

DISHWASHER USING HIGH PRESSURE WATER

FIELD OF THE INVENTION

This invention relates to a dish washing machine and a dish washing
5 method using the same. In particular, the present invention relates to a high
pressure dish washing machine and the use of high pressure water for
washing dishes.

BACKGROUND OF THE INVENTION

10 Currently available dishwasher machines, either commercial or domestic,
make use of chemical detergent and hot water, hold the dishes in a rack or a
tray, subject the dishes to multiple wash and rinse cycles. The rack or tray of
dishes goes into a chamber, or pass through several chambers, and comes out
clean. Water, dosed with chemical detergent, spray from top and bottom and/or
15 sides. The final rinse is usually hot water of above 80 degree Celsius, to
sterilize and to dry the dishes.

The main problem with these type of dishwashers is that a large quantity of
water is used, together with a corresponding large quantities of chemical and
heating energy. The reason being that water is sprayed through a large
20 number of spray nozzles, aimed at every possible angles, aimlessly trying to
cover the whole rack area while dishes are placed randomly, many
overlapping or shielding one another from the direction of the spray. Long
spraying time and multiple nozzles at different angles are needed to give good

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coverage, hence consume more water than actually necessary. However, some corners and crevices are often not cleaned due to the angle of spray, the dishes covering one another, or the depth produced by the curved contour of the dishware.

5 Another problem is that the quality of the cleanliness and sanitation of the current washers depend on variables such as correct level of chemical dosage and the hot water temperature. Hot water typically requires 60 to 65°C for washing and above 80°C for rinsing. The incoming water temperature required is set at 40 to 45°C and the dishwasher has a booster-heater to post-heat the
10 water up to the required temperature. In real life, water temperature from the storage tank cannot be assured to maintain at above 40°C if it runs continuously, hence the designed required temperature cannot always be maintained. The alternative for hot water sanitation is to use chlorine but users face the danger of chlorine not completely rinsed and removed. Insufficient
15 dosage of chemical detergent in the wash cycle results in improper removal of oil and grease. Excessive dosage without corresponding prolonged rinsing results in chemical contamination on the dishes. Either way, it affects the standard of cleanliness and hygiene.

Some other less commonly used dishwasher designs can be found in US
20 Pat. No. 4,561,144 (Machine for washing flat tableware, Marais), US Pat. No. 5,846,339 (Machine dish washing process, Masshoff), US Pat. No. 5,267,580 (Dish washing machine and method, Payzant) and US Pat. No. 5,667,431 (Dishwasher Machine, Mortin).

The above-mentioned inventions and other current dish washers use low
25 pressure water with high flow rate. The washing is done with the addition of

chemical detergent in hot water. They are environmentally unfriendly in terms of energy and water resource used, in addition to contributing to environmental pollution. In addition, almost all current machines require users to manually scrape off the food soils before entering the machines. Some machines employ
5 a separate scraping process before washing, an example of using a brush to scrape is illustrated in US Pat. No. 4561144 (Machine for washing flat tableware). Machines that use recycled water typically require that the dishes be rid of solid soil in order to preserve the life span of the filtering system. Further more, if the food soils were dried up considerably, then the cleanliness
10 cannot be guaranteed. Under this circumstance, soaking and manually washing the dishes become mandatory.

It is therefore an object of the present invention to provide an environmentally friendly dishwashing machine with reduced energy consumption.

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BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is schematic illustration of a one-side washing machine according to one embodiment of the present invention.

Figure 2 is sectional view of a dish placed onto the conveyor belt in Fig.1 with
20 rubber studs of different heights.

Figure 3 is a schematic drawing of a two-side washing machine according to another embodiment of the present invention.

Figure 3a is a schematic drawing of a two-side washing machine according to a further embodiment of the present invention.

Figure 4 is a perspective view of holding device for use with a machine according to the present invention.

Figure 5 is a front view of the stabilizer of Figure 4 in operation, as seen applied to a bowl with relatively small base.

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Figure 6 shows the construction of a manual dishwasher using a single line oscillating nozzle.

