March 23, 1943. D. K. FERRIS 2,314,332

APPARATUS FOR WASHING ARTICLES

Filed June 10, 1936 5 Sheets-Sheet 1

Fig. 1

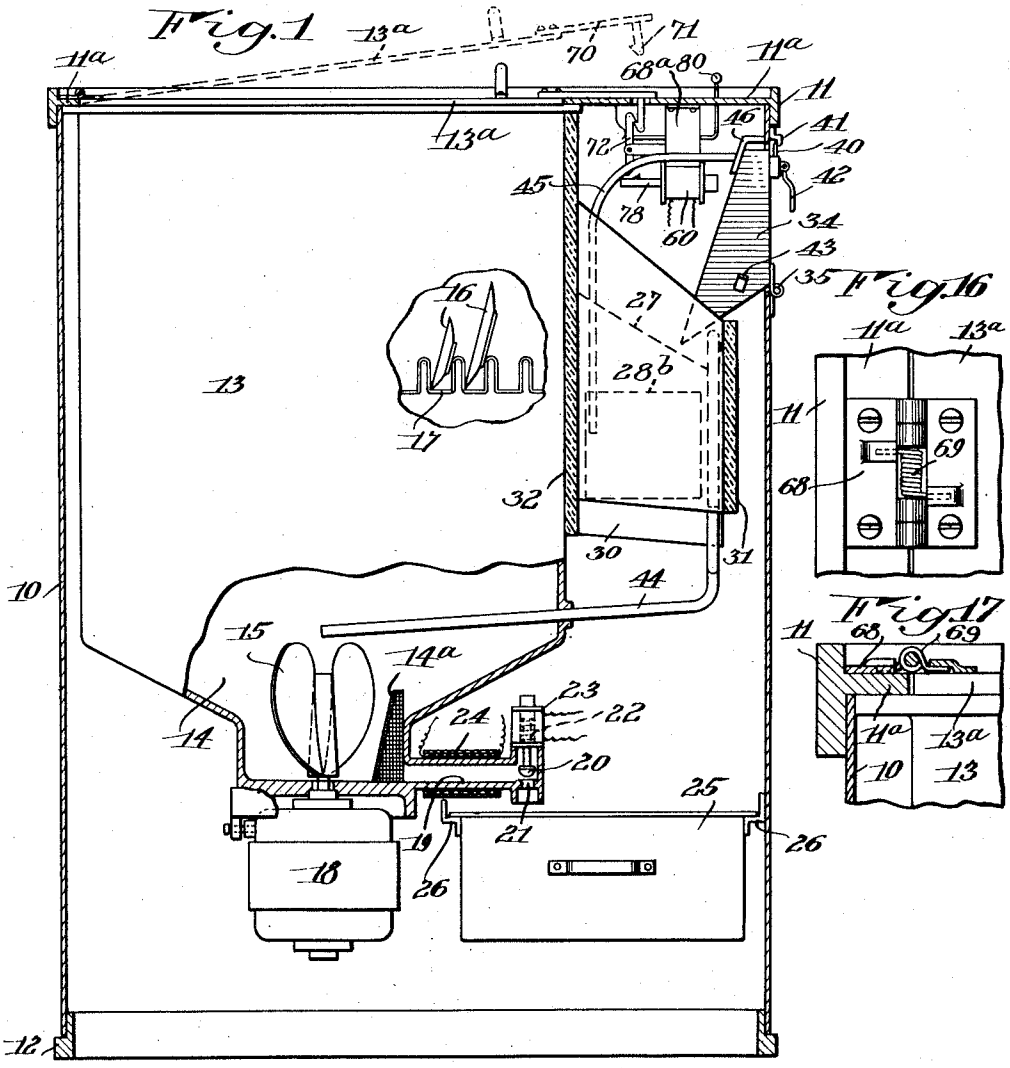
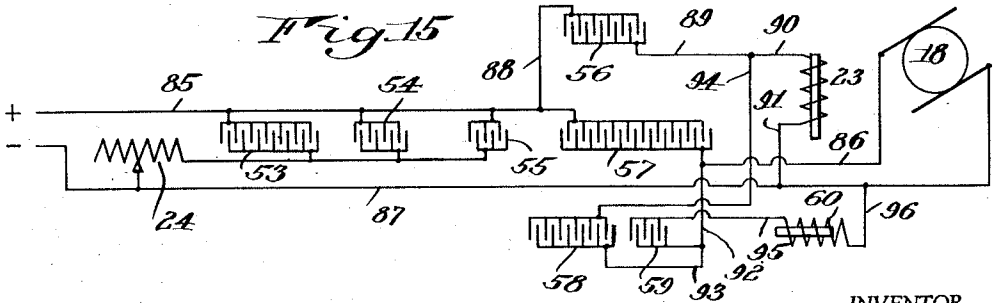


