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(54) **BATCH DISHWARE WASHING MACHINE WITH STEAM VENTING**

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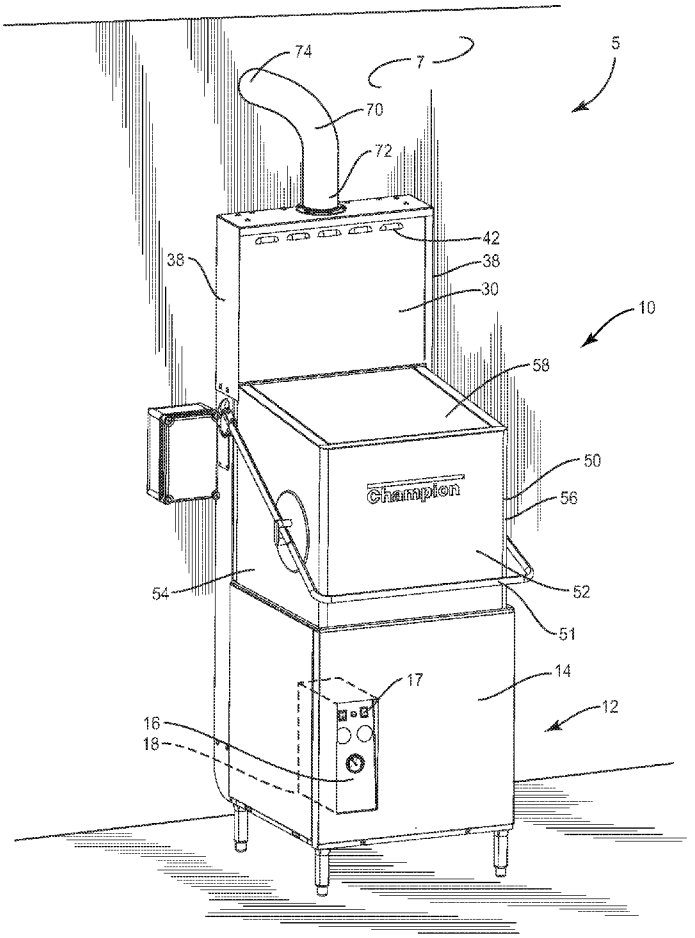
(57) **ABSTRACT**

A batch ware washing machine and/or related method of washing wares. The machine includes a moveable door which partially encloses a steam cavity. When the door is in the up or open position, hot moist air may be forcibly pulled from the steam cavity and into an exhaust plenum via an air inlet port that is strategically positioned above the top wall of the door when the door is in the closed position, but below the top wall when the door is in the open position. A controller causes the air to be forcibly pulled through the plenum for a predetermined exhaust time period, such as one minute, and then automatically stops the forced air exhaust movement. The exhaust plenum may be ducted directly to the outside of the surrounding building. The air conditioning load on the HVAC units serving the kitchen are reduced, thereby reducing energy consumption.