SUMMARY OF THE INVENTION

10 Accordingly, the present invention provides, in one aspect, a dishwashing machine for cleaning soiled dishes, tableware and utensil, comprising a high pressure, fresh water pumping delivery system for blasting high pressure water through one or more nozzles onto the dishes to be cleaned. The nozzles are the single straight jet type which moves at high speed, for
15 example by rotation or by oscillation.

 According to another feature of the present invention, a transporting system is provided to hold the dishes in place and to move under and past the high pressure water screen produced by the high speed moving straight jet nozzles. The washing process can be performed at high speed, typically one to
20 three seconds per dish. The cleaning may be done without use of detergent and hot water.

 In one embodiment of the present invention, the dishes pass the high pressure water screen only once. Hence only one side of the dish is cleaned. To wash the other side, the user manually flip over the dish and re-enter the
25 machine with the unwashed side.

In another embodiment, the dishes are flipped automatically via flipping means provided within the machine. In this embodiment, the dishes pass under a first high pressure water screen means to be cleaned on one side, then flipped over via flipping means to enter the second high pressure water screen means to be cleaned on the opposite side.

In the embodiments described above, each side of the dish is cleaned only once. The entire surface of the dish is impinged with high pressure fresh water, fully and evenly. The dish will be clean of oil, grease and bacteria, and be ready for fresh use without further washing. This is possible without the use of detergent or further rinsing.

DESCRIPTION OF THE INVENTION

The following detailed description describes various embodiments for implementing the underlying principles of the present invention. One skilled in the art should understand, however, that the following description is meant to be illustrative of the present invention, and should not be construed as limiting the principles discussed herein. In the following discussion, and in the claims the terms "including", "having" and "comprising" are used in an open-ended fashion, and thus should be interpreted to mean "including but not limited to". Also, the term "couple" or "couples" is intended to mean either an indirect or direct mechanical connection. Thus if a first device "couples" to a second devices, that connection may be a direct mechanical connection or indirectly via other devices or connections.

In the following description, numerous specific details are set forth such as specific parts of a dishwasher in order to provide a thorough understanding of the present invention. In other instances, well known elements such as the motor and electrical connections for the conveying systems, and high pressure water pumping systems are not described in order not to unnecessarily obscure the present invention. It should be understood by one of ordinary skill in the art that automated dishwashers would require a power supply, and may also be controlled by other electronic means or by a programmable device like a computer.

In detail now and referring to the drawings, **Fig.1** shows one embodiment of the present invention in which dishes are placed on the conveyor facing upwards, and the dishwashing machine only washes one side of the dish. The high pressure and high speed moving single straight jet nozzles **12** and **12a** are connected to a high pressure pumping system and water source. Examples of this type of nozzles are single jet rotating nozzles (commercially available product made from US Pat. No. 4,989,786, Kranzle) or single line oscillating nozzles (commercially available product made from US Pat. No. 4,732,325, Jensen). The nozzles are directed onto the top of the conveyor belt with the jetting angle of the rotating or oscillating nozzles preferably not more than 30 degrees. The nozzles **12** and **12a** are so positioned at a height above the conveyor such that their blasting area would cover the entire width of the conveyor. The width of the conveyor is designed to cater for the biggest dishware or crockery that the system would serve. The dishes **16** sits on the conveyor **17**. The conveyor belt is preferably made of rubber, with rubber studs **18** of good surface friction. The dish **16** moves into the high pressure blasting

water screen following the movement of the conveyor 17. The high speed moving water jet, typically at a speed of several thousands revolutions per minute, impinge onto the open surface of the dish 16 and blasted off any food soil at a force that is depending on the high pressure water pumping system.

- 5 The pressure and flow rate of the high pressure water are so selected to be sufficiently high (typically in the range injurious to human limbs and flesh) to blast off the soils and bacteria, including scorched food, but not destructive to the surface material of the dishware. The pump pressure and the flow rate calculation depend on the number of nozzles in the system, and the basic
10 design, and may be determined without undue experimentation. For example to cover a conveyor of width 35cm with one single nozzle, water pressure of 120 bar at a flow rate of around 12 liters per minute is suitable. To perform the same task with two nozzles, water pressure of 80 bar at a flow rate of 15 liters per minutes may be used. Lower pressure can be used in the latter example
15 because the nozzles can be mounted lower and nearer to the dishes. In either case, the nozzles are suitably sized to produce the desired impact. For other types of cleaning, water pressures in the range of 40-80 bars may be used. The duration of the blast for each dish may also be adjusted. There are many high pressure pumping equipment manufacturers who can supply systems to the
20 desired specifications.

The sectional view of **Fig.2** shows a rubberized conveyor belt with studs to provide stability for the dishes. Besides performing a transferring function, the conveyor belt 27 is also used to absorb the vertical thrust produced by the high pressure water. The rubber studs 28 or other corrugated rubber surfaces are
25 made to generate a high frictional coefficient to absorb any lateral forces

produced by the high pressure water screen. Rubber studs of varying heights are preferred to cater for dishware of different base designs with different heights and depths. The high pressure water jet impinged onto the surface, moving at high speed, would not create a force strong enough at any single point on the dishware for a long enough time to exert a force that is great enough to flip the dish 26 considerably or to do damage to the surface.

Generally, good frictional force created by the studs 28 on the conveyor 27 to the interface with the dish 26 prevents any lateral movement of the dish 26. Other designs may be determined by one in the art without undue experimentation. Certain design of dishes 26 might experience slight tilting during the washing but would be acceptable as long as the dishes are not completely displaced. The optimum pressure and flow rate of the high pressure impinging water have to be carefully balanced with the intended speed with which the conveyor 27 is moving the dishes 26. The combination of the design is very important to achieve the total coverage required. If the conveyor 27 speed is too slow, the dish 26 may encounter difficulty feeding itself into the high pressure water screen. If the conveyor 27 speed is too fast, the disk 26 may not be cleaned completely. If the water pressure is too high, the flow rate will be correspondingly reduced and also the dish 26 may find difficulty entering the water screen. At the same time, the dish 26 may not be cleaned due to insufficient quantity of water in the water jet. If the moving speed of the single straight jets are too slow, the dish 26 may not be cleaned properly, if the moving speed of the jet is too fast, much flow energy is wasted on creating the speed without productive result. The final selection of the combined system parameters depends on the width of the largest crockery intended, the worst

case of the dried up soils on the dishes and desired cleaning speed. An example of a feasible working range is 80-150 bars at 12-15 liters per minute at a height of 35-50cm from the dish for each of the one-sided washing station.

The front view of **Fig.3** shows an embodiment of an automated, two-side
 5 dishwasher for washing both sides of a dish using a flipping means. In this embodiment, the dish **36** is first blasted by the first set of high pressure nozzles **32**. The dish **36** is flipped-over as it slides off the end of the first conveyor belt **37** onto rubber flaps **30** and **30a**, which directs the falling dish **36** onto a second conveyor belt **37a** with the opposite or reverse side now facing nozzle
 10 **32a**. It is then blasted by the second set of high pressure nozzles **32a**. After being cleaned on both surfaces, the dish **36** is then passed over a third conveyor **33** for drying. Third conveyor **33** is preferably made of stainless steel wires with through holes, to enable hot air to blow through freely from top and below. With an effective hot air re-circulation system, the dishes is clean and
 15 dry upon exit.

Fig.3a is another possible configurations of an automated, two-side dishwasher with a different flipping means. In this embodiment, the dish **46** is first blasted by the first set of high pressure nozzles **42**. The dish **46** is flipped-over as it slides off the end of the first conveyor **47** onto the flipping mechanism
 20 **40** which direct the falling dish **47** onto the second conveyor **47a** with the opposite or reverse side of the dish **46** now facing nozzle **42a**. It is then blasted by the second set of high pressure nozzles **42a**. After being cleaned on both surfaces, the dish **46** is then passed over a third conveyor **43** for drying. Third conveyor **43** is preferably made of stainless steel wires with
 25 through holes, with plastic fingers **48** perpendicular to the conveyor surface, to

hold and guide the dishes **46** upward. Hot air blows through the dishes **46** freely. With an effective hot air re-circulation system, the dishes shall be clean and dry on exit.

Another embodiment of the above invention is to use conveyors made of
5 hard PVC or stainless steel wires, mounted with suitably spaced rubber studs. In the embodiment with stainless steel wires conveyor, blasting the dish from the bottom is made possible with a restrainer from top. In the embodiment with hard PVC conveyor, flat table top circular type conveyor is used for delicate tableware that are not suitable for free falling at the end of the conveyor.

10 The embodiment of **Fig.4** shows the perspective view of a holding device to hold those inherently unstable dishware **56** in place under the high pressure jet. The device includes a stainless steel shaft **52**, a number of (e.g. five to eight) stainless steel rings **53** and each ring holds at least four suitably tough yet flexible nylon rods **54**. The rings **53** are slotted into the shaft **52** freely and
15 allowed to rotate freely at a slight force. These rods prevent excessive upward and lateral movement of the dishes during the washing process. The term "excessive" is defined as causing the dishes **56** to be displaced from the surface of the transporter or to be tilted to such an extent as to be toppled or be unable to return to their original position.

20 **Fig.5** shows the front view of the operation of the stabilizer device of **Fig.4**. The nylon rods **54** would be in contact with the dishware **56** on the side and from the top, restraining as well as supporting it in place to prevent lateral movement as well as toppling of the dishware **56**. The conveyor **57**, together with the high frictional rubber studs **58** which provides the gripping force, move
25 the dish **56** forward into the high pressure water blasting area.

The embodiment of **Fig.6** shows a manually operated dishwasher, it is to be placed either inside or on top of a kitchen sink. The cover **65** is preferably made of clear acrylic so that user can look at the cleaning process. A handle and trigger grip **64** is attached to the top of an opened slot **63**. The handle and trigger grip assembly **64** connects to a high pressure water source which may be a standard commercially available product of any high pressure cleaning system. The outlet from the handle trigger grip assembly **64** is connected to a high speed moving single straight jet nozzle **62**. The assembly of the trigger grip **64** and nozzle **62** is attached to slot **63** such as to allow the nozzle to tilt left and right freely as well as to slide along slot **63** via a retaining ring **61**. The high speed rotating or oscillating nozzle **62** provides a high pressure blasting water screen in the direction of the base plate **67**, where the dish **66** is placed. The base plate has rubber studs **68** and grills **60** for soils to discharge to the sink. The acrylic cover **65** is hinged to the base plate **67** at the one side, it opens and closes for changing of dishes. It can be removed from the base plate **67** completely for cleaning of the assembly. An example of a feasible working range is a high pressure water of 100 bars at 6 liters per minute through a 30 degree oscillating nozzle of 1 mm diameter at a height of 225 mm from the base plate.

The machine and the process of using thereof may also be employed as a soil scrapper for heavily soiled dishes. In this application, the dishes being subject to further washing and cleaning. In this case, the water used may be recycled.

While a preferred embodiment and method of the present invention has been described in detail with accompanying examples, it is clear that they are for

illustrations only. Modifications and alterations may be made without departing from the principles disclosed in the present invention of using suitably selected water pressure and flow rate, with the right combination of rotating or oscillating nozzles to scrap, clean and sterilize the dishes within a very short time. The
5 sphere and scope of the invention are defined in the appended claims.

What is claimed is:



- 1 1. A machine for washing dishes comprising :
 - 2 a housing;
 - 3 means, connected to a water source, for producing high pressure water;
 - 4 at least one nozzle, coupled to said housing and connected to said means
 - 5 for producing high pressure water, for producing a blast of water for
 - 6 cleaning.
- 1 2. A machine for washing dishes comprising :
 - 2 a housing;
 - 3 means, connected to a water source, for producing high pressure water;
 - 4 a first blasting means, containing at least one first nozzle connected to said
 - 5 means for producing high pressure water, said first blasting means,
 - 6 attached to said housing, for producing a blast of water for cleaning;
 - 7 a first conveying means for transporting dishes to be washed, said
 - 8 conveying means coupled to said housing below said first blasting means
 - 9 such that dishes placed on said first conveying means would move under
 - 10 the stream of high pressure water blasting from said first nozzle;
 - 11 a second blasting means, containing at least one second nozzle connected
 - 12 to said means for producing high pressure water, said second blasting
 - 13 means, attached to said housing, for producing a blast of water for cleaning;
 - 14 a second conveying means for transporting dishes to be washed, said
 - 15 conveying means coupled to said housing below said second blasting



16 means such that dishes placed on said second conveying means would
17 move under the stream of high pressure water blasted from said second
18 nozzle; and

19 flipping means, coupled to said housing, and disposed between said first
20 conveying means and second conveying means for flipping the dishes over
21 such that the dishes are washed on one side by said first blasting means
22 and washed on the opposing side by said second blasting means.

1 3. A machine according to claim 1 wherein said nozzle is of the high pressure,
2 high speed moving single straight jet type.

1 4. A machine according to claim 1 wherein said nozzle is a the high pressure
2 and high speed single jet rotating nozzle or a high pressure and high
3 speed single jet oscillating nozzle.

1 5. A machine according to claim 1 wherein said means for high pressure
2 water is a high pressure water pump capable of delivering water pressures
3 of between 40 to 150 bar and deliver a flow rate of 6 to 15 liters per minute.

1 6. A machine according to claim 3 further comprising a conveying means for
2 transporting dishes to be washed, said conveying means coupled to said
3 housing below said nozzle such that dishes placed on said conveying
4 means would move under the stream of high pressure water blasted from
5 said nozzle.

1 7. A machine according to claim 3 wherein said means for high pressure
2 water is a high pressure water pump capable of delivering water pressures
3 of between 40 to 150 bar and deliver a flow rate of 6 to 15 liters per minute.



- 1 8. A machine according to claim 6 wherein said conveying means comprises
2 a conveyor belt with rubber studs facing said nozzles for gripping and
3 moving said dishes.
- 1 9. A machine according to claim 3 further comprising a stabilizing means for
2 holding dishes onto said conveying means during the high pressure
3 blasting process.
- 1 10. A machine according to claim 3 further comprising a stabilizing means for
2 holding dishes onto said conveying means during the high pressure
3 blasting process, said stabilizing means comprising
4 a plurality of shafts coupled to said housing and proximate said conveying
5 means, said shafts extending towards said nozzles in a direction
6 substantially perpendicular to the conveying direction, and
7 a plurality of flexible rods having one end rotatably coupled to said shaft
8 and a second end extending radially from said shaft, said rods adapted to
9 interact with dishes placed on said conveying means to prevent excessive
10 upward and lateral movement of said dishes.
- 1 11. A machine according to claim 2 wherein said nozzle is of the high pressure,
2 high speed moving single straight jet type.
- 1 12. A machine according to claim 2 wherein said nozzle is a high pressure and
2 high speed single jet rotating nozzle or a high pressure and high speed
3 single jet oscillating nozzle.
- 1 13. A machine according to claim 2 wherein said means for high pressure
2 water is a high pressure water pump capable of delivering water pressures



3 of between 40 to 150 bars and deliver a flow rate of 20 to 35 liters per
4 minute.

1 14.A machine according to claim 11 further comprising a drying module for
2 drying said dishes after washing.

1 15.A machine according to claim 11 wherein said first and second conveying
2 means each comprises a conveyor belt with rubber studs facing said
3 nozzles for gripping and moving said dishes.

1 16.A machine according to claim 11 further comprising a first stabilizing
2 means for holding dishes onto said first conveying means during the high
3 pressure blasting process.

1 17.A machine according to claim 11 further comprising a first stabilizing means
2 for holding dishes onto said first conveying means during the high pressure
3 blasting process, said first stabilizing means comprising
4 a plurality of shafts coupled to said housing and proximate said first
5 conveying means, said shafts extending towards said nozzles in a direction
6 substantially perpendicular to the conveying direction, and
7 a plurality of flexible rods having one end rotatably coupled to said shaft
8 and a second end extending radially from said shaft, said rods adapted to
9 interact with dishes placed on said first conveying means to prevent
10 excessive upward and lateral movement of said dishes.

1 18.A method for washing dishes comprising blasting said dishes with a blast of
2 high pressure high speed water.



1 19. A method according to claim 18 wherein said blast of water further
2 comprises a moving single jet.

1 20. A method according to claim 18 wherein said blast of water is generated by
2 at least one single jet rotating nozzle or oscillating nozzle.