Fig. 16

Fig. 17

Fig. 15



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APPARATUS FOR WASHING ARTICLES

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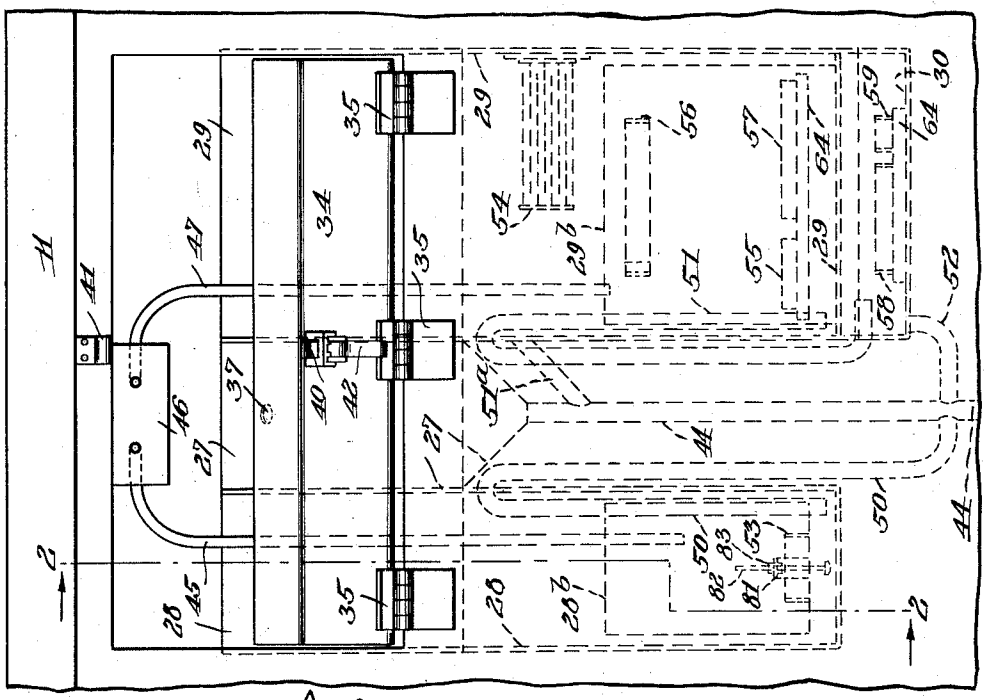


