/slides/rails 36. The third level rack 28 is typically used to hold utensils, such as tableware, spoons, knives, spatulas, etc., in an on-the-side or flat orientation. However, the third level rack 28 is not limited to holding utensils. If an item can fit in the third level rack 28, it can be washed in the third level rack 28. The third level rack 28 generally has a much shorter height or lower profile than the upper and lower dish racks 32, 34. Typically, the height of the third level rack 28 is short enough that a typical glass cannot be stood vertically in the third level rack 28 and the third level rack 28 still be slid into the treating chamber 16.

[0018] Another dedicated dish holder can be a utensil

or silverware basket (not shown), which is typically located in the treating chamber 16 and carried by one of the upper or lower dish racks 32, 34 or mounted to the door assembly 20. The silverware basket typically holds utensils and the like in an upright orientation as compared to the on-the-side or flat orientation of the third level rack 28. More than one silverware basket can be provided with the dishwasher 10.

[0019] A dispenser assembly 48 is provided to store and dispense treating chemistry, e.g. detergent, anti-spotting agent, etc., into the treating chamber 16. The dispenser assembly 48 can be mounted on an inner surface of the door assembly 20, as shown, or can be located at other positions within the chassis or treating chamber 16, such that the dispenser assembly 48 is positioned to be accessed by the user for refilling of the dispenser assembly 48, whether it is necessary to refill the dispenser assembly 48 before each cycle (i.e. for a single use dispenser) or only periodically (i.e. for a bulk dispenser). The dispenser assembly 48 can dispense one or more types of treating chemistries. The dispenser assembly 48 can be a single-use dispenser, which holds a single dose of treating chemistry, or a bulk dispenser, which holds a bulk supply of treating chemistry and which is adapted to dispense a dose of treating chemistry from the bulk supply during the cycle of operation, or a combination of both a single use and bulk dispenser. The dispenser assembly 48 can further be configured to hold multiple different treating chemistries. For example, the dispenser assembly 48 can have multiple compartments defining different chambers in which treating chemistries can be held.

[0020] Turning to FIG. 2, the spray system 40 is provided for spraying liquid in the treating chamber 16 and can have multiple spray assemblies or sprayers 41, 42, 43, 44, 45, 130, some of which can be dedicated to a particular one of the dish holders, to particular area of a dish holder, to a particular type of cleaning, or to a particular level of cleaning, etc. The sprayers 41, 42, 43, 44, 45, 130 can be fixed or movable, such as rotating, relative to the treating chamber 16 or dish holder. Exemplary sprayers 41, 42, 43, 44, 45, 130 are illustrated and include an upper spray arm 41, a lower spray arm 42, a third level sprayer 43, a deep-clean sprayer 44, and a spot sprayer 45. The upper spray arm 41 and lower spray arm 42 can be rotating spray arms, located below the upper dish rack 32 and lower dish rack 34, respectively, and rotate about a generally centrally located and vertical axis. The third level sprayer 43 is located above the third level rack 28. The third level sprayer 43 is illustrated as being fixed, but could move, such as in rotating. In addition to the third level sprayer 43 or in place of the third level sprayer 43, a sprayer 130 can be located at least in part below a portion of the third level rack 28, though it will be understood that such a sprayer 130 can be provided adjacent any of the racks 28, 32, 34. The sprayer 130 is illustrated as a fixed tube, carried by the third level rack 28, but could move, such as in rotating about a lon-

gitudinal axis.

[0021] The deep-clean sprayer 44 is a manifold extending along a rear wall of the tub 14 and has multiple nozzles 46, with multiple apertures 47, generating an intensified and/or higher pressure spray than the upper spray arm 41, the lower spray arm 42, or the third level sprayer 43. The nozzles 46 can be fixed or can move, such as by way of rotating. The spray emitted by the deep-clean sprayer 44 defines a deep clean zone, which, as illustrated, would extend along a rear side of the lower dish rack 34. Thus, dishes needing deep cleaning, such as dishes with baked-on food, can be positioned in the lower dish rack 34 to face the deep-clean sprayer 44. The deep-clean sprayer 44, while illustrated as only one unit on a rear wall of the tub 14, could comprise multiple units and/or extend along multiple portions, including different walls, of the tub 14, and can be provided above, below, or beside any of the dish holders 28, 32, 34 where-in deep cleaning is desired.

[0022] The spot sprayer 45, like the deep-clean sprayer 44, can emit an intensified and/or higher pressure spray, especially to a discrete location within one of the dish holders 28, 32, 34. While the spot sprayer 45 is shown below the lower dish rack 34, it could be adjacent any part of any dish holder 28, 32, 34 or along any wall of the tub 14 where special cleaning is desired. In the illustrated location below the lower dish rack 34, the spot sprayer 45 can be used independently of or in combination with the lower spray arm 42. The spot sprayer 45 can be fixed or can move, such as in rotating.

[0023] These sprayers 41, 42, 43, 44, 45, 130 are illustrative examples of suitable sprayers and are not meant to be limiting as to the type of suitable sprayers 41, 42, 43, 44, 45, 130. Additionally, it will be understood that not all of the exemplary sprayers 41, 42, 43, 44, 45, 130 need be included within the dishwasher 10, and that less than all of the sprayers 41, 42, 43, 44, 45, 130 described can be included in a suitable dishwasher 10.

[0024] The recirculation system 50 recirculates the liquid sprayed into the treating chamber 16 by the sprayers 41, 42, 43, 44, 45, 130 of the spray system 40 back to the sprayers 41, 42, 43, 44, 45, 130 to form a recirculation loop or circuit by which liquid can be repeatedly and/or continuously sprayed onto dishes in the dish holders 28, 32, 34. The recirculation system 50 can include a sump 51 and a pump assembly 52. The sump 51 collects the liquid sprayed in the treating chamber 16 and can be formed by a sloped or recess portion of a bottom wall of the tub 14. The pump assembly 52 can include one or more pumps such as recirculation pump 53. The sump 51 can also be a separate module that is affixed to the bottom wall and include the pump assembly 52.

[0025] Multiple supply conduits 54, 55, 56, 57, 58 fluidly couple the sprayers 41, 42, 43, 44, 45, 130 to the recirculation pump 53. A recirculation valve 59 can selectively fluidly couple each of the conduits 54, 55, 56, 57, 58 to the recirculation pump 53. While each sprayer 41, 42, 43, 44, 45, 130 is illustrated as having a corresponding

dedicated supply conduit 54, 55, 56, 57, 58, one or more subsets, comprising multiple sprayers from the total group of sprayers 41, 42, 43, 44, 45, 130, can be supplied by the same conduit, negating the need for a dedicated conduit 54, 55, 56, 57, 58 for each sprayer 41, 42, 43, 44, 45, 130. For example, a single conduit can supply the upper spray arm 41 and the third level sprayer 43. Another example is that the sprayer 130 is supplied liquid by the conduit 56, which also supplies the third level sprayer 43.

[0026] The recirculation valve 59, while illustrated as a single valve, can be implemented with multiple valves. Additionally, one or more of the conduits 54, 55, 56, 57, 58 can be directly coupled to the recirculation pump 53, while one or more of the other conduits 54, 55, 56, 57, 58 can be selectively coupled to the recirculation pump 53 with one or more valves. There are essentially an unlimited number of plumbing schemes to connect the recirculation system 50 to the spray system 40. The illustrated plumbing is not limiting.

[0027] The drain system 60 drains liquid from the treating chamber 16. The drain system 60 includes a drain pump 62 fluidly coupling the treating chamber 16 to a drain line 64. As illustrated, the drain pump 62 fluidly couples the sump 51 to the drain line 64.

[0028] While separate recirculation 53 and drain pumps 62 are illustrated, a single pump can be used to perform both the recirculating and the draining functions, such as by configuring the single pump to rotate in opposite directions, or by providing a suitable valve system. Alternatively, the drain pump 62 can be used to recirculate liquid in combination with the recirculation pump 53. When both a recirculation pump 53 and drain pump 62 are used, the drain pump 62 is typically more robust than the recirculation pump 53 as the drain pump 62 tends to have to remove solids and soils from the sump 51, unlike the recirculation pump 53, which tends to recirculate liquid which has solids and soils filtered away to at least some extent.

[0029] A water supply system 70 is provided for supplying fresh water to the dishwasher 10 from a water supply source, such as a household water supply via a household water valve 71. The water supply system 70 includes a water supply unit 72 having a water supply conduit 73 with a siphon break 74. While the water supply conduit 73 can be directly fluidly coupled to the tub 14 or any other portion of the dishwasher 10, the water supply conduit 73 is shown fluidly coupled to a supply tank 75, which can store the supplied water prior to use. The supply tank 75 is fluidly coupled to the sump 51 by a supply line 76, which can include a controllable valve 77 to control when water is released from the supply tank 75 to the sump 51.

