

Feb. 24, 1970

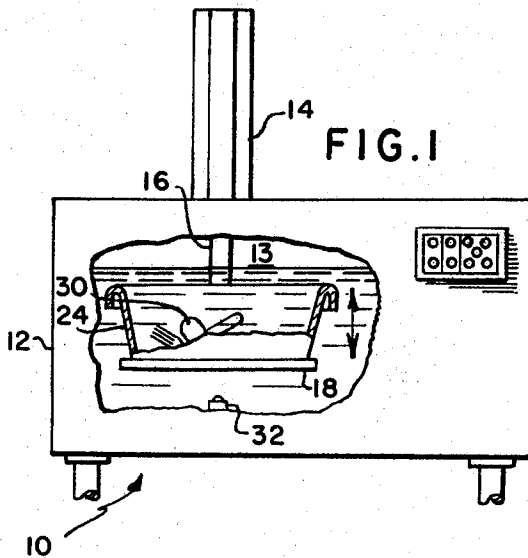
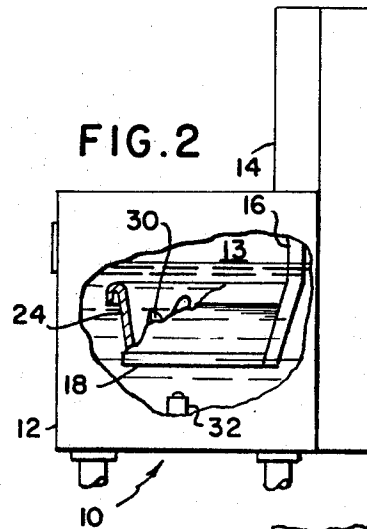
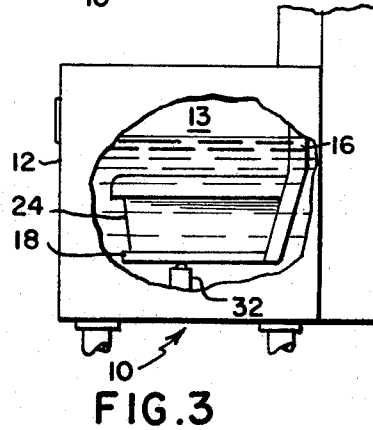
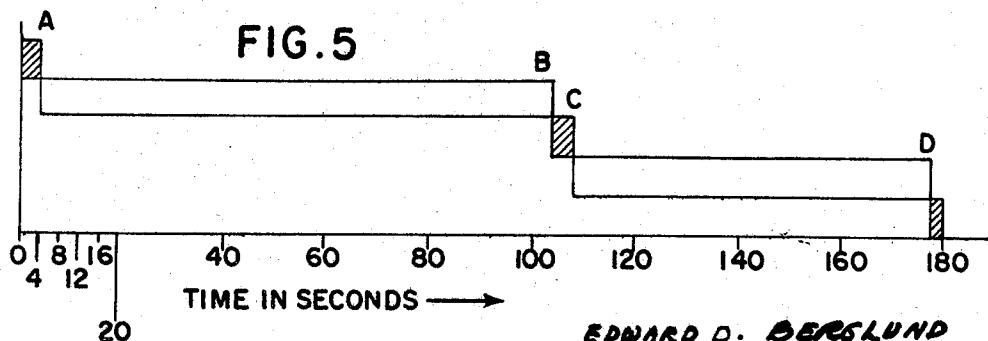
E. D. BERGLUND ET AL