Fig. 3

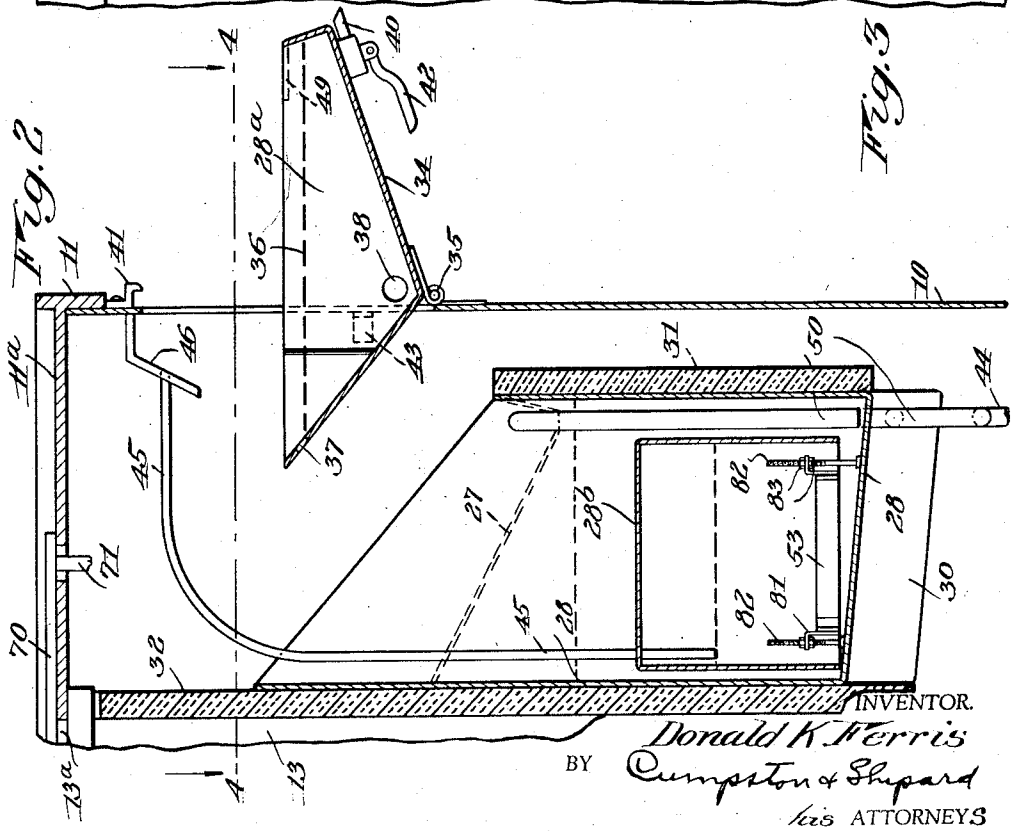


Fig. 2

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APPARATUS FOR WASHING ARTICLES

