

**Apparatus for Cleaning Tableware****07 NOV 2005**

This invention relates to a method of and apparatus for cleaning tableware and the like, and in particular, a method and apparatus that uses ultrasonic energy.

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In traditional dishwashers, water jets are used for dislodging particles of food and other contaminants from the surface of tableware. Water alone, even when very hot, is not normally effective enough, and strongly alkaline or oxidizing detergents must be used. The strong detergents tend to bleach overglazes and other coloured decorations on tableware. In addition, the cleanliness level obtained by traditional dishwashers is generally not satisfactory, especially in the case of irregularly shaped tableware. This is partly because water jets cannot reach every surface.

15 The use of ultrasonic dishwashers has been proposed. Ultrasonic cleaning offers many advantages in the field of dishwashers. Ultrasonic cleaning operates on the principle of creating cavitation in a cleaning medium to effect a separation of soil particles from dishware and the like. The cavitation is able to reach all parts of the tableware, even of irregular shapes. It is widely
20 recognized that the efficiency of this ultrasonic cleaning mechanism is dependent on the manner of application of such ultrasonic energy. Although a number of dishwashing machines have previously been proposed, there is currently no commercially available ultrasonic dishwashing machine that can be used to successfully wash dishware and the like using ultrasonic energy.

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Most of the proposed dishwashing machines suffer from the disadvantage that they have not used suitable frequency for the ultrasonic generator or, more importantly, have not determined the correct power level for cleaning. Because of this, the cleanliness level is not satisfactory and in some cases, the tableware is damaged. Inaccurate frequency and power level are known to exert forces that cause erosion on the surfaces, especially on sensitive and delicate surfaces. In addition, these prior art machines relied on detergent and hot water for cleaning. Detergent and hot water incur the disadvantages of environmental degradation and higher energy cost.

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In accordance with a first aspect of the present invention, there is provided apparatus for cleaning tableware, the apparatus comprising a container adapted to hold a liquid, an ultrasonic generation device mounted on the container so as to emit ultrasonic energy into the container, the container being adapted to have tableware placed inside the container, and the ultrasonic energy generation device emitting ultrasonic energy in the frequency range from substantially 20kHz to 80kHz.

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In accordance with a second aspect of the present invention, there is provided a method of cleaning tableware comprising immersing the tableware in a liquid and generating ultrasonic energy in the liquid, the ultrasonic energy generated having a frequency in the region of substantially 20kHz to 80kHz.

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The term "tableware" as used herein includes all utensils or dishes used in the preparation, storage, serving or consumption of food, such as kitchen utensils,

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cutlery, pots, pans, casserole dishes, plates, bowls, cups, saucers, mugs and glasses. In addition, the tableware may be manufactured from any suitable material, such as metal, glass, ceramic or plastic.

- 5 Preferably, the ultrasonic energy is in the frequency range from substantially 28kHz to 68kHz.

Typically, the input power to the ultrasonic energy generation device is in the region of 5W to 45W per liter of liquid within the container, in use, and
10 preferably, in the range from 5W to 25W.

Preferably, the ultrasonic energy generation device is located adjacent a side wall of the container, and typically adjacent a bottom wall.

- 15 Preferably, the ultrasonic energy generation device is located outside the container. However, alternatively, the ultrasonic energy generation device could be mounted inside the container.

Typically, the apparatus further comprises a liquid reservoir coupled to the
20 container. Preferably, a valve is located between the reservoir and the container, the valve being movable between a closed position in which liquid in the reservoir is prevented from entering the container, and an open position in which liquid in the reservoir is permitted to flow from the reservoir to the container. Typically, the apparatus also comprises a pump to pump liquid from
25 the reservoir to the container.

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Preferably, the apparatus comprises another container adapted to hold a liquid, another ultrasonic generation device mounted on the other container so as to emit ultrasonic energy into the other container, the other container being
5 adapted to have tableware placed inside the other container, and the other ultrasonic energy generation device emitting ultrasonic energy in the frequency range from substantially 20kHz to 80kHz.

Typically, where a reservoir is provided, the reservoir is coupled to the container
10 and the other container.

Preferably, the containers are coupled to each other to permit liquid to be transferred between the containers.

15 Typically, the container has a door in a side wall of the container, the door being movable between an open position in which tableware may be inserted into the container and a closed position.

Preferably, the apparatus further comprises a rack located within the container,
20 the rack being adapted to receive items of tableware. Typically, the rack is movable relative to the container, and where the container has a door in a side wall, the rack is preferably slidable into and out of the container when the door is in the open position.

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Typically, the liquid in which the tableware is immersed has a temperature in the range from 15°C to 50°C. Preferably, the liquid has a temperature in the range from 15°C to 35°C, and most preferably, the liquid has a temperature in the range from 20°C to 30°C.

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Preferably, the liquid comprises water and may optionally include a detergent and/or a surfactant.

Examples of apparatus for and a method of cleaning tableware in accordance with the invention will now be described with reference to the accompanying drawings, in which:

- Figure 1 is a cross-sectional side view of a first example of an ultrasonic dishwashing machine with a movable support in a first position;
- 15 Figure 2 is a cross-sectional side view of the machine shown in Figure 1 with the movable support in a second position;
- Figure 3 is a cross-sectional side view of the machine shown in Figure 1 with the movable support in a third position;
- Figure 4 is a cross-sectional front view of the machine shown in Figure 1;
- 20 Figure 5 is a cross-sectional front view of a second example of an ultrasonic dishwashing machine;
- Figure 6 is a cross-sectional side view of the machine shown in Figure 5 with a door in an open position;
- Figure 7 is a rear view of the machine shown in Figure 5;

Figure 8 is a transparent perspective view of a third example of an ultrasonic dishwashing machine;

Figure 9 is a cross-sectional side view of the machine shown in Figure 8 with a door in an open position; and

5 Figure 10 is a rear view of the machine shown in Figure 8.

Figures 1 to 4 show an ultrasonic dishwashing machine 10 that comprises a housing 11 with a first washing machine compartment 5 and a second washing compartment 6. Located at the front of the housing 11 is a door 12 that opens
10 outwardly and permits a rack 13 in which dishes 14 may be mounted, to be loaded into the first compartment 5 of the washing machine 10 through the open door 12. Above the door 12 is an exit door 9 through which the rack 13 exits from the machine 10.

15 The dishwashing machine 10 also includes a first conveyor belt system 15 located adjacent to the door 12. The conveyor belt system 15 has a lower set of rollers 38 and an upper set of rollers 39. Located within the conveyor belt system 15 are nozzles 16 which are fed by a water pipe 17 from a water reservoir 21. Located below the conveyor 15 is a collecting funnel 18 which has
20 an outlet 19 which extends into a filter tray 20 in the water reservoir 21. The water reservoir 21 has an outlet 22 which is coupled to an inlet 23 of a water pump 24. The outlet of the water pump 24 is coupled by a pipe 25 to the water pipe 17 that feeds the nozzles 16.

The second compartment 6 of the dishwashing machine 10 includes a second conveyor belt system 26 which is mounted on a movable support 27. The movable support 27 is movable vertically within the second compartment 6 in the direction of the arrows 28, 29 by means of a pulley system 30 which is driven by a motor 31. Located at the base of the second compartment 6 are a number of ultrasonic transducers 32 which generate ultrasonic energy. In addition, nozzles 33 are provided which are connected to a water supply and are directed to spray water into the second compartment 6. Two sensors 34, 35 are also located in the second compartment 6 to sense the position of the support 27.

The machine 10 is provided with an ultrasonic generator 36 which is coupled to the ultrasonic transducers 32 and controls the output power and frequency of the ultrasonic transducers 32. The machine 10 is also provided with a hot air blower 37.

In use, tableware, such as dishes 14 are loaded into a rack 13. The door 12 of the machine 10 is then opened and the rack 13 is inserted into the first compartment 5 so that the rack 13 is positioned on the conveyor belt system 15 on the lower set of rollers 38 (as shown in Figure 1) and the door 12 is closed.

An operator then commences the washing cycle by pressing a start button. This opens valves (not shown) which permit water from a mains water supply to fill the reservoir 21. When the reservoir 21 is filled the pump 24 is actuated to pump water from the water reservoir 21 through the water pipes 25, 17 to

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supply water to the nozzles 16. Water from the nozzles 16 sprays over the dishes 14 and washes loose particles of dirt from the dishes 14. The particles of dirt are washed to the collecting funnel 18. The dirt washed from the dishes 14 is moved by flowing water in the collecting funnel 18 to the outlet 19 where it
5 enters the filter tray 20 and the water re-enters the reservoir 21 for recycling. The filter tray 20 collects the dirt particles and minimises the dirt particles being pumped back to the nozzles 16 by the recycling of the water in the reservoir 21.

After the preliminary wash cycle in the first compartment 5 is completed, the
10 support 27 is moved to the position shown in Figure 1. This position is detected by the sensor 34 which stops operation of the motor 31 when the support 27 is in the correct position. The conveyor belt system 15 is then driven to move the rack 13 from the first compartment 5 onto the conveyor belt system 26 on the support 27 so that the rack 13 moves to the position on the support 27 shown in
15 Figure 1. When the rack 13 is in position on the support 27, the motor 31 is driven to move support 27 downwards in the direction of the arrow 29 until the lower side of the support 27 is adjacent to the transducers 32 and the support is in a lower section 7 of the second compartment 6. This position is shown in Figure 2 where the rack 13 and dishes 14 have been omitted for clarity. The
20 lower section 7 is filled with water up to a line 8 indicated in Figure 1, so that when the support 27 is located in the lower section 7, dishes in the rack 13 are submerged in the water in the lower section 7.

When the support 27 is in the position shown in Figure 2, the generator 36 is
25 operated to drive the ultrasonic transducers 32 to generate ultrasonic energy.

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Typically, the ultrasonic energy generated has a power of 5 to 25 Wl⁻¹.

However, the ultrasonic power can vary from 5 to 45 Wl⁻¹, as desired. Typically, the frequency of the ultrasonic power omitted by the transducers 32 is in the range from 20 to 80 kHz and preferably from 28 to 68 kHz. While the

5 transducers 32 would normally operate at a fixed frequency, it is also possible that the frequency emitted by the transducers 32 could vary between a minimum frequency and a maximum frequency during the cleaning operation.

After a preset time, the generator 36 is switched off and the motor 31 is
10 actuated to move the support 27 upwards to the position shown in Figure 1.

When the support 27 reaches this position, the sensor 34 detects the support 27, turns off the motor 31 and clean water is sprayed from the nozzles 33 onto the dishes 14 to rinse them. After rinsing, the motor 31 is reactivated to move the support upwards to the position shown in Figure 3. When the support 27
15 reaches this position, the sensor 35 detects the support 27, turns off the motor 31 and activates the blower 37 to blow hot air onto the dishes 14 located in the tray 13 to dry the dishes 14.

After the drying operation has been completed, the conveyor belt system 26 is
20 driven to move the tray 13 onto the upper set of rollers 39 of the conveyor belt system 15. The conveyor belt system 15 is then driven to move the tray 13 and the dishes 14 towards the exit door 9. A sensor 4 is located by the exit door 9. When tray 13 reaches the sensor 4, the sensor 4 detects the presence of the tray 13 and switches off the conveyor belt systems 15, 26. A user can then
25 manually open the exit door 9 and remove the tray 13 with the cleaned dishes.

During the washing operation, water at a temperature of 15°C to 35°C would normally be used. However, if appropriate, the water exiting the nozzles 16, 33 and/or the water in the lower section 7 could be heated to any temperature
5 between 20 to 100°C. In addition, a detergent and/or surfactant could be optionally mixed with the water to help remove residues, such as grease from the dishes 14. Although the operation of the washing machine 10 is described above with specific reference to the cleaning of dishes, the washing machine 10 may be used to clean any item of tableware.

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Figures 5 to 7 show a second example of an ultrasonic dishwashing machine 40 which includes a housing 41 having a door 42 which pivots outwardly on the housing 41 by means of a hinge 43. When the door 42 is shut, the door 42 is maintained in a closed position by a releasable catch 44. The housing 41 also
15 includes on its front upper surface a control panel 45 to permit an operator to control the operation of the dishwashing machine 40.

Within the machine 40 are two cleaning compartments 46, 66 which have mounted within them respective upper trays 47, 57 and respective lower trays
20 48, 58. The upper trays 47, 57 are slidably mounted within the cleaning compartments 46, 66 by means of a roller and slide arrangement 49. The lower trays 48, 58 are slidably mounted within the cleaning compartments 46, 66 by means of rollers 50 which engage with tracks 51, 52 formed on the bottom of the compartments 46, 66 and the inside of the door 42. The racks 47, 48, 57,
25 58 are designed to enable tableware, such as bowls 53, cups 54, glasses 55,

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56 and plates 60, 61 and saucers 59 to be positioned in the racks 47, 48, 57, 58. Located within the cleaning compartments 46, 66 are nozzles 62, 63 respectively which are used to spray water upwardly and downwardly into the cleaning compartments 46, 66. Located at the bottom of each of the cleaning compartments 46, 66 are respective sets of ultrasonic transducers 64, 65 which are controlled by an ultrasonic generator 67.

In the machine 40, the nozzles 62, 63 are fixed relative to the compartments 46, 66. However, it is possible that the nozzles 62, 63 could rotate or move within the respective compartment 46, 66.

Figure 7 shows a rear view of the machine 40. From this it can be seen that the machine 40 also includes a water pump 68 which has an inlet pipe 69 and an outlet pipe 70. The inlet pipe 69 is coupled via a filter 71 and a valve 72 to an outlet 73 from the washing tank 46, and via a valve 74 to an outlet 75 from the tank 66. In addition, the inlet 69 is also coupled to a water reservoir 76 via a valve 77 and an outlet 78 from the reservoir 76.

The outlet 70 from the pump 68 is coupled via a valve 79 to an inlet 80 to the compartment 46 and via a valve 81 to an inlet 82 to the compartment 66.

A water supply pipe 83 is connected via a pipe (not shown), which is typically a flexible pipe, to a mains water supply (not shown). The water supply pipe 83 is coupled via a valve 84 to a second inlet 85 of the compartment 46, via a valve

86 to a second inlet 87 of the compartment 66 and via a valve 88 to an inlet 89 of the reservoir 76.

In addition, each of the compartments 46, 66 has a respective waste outlet 90, 91 which are coupled via valves 92, 93 respectively to a waste water pipe 94.

In use, tableware to be cleaned, such as cups 54, saucers 59, bowls 53, glasses 55, 56 and plates 60, 61 are stacked in the racks 47, 48, 57, 58 and the door 42 is closed. The ultrasonic dishwashing machine 40 is then started by an operator operating a control switch on the control panel 45. After the machine 40 is started, the valve 88 is opened and water from the water supply pipe enters the reservoir 76. When the reservoir 76 is full a water level sensor in the reservoir 76 sends a signal to the central control system 95. In response to this signal, the control system 95 closes the valve 88 and opens the valves 77, 79 and starts the pump 68. This causes water to be pumped from the reservoir 76 to the outlet 80 to spray water from the nozzles 62 in the compartment 46 upwards and downwards over tableware 54, 59, 56, 60 in the racks 47, 48 in the compartment 46. The water sprayed from the nozzles 62 acts to remove larger particles from the tableware 54, 59, 56, 60. During this pre-wash, the valve 92 is open so that dirt washed off the tableware 54, 59, 56, 60 is washed out of the compartment 46 through the outlet 90 into the waste pipe 94.

After the pre-wash is complete, the valves 77, 79 are closed and the pump 68 is stopped. The waste outlet valve 92 is then closed and valve 84 is opened to permit water from the water supply pipe 83 to fill the compartment 46 through

the inlet 85. After the compartment 46 has been filled to the desired level, which is typically detected via a water level sensor located within the compartment 46 which is coupled to the control system 95, valves 72 and 79 are opened and the water pump 68 is started to circulate the water within the compartment 46 to thoroughly mix the detergent with the water. After mixing of the detergent with the water, the valves 72, 79 are closed and the pump 68 is stopped. The control system 95 then activates the ultrasonic generator 67 to cause the transducer unit 64 to emit ultrasonic energy into the compartment 46 to ultrasonically clean the tableware 54, 56, 59, 60 in the racks 47, 48. The duration of the ultrasonic washing process can be selected from the control panel 45 depending on the size of the wash load and the amount of soiling of the tableware 54, 56, 59, 60.

After the ultrasonic wash in compartment 46 is completed, valves 72, 81 are opened and the pump 68 started to pump water from the compartment 46 to the nozzles 63 in the compartment 66. Any particles of dirt in the water from the compartment 46 are trapped by filter 71 before being pumped to the nozzles 63 of the compartment 66. During this pre-wash for the compartment 66, the waste outlet valve 93 is opened to permit dirt particles washed off the tableware 53, 55, 61 in the second compartment 66 to be washed out of the outlet 91 into the waste water pipe 94. After this pre-wash, valves 72, 74 are opened and water flows from compartment 46 into the compartment 66 by gravity until the water levels in the compartments 46, 66 are level. When the water level is the same, valve 74 is closed and pump 68 pumps the remaining water from the compartment 46 through valve 81 to the nozzles 63 in the compartment 66. If

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additional water is required in the compartment 66, this can be provided by opening valve 86 to permit water from water supply pipe 83 to enter the compartment 66 through the inlet 87.

- 5 After the compartment 66 is filled to the desired level, valve 72 is closed and valve 74 is opened and the pump 68 started to circulate water through the compartment 66 to mix the water with the detergent in the compartment 66. After the mixing of the detergent with the water is complete, valves 74, 81 are closed and the pump 68 is stopped. The control system 95 then operates the
- 10 ultrasonic generator 67 to activate the set of transducers 65 to emit ultrasonic energy into the compartment 66 to ultrasonically clean the tableware 53, 55, 61 in the compartment 66.

- During the ultrasonic washing stage in the compartment 66, remaining water
- 15 from the compartment 46 is drained through the outlet 90 into the waste water pipe 94 by opening the waste valve 92. Simultaneously, fresh water from reservoir 76 is pumped to the compartment 46 through nozzles 62 to rinse the tableware 54, 56, 59, 60 in the compartment 46. Valves 77, 79 are open during this operation. The rinsing operation continues for 20 to 120 seconds
- 20 depending on the wash program selected. During rinsing, the waste valve 92 remains open to allow water and any dirt to drain from the compartment 46.

- After the ultrasonic washing operation in compartment 66 is completed, the control system 95 switches off the ultrasonic generator 67 and water in the
- 25 compartment 66 is drained through the outlet 91 to the waste outlet pipe 94 by

opening the valve 93. After that, fresh water is sprayed into the compartment 66 by opening valves 77, 81 and running the pump 68 to pump water from the reservoir 76 through the nozzles 63 to rinse the tableware 53, 55, 61 in the compartment 66.

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The control system 95 is designed to control the generator 67 so that the generator can control the power level emitted by the transducers 64, 65. For example, preferably, the power for the ultrasonic transducers 64 in the compartment 46 is 1200 watts and the power for the compartment 66 is 600
10 watts. After the ultrasonic washing process in compartment 46 is completed, the control system 95 automatically switches the ultrasonic generator 67 to the transducers 65 and adjusts the power level from 1200 W to 600 W.

In another example of operation of the washing machine 40, it is possible that
15 the compartments 46, 66 may only be filled up to the levels 96, 97 shown in Figure 5. In this instance, items in the lower racks 48, 58 are submerged in water and are therefore subjected to the ultrasonic energy emitted by the transducers 64, 65. However, the items 53, 54, 55, 56, 59 in the upper racks 47, 57 are only cleaned by water sprayed from the nozzles 62, 63. In this mode
20 of operation, during ultrasonic washing of the items 60, 61 in the lower racks 48, 58, the pump 68 sprays water through the nozzles 62, 63 onto the items 53, 54, 55, 56, 59 in the upper racks 47, 57. This mode of operation has the advantage of reducing the water and energy used and can be used if the items 53, 54, 55, 56, 59 in the upper racks 47, 57 are only lightly soiled.

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Figures 8 to 10 show a third example of an ultrasonic dishwashing machine 100 which is effectively a smaller version of the machine 40. The machine 100 operates in a similar manner to the machine 40 but has only one cleaning compartment 101. The machine 100 has a housing 102 which includes a door 103 which is hinged on the housing 102 by a hinge 104. The washing machine 100 also has only one rack 105 which is slidable in and out of the tank 101 to permit dishes 106 to be stacked in the rack 105. Located within the compartment 101 are nozzles 107 which are supplied with water by a pipe 108, which supplies water to the nozzles 107 from an internal water reservoir 112 by a water pump 111. A waste outlet 113 extends from the bottom of the compartment 101 to a waste pipe 114 via a valve 120. Also located at the bottom of the compartment 101 are a set of ultrasonic transducers 115. A water supply pipe 109 is coupled via a valve 116 to an inlet 117 into the compartment 101 and also to the reservoir 112 via valve 118 and inlet 119.

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In use, the operation of the washing machine 101 is similar to the cleaning operation which is performed in one of the compartments 46, 66 of the washing machine 40. Initially, the reservoir 112 is filled with water by opening the valve 118. After the reservoir 112 is full the pump 111 is operated to spray water onto the dishes 106 in the rack 105 by pumping water through the pipe 108 to the nozzles 107. During this pre-wash operation, the waste outlet 113 is opened by the opening of the valve 120 to permit waste water to flow through the outlet 113 into the waste pipe 114. After the pre-wash operation is complete, valve 120 is closed and the tank 101 is filled by water from the water supply pipe 109 via the inlet 117 by opening the valve 116. When the tank 101 is filled to the

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desired level with water, the ultrasonic transducers 115 are operated to perform ultrasonic cleaning of the dishes 106 in the tank 101.

After the ultrasonic wash operation is completed, the valve 120 is opened to
5 permit waste water to flow out through the waste outlet 113 to the waste pipe 114 and water from the reservoir 112 is sprayed into the tank 101 through the nozzles 107 to rinse the dishes 106.

The invention has the advantage that it enables more efficient cleaning of
10 tableware by using ultrasonic cleaning techniques. In addition, the washing machine 40 has the advantage that it enables a more efficient washing operation as it can be operated with different capacities and the water and ultrasonic energy used can be altered depending on the size of the washing load. Also, the washing machine 40 permits re-use of waste water from one of
15 the compartments to pre-wash and ultrasonically wash in the other compartment. This reduces the amount of water consumed by the machine 40.

CLAIMS

1. Apparatus for washing tableware comprising a container adapted to hold a liquid having a temperature in the range 15°C to 50°C, an ultrasonic generation device
5 mounted on the container so as to emit ultrasonic energy into the container, the container being adapted to have tableware placed inside the container, and the ultrasonic energy generation device emitting ultrasonic energy in the frequency range from substantially 20kHz to 80kHz and wherein the input power to the ultrasonic energy generation device is in the region of 5W to 45W per liter of
10 liquid within the container, in use.
2. Apparatus according to claim 1, wherein the ultrasonic energy is in the frequency range from substantially 28kHz to 68kHz.
- 15 3. Apparatus according to claim 1 or claim 2, wherein the input power is in the range from 5W to 25W per liter of liquid within the container, in use.
4. Apparatus according to any of the preceding claims, wherein the ultrasonic energy generation device is located adjacent a side wall of the container.
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5. Apparatus according to any of the preceding claims, wherein the ultrasonic energy generation device is located outside the container.

6. Apparatus according to any of the preceding claims, further comprising a liquid reservoir coupled to the container.
7. Apparatus according to claim 6, further comprising a valve located between the reservoir and the container, the valve being movable between a closed position in which liquid in the reservoir is prevented from entering the container, and an open position in which liquid in the reservoir is permitted to flow from the reservoir to the container.
8. Apparatus according to claim 6 or claim 7, further comprising a pump to pump liquid from the reservoir to the container.
9. Apparatus according to any of the preceding claims, further comprising another container adapted to hold a liquid, another ultrasonic generation device mounted on the other container so as to emit ultrasonic energy into the other container, the other container being adapted to have tableware placed inside the other container, and the other ultrasonic energy generation device emitting ultrasonic energy in the frequency range from substantially 20kHz to 80kHz.
10. Apparatus according to claim 9 when dependent on any of claims 6 to 8, wherein the reservoir is coupled to the container and the other container.

11. Apparatus according to claim 9 or claim 10, wherein the containers are coupled to each other to permit liquid to be transferred between the containers.
12. Apparatus according to any of claims 9 to 11, where the container has a larger
5 volume than the other container and the ultrasonic energy emitted into the container is greater than that emitted into the other container.
13. Apparatus according to any of the preceding claims, wherein the container has a
10 door in a side wall of the container, the door being movable between an open position in which tableware may be inserted into the container and a closed position.
14. Apparatus according to any of the preceding claims, further comprising a rack
15 located within the container, the rack being adapted to receive items of tableware.
15. Apparatus according to claim 14, wherein the rack is movable relative to the container.
- 20 16. Apparatus according to claim 14 or claim 15 when dependent on claim 14, the rack being slidable into and out of the container when the door is in the open position.

17. A method of washing tableware comprising immersing the tableware in a liquid having a temperature range from 15°C to 50°C and generating ultrasonic energy in the liquid, the ultrasonic energy generated having a frequency in the region of substantially 20kHz to 80kHz and supplying an ultrasonic energy device for
5 generating the ultrasonic energy with input power in the region of 5kw to 45kw per liter of liquid within the container.
18. A method according to claim 17, wherein the ultrasonic energy has a frequency in the region of 28kHz to 68kHz.
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19. A method according to claim 17, wherein the liquid has a temperature in the range from 15°C to 35°C.
20. A method according to claim 19, wherein the liquid has a temperature in the
15 range from 20°C to 30°C.