3,497,445

APPARATUS FOR CLEANING AND DETARNISHING SILVERWARE

Filed July 28, 1967

2 Sheets-Sheet 1



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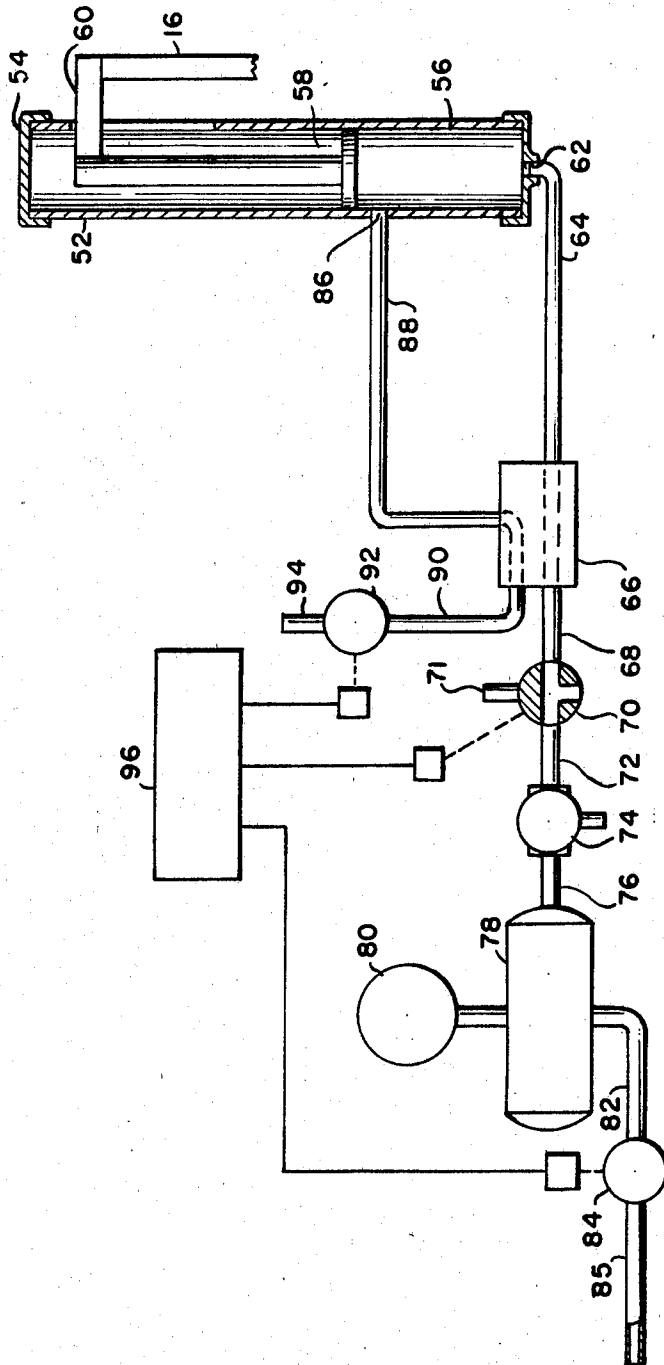


FIG. 4

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APPARATUS FOR CLEANING AND DETARNISHING SILVERWARE

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Filed July 28, 1967, Ser. No. 656,835
Int. Cl. C23b 1/00; B01k 3/00
U.S. Cl. 204—222

4 Claims

ABSTRACT OF THE DISCLOSURE

An apparatus for removing food soils from the silverware and detarnishing that silverware in a detergent solution having electrolytic properties is shown. A silverware basket containing soiled silverware is mechanically agitated in detergent solution in a tank to remove food soils; the silverware basket is then contacted with an electrode at the bottom of the tank and electrons pass from the silverware in contact with the basket through the detergent solution and into the walls of the tank thereby detarnishing the silverware. The cleaning and detarnishing is most satisfactorily achieved using a detergent solution maintained at 100° to 130° F. and a current density maintained at 0.1 to 2 amperes per square foot of silverware surface.

This invention relates to an apparatus for removing food soils and tarnish from silverware. More specifically, it relates to an apparatus which, in a single bath of detergent having electrolytic properties, first removes superficial food soils from silverware by mechanical action and then detarnishes that silverware by electrolytic action.