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Fig. 4

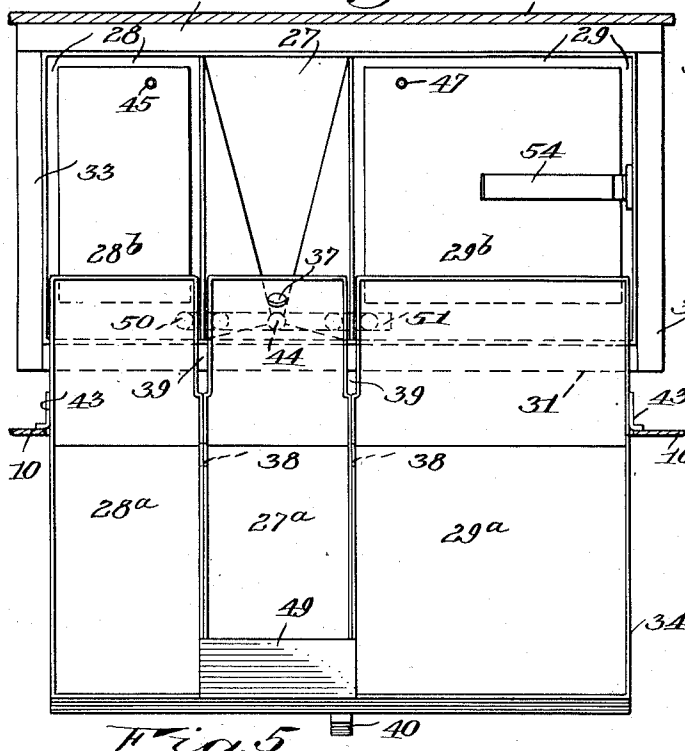


Fig. 18

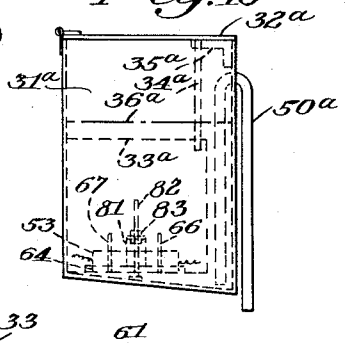


Fig. 6

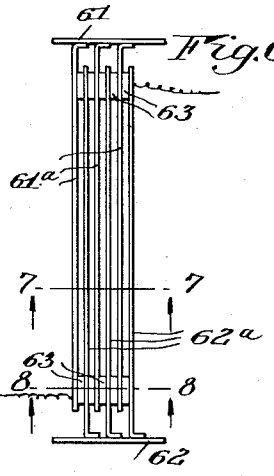


Fig. 5

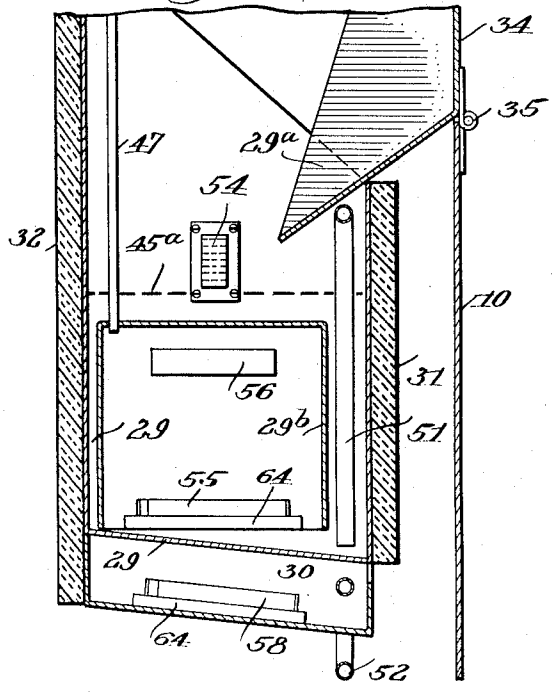


Fig. 7

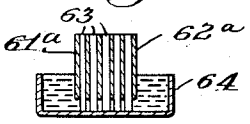
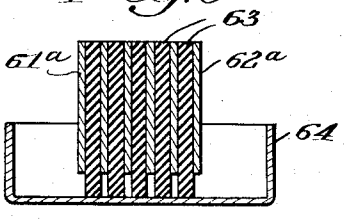


Fig. 8



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APPARATUS FOR WASHING ARTICLES