[0030] The supply tank 75 can be conveniently sized to store a predetermined volume of water, such as a volume required for a phase of the cycle of operation, which is commonly referred to as a "charge" of water. The storing of the water in the supply tank 75 prior to use is ben-

eficial in that the water in the supply tank 75 can be "treated" in some manner, such as softening or heating prior to use.

[0031] A water softener 78 can be provided with the water supply system 70 to soften the fresh water. The water softener 78 is shown fluidly coupling the water supply conduit 73 to the supply tank 75 so that the supplied water automatically passes through the water softener 78 on the way to the supply tank 75. However, the water softener 78 could directly supply the water to any other part of the dishwasher 10 than the supply tank 75, including directly supplying the tub 14. Alternatively, the water softener 78 can be fluidly coupled downstream of the supply tank 75, such as in-line with the supply line 76. Wherever the water softener 78 is fluidly coupled, it can be done so with controllable valves, such that the use of the water softener 78 is controllable and not mandatory.

[0032] A first drying system 80 is optionally provided to aid in the drying of the dishes during the drying phase. The first drying system 80, which can be thought of as a condensing drying system 80, as illustrated includes a condensing assembly 81 having a condenser 82 formed of a serpentine conduit 83 with an inlet fluidly coupled to an upper portion of the tub 14 and an outlet fluidly coupled to a lower portion of the tub 14, whereby moisture laden air within the tub 14 is drawn from the upper portion of the tub 14, passed through the serpentine conduit 83, where liquid condenses out of the moisture laden air and is returned to the treating chamber 16 where it ultimately evaporates or is drained via the drain pump 62. The serpentine conduit 83 can be operated in an open loop configuration, where the air is exhausted to atmosphere, a closed loop configuration, where the air is returned to the treating chamber, or a combination of both by operating in one configuration and then the other configuration.

[0033] To enhance the rate of condensation, the temperature difference between the exterior of the serpentine conduit 83 and the moisture laden air can be increased by cooling the exterior of the serpentine conduit 83 or the surrounding air. To accomplish this, an optional cooling tank 84 is added to the condensing assembly 81, with the serpentine conduit 83 being located within the cooling tank 84. The cooling tank 84 is fluidly coupled to at least one of the spray system 40, recirculation system 50, drain system 60, or water supply system 70, such that liquid can be supplied to the cooling tank 84. The liquid provided to the cooling tank 84 from any of the systems 40, 50, 60, 70 can be selected by source and/or by phase of cycle of operation such that the liquid is at a lower temperature than the moisture laden air or even lower than the ambient air.

[0034] As illustrated, the liquid is supplied to the cooling tank 84 by the drain system 60. A valve 85 fluidly connects the drain line 64 to a supply conduit 86 fluidly coupled to the cooling tank 84. A return conduit 87 fluidly connects the cooling tank 84 back to the treating chamber 16 via a return valve 79. In this way a fluid circuit is formed by the drain pump 62, drain line 64, valve 85, supply conduit

86, cooling tank 84, return valve 79 and return conduit 87 through which liquid can be supplied from the treating chamber 16, to the cooling tank 84, and back to the treating chamber 16. Alternatively, the supply conduit 86 could fluidly couple to the drain line 64 if re-use of the water is not desired.

[0035] To supply cold water from the household water supply via the household water valve 71 to the cooling tank 84, the water supply system 70 would first supply cold water to the treating chamber 16, then the drain system 60 would supply the cold water in the treating chamber 16 to the cooling tank 84. It should be noted that the supply tank 75 and cooling tank 84 could be configured such that one tank performs both functions.

[0036] The condensing drying system 80 can use ambient air, instead of cold water, to cool the exterior of the serpentine conduit 83. In such a configuration, a blower 88 is connected to the cooling tank 84 and can supply ambient air to the interior of the cooling tank 84. The cooling tank 84 can have a vented top 89 to permit the passing through of the ambient air to allow for a steady flow of ambient air blowing over the serpentine conduit 83.

[0037] The cooling air from the blower 88 can be used in lieu of the cold water or in combination with the cold water. The cooling air will be used when the cooling tank 84 is not filled with liquid. Advantageously, the use of cooling air or cooling water, or combination of both, can be selected based on the site-specific environmental conditions. If ambient air is cooler than the cold water temperature, then the ambient air can be used. If the cold water is cooler than the ambient air, then the cold water can be used. Cost-effectiveness can also be taken into account when selecting between cooling air and cooling water. The blower 88 can be used to dry the interior of the cooling tank 84 after the water has been drained. Suitable temperature sensors for the cold water and the ambient air can be provided and send their temperature signals to the controller 22, which can determine which of the two is colder at any time or phase of the cycle of operation.

[0038] A heating system 90 is provided for heating water used in the cycle of operation. The heating system 90 includes a heating element, illustrated herein as a heater 92, such as an immersion heater 92, located in the treating chamber 16 at a location where it will be immersed by the water supplied to the treating chamber 16, such as within or near the sump 51. By way of non-limiting example, the heater 92 can be provided as a calrod heater 92. However, it will also be understood that the heater 92 need not be an immersion heater 92; it can also be an in-line heater located in any of the conduits. There can also be more than one heater 92, including both an immersion heater 92 and an in-line heater. The heater 92 can also be thermally coupled with the treating chamber 16 to heat air contained in the treating chamber 16. Alternatively, a separate heating element (not shown) can be provided for heating the air circulated through the

treating chamber 16.

[0039] The heating system 90 can also include a heating circuit 93, which includes a heat exchanger 94, illustrated as a serpentine conduit 95, located within the supply tank 75, with a supply conduit 96 supplying liquid from the treating chamber 16 to the serpentine conduit 95, and a return conduit 97 fluidly coupled to the treating chamber 16. The heating circuit 93 is fluidly coupled to the recirculation pump 53 either directly or via the recirculation valve 59 such that liquid that is heated as part of a cycle of operation can be recirculated through the heat exchanger 94 to transfer the heat to the charge of fresh water residing in the supply tank 75. As most wash phases use liquid that is heated by the heater 92, this heated liquid can then be recirculated through the heating circuit 93 to transfer the heat to the charge of water in the supply tank 75, which is typically used in the next phase of the cycle of operation.

[0040] A filter system 100 is provided to filter undissolved solids from the liquid in the treating chamber 16. The filter system 100 includes a coarse filter 102 and a fine filter 104, which can be a removable basket 106 residing in the sump 51, with the coarse filter 102 being a screen 108 circumscribing the removable basket 106. Additionally, the recirculation system 50 can include a rotating filter in addition to or in place of either or both of the coarse filter 102 and fine filter 104. Other filter arrangements are contemplated, such as an ultrafiltration system.

[0041] Additionally, or alternatively, to the condensing drying system 80, the dishwasher 10 can further include a second drying system 200, illustrated herein as a fan-assisted drying system 200, that is provided to aid in the drying of the dishes during the drying cycle or phase by moving air through or within the treating chamber 16. The fan-assisted drying system 200 as illustrated is provided with and carried by the door assembly 20, though it will be understood that such position is not limiting and the fan-assisted drying system 200 can be provided in any suitable location, such as with a wall of the tub 14. The fan-assisted drying system 200 includes an air conduit 230 extending within the door assembly 20 and having an inlet 210 provided on the door assembly 20, fluidly coupled to the treating chamber 16, such as at an upper portion of the door assembly 20, and an outlet 240 fluidly coupled to ambient air exterior of the dishwasher 10 at a lower portion of the door assembly 20. A fan or blower 220 is fluidly coupled with the air conduit 230 to force air through the air conduit 230. The fan-assisted drying system 200 is provided such that moisture laden air within the tub 14 is drawn by the blower 220 from the upper portion of the tub 14 to pass through the air conduit 230 to be ultimately exhausted or emitted into ambient air exterior of the dishwasher 10. While the fan-assisted drying system 200 is illustrated herein as being operated in an open loop configuration, where the air is exhausted to atmosphere, it is also contemplated that the fan-assisted drying system 200 can be operated in a closed

loop configuration, where the air is returned to the treating chamber 16, or a combination of both by operating in one configuration and then the other configuration.