The extensive use of silverware in the food service industry, in hotels and large restaurants, for example, has created a need for fast, inexpensive and reliable means for cleaning and detarnishing soiled silverware after each use. The cleaning of irregularly shaped utensils such as flatware is attended by problems caused by the tenacious nature of many food soils and requires particular washing procedures. The reaction of the silver surfaces of such utensils with atmospheric sulfides and sulfides in foods and the attendant formation of unsightly, golden, brown or black sulfide tarnish makes frequent detarnishing imperative. The silver sulfide tarnish is a relatively inert and insoluble compound requiring a substantial amount of energy to reduce it to metallic silver and hydrogen sulfide.

One effective technique which has been used to clean and detarnish silverware includes the steps of (1) pre-soaking the silverware in a detergent solution to loosen soils that can be easily washed off in subsequent dish machine washing steps and (2) electrolytically detarnishing the cleaned silverware by forming an electrolytic cell with aluminum and an electrolyte. One disadvantage of this technique is that the hotel or restaurant must maintain high inventories of silverware to insure an adequate supply at all times. Detarnishing by the aluminum cell method has other disadvantages. In the aluminum-silver cell, the aluminum becomes anodic and the silver becomes cathodic; the electrons, required for the reduction of silver sulfide to metallic silver, come from the oxidation of aluminum metal to aluminum oxide, the aluminum oxide becoming hydrated in the electrolyte bath. This detarnishing technique, therefore, consumes aluminum and is referred to as a sacrificial system. The aluminum anodes must be replaced from time to time involving expense and operational inefficiency.

Furthermore, as the hydrated aluminum oxide forms on the surface of the anode, it creates a resistive or insulat-

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ing barrier so that not only does the interaction between the aluminum and the electrolyte become lessened but also the cell potential decreases with time and eventually silver ion reduction will no longer take place.

It has been recognized that tarnish can be removed from silver other than by formation of an aluminum-silver electrolytic cell such as by supplying a potential to the silver from an external source so that the silver becomes cathodic to a neighboring metal which is anodically polarized. This is a reverse cell and the flow of current from anode to cathode reduces the silver sulfide tarnish to silver metal, the anode is not sacrificial and, with proper choice of material, is not subject to the formation of a resistive oxidative film. Although the mechanism is complicated, the silver sulfide is reduced by the action of atomic or nascent hydrogen produced at the silver surface by the imposition of a cathodic potential on the silverware.

It is the purpose of this invention to provide an apparatus and method which removes food soil from used silverware and detarnishes that silverware in a rapid, efficient process.

It is a further object of the invention to provide a single, inexpensive unit requiring minimum attention which thoroughly cleans and detarnishes the silverware while keeping "rejects," incompletely cleaned pieces, to a minimum.

It is a further object of this invention to provide an apparatus and method employing a single wash or detergent solution to perform the dual functions of food soil removal and serve as the electrolyte in the detarnishing.

It is still a further objective of this invention to provide an electrolytic system wherein the non-silver electrode is not sacrificed or rendered less efficient by formation of a resistive oxidative film.

These and other objects of the invention are accomplished by means of an apparatus comprising a tank for detergent solution constructed of stainless steel in which a conventional silverware basket of stainless steel or other resistant metal is supported. The basket is supported from outside the tank by a support member adapted to raise from and lower the basket into the tank and is connected with means to rapidly agitate the basket in the tank when the latter is filled with detergent solution. The tank is further provided with an electrode positioned near the bottom of the tank and insulated therefrom which electrode makes contact with the silverware basket when it is in supported position near the bottom of the tank. This electrode is in turn connected to the cathode of a source of direct current and forms, with the walls and bottom of the tank separately connected to the anode of the source of direct current, the electrolytic cell for the reduction of silver sulfide tarnish on the silverware being cleaned.

In operation, the tank is filled with a detergent solution which has electrolytic properties and preferably is mildly alkaline. The basket filled with silverware is lowered into the solution and rapidly agitated therein. After agitation for a period sufficient to loosen about 95% of the food soil, the basket is lowered to its supported position near the bottom of the tank to contact the electrode near the bottom of the tank. A circuit is then completed, creating a potential between the silverware basket and the silverware in the basket on the one hand and the walls and bottom of the tank on the other hand. A controlled current flows until satisfactory detarnishing has been accomplished. The basket is then raised and removed from the detergent solution. A final wash or rinse in a conventional dishwashing machine is all that is necessary to accomplish the complete removal of any food soil still adhering to the silverware.

The invention is more completely described in the fol-

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lowing drawings which represent a preferred embodiment.

FIG. 1 is a front view of the silverware cleaner-detarnisher with portions cut away to show internal detail;

FIG. 2 is a side view of the silverware cleaner-detarnisher with portions cut away;

FIG. 3 is a side view of the silverware cleaner-detarnisher with portions cut away showing the silverware basket in contact with the electrode near the bottom of the tank;

FIG. 4 is a schematic representation of a preferred pneumatic agitation mechanism; and

FIG. 5 is a bar-graph showing the cycle timing for a wash-detarnishing operation.

Referring now to FIG. 1, reference numeral 10 designates the silverware cleaner-detarnisher of this invention. The unit includes sink or tank 12 which is preferably of stainless steel construction. Tank 12 has a drain connection (not shown) at the bottom. Tank 12 contains detergent solution 13. At one side is an agitation mechanism shown generally as 14. Agitation mechanism 14 includes at one end a vertical support bar 16 for the silver basket and at the other end means for rapidly reciprocating the bar. This latter means may be a compressed air piston/cylinder arrangement as shown in U.S. Patent No. 2,857,923 to Zinty and in FIG. 5 or of a cam or other type well known to the art. Support bar 16 extends downwardly into tank 12 and at its lower extension is joined to horizontal silverware basket support frame 18. Support frame 18 is preferably a square, angle iron type frame and can have locking arms adapted to hold the silverware basket in place during agitation. Silverware basket 24 is shown positioned on support frame 18. Sidewalls 26 of silverware basket 24 can be of any suitable solid or mesh construction. Silverware basket 24 has a screen of suitable conductive metal for a bottom 28 which supports the silverware 30, loaded thereupon, and permits thorough-surfing of the detergent solution upon vertical agitation of the basket. Preferably the sidewalls 26 of the silverware basket 24 are of solid construction so that during agitation the detergent solution 13 is forced through the basket and not out the sides. Located near the bottom of tank 12 is stainless steel electrode 32 connected to the cathode of a source of direct current (not shown). Electrode 32 is insulated from tank 12 by insulation which can be any conventional insulation suitable for the purpose. The walls and bottom of tank 12 are connected to the anode of the source of direct current (not shown). An important feature of the silverware cleaner-detarnisher design is that the silverware basket is supported equi-distant from the walls of the tank and from the bottom of the tank during the detarnishing operation so that silverware in the basket will be subjected to about the same potential, thereby detarnishing all silverware uniformly and at about the same rate.

Typically the tank is 24 inches wide by 24 inches long and the silverware basket is 20 inches wide by 20 inches long. During detarnishing the basket, which is centered in the tank, is supported 2 inches above the floor of the tank thereby establishing circuit paths through the detergent solution of equal distance.

A partial tank shield covering the outer periphery of the top of the tank, i.e. the area between the walls of the tank and the sides of the silverware basket, is desirable. This precludes silverware added to the tank before and after the detarnishing operation has begun from falling between the basket and the wall and short circuiting the system. Silverware which falls to the bottom of the tank will be oxidized rather than detarnished. A black film will form which can be removed only by polishing.

Racked baskets of silverware can be placed upon the support frame or silverware can be added to an empty basket already in the machine. It has been found that horizontally stacked silver is cleaned and detarnished more completely than vertically stacked silver.

The silverware cleaner-detarnisher should be connected

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to a source of direct current, preferably associated with it. The current density established in the electrolyte is determined by the potential maintained, the geometry of the system, and the electrolyte concentration. The current density should not exceed about 2.0 amperes per square foot of silverware surface and the power source should be adequate for that purpose. Above that current density, damage to knife blades is likely to occur and hydrogen embrittlement or blistering of stainless steel is also likely to occur. The optimum range is from 0.1 to 1.0 ampere per square foot and best results are obtained if the current density is maintained at about 0.50 ampere per square foot.

The silverware cleaner-detarnisher can be provided with an automatic temperature control device such as an electric coil heater. This device should be capable of maintaining the temperature of the detergent in the tank at from 100° to 130° F. Although the detarnishing operation is relatively independent of temperature, it has been found that above about 130° F., protein food soils coagulate and below about 100° F., fats solidify making the removal of food soils prior to detarnishing more difficult. Temperature of each batch of fresh detergent solution is advantageously set in the upper part of the temperature range.

In FIG. 4, reference numeral 50 designates generally the pneumatic agitation system preferably incorporated into the apparatus of this invention. Reference numeral 52 is a cylinder having a cap 54 in which piston 56 is free to move vertically. Piston 56 is connected to vertical bar 58 which is in turn connected at its upper extension to horizontal bar 60. Horizontal bar 60 is free to move in a vertical slit in the upper part of cylinder 52.

Depending from vertical bar 60 is support bar 16 to which is attached silverware support frame 18 (shown in FIGURES 1-3). Cylinder 52 is provided with air inlet port 62 connected by means of line 64 to pneumatic switch 66. Switch 66 works on a flip-flop basis i.e. air flowing one way precludes air from flowing the other way. Switch 66 is connected via line 68 to three-way, coil-operated solenoid valve 70 vented to the atmosphere via line 71. Valve 70 is in turn connected via line 72 to pressure regulator 74. Pressure regulator 74 is connected via line 76 to air tank 78 fed by compressor 80, air tank 78 and compressor 80 being vented via line 82, two-way solenoid valve 84, and line 85. Cylinder 52 is also provided with an upper port 86 connected via line 88 to pneumatic switch 66. Line 88 extends through pneumatic switch 66 to line 90, to two-way solenoid valve 92 and from there to the atmosphere via line 94. Solenoid valves 70, 84, and 92 are shown connected by electrical lines to a timer 96 which controls their operation.

In operation, compressed air is fed at controlled pressure via solenoid valve 70 and pneumatic switch 66 to the bottom of cylinder 52. This causes piston 56 to rise upwardly in cylinder 52 until it passes port 86. The air introduced at the base of cylinder 52 then vents through lines 88 and 90, open solenoid valve 92 and line 94. Piston 56, support arm 16, support frame 18 connected thereto and silverware basket 24 supported thereon move downwardly until port 86 is covered. At this point, piston 56 is again impelled upwardly. By varying the sizes of the inlet and outlet ports, the pressure of the air supplied, the size of the loads, and the friction of the piston in the cylinder, it is possible to achieve any desired rate of pulsation.

At the start of the washing and the finish of the detarnishing operation, solenoid valve 70 is opened but solenoid valve 92 is closed. This causes piston 56 to rise as high as it can with cylinder 52. A suitable stop can be placed within the cylinder at any desired height or, as shown, horizontal bar 60 may contact cylinder cap 52. A silverware basket of soiled silver can then be

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placed on the support frame or a cleaned and detarnished basket of silverware can be removed.

At the start of the detarnishing cycle, solenoid valve 70 is opened allowing air to vent from beneath piston 56 through lines 64, 68 and 71 and switch 66. The piston and its associated support bar 16 will then be at its low point and suitable positioning will permit silverware basket 24 supported on support frame 18 to contact electrode 32 near the bottom of tank 12.

FIG. 5 shows a preferred timing cycle for operation of the silverware cleaner-detarnisher. At the start, (time=0) soiled silverware is loaded into silverware basket 24 and a detergent having electrolytic and mildly alkaline properties is added to the tank at a temperature of 100-130° F. The cycle is controlled by an automatic timer and lasts for three minutes, each operation being started and stopped according to a pre-set schedule. The agitation mechanism is first activated. The basket drops into the solution and agitation commences after about four seconds as shown by point A on the timing graph. Agitation continues for about 100 seconds as shown by point B on the timing graph. The silverware basket 24 is then automatically lowered to near the bottom of the tank where it makes contact with electrode 32 (point C). The detarnish circuit is closed by the timer and the detarnishing operation commences. Detarnishing takes about 30 seconds. The silver basket is then automatically raised out of the detergent solution (point D) and can be removed from the apparatus. The compressed air is preferred over other electro-mechanical or mechanical drive systems. It is rugged, reliable and efficient and if it is stopped accidentally at some point in its operation, there is no danger of burning out an electric motor or damaging gears. Other means which may be adapted to agitate the silverware basket in the apparatus of this invention are those shown in U.S. Patents Nos. 2,520,354; 2,628,460; 2,726,642 and 3,047,436.

The choice of detergent is affected by several considerations. Firstly, it must have satisfactory detergent properties and electrolytic properties. Secondly, since prior to the subsequent final washing operation, the silverware which has been cleaned and detarnished by the apparatus and method of this invention may be permitted to stand and dry, the detergent must not have strongly alkaline properties. Products having a high alkalinity will result in oxide formation under these conditions. Of course, chlorinated compounds should not be used in the detergent solution. Representative of satisfactory detergents are those having for their basic ingredient the silicates, metasilicates, phosphates, polyphosphates, carbonates or hydroxides of sodium or potassium. These detergents are known to the art. Non-ionic constituents can also be used but the foregoing provide the detergent solution with electrolytic properties. Assure is the preferred detergent to use and is satisfactory in concentrations of 0.1 to 3.0%.

Generally 10 to 100 seconds are required for detarnishing with these detergents. Detergent life in the apparatus is governed by the rate of food-soil build-up in the solution. When food soil load becomes so high that cleaning efficiency is affected, the tank should be drained and recharged. The apparatus and method of this invention are equally effective with silver hollowware. They do not

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eliminate the requirement of burnishing the silverware but the procedure is required less often than with heretofore available procedures and apparatus. The apparatus and method of this invention can be used if desired to augment the effectiveness of ultrasonic methods of silverware cleaning.

We claim:

1. An apparatus for cleaning and detarnishing soiled silverware comprising: a tank of stainless steel construction for holding an inventory of detergent solution in said tank, said detergent having electrolytic properties; a vertical bar extending into said tank having a silverware basket support means at its lower extension, said bar being moveable vertically to raise said support means in and out of said tank; a silverware basket supported on said support means having a bottom grating permitting detergent solution to pass upwardly and downwardly through said basket; agitation means connected to said support bar vertically to reciprocate said support bar, said support means and said silverware basket; a source of direct current; electrode means positioned near the bottom of said tank such that the electrode means contacts the bottom grating of the silverware basket in lowered position, the electrode means being insulated from the tank and connected to the cathode of said source of direct current; means interconnecting the walls and bottom of the tank with the anode of said source of direct current; control means to start and stop reciprocation of the agitation means and control means to start and stop the flow of direct current.

2. The apparatus of claim 1 wherein said supported silverware basket when in contact with said electrode, is approximately perpendicularly equi-distant from the walls and bottom of said tank.

3. The apparatus of claim 1 wherein the agitation means is comprised of a vertically disposed cylinder, a piston therein, a source of compressed air, a compressed air inlet port in the lower end of said cylinder connected to the compressed air source and an exhaust port located in said cylinder at a height representing an intermediate point in the desired stroke of the piston.

4. The apparatus of claim 3 wherein the opening and closing of the inlet and exhaust ports in said cylinder are controlled by solenoid valves.

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U.S. Cl. X.R.

204—141, 225, 273, 287