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Fig. 11

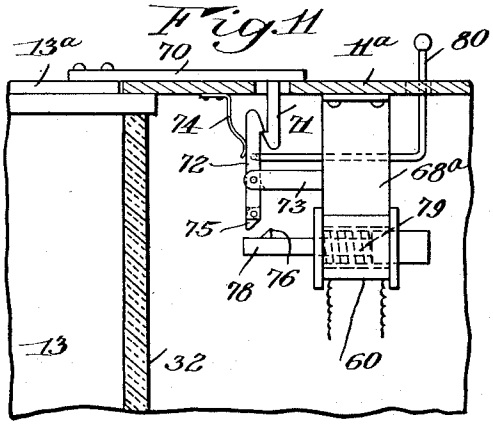


Fig. 12

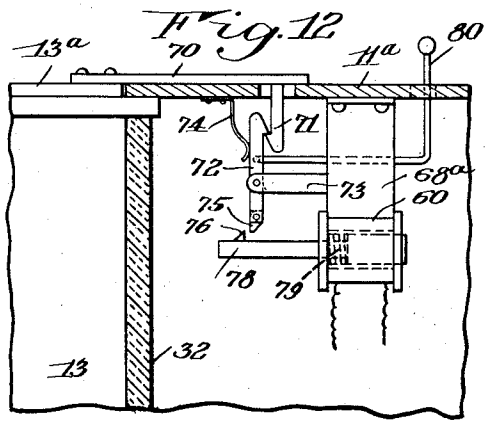


Fig. 13

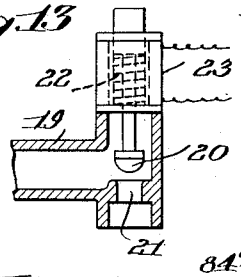


Fig. 19

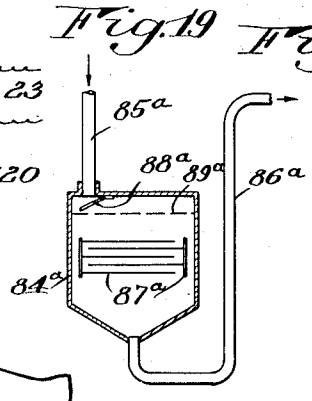


Fig. 14

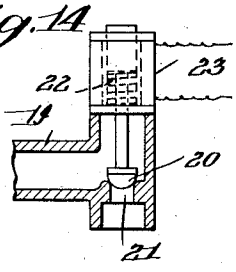


Fig. 9

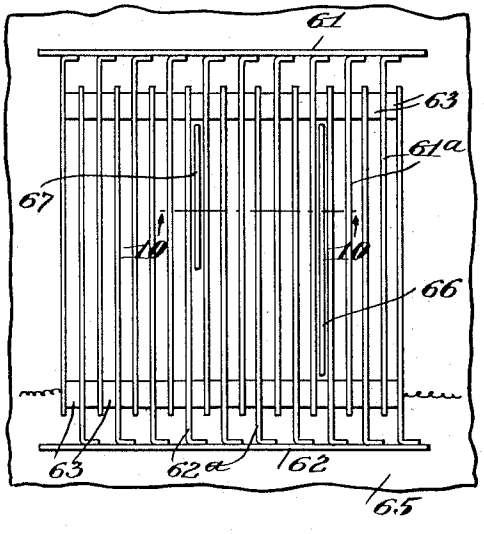
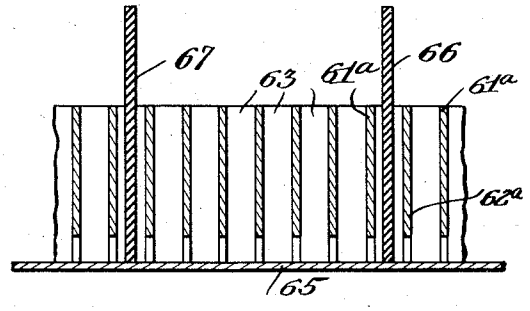


Fig. 10



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APPARATUS FOR WASHING ARTICLES