[0042] To further enhance the rate of drying of the dishes during a drying phase or cycle, the fan-assisted drying system 200 can optionally be operated in cooperation with the heating system 90, and specifically with the heater 92, such that the movement of air through and within the treating chamber 16 that is driven by the blower 220 comprises forcing or moving heated air through the treating chamber 16 when the blower 220 is operated. To accomplish this, as described previously with respect to the heating system 90, the heater 92 is operated to heat air contained within the treating chamber 16 to form heated air within the treating chamber 16. Either simultaneously with, or subsequently to, the operation of the heater 92, operation of the blower 220 draws the heated air to the inlet 210, thereby forcing movement, such as flowing, circulating, or recirculating, of at least a portion of the heated air through the treating chamber 16 as the at least a portion of the heated air is drawn into the inlet 210. In this way, the fan-assisted drying system 200 and the heating system 90, specifically the heater 92, can be collectively thought of as comprising a heated drying system, such as a heated, fan-assisted drying system. While the fan-assisted drying system 200 is described in this example as being operated in combination with the heating system 90, it will be understood that the fan-assisted drying system 200 can be operated with or without the heat drying provided by the heating system 90, and further that the fan-assisted drying system 200 can be provided in addition to the condensing drying system 80 to further improve drying performance during the drying cycle, or that the fan-assisted drying system 200 can be provided to replace the condensing drying system 80.

[0043] As illustrated schematically in FIG. 3, the controller 22 can be coupled with the heater 92 for heating the wash liquid or the air within the treating chamber 16 during a cycle of operation, the drain pump 62 for draining liquid from the treating chamber 16, the recirculation pump 53 for recirculating the wash liquid during the cycle of operation, the user interface 24 for receiving user selected inputs and communicating information to the user, the dispenser assembly 48 for selectively dispensing treating chemistry to the treating chamber 16, the actuating mechanism 142 for controlling the operation of and selectively actuating the door opener 140 to move the door assembly 20 to the partially open position, and the blower 220 for moving air through the treating chamber 16 and into the fan-assisted drying system 200. The controller 22 can also communicate with the recirculation valve 59, the household water valve 71, the controllable valve 77, the return valve 79, and the valve 85 to selectively control the flow of liquid within the dishwasher 10. Optionally, the controller 22 can include or communicate with a wireless communication device 116.

[0044] The controller 22 can be provided with a memory 110 and a central processing unit (CPU) 112. The

memory 110 can be used for storing control software that can be executed by the CPU 112 in completing a cycle of operation using the dishwasher 10 and any additional software. For example, the memory 110 can store a set of executable instructions including one or more pre-programmed automatic cycles of operation that can be selected by a user and executed by the dishwasher 10. Examples, without limitation, of cycles of operation include: wash, heavy duty wash, delicate wash, quick wash, pre-wash, refresh, rinse only, timed wash, dry, heavy duty dry, delicate dry, quick dry, or automatic dry, which can be selected at the user interface 24. The memory 110 can also be used to store information, such as a database or table, and to store data received from one or more components of the dishwasher 10 that can be communicably coupled with the controller 22. The database or table can be used to store the various operating parameters for the one or more cycles of operation, including factory default values for the operating parameters and any adjustments to them by the control assembly or by user input.

[0045] The controller 22 can also receive input from one or more sensors 114 provided in one or more of the assemblies or systems of the dishwasher 10 to receive input from the sensors 114, which are known in the art and not shown for simplicity. Non-limiting examples of sensors 114 that can be communicably coupled with the controller 22 include, to name a few, an ambient air temperature sensor, a treating chamber temperature sensor, such as a thermistor, a water supply temperature sensor, a door open/close sensor, a moisture sensor, a chemical sensor, and a turbidity sensor to determine the soil load associated with a selected grouping of dishes, such as the dishes associated with a particular area of the treating chamber 16.

[0046] Turning now to FIG. 4, the rear view illustrates the door assembly 20 with the fan-assisted drying system 200 in further detail. The door assembly 20 comprises an inner surface, illustrated herein as an inner panel 21, coupled with and at least partially spaced from an outer surface, illustrated herein as an outer panel 23, to at least partially define a door interior 25 provided in the space between at least a portion of the inner panel 21 and the outer panel 23. One of the inner panel 21 and the outer panel 23 can at least partially define a top edge 27 of the door assembly 20, which can receive the user interface 24, as described previously. As illustrated herein, the top edge 27 is provided with the inner panel 21, though it will be understood that the top edge 27 can alternatively be provided with the outer panel 23, or the top edge 27 can be formed by both the inner panel 21 and the outer panel 23. Further, one of the inner panel 21 and the outer panel 23 can at least partially define a bottom edge 29 of the door assembly 20. As illustrated herein, the outer panel 23 is shown as having a vertical height that is greater than the vertical height of the inner panel 21, such that the bottom edge 29 of the outer panel 23 extends below a lower portion of the inner panel 21, though it will be

understood that the inner panel 21 and the outer panel 23 can have any suitable relative heights, including that both panels 21, 23 can have the same height.

[0047] The air conduit 230 is provided at least partially within the door interior 25 to extend in a generally vertical orientation along at least a portion of the vertical height of the door assembly 20. The inlet 210 is provided on and at least partially defined by the inner panel 21 of the door assembly 20 to fluidly couple the treating chamber 16 with the air conduit 230, such as at an upper portion of the inner panel 21, positioned near the top edge 27. By way of non-limiting example, the inlet 210 comprises a vent cover 212 that is selectively openable and closeable to either allow air within the treating chamber 16 to enter, or to prevent air within the treating chamber 16 from entering, the air conduit 230. As illustrated herein, the vent cover 212 is provided as a louvered vent cover 212, though it will be understood that any suitable vent cover 212 that is openable and closeable to selectively fluidly couple the treating chamber 16 with the fan-assisted drying system 200 can be provided. The air conduit 230 extends downward from the inlet 210 within the door interior 25, toward and beyond the bottom edge 29 of the door assembly 20. At the bottom edge 29, the air conduit 230 protrudes from the door interior 25 to extend lower than the bottom edge 29 of the door assembly 20 and to at least partially define the outlet 240 that is positioned below the bottom edge 29 of the door assembly 20 to fluidly couple the air conduit 230 with ambient air exterior of the dishwasher 10.

[0048] Turning now to FIG. 5, the partially exploded view illustrates in greater detail the positioning and arrangement of the fan-assisted drying system 200 within the door interior 25. The inlet 210 further comprises an actuator 214 operably coupled to the vent cover 212 to selectively open or close the vent cover 212, and thus to selectively open or close the inlet 210. The actuator 214 can be provided as an actuator 214 for selectively opening and closing a closure for the inlet 210, such as a closure that can be provided within the air conduit 230, downstream of the vent cover 212, or the actuator 214 can selectively open and close the vent cover 212 itself. By way of non-limiting example, in such a case that the vent cover 212 is provided as a louvered vent cover 212, the actuator 214 can be operably coupled to the vent cover 212 for selectively moving the louvers of the vent cover 212 themselves, thus selectively allowing or preventing fluid communication between the treating chamber 16 and the air conduit 230. The actuator 214 can be any suitable type of actuator 214, a non-limiting example of which including the actuator 214 being provided as a wax motor operably coupled with a flapper that selectively opens or seals the inlet 210. The actuator 214 can be coupled with the controller 22 for selectively opening and closing the inlet 210 for the fan-assisted drying system 200.

[0049] The blower 220 is illustrated herein as being positioned within the door interior 25, downstream of the

inlet 210 and upstream of the air conduit 230 and the outlet 240. It will be understood that the blower 220 and the air conduit 230 can be provided in any suitable relative arrangement, such as that the blower 220 can be provided within the air conduit 230, or such that the blower 220 is positioned outside of but is still fluidly coupled with the air conduit 230, so long as the blower 220 is in fluid communication with the air conduit 230 and the inlet 210 to fluidly couple the treating chamber 16 with the fan-assisted drying system 200, and more specifically to draw air from and through the treating chamber 16 and into the air conduit 230 via the inlet 210 to be exhausted to the ambient air atmosphere at the bottom edge 29 of the door assembly 20.

[0050] As described previously, the air conduit 230 extends downwardly along the vertical height of the door assembly 20 and beyond the bottom edge 29 of the door assembly 20, such that the outlet 240 is positioned below the bottom edge 29 of the door assembly 20, such as near a toe kick area of the dishwasher 10. Further, it is illustrated herein that the outlet 240 can be oriented at a non-zero angle relative to the generally vertically extending air conduit 230, such as, by way of non-limiting example, that the outlet 240 is oriented generally orthogonally to the vertical height of the air conduit 230. Further by way of non-limiting example, as illustrated herein, the outlet 240 is provided at a non-zero angle relative to the air conduit 230 such that the outlet 240 opens away from a front of the dishwasher 10 such that air emitted from the treating chamber 16 via the outlet 240 into the ambient air atmosphere exterior of the dishwasher 10 is directed away from the dishwasher 10.

[0051] Turning now to the operation of the drying system 200, it is understood that optimizing methods of drying dishes during a drying cycle, in particular within dishwashers having different or multiple drying features or drying types, can present a challenge of balancing speed of drying with achieving a desired degree of dryness of the dishes, even hours after the drying cycle has completed. For example, in dishwashers using closed-door drying methods, which can include condensing drying systems, fan-assisted or forced air drying systems, whether they are heated or not heated, or non-fan-assisted heated drying systems, during which the dishwasher door remains closed, the dishes tend to be dried fairly quickly and the drying cycle ceases. However, when a user does not unload the dishwasher for several hours after the drying cycle has completed, residual moisture within the dishwasher can re-condense on the dishes, giving the user an impression of a lower than desired degree of dryness of the dishes after the drying cycle. Alternatively, in dishwashers using open-door drying methods wherein the door is at least partially opened to allow fluid communication with ambient air, the issue of moisture re-condensing on the dishes is typically avoided or reduced, but the drying time is slower than that of the closed-door drying methods.

[0052] Thus, it is contemplated that combining both

closed-door and open door drying approaches could result in improved drying speed, while avoiding the common problem of moisture re-condensing on the dishes after the drying cycle. However, it may be inefficient to have the door assembly 20 open throughout the drying cycle, as well as that the temperature within the treating chamber 16 may be too high at the beginning of a drying cycle to safely open the door assembly 20. While a dishes drying method combining both closed-door and open door drying approaches may improve drying performance as compared to using either type of drying method alone, the dishes drying method should still be specifically designed to address these challenges.

[0053] Referring now to FIG. 6, a method 300 of drying dishes within the dishwasher 10 for use with the fan-assisted drying system 200, and according to an automatic drying cycle of operation or a drying phase of an automatic cycle of operation, is illustrated as a flow chart. According to the method 300 of drying dishes as illustrated herein, upon the completion of a wash cycle of operation, or of a wash phase of a treating cycle of operation, the drying phase or drying cycle is begun at step 302. In many automatic cycles of operation, the wash cycle or phase ends with a final rinse phase that typically uses heated rinse liquid, creating an air temperature within the treating chamber 16 that is elevated relative to ambient temperature. By way of non-limiting example, the temperature within the treating chamber 16 can be at least 55 °C when the wash cycle completes and the drying cycle is commenced. In order to ensure safety for the user and to avoid damage to the surroundings of the dishwasher 10, the door assembly 20 is typically not opened until the temperature within the treating chamber 16 falls below a predetermined threshold, such as, by way of non-limiting example, at least below 55 °C, further between 45 °C and 55 °C, further yet at least below 50 °C, and further yet at least below 45 °C. Thus, when the drying cycle commences at step 302, the door assembly 20 is in the closed position, to remain in the closed position until the temperature within the treating chamber 16 falls below the predetermined threshold.

[0054] Optionally, at step 304, the drying cycle can begin with a short drip dry phase, which can be thought of as a static drying phase. During this optional step, the initial liquid drops that may be present on the dishes at the end of the rinse phase can drip or run off of the dishes prior to beginning an active drying phase of the drying cycle. It is also contemplated that hot, humid air within the treating chamber 16 can begin to cool and condense, such as on the tub 14 walls, during the static drying phase. By way of non-limiting example, the drip dry phase can last about six minutes, which has been found to improve drying performance without significantly lengthening the duration of the drying cycle.

[0055] At step 306, the active drying phase of the drying cycle is commenced. The active drying phase comprises operating at least one of the blower 220 and the heater 92 at least intermittently during the active drying phase.

While it is contemplated that the blower 220 and the heater 92 can be operated simultaneously during at least a portion of the active drying phase, it will be understood that it is not necessary for the blower 220 and the heater 92 to be operated simultaneously during the active drying phase, and that the blower 220 and the heater 92 can each be operated at least intermittently and independently of one another. Thus, commencing the active drying phase comprises two independent steps that may or may not occur simultaneously, namely operating the heater 92 at least intermittently, at step 310, and operating the blower 220 at least intermittently, at step 320.

[0056] Further, at step 310, the heater 92 is operated at least intermittently during the active drying phase, which can include, by way of non-limiting example, operating the heater 92 prior to operating the blower 220. More specifically, and further by way of non-limiting example, the heater 92 can be operated for at least one on/off cycle prior to operating the blower 220. Such an on/off cycle can comprise operating the heater 92 for 3 minutes on, followed by 3 minutes off where the heater 92 is not operating. Further yet, the heater 92 can be operated for two such on/off cycles prior to operating the blower 220. This serves to ensure that the temperature within the treating chamber 16 is sufficiently high to ensure effective drying performance.

[0057] After the two initial on/off cycles and the subsequent initial operation of the blower 220, the operation of the heater 92 for the remainder of the active drying phase can continue according to the same on/off cycles as previously described. The total number of on/off cycles completed by the heater 92 during a given active drying phase is predetermined based on the cycle of operation that was selected, whether the selection was made by the user or was automatically selected by the dishwasher 10. By way of non-limiting example, the controller 22 may operate the heater 92 for a total of seven on/off cycles during the active drying phase when a heated dry cycle of operation is implemented, but may alternatively operate the heater 92 for a total of fourteen on/off cycles during the active drying phase when an extended dry cycle of operation is implemented. When the predetermined number of on/off cycles for the heater 92 have been completed during the active drying phase, the operation of the heater 92 is ceased, even if the active drying phase is still ongoing and if the blower 220 is still being operated.

[0058] Referring again to step 320, which occurs at least partially contemporaneously with step 310 during the active drying phase, the blower 220 is also operated at least intermittently during the active drying phase, and can further be operated either simultaneously with or separately from the heater 92 at various times within the active drying phase. More specifically, and by way of non-limiting example, after the two initial on/off cycles of the heater 92 operating on its own and prior to operation of the blower 220 have been completed, the blower 220 can then initially be operated, which comprises the controller 22 operating the actuator 214 to open the inlet 210

for the fan-assisted drying system 200 to fluidly couple the blower 220 with the treating chamber 16, as well as operating the blower 220. It is contemplated that the blower 220 can be operated continuously throughout the remainder of the active drying phase after its initial operation, or, alternatively, that the blower 220 can be operated intermittently throughout the remainder of the active drying phase after its initial operation.

[0059] While the operation of the heater 92 serves to increase the temperature within the treating chamber 16 to promote drying of the dishes, even prior to the opening of the inlet 210 and the operating of the blower 220, the operation of the fan-assisted drying system 200, and specifically of the blower 220, which is configured to ensure effective drying performance by forcing movement of at least a portion of the air within the treating chamber 16, which has been heated by the heater 92 to form heated air, within and through the treating chamber 36 as the blower 220 draws at least a portion of the heated air from the treating chamber 16 toward the inlet 210, to the blower 220, and into the air conduit 230, such that the flowing of the heated air further promotes evaporation of moisture from the dishes.

[0060] Further, the operation of the blower 220 also serves to improve drying performance by providing a pathway for removing moisture-laden air from the treating chamber 16 to be vented or exhausted to the outside of the dishwasher 10 via the outlet 240. Further yet, it is contemplated that, in addition to the fan-assisted drying system 200 removing humid, moisture-laden air from the treating chamber 16 to be exhausted to the ambient atmosphere, in order to allow the heated air remaining in the treating chamber 16 to be able to continue to absorb the moisture evaporating from the dishes, the dishwasher 10 can also be configured to inlet ambient air into the treating chamber 16. The ambient air can be drawn into the treating chamber 16 via any suitable inlet provided with the dishwasher 10, such as, by way of non-limiting example, via openings or louvers (not shown) provided near the bottom edge 29 of the door assembly 20 to allow ambient air to be drawn into the treating chamber 16. Such openings or louvers can be provided as part of the door assembly 20, but separate from the air conduit 230, or along another portion of the dishwasher 10 near the bottom edge 29 of the door assembly 20, such as with the tub 14 along a lower portion of the open face 18.

[0061] While such openings or louvers would allow for passive flow of ambient air into the treating chamber 16, it is understood that, beyond that, when the blower 220 is operated to draw air from the treating chamber 16 into the air conduit 230 to be exhausted, the removal of the at least a portion of the heated air from the treating chamber 16 creates a negative pressure environment within the treating chamber 16, which results in ambient air being drawn into the treating chamber 16 through the openings or louvers to replace the humid, moisture-laden air that was removed to the outlet 240. While the ambient air that is drawn into the treating chamber 16 is at ambient

temperature and is not yet heated to provide the drying performance benefit due to heat, the ambient air typically has less moisture in it than the air within the treating chamber 16. Thus, the ambient air has a greater capacity to absorb moisture that is evaporated from the dishes than the air already within the treating chamber 16, so the drawing in of the ambient air serves to further improve drying performance within the dishwasher 10 for that reason. Additionally, the ambient air that is drawn into the treating chamber 16 is also subsequently heated by the heater 92 for as long as the heater 92 continues to be operated during the active drying phase, to further still improve drying performance in removing moisture from the dishes. In this way, the heated air that is forced to move within or through the treating chamber 16 by the operation of the fan-assisted drying system 200 can be thought of further as comprising forcing the movement of heated ambient air within or through the treating chamber 16 and to the inlet 210 and the air conduit 230 to be exhausted or emitted from the treating chamber 16 to the ambient air atmosphere exterior of the dishwasher 10 via the outlet 240.

[0062] Only once the previously described predetermined number of on/off cycles of operation of the heater 92 have been completed, the operation of the heater 92 is ceased. If, when the operation of the heater 92 ceases, and at step 322, the temperature within the treating chamber 16 is still above the predetermined threshold temperature at which the door assembly 20 can be safely opened, then the operation of the blower 220 continues on its own, with no concurrent operation of the heater 92, and with the door assembly 20 remaining in the closed position and with the inlet 210 open, until the temperature within the treating chamber 16 falls to at or below the predetermined threshold temperature.

[0063] When the temperature within the treating chamber 16 has fallen to at or below the predetermined threshold temperature, whether reaching the predetermined threshold temperature occurs as soon as the operation of the heater 92 was ceased, or after the blower 220 was operated on its own, without operation of the heater 92, for a period of time, the reaching of the predetermined threshold temperature, at step 330, results in the controller 22 actuating the door opener 140, and specifically the actuating mechanism 142, to move the opening pin 144 from the retracted position to the extended position, wherein the opening pin 144 is brought into contact with and bears against the door assembly 20 to move the door assembly 20 from the closed position to the partially open position. By way of non-limiting example, it is contemplated that, as the door assembly 20 is moved to the partially open position, the blower 220 may still be operating, such that the door assembly 20 is moved to the partially open position while heated air or previously heated air is still being forced to move within or through the treating chamber 16, at least until the door assembly 20 reaches the partially open position, at step 332, at which point the forced movement of the heated air or previously

heated air within or through the treating chamber 16 by the operation of the blower 220 is ceased.

[0064] In a non-limiting example, it is contemplated that the opening pin 144 need not remain in the extended position in order for the door assembly 20 to remain in the partially open position. Rather, once the door assembly 20 reaches the partially open position, at step 332, due to the movement of the door opener 140 and the opening pin 144, the door assembly 20 will remain in the partially open position on its own. The door opener 140 and the opening pin 144, then, can immediately be returned to the non-actuated or retracted position, while the door assembly 20 remains in the partially open position until the user moves the door assembly 20 for unloading of the treated dishes.

[0065] When the door assembly 20 is in the partially open position, increased fluid communication between the treating chamber 16 and the ambient air atmosphere can occur, allowing the heated, humid air to vent out of the treating chamber 16, as well as by allowing additional cool, dry ambient air to enter the treating chamber 16 and to replace the heated, humid air that was exhausted. It is contemplated that the inlet 210 can either remain open to allow further passive fluid communication between the treating chamber 16 and the ambient air as is already being permitted by the partially open door assembly 20, or that the inlet 210 can be actuated by the controller 22 to be closed once the door assembly 20 reaches the partially open position.

[0066] While the blower 220 was previously described as potentially still being in operation while the door assembly 20 is moving to the partially open position, once the door assembly 20 has reached the partially open position, at step 332, operation of the blower 220 then ceases, at step 334, and there is no further operation of either the blower 220 or of the heater 92, whose operation was already ceased at step 322, for the remainder of the drying cycle, which ends the active drying phase of the drying cycle. The opening of the door assembly 20 into the partially open position can be thought of as dividing the drying cycle into at least two drying phases: first, the active drying phase, during which the heater 92 and the blower 220 can be operated and the door assembly 20 remains in the closed position until the heater 92 has completed its predetermined on/off cycles and until the temperature in the treating chamber 16 falls below the predetermined threshold temperature, and which is then ended when the door assembly 20 reaches the partially open position, and, second, the passive, open door drying phase, at step 336, which begins once the door assembly 20 reaches the partially open position, and during which the door assembly 20 remains in the partially open position and the heater 92 and the blower 220 are not operated. The passive, open door drying phase of step 336 continues, with the door assembly 20 remaining in the partially open position, until the user moves the door assembly 20 either back to the closed position or to the fully opened position for unloading of the treated dishes.

[0067] The aspects described herein provide a drying system for a dishwasher that can produce improved drying performance during a drying phase or a drying cycle of operation by combining the operation of different types of dishwasher drying systems. Specifically, the drying system of the present disclosure combines aspects of a fan-assisted drying system, a heated drying system, and a door open drying system to obtain improved drying performance while avoiding the challenges that some of these drying system types can be subjected to when they are implemented on their own. The heated drying by use of the dishwasher's heater increases temperature within the treating chamber during the drying cycle to improve drying, while the fan-assisted drying system also makes use of the operation of a blower to force air movement within and through the treating chamber to further promote evaporation of moisture from the dishes, to exhaust humid air from the treating chamber, and to draw in dry, cool ambient air from outside the dishwasher, as well as also employing open door drying methods once the active drying phase of the drying cycle is complete and the temperature in the treating chamber is low enough for the door to be partially opened. By ending the drying cycle with the door partially opened, re-condensing of moisture from the treating chamber onto the dishes before a user proceeds to unloading the treated dishes can be avoided or reduced, while also allowing drying to continue in an energy efficient manner.

[0068] It will also be understood that various changes and/or modifications can be made without departing from the spirit of the present disclosure. By way of non-limiting example, although the present disclosure is described for use with a dishwasher having a door assembly pivotable about a horizontal axis, it will be recognized that the door assembly can be employed with various constructions, including door assemblies pivotable about a vertical axis and/or door assemblies for drawer-style dishwashers. Further by way of non-limiting example, the present disclosure is contemplated for use with dishwashers having tubs of various materials or constructions, such as with either plastic tubs or stainless steel tubs.

[0069] To the extent not already described, the different features and structures of the various aspects can be used in combination with each other as desired. That one feature is not illustrated in all of the aspects is not meant to be construed that it cannot be, but is done for brevity of description. Thus, the various features of the different aspects can be mixed and matched as desired to form new aspects, whether or not the new aspects are expressly described. Combinations or permutations of features described herein are covered by this disclosure.

[0070] This written description uses examples to disclose aspects of the disclosure, including the best mode, and also to enable any person skilled in the art to practice aspects of the disclosure, including making and using any devices or systems and performing any incorporated methods. While aspects of the disclosure have been spe-

cifically described in connection with certain specific details thereof, it is to be understood that this is by way of illustration and not of limitation. Reasonable variation and modification are possible within the scope of the forgoing disclosure and drawings without departing from the spirit of the disclosure, which is defined in the appended claims.

[0071] Further aspects of the disclosure are provided by the subject matter of the following clauses:

[0072] A method of drying dishes within a dishwasher having a tub at least partially defining a treating chamber, with an access opening, and a closure movable between opened and closed positions to selectively open/close the access opening, the method comprising forcing heated air through the treating chamber and moving the closure to a partially open position between the closed and opened positions while forcing heated air through the treating chamber.

[0073] The method of the previous clause wherein the forcing heated air through the treating chamber comprises recirculating at least a portion of the heated air through the treating chamber.

[0074] The method of any of the previous clauses wherein the forcing heated air through the treating chamber comprises heating ambient air.

[0075] The method of any of the previous clauses wherein the forcing heated air through the treating chamber comprises flowing the heated ambient air through the treating chamber.

[0076] The method of any of the previous clauses wherein the forcing heated air through the treating chamber comprises emitting the heated ambient air from the treating chamber.

[0077] The method of any of the previous clauses wherein the closure remains in the closed position until a temperature in the treating chamber falls below a predetermined threshold.

[0078] The method of any of the previous clauses wherein the predetermined threshold is 50°C.

[0079] The method of any of the previous clauses wherein the moving the closure to the partially open position from the closed position occurs when the temperature in the treating chamber falls below the predetermined threshold.

[0080] The method of any of the previous clauses wherein the forcing heated air through the treating chamber comprises forcing the heated air through the treating chamber until the closure reaches the partially open position.

[0081] The method of any of the previous clauses wherein the forcing heated air through the treating chamber ceases when the closure reaches the partially open position.

[0082] The method of any of the previous clauses wherein the closure remains in the partially open position once the closure is moved to the partially open position.

[0083] The method of any of the previous clauses wherein the forcing heated air through the treating cham-

ber comprises operating a heating element provided within and thermally coupled with the treating chamber to heat the air within the treating chamber.

[0084] The method of any of the previous clauses wherein the operating the heating element comprises intermittently operating the heating element.

[0085] The method of any of the previous clauses wherein the intermittently operating the heating element comprises operating the heating element for a predetermined number of on/off cycles.

[0086] The method of any of the previous clauses wherein the forcing heated air through the treating chamber comprises operating a blower that is fluidly coupled with the treating chamber and configured to draw at least a portion of the heated air through the treating chamber and to the blower.

[0087] The method of any of the previous clauses wherein the operating the blower comprises intermittently operating the blower while the closure is in the closed position.

[0088] The method of any of the previous clauses wherein the operating the blower comprises operating the blower until the closure reaches the partially open position.

[0089] The method of any of the previous clauses wherein the operating the blower to draw the at least a portion of the heated air through the treating chamber comprises drawing the at least a portion of the heated air from the treating chamber into an air conduit provided within the closure.

[0090] The method of any of the previous clauses wherein the air conduit comprises an inlet provided in an inner surface of the closure, the inlet fluidly coupling the treating chamber with the air conduit.

[0091] The method of any of the previous clauses wherein the air conduit comprises an outlet provided at a lower portion of the closure, the outlet fluidly coupling the air conduit with ambient air exterior of the dishwasher to emit the at least a portion of the heated air from the treating chamber.

Claims

1. A method (300) of drying dishes within a dishwasher (10) having a tub (14) at least partially defining a treating chamber (16), with an access opening, and a closure (20) movable between opened and closed positions to selectively open/close the access opening, the method (300) comprising:

forcing heated air (310, 320) through the treating chamber (16); and
moving the closure (20) to a partially open position between the closed and opened positions (332) while forcing heated air through the treating chamber (16).

2. The method (300) of claim 1 wherein the forcing heated air (310, 320) through the treating chamber (16) comprises recirculating at least a portion of the heated air through the treating chamber (16).
3. The method (300) of claim 1 wherein the forcing heated air (310, 320) through the treating chamber (16) comprises heating ambient air.
4. The method (300) of claim 3 wherein the forcing heated air (310, 320) through the treating chamber (16) comprises flowing the heated ambient air through the treating chamber (16).
5. The method (300) of claim 4 wherein the forcing heated air (310, 320) through the treating chamber (16) comprises emitting the heated ambient air from the treating chamber (16).
6. The method (300) of claim 1 wherein the closure (20) remains in the closed position until a temperature in the treating chamber (16) falls below a predetermined threshold (330).
7. The method (300) of claim 6 wherein the predetermined threshold is 50°C.
8. The method (300) of claim 6 wherein the moving the closure (20) to the partially open position from the closed position occurs when the temperature in the treating chamber falls below the predetermined threshold.
9. The method (300) of claim 8 wherein the forcing heated air (310, 320) through the treating chamber (16) comprises forcing the heated air (310, 320) through the treating chamber (16) until the closure (20) reaches the partially open position.
10. The method (300) of claim 9 wherein the forcing heated air (310, 320) through the treating chamber (16) ceases when the closure (20) reaches the partially open position.
11. The method (300) of claim 9 wherein the closure (20) remains in the partially open position once the closure (20) is moved to the partially open position.
12. The method (300) of claim 1 wherein the forcing heated air (310, 320) through the treating chamber (16) comprises operating a heating element (92) provided within and thermally coupled with the treating chamber (16) to heat the air within the treating chamber (16).

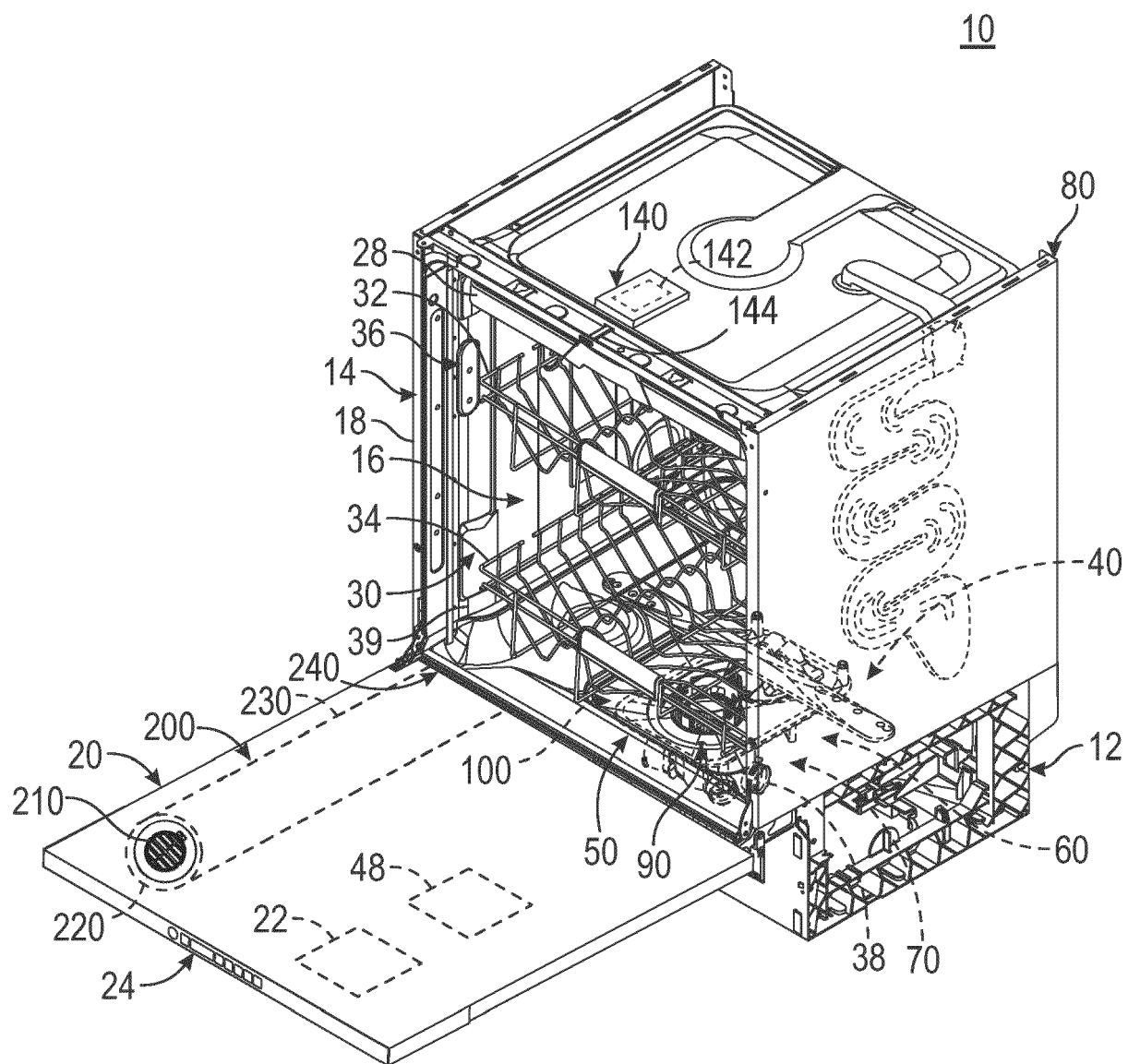


FIG. 1

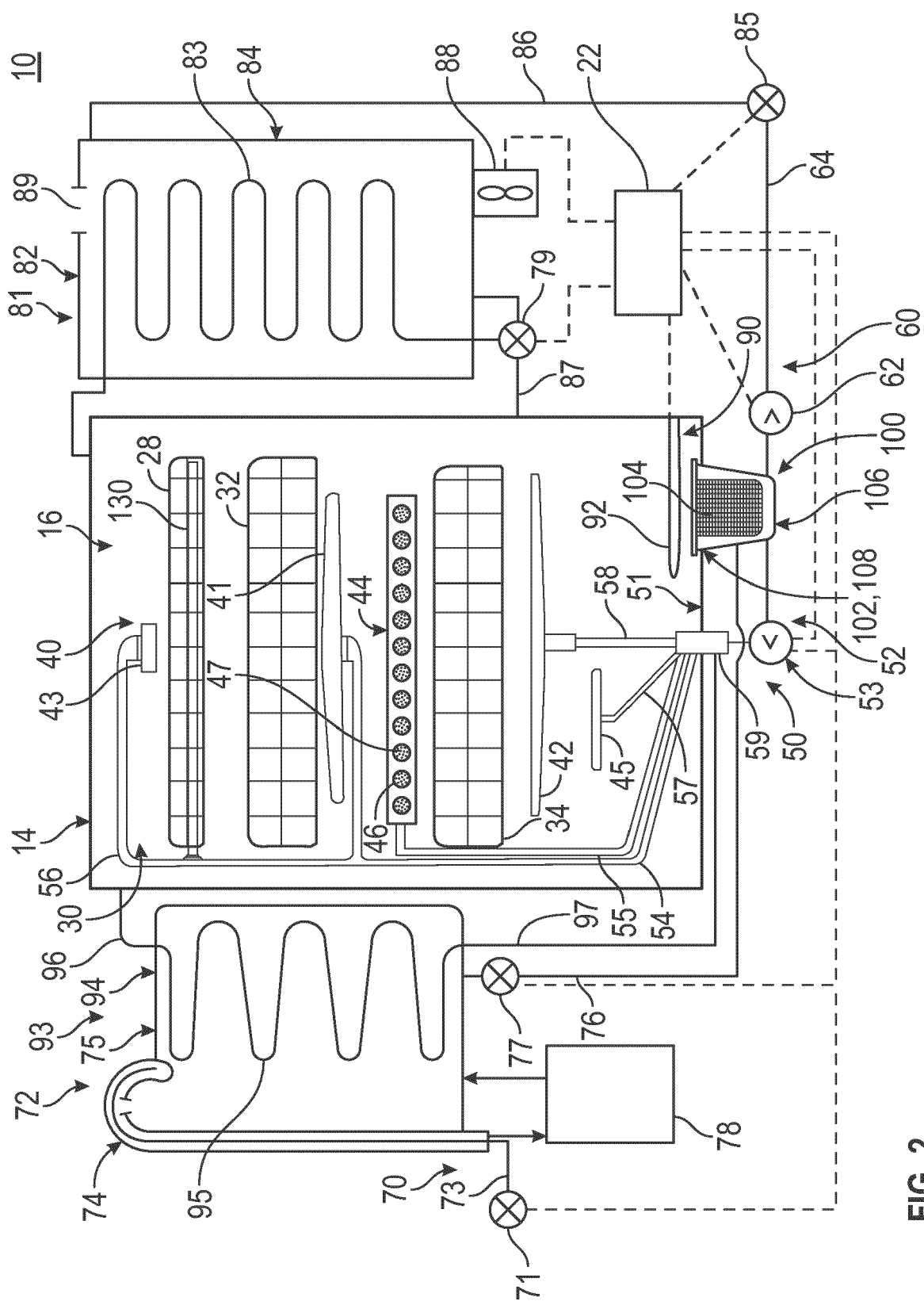


FIG. 2

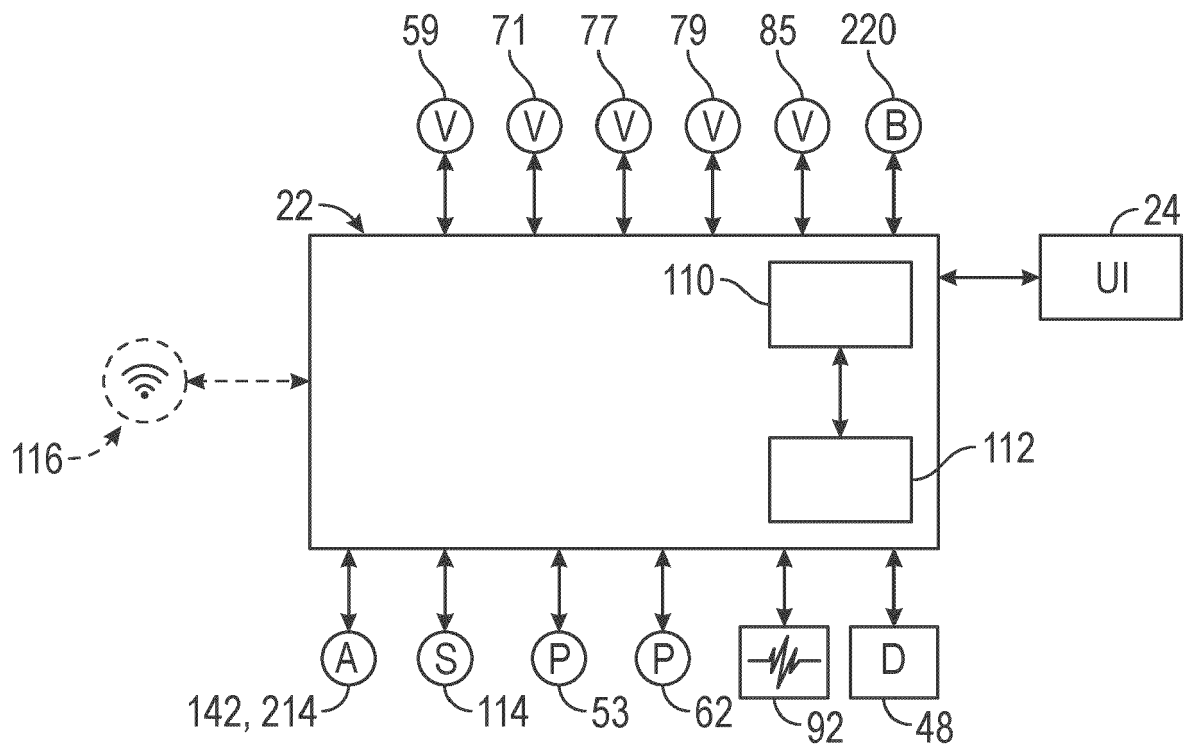


FIG. 3

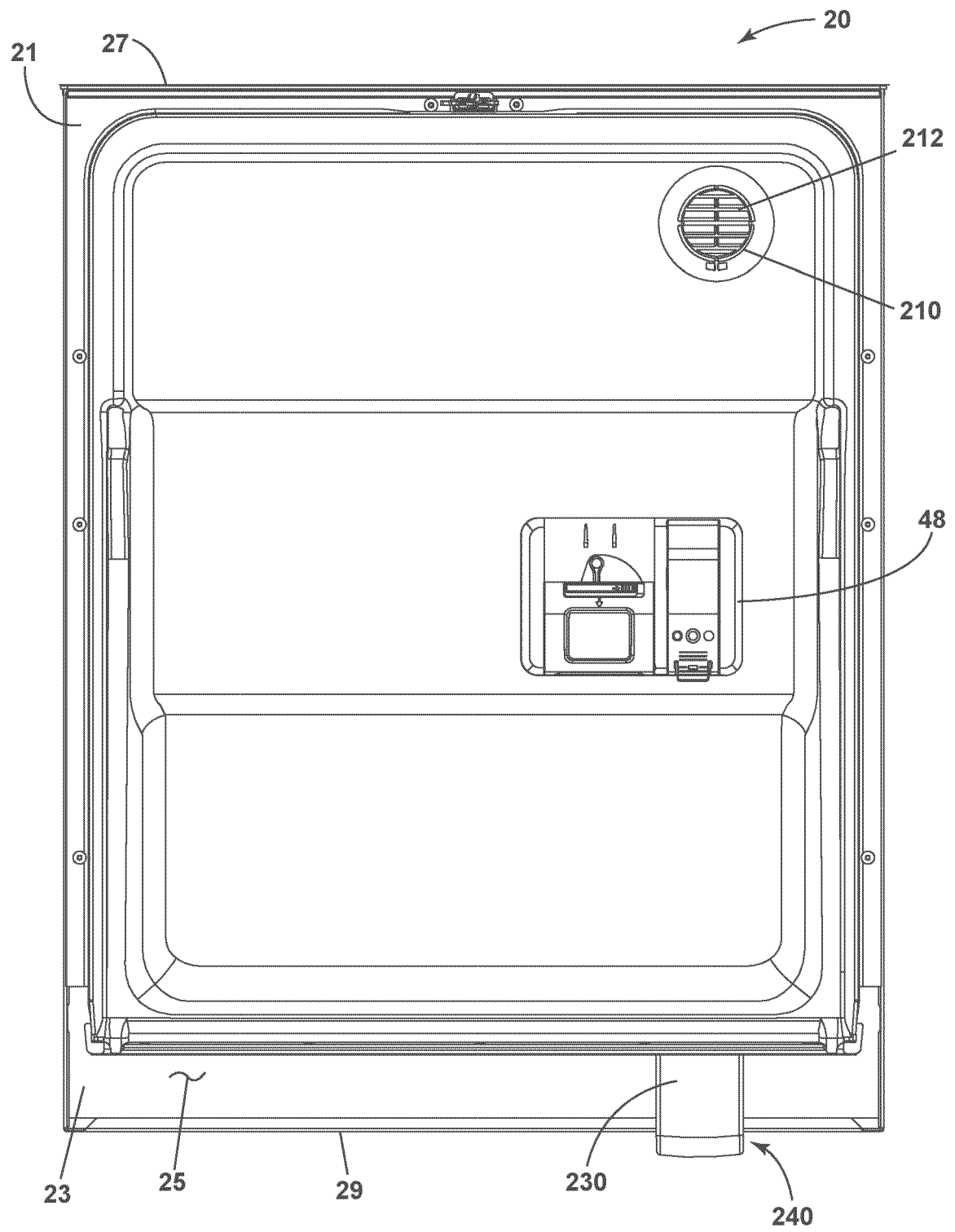


FIG. 4

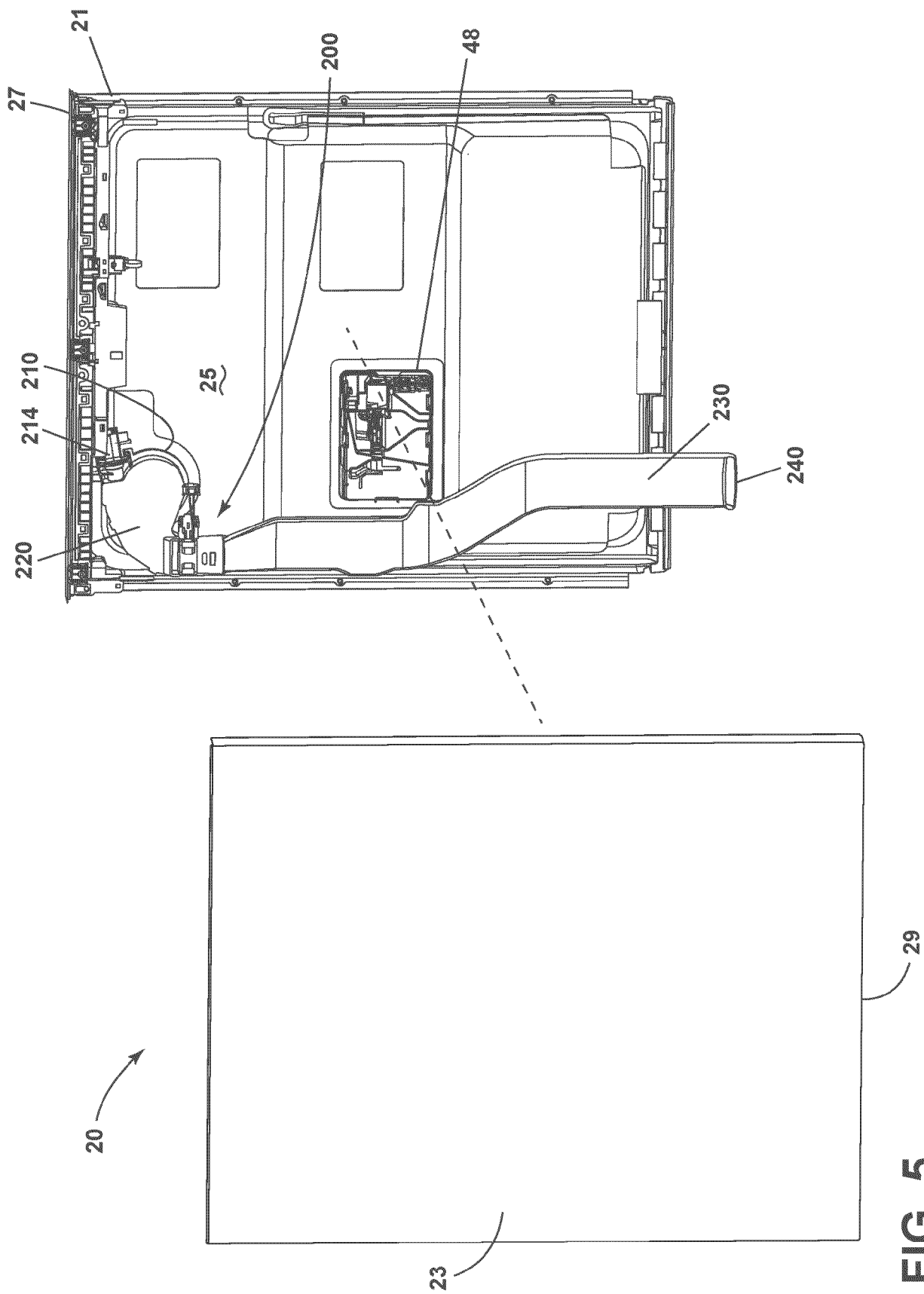


FIG. 5

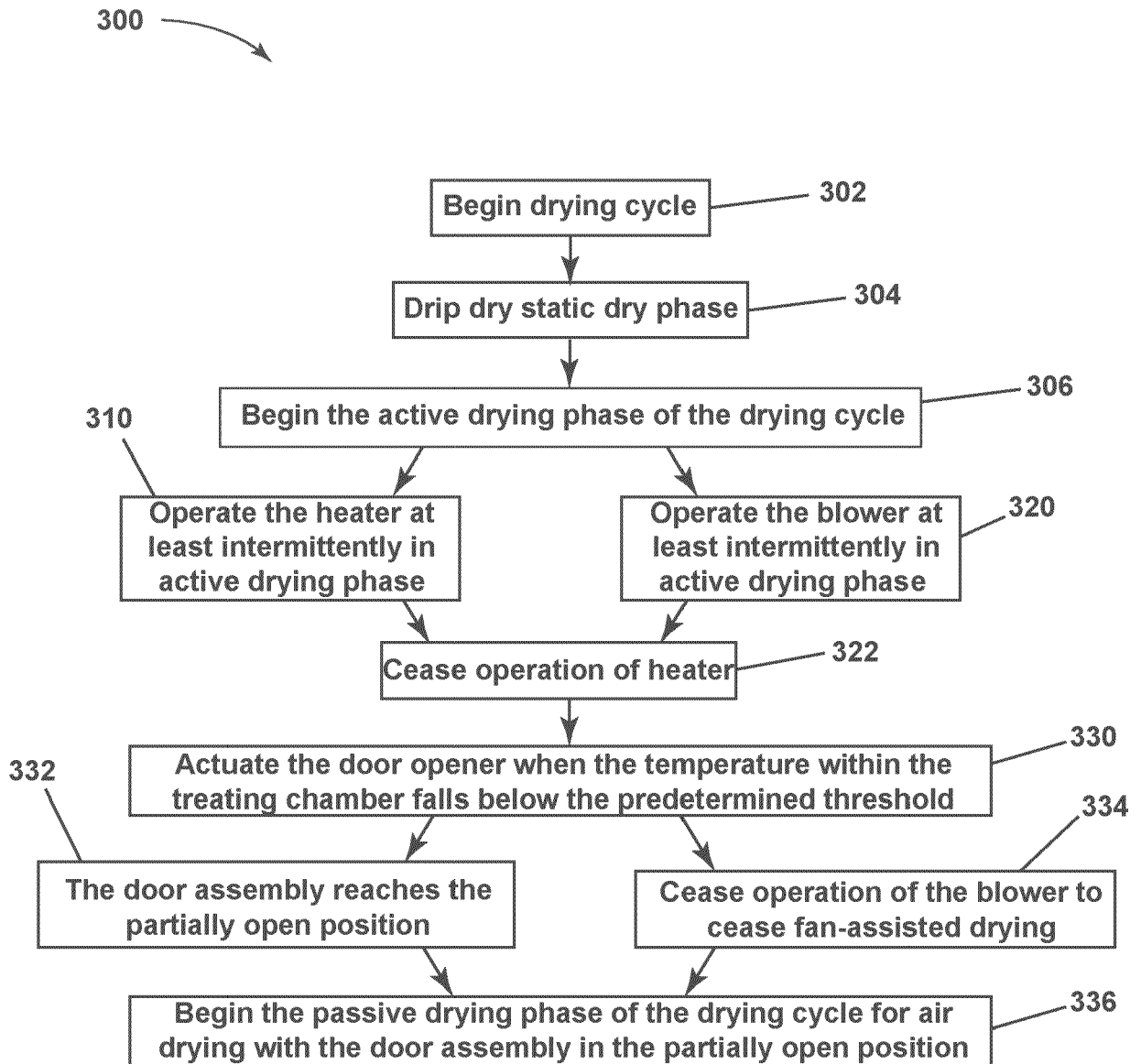


FIG. 6



EUROPEAN SEARCH REPORT

Application Number

EP 23 16 3446

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A	* paragraph [0038]; claims; figures * -----	7, 10	ADD. A47L15/42
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A	* paragraphs [0004], [0005], [0007], [0013]; claims; figures * -----	10	
X	US 2019/104916 A1 (KIM DO-HAENG [KR] ET AL) 11 April 2019 (2019-04-11)	1-6, 8, 9, 11, 12	
A	* paragraphs [0029], [0031], [0034], [0037], [0040], [0104]; claims; figures * -----	7, 10	
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EPO FORM 1503 03.82 (P04C01)

Place of search

Munich

Date of completion of the search

1 August 2023

Examiner

Popara, Velimir

CATEGORY OF CITED DOCUMENTS

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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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01-08-2023

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