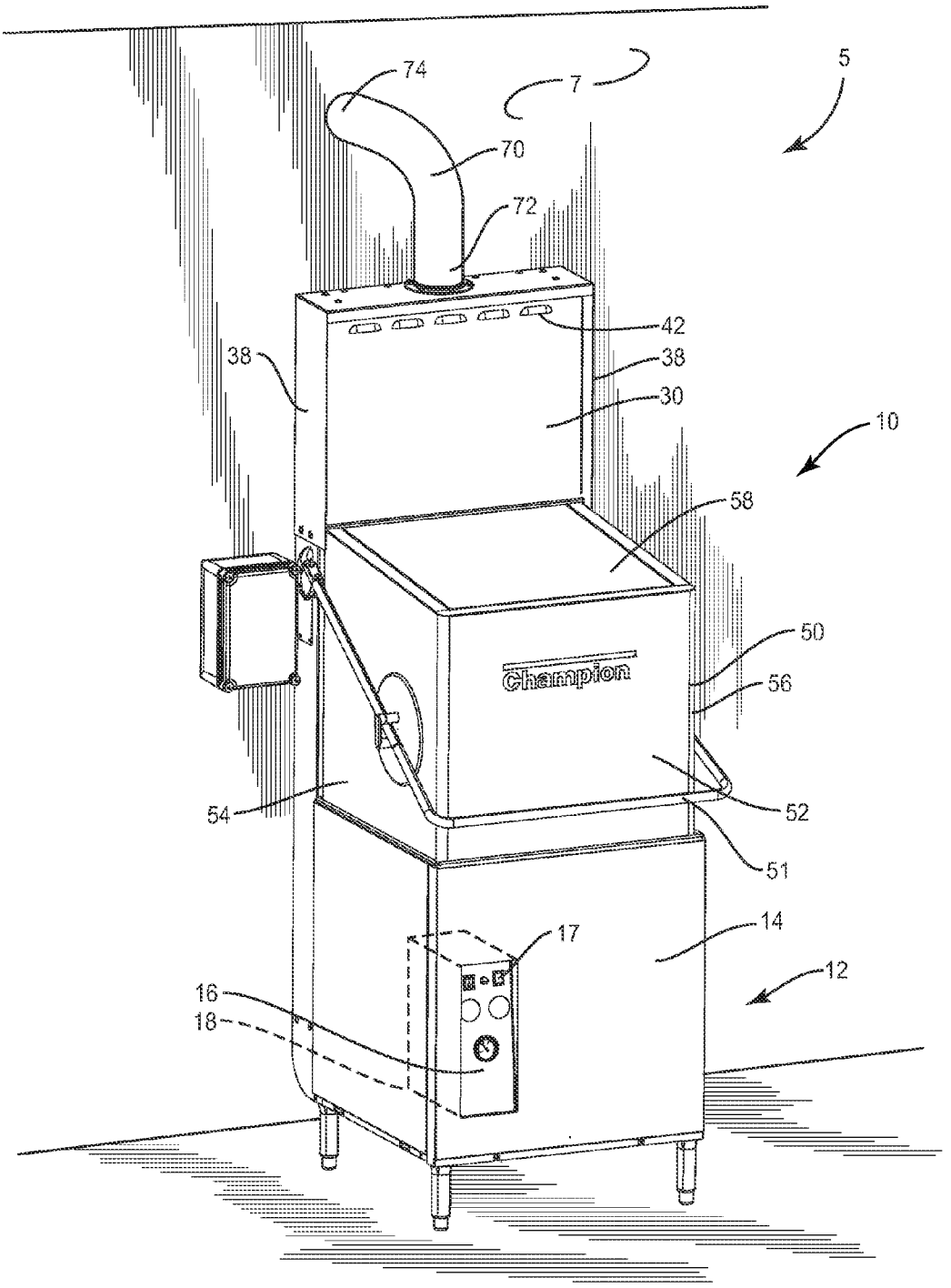


FIG. 1

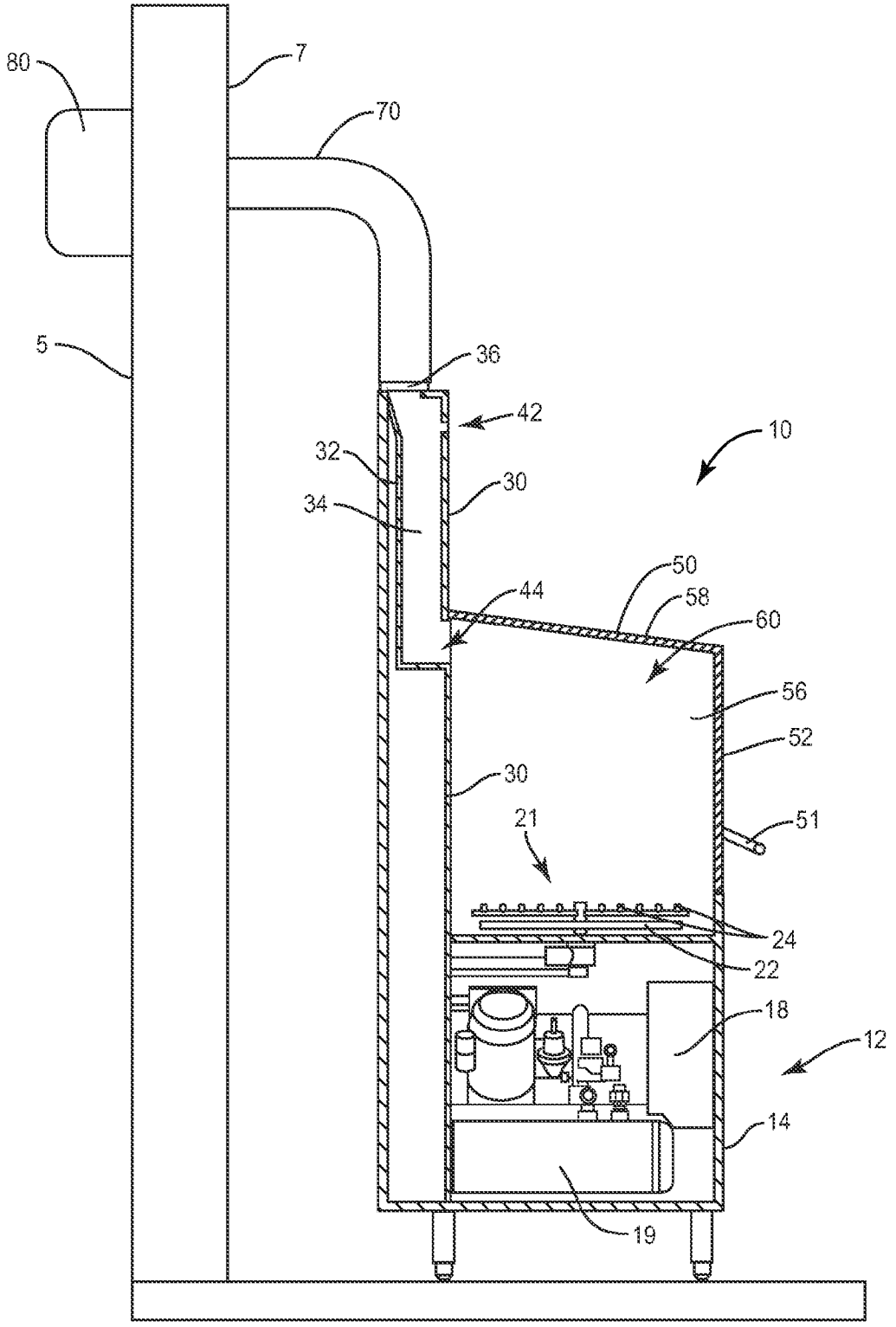


FIG. 2

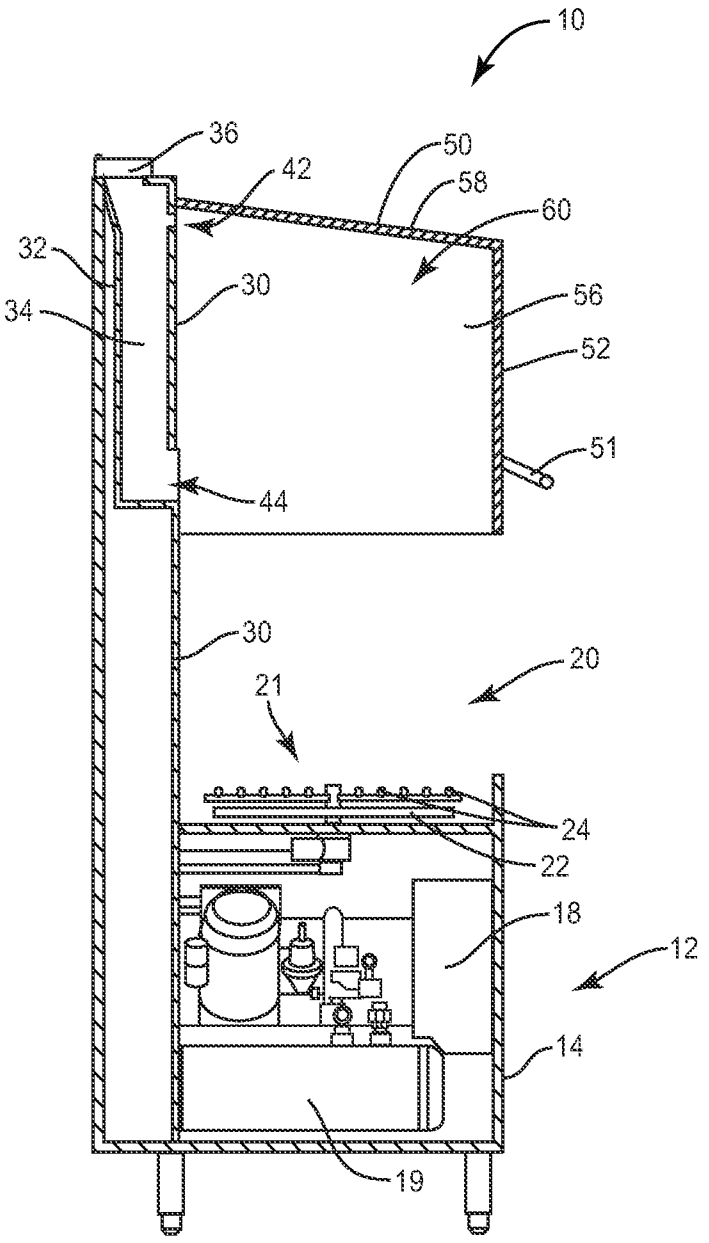


FIG. 3

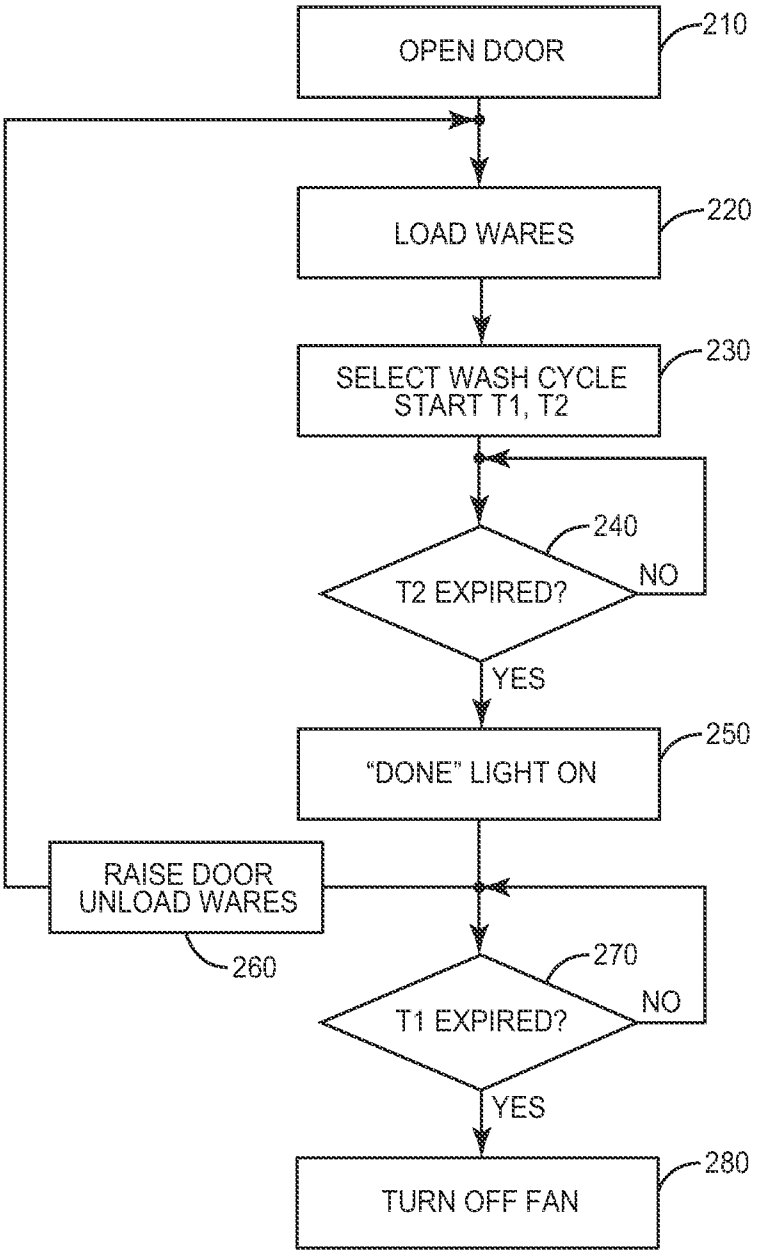

OPEN DOOR
210
LOAD WARES
220
SELECT WASH CYCLE
START T1, T2
230
240
T2 EXPIRED?
NO
YES
"DONE" LIGHT ON
250
RAISE DOOR
UNLOAD WARES
260
270
T1 EXPIRED?
NO
YES
TURN OFF FAN
280

FIG. 4

BATCH DISHWARE WASHING MACHINE WITH STEAM VENTING

[0001] This application is a divisional of prior application Ser. No. 13/332,692, filed 21 Dec. 2011, the disclosure of which is incorporated herein by reference in its entirety.

BACKGROUND

[0002] The present invention is generally directed to food dishware washing devices, and more particularly to a device that washes wares with an improved steam exhaust technique, and related methods.

[0003] Restaurants and other food service establishments typically employ numerous devices to clean their plates, cups, glasses, utensils, and the like, collectively referred to in the art as "dishware" or simply "wares". One common example is a dishwashing machine. While dishwashing machines are also found in household settings, commercial dishwashing equipment differs in that they are typically faster and must meet numerous additional requirements, such as those dictated by health codes. Faster cleaning allows the food service establishment to have a lower inventory of wares, which takes up less physical space and lowers operating costs. However, health codes typically require that each piece of ware be rinsed by at least a certain minimum amount of water at or above a certain temperature (such as 180° F.), with the intent being that the surfaces of the ware will therefore necessarily reach at least a certain temperature in order to kill any bacteria that may be present thereon.

[0004] The use of hot water for rinsing tends to create hot moist air, sometimes referred to as steam, in the ware rinse area. Many typical ware washing machines allow this steam to enter the surrounding kitchen when the washing machine door is opened. Other ware washing machines employ a continuously-on exhaust fan to exhaust the steam into the surrounding kitchen. Further still, many ware washing machines are required to be placed under continuously running vent hoods so that the escaping steam may be vented outside the building. However, all of these approaches have proven less than satisfactory, primarily due to their excess energy consumption. As such, there remains a need for alternative approaches to ware washing machines and related methods, particularly approaches that result in better overall energy consumption.

SUMMARY

[0005] The present invention provides a batch ware washing machine and/or related method of washing wares. The batch ware washing machine includes a moveable door which partially encloses a steam cavity. When the door is in the up or open position, hot moist air may be forcibly pulled from the steam cavity and into an exhaust plenum via an air inlet port that is strategically positioned above the top wall of the door when the door is in the closed position, but below the top wall when the door is in the open position. A controller causes the air to be forcibly pulled through the plenum for a predetermined exhaust time period, such as one minute, and then automatically stops the forced air exhaust movement. The exhaust plenum may be ducted directly to the outside of the surrounding building. By limiting the time period that air is exhausted, and by exhausting the air to the outside rather than the kitchen area, the air conditioning load on the HVAC units serving the kitchen are reduced, thereby reducing energy consumption.

[0006] In one aspect, the present invention provides a batch ware washing machine that comprises a base unit and a moveable multi-sided door. The base unit has a plurality of output nozzles for delivering wash fluid and rinse fluid to a ware wash area. The moveable door defines a downwardly open steam cavity and is moveably mounted to the base unit for movement between a closed position to an open position. The door has a front wall, first and second lateral sidewalls disposed on opposing sides of the front wall, and a top wall. The door first and second lateral sidewalls may be disposed generally orthogonal to the front wall of the door. The steam cavity is upwardly bounded by the top wall and laterally bounded by the first and second sidewalls. The base unit has a rear wall rearwardly bounding the steam cavity and disposed opposite the front wall. A plenum is disposed in the rear wall. The rear wall comprises first and second air input ports leading to the plenum. The ware washing machine further comprises a controller operative to control drawing of air through the plenum. With the door in the closed position: 1) the door is lower than in the open position; 2) the door laterally and upwardly encloses the wash area; 3) first input port is disposed below the top wall and operatively interconnects the steam cavity to the plenum; and 4) the second input port is disposed above the door. With the door in the open position: 1) the door is higher than in the closed position; 2) the steam cavity is disposed above the wash area; 3) the wash area is open laterally; 4) the second input port is disposed below the top wall of the door and operatively connects the steam cavity with the plenum. The controller is configured to: a) cause air to be forcibly drawn in through at least the first input port and through the plenum for a predetermined time period; and b) thereafter, automatically cause the cessation of air being forcibly drawn through the plenum. The time period may be approximately one minute.

[0007] The controller may be configured to cause air to be forcibly drawn in through both the first and second input ports and through the plenum for the predetermined time period. The rear wall may have a plurality of forwardly extending lateral flanges disposed laterally outboard of the door in the open position. The batch ware washing machine may further comprise a duct opening to the plenum on one end and opening on the other end external to a building surrounding the base. The batch ware washing machine may further comprise a fan operative to draw air through the plenum and controlled by the controller. The fan may be disposed external or internal to the base unit. The door may be pivotally mounted to the base unit. There may be third, fourth, fifth, etc. inlet ports disposed a similar height above the second inlet port as the first inlet port (such as in a line or the like); each leading to the plenum.

[0008] In another aspect, the present invention provides a method of cleaning dishware, comprising washing and rinsing dishware in a wash area of a dishware machine while a multi-sided door in a closed position laterally and upwardly encloses the wash area. Thereafter, while the door remains in the closed position, forcibly drawing air into a generally vertically flowing plenum from a cavity defined by the door from via at least a first air inlet port disposed below a top wall of the door. Thereafter: a) moving the door upward to an open position above the closed position to laterally expose the wash area and move the cavity upward; and b) forcibly drawing air from the upwardly moved cavity into the plenum via at least a second air inlet port disposed below the top wall of the door when the door is in the open position, but above the top

wall when the door is in the closed position. Thereafter, automatically ceasing the forcible drawing in of air to the plenum. The duration of the forcible drawing of air into the plenum is a first predetermined time period. The first predetermined time period may be approximately one minute.

[0009] The method may further comprise feeding output of the plenum directly to one end of a duct, the opposing end of the duct terminating outside a building that surrounds the dishware machine. The method may be such that, after the moving of the door to the open position, air is forcibly drawn into the plenum via the first and second inlet ports. The method may further comprise indicating the expiration of a second predetermined time period prior to the moving of the door to the open position; wherein the second time period begins with the initiation of forcibly drawing air into the plenum. The second time period may be approximately ten seconds. The forcibly drawing air into the plenum via at least a second air inlet port when the door is in the open position may comprise forcibly drawing air into the plenum via a fan disposed external to the dishware machine and operatively connected thereto by an intervening duct. The fan may be disposed external to a building housing the dishware machine. The forcibly drawing air into the plenum via at least a second air inlet port when the door is in the open position may comprise forcibly drawing air into the plenum via a fan disposed internal to the dishware machine and operatively connected to an exhaust duct that terminates outside a building that surrounds the dishware machine. The moving the door upward to the open position may comprise moving the door in a pivoting fashion.

[0010] The various optional features and aspects described above and below may be used alone or in any combination.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] FIG. **1** shows a ware washing machine according to one embodiment disposed in a kitchen area of a building.

[0012] FIG. **2** shows a side partial cross-sectional view of the ware washing machine of FIG. **1** with the door in the closed position.

[0013] FIG. **3** shows a view similar to FIG. **2**, with the door in the open position and some items removed for better clarity.

[0014] FIG. **4** shows a simplified flow diagram of one ware washing process.

DETAILED DESCRIPTION

[0015] In one embodiment, the present application is directed to a batch ware washing machine and/or related method of washing wares. The batch ware washing machine includes a moveable door which partially encloses a steam cavity. When the door is in the up or open position, hot moist air may be forcibly pulled from the steam cavity and into an exhaust plenum via an air inlet port that is strategically positioned above the top wall of the door when the door is in the closed position, but below the top wall when the door is in the open position. A controller causes the air to be forcibly pulled through the plenum for a predetermined exhaust time period, such as one minute, and then automatically stops the forced air movement. The exhaust plenum may be ducted directly to the outside of the surrounding building. By limiting the time period that air is exhausted, and by exhausting the air to the outside rather than the kitchen area, the air conditioning load on the HVAC units serving the kitchen are reduced, thereby reducing energy consumption.

[0016] FIG. **1** shows a kitchen area of building **5**, such as a restaurant, nursing home, or the like. A batch ware washing machine, generally indicated at **10**, is located in the kitchen, advantageously in proximity to an outer wall **7**. An exhaust duct **70** connects the washing machine **10** to the outer wall **7**, and provides a route for exhausting hot moist air from the washing machine **10** to outside the building **5**. As such, an inlet end **72** of the exhaust duct **70** attaches to the washing machine **10**, and an outlet end **74** of the exhaust duct **70** terminates at or beyond the outer wall **7** so as to direct the exhaust outside the building **5**. A fan **80** is operatively connected to the exhaust duct **70** to force air/steam to move through the exhaust duct **70**. The fan **80** may be disposed on the outer wall **7** or elsewhere as described below. The fan **80** operates under the control of controller **18** of the ware washing machine **10**, as discussed further below.

[0017] As shown in FIG. **2**, the washing machine **10** includes a base unit **12** and a door **50** moveably supported by the base unit **12**. The base unit **12** includes a cabinet **14** for housing controller **18**, one or more water heaters **19**, wash/rinse equipment **22**, and other components of the washing machine **10** known in the art. An operator interface panel **16** is located on the front of the base unit **12**, and includes suitable gages, switches, and indicator lights **17** as known in the art. The wash/rinse equipment **22**, advantageously including nozzles **24** on rotatable arms, is disposed in a well **21** in the base unit **12**, as shown in FIG. **2**. The wash/rinse equipment **22** supplies wash fluid and rinse fluid to the ware wash area **20** formed by base unit **12** and door **50** to clean the wares therein. The well **21** forms the lower extent of the ware wash area **20**, and the door **50** (in the closed position) forms the upper, front, and lateral sides of ware rinse area **20**. A rear wall **30** of the base unit **12** provides the rear wall of the ware rinse area **20**. The rear wall **30** of base unit **12** extends upward above the well **21** and provides a location for moveably mounting the door **50**.

[0018] As indicated above, the door **50** is moveably mounted to the base unit **12**. For the embodiment of FIG. **2**, the door **50** is indirectly mounted to the base unit **12** via pivoting handle **51**. A counter-weight mechanism may be associated with handle **51** to facilitate easy opening of the door **50**. Door **50** includes a top wall **58**, a front wall **52**, and a left lateral side wall **54** and a right lateral side wall **56**. The walls **52**,**54**,**56**,**58** are advantageously disposed so as to form a generally rectangular enclosure, with an open bottom and an open rear. The rear wall **30** of the base unit **12** is disposed behind the door **50**, and acts as a rear wall for the cavity **60** formed by the door **50**. Because this cavity **60** typically encloses hot moist air ("steam") during the washing process, this cavity bounded by the walls of door **50** may be referred to as the steam cavity **60**. The door **50** is movable between a closed position, where the door **50** laterally and frontwardly encloses the ware wash area **20**, and a raised or open position where the door **50** is disposed higher than in the closed position and does not laterally enclose the ware wash area **20**, so that wares may be loaded and unloaded from the ware wash area **20**. As can be appreciated, when the door **50** is in the closed position, the steam cavity **60** and the ware rinse area **20** overlap so that the steam cavity **60** is coincident with part of the ware wash area **20**, above the well **21**. Note that to contain the fluids sprayed during the wash cycle, the interface between the lower edge of the door **50** and the base unit **12**

should be sufficiently sealed to prevent the liquid from escaping, but advantageously open enough to allow the drawing in of air, as explained further below.

[0019] The wash/rinse equipment **22** supplies wash fluid and rinse fluid to the ware wash area **20** during the wash cycle. During the rinse portion of the wash cycle, hot water is sprayed in the ware wash area **20** via nozzles **24**. Typically, the hot water is sprayed for a sufficient time so that the wares reach a mandated temperature, such as **180°** . The hot water causes steam to be generated, which the washing machine **10** exhausts using a novel approach that utilizes a pair of inlet ports **42**,**44** disposed on rear wall **30** and control of the exhaust air flow, as discussed further below. Although any suitable configuration of wash/rinse equipment **22** known in the art may be used, the wash/rinse equipment **22** may advantageously take a configuration similar to that shown in U.S. Patent Application Publication No. 2010/0051063.

[0020] A pair of air inlet ports **42**,**44** are disposed on rear wall **30**, with inlet port **42** disposed higher than inlet port **44**. The inlet ports **42**,**44** lead to plenum **34** which is disposed inside rear wall **30**. The plenum **34** extends downward to at least inlet port **44**, and upward to the top of rear wall **30**. The plenum **34** may be approximately the same cross-sectional size as the interior of the rear wall **30**, or may advantageously be smaller, such as partially defined by a partition **32** internal to rear wall **30**. The plenum **34** is operatively connected to exhaust duct **70** at plenum outlet **36** so that air leaving plenum **34** is exhausted outside of the building **5**. The lower inlet port **44** is vertically positioned below the level of the top wall **58** of door **50** when door **50** is in the closed position so that the lower inlet port **44** provides an airflow path between the steam cavity **60** and the plenum **34** when the door **50** is closed. Advantageously, the vertical position of the lower inlet port **44** also allows the lower inlet port **44** to open to the steam cavity **60** when the door **50** is in the open position, although this is not required in all embodiments. The upper inlet port **42** is disposed higher than the lower inlet port **44** so that the upper inlet port **42** is vertically positioned above the door **50** when the door **50** is closed, but below the door top wall **58** when the door **50** is in the open position. Thus, the upper inlet port **42** provides an airflow path between the steam cavity **60** and the plenum **34** when the door **50** is open.

[0021] To wash the wares, the door **50** is moved to the open (raised) position (step **210**), and the wares, typically loaded on a ware tray, are loaded into the ware wash area **20** (step **220**). The door **50** is then closed, and the wash cycle is initiated, either automatically or via user input at the operator interface panel **16** (step **230**). The wash/rinse equipment **22**, optionally including the nozzles **24**, are then used to spray wash fluid (e.g., water and detergent) in the ware wash area **20**. When the wash portion of the wash cycle is complete, the wash/rinse equipment **20**, including nozzles **24**, then spray rinse fluid (e.g., hot water) in the ware wash area **20**. Either during the spraying of the rinse fluid, or at the conclusion thereof, the controller **18** causes the fan **80** to turn on so as to forcibly draw air from the steam cavity **60**. The fan **80** forces air out of the plenum **34**, with that air being replaced by air input to the plenum **34** from the steam cavity **60** via the lower air inlet port **44**, with that air in turn replaced by ambient air from the kitchen (entering the wash area **20** via the interface between the lower edge of the door **50** and the base unit **12**). During this initial draw-out of air, the indicator **17** should indicate to the user that the wash cycle is not yet complete. This initial draw-out of air lasts a predetermined time period T**2** (step **240**), after which the "done" indicator **17** may change status to indicate to the user that the door **50** can be raised (step **250**). The length of time period T**2** may be adjusted as desired, but a period of approximately ten seconds is believed appropriate for most situations. The door **50** is then raised to the open position (step **260**), so that the steam cavity **60** is raised upward and the door **50** does not laterally bound the ware wash area **20**. The user may then remove the wares, if desired. It should be noted that the fan **80** continues to run at this point, forcing airflow through the plenum **34**. However, with the door **50** in the open (raised) position, the steam cavity **60** is now able to supply air to the plenum **34** via the upper inlet port **42**. Thus, air is drawn from the steam cavity **60** via the upper inlet port **42** (and optionally also the lower inlet port **44**), into the plenum **34**, to the duct **70**, and exhausted outside the building **5**. After a predetermined time period T**1** (step **270**), the fan **80** is stopped (step **280**). The length of time period T**1** may be adjusted as desired, but a period of approximately one minute (e.g., about forty-five seconds to about seventy-five seconds, more preferably about sixty seconds) to is believed appropriate for most situations. This duration allows for the hot air to be exhausted from the steam cavity **60**, while minimizing the amount of excess ambient air from the kitchen that is exhausted. Thus, there is less "make up" air that the kitchen HVAC system needs to condition, as less air has been removed from the kitchen.

[0022] In some embodiments, the base unit **12** may include forwardly extending side flanges **38** attached to the rear wall **30**. These flanges **38** advantageously laterally overlap the rear portion of door **50**, and act to help contain the steam in steam cavity **60**.

[0023] In some embodiments, the fan **80** may be located on outer wall **7** of building **5**, with suitable electrical connections to controller **18** so that controller **18** may control the operation of fan **80**. In other embodiments, a fan **80** may be additionally or alternatively internal to ware washing machine **10**. For example, fan **80** may be disposed at the exhaust end of plenum **34**, internal or external to rear wall **30**.

[0024] In some embodiments, an automatic interlock (not shown) may be used to ensure that door **50** stays closed during time period T**2**. For example, controller **18** may control interlock so that the door **50** is locked in the closed position until the expiration of time period T**2**, and thereafter release the interlock so that door **50** may be raised by the operator.

[0025] Note that the discussion above has assumed that time periods T**1**, T**2** start with the initiation of the wash cycle. An equivalent approach is to start time periods T**1**, T**2** from the start of the wash cycle, with suitable adjustments to their duration.

[0026] Note further that, in some embodiments, there may be an additional open exhaust hood above the ware washing machine **10**, but such is not required, and the ware washing machine **10** may be located away from an open exhaust hood because the steam is vented out of the building even when the door **50** is open.

[0027] The ware washing machine **10** allows for a shortened cycle time because in the door up position (FIG. **3**), the door **50** with the rear wall **30** allows the cavity **60** to act as an exhaust hood above the wares that continue to exhaust steam and heat produced in the washing/rinse cycles as well as the steam and heat coming off the wares in the door open opposition.

[0028] All U.S. patents, patent application publications, and applications mentioned above are hereby incorporated herein by reference in their entirety.

[0029] The present invention may, of course, be carried out in other ways than those specifically set forth herein without departing from essential characteristics of the invention. The present embodiments are to be considered in all respects as illustrative and not restrictive, and all changes coming within the meaning and equivalency range of the appended claims are intended to be embraced therein.

What is claimed is:

1. A batch ware washing machine, comprising:

a base unit having a plurality of output nozzles for delivering wash fluid and rinse fluid to a ware wash area;

a moveable multi-sided door defining a downwardly open steam cavity and moveably mounted to the base unit for movement between a closed position to an open position;

the base unit having a rear wall rearwardly bounding the steam cavity and disposed opposite the front wall;

a plenum disposed in the rear wall;

the rear wall comprising first and second air input ports leading to the plenum;

wherein, with the door in the closed position:

the door is lower than in the open position;

the door laterally and upwardly encloses the wash area;

first input port is disposed below the top wall and operatively interconnects the steam cavity to the plenum;

the second input port is disposed above the door;

wherein, with the door in the open position:

the door is higher than in the closed position;

the steam cavity is disposed above the wash area;

the wash area is open laterally;

the second input port is disposed below the top wall of the door and operatively connects the steam cavity with the plenum.

2. The batch ware washing machine of claim **1**:

wherein the door has a front wall, first and second lateral sidewalls disposed on opposing sides of the front wall, and a top wall; the steam cavity upwardly bounded by the top wall and laterally bounded by the first and second sidewalls;

further comprising a controller operative to control drawing of air through the plenum;

wherein the controller is configured to:

cause air to be forcibly drawn in through at least the first input port and through the plenum for a predetermined time period;

thereafter, automatically cause the cessation of air being forcibly drawn through the plenum.

3. The batch ware washing machine of claim **2**, wherein the controller is configured to cause air to be forcibly drawn in through both the first and second input ports and through the plenum for the predetermined time period.

4. The batch ware washing machine of claim **2**, wherein the time period is approximately one minute.

5. The batch ware washing machine of claim **2**, further comprising a fan operative to draw air through the plenum and controlled by the controller.

6. The batch ware washing machine of claim **5**, wherein the fan is disposed external to the base unit.

7. The batch ware washing machine of claim **2**, wherein the door first and second lateral sidewalls are disposed generally orthogonal to the front wall of the door.

8. The batch ware washing machine of claim **1**, wherein the rear wall has a plurality of forwardly extending lateral flanges disposed laterally outboard of the door in the open position.

9. The batch ware washing machine of claim **1**, further comprising a duct opening to the plenum on one end and opening on the other end external to a building surrounding the base unit.

10. The batch ware washing machine of claim **1**, wherein the door is pivotally mounted to the base unit.

11. The batch ware washing machine of claim **1**, further comprising a third inlet port disposed a similar height above the second inlet port as the first inlet port; the third inlet port leading to the plenum.

12. The batch ware washing machine of claim **1**:

wherein the door has a front wall, first and second lateral sidewalls disposed on opposing sides of the front wall, and a top wall; the steam cavity upwardly bounded by the top wall and laterally bounded by the first and second sidewalls;

wherein the door first and second lateral sidewalls are disposed generally orthogonal to the front wall of the door;

wherein the door is pivotally mounted to the base unit;

further comprising a controller operative to control drawing of air through the plenum;

wherein the controller is configured to:

cause air to be forcibly drawn in through at least the first input port and through the plenum for a predetermined time period;

thereafter, automatically cause the cessation of air being forcibly drawn through the plenum.

wherein the controller is configured to cause air to be forcibly drawn in through both the first and second input ports and through the plenum for the predetermined time period.

13. The batch ware washing machine of claim **12**, wherein the time period is approximately one minute.

14. The batch ware washing machine of claim **12**, further comprising a fan operative to draw air through the plenum and controlled by the controller.

15. The batch ware washing machine of claim **14**, wherein the fan is disposed external to the base unit.

16. The batch ware washing machine of claim **12**, wherein the rear wall has a plurality of forwardly extending lateral flanges disposed laterally outboard of the door in the open position.

17. The batch ware washing machine of claim **12**, further comprising a duct opening to the plenum on one end and opening on the other end external to a building surrounding the base unit.

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