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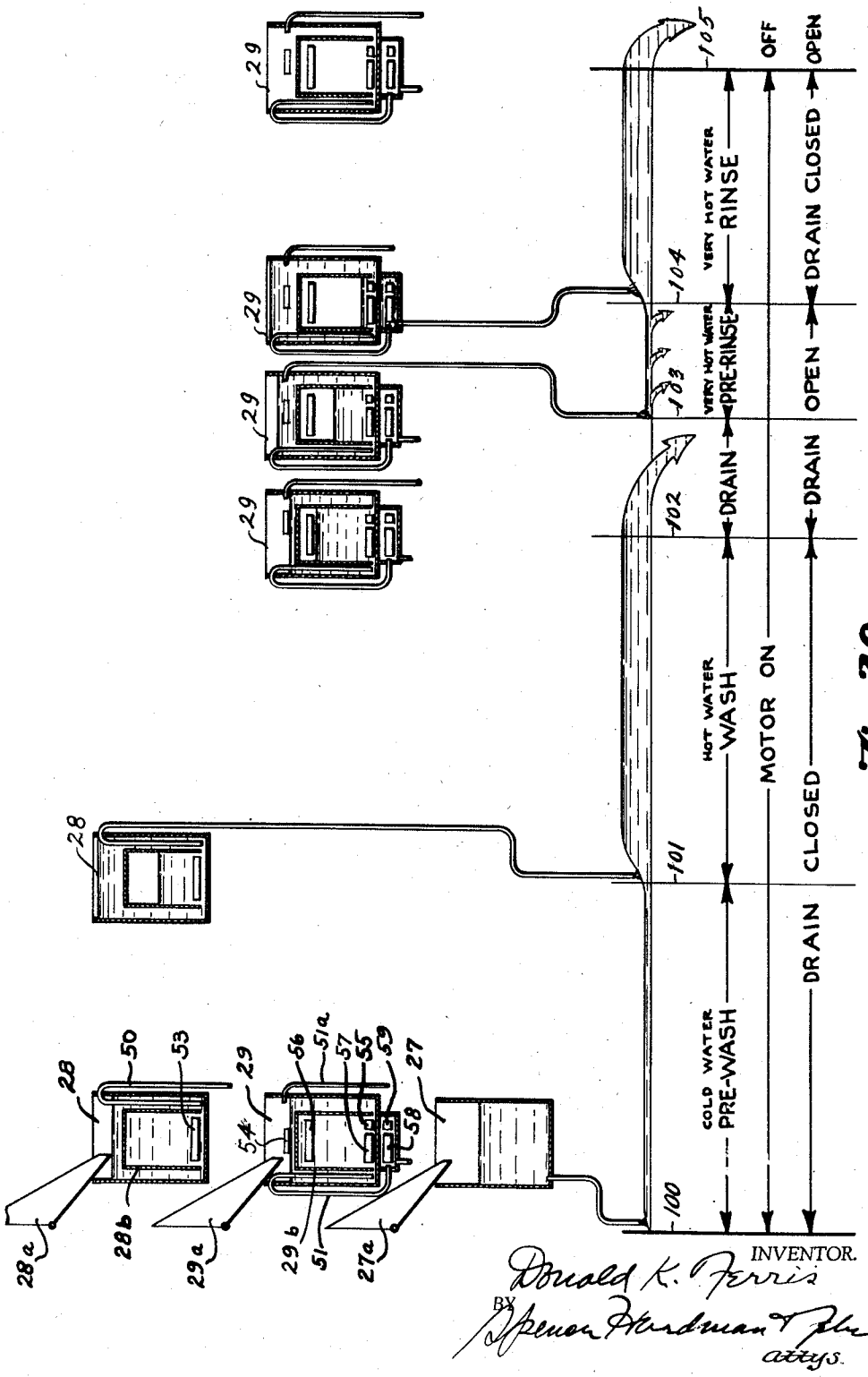


Fig. 20

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UNITED STATES PATENT OFFICE

2,314,332

APPARATUS FOR WASHING ARTICLES

Donald K. Ferris, Geneva, N. Y.

Application June 10, 1936, Serial No. 84,504

27 Claims. (Cl. 141—9)

The present invention relates to apparatus for washing articles and has for its object to provide improvements in apparatus of this character whereby to simplify the construction and to reduce the cost of manufacturing the same.

A further object of the invention is to provide improved apparatus of this class, particularly adapted for use in the washing of dishes and other articles and including an improved arrangement of electrical devices for heating and controlling the flow of the washing and rinsing fluid.

A further object of the invention is to provide an improved liquid heating unit embodying a container or receptacle for the liquid having electric heating means for generating steam and means by which to control and employ the steam to vary the level of the liquid and to control and effect discharge of the liquid from the unit.

A further object of the invention is to provide an improved arrangement of electric heating and circuit controlling devices within the liquid holding receptacles under the control of the liquid and adapted to operate or function in a predetermined timed relation to insure delivery of the heated washing and rinsing supplies of water to the washing chamber at proper intervals and at the desired temperatures.

A further object of the invention is to provide in a machine of the class described, a washing chamber and individual compartments for supplying pre-washing, washing, and rinsing liquids thereto with electrical devices for generating steam in the compartments containing the washing and rinsing liquids to effect discharge of the liquid therefrom at predetermined intervals, and in which apparatus electrical devices are also provided for circulating the liquid within the washing chamber and for controlling the drain passage leading therefrom, said electrical devices operating automatically in a predetermined sequence to successfully complete the required operations.

A further object of the invention is to provide receptacles in which to heat the washing and rinsing liquids and one or more heating devices in each of the receptacles for heating the liquid as well as for the purpose of generating steam to provide pressure within the receptacles sufficient to effect discharge of the liquid to the washing chamber and also to provide means for varying the position of the heating device or devices relative to the level of the liquid in order to be able to vary the period required to effect the discharge of the liquid from each receptacle, and to make it possible to be able to better control the intervals of discharge of the liquid from the several receptacles and the temperature at which the liquid is supplied to the washing chamber.

To these and other ends the invention resides in certain improvements and combinations of parts, all as will be hereinafter more fully described, the novel features being pointed out in the claims at the end of the specification.

In the drawings:

Fig. 1 is a sectional elevation of a washing machine embodying one form of the invention;

Fig. 2 is a fragmentary sectional elevation on line 2—2 of Fig. 3;

Fig. 3 is a front elevation as viewed from the right of Fig. 2;

Fig. 4 is a sectional plan taken substantially on line 4—4 of Fig. 2;

Fig. 5 is a fragmentary sectional elevation through the receptacle containing the rinse water;

Fig. 6 is a plan view illustrating the manner of constructing the switch and heating units for controlling and heating the liquid;

Fig. 7 is a sectional elevation on line 7—7 of Fig. 6;

Fig. 8 is an enlarged sectional elevation on line 8—8 of Fig. 6;

Fig. 9 is a top plan view of a slightly modified form of heating unit;

Fig. 10 is a sectional elevation taken on line 10—10 of Fig. 9;

Fig. 11 is a fragmentary sectional elevation illustrating the latch mechanism for securing the cover for the washing chamber in closed position with the magnet for releasing the latch shown in normal deenergized position;

Fig. 12 is a similar view showing the armature of the magnet in position to effect release of the latch when the armature becomes deenergized.

Fig. 13 is a part sectional elevation illustrating the drain for the dish washing chamber and associated parts;

Fig. 14 is a similar view showing the drain valve in closed position;

Fig. 15 is a diagrammatic view showing the electrical devices and the circuit connections therefor;

Fig. 16 is a plan view of one of the hinges for raising the cover of the machine when the latching means therefor is released;

Fig. 17 is a transverse sectional elevation through the hinge shown in Fig. 16;

Fig. 18 is a view in elevation of a modified form of the invention, and

Fig. 19 is a sectional elevation of another modification.

Fig. 20 is a diagrammatic representation of a portion of the machine.

The same reference numerals throughout the several views indicate the same parts.

The present invention embodies generally, liquid heating apparatus in which steam is generated in a receptacle containing the liquid by means of a suitable heating device such, for example, as an electric heater of any preferred type. The steam is collected and controlled in such a manner as to exert pressure on the liquid sufficient to force it downwardly through a suitable outlet or to raise it to a predetermined level for discharge from the receptacle at a point above the normal level of the liquid. A siphon is preferably employed for withdrawing the heated liquid from the receptacle for discharge to any desired point when raising the level of the liquid, as distinguished from forcing it downwardly within the receptacle. The siphon will begin operation after the water has reached the boiling point and sufficient steam has been generated to exert pressure on the liquid to raise it to the required level.

When the apparatus is to be used for heating water for dish washing purposes it can be directly associated with a dish washing machine of any suitable design, such, for example, as that shown in Fig. 1. In this case three receptacles are employed for receiving the pre-wash, the wash, and the rinsing water, respectively, the pre-wash water being discharged directly to the dish-washing chamber. The electric heating and circuit control devices within the receptacles containing the washing and rinsing water are so designed and relates as to function or operate in a predetermined sequence whereby to effect heating and delivery of the washing and rinsing water to the dish washing chamber at predetermined intervals, the rinsing water being delivered thereto as soon as the main supply of wash water has been discharged therefrom. In other words, the apparatus is so designed that it is only necessary to place the dishes and a suitable detergent within the washing chamber and the water within the different receptacles provided, the operations thereafter being automatic, the motor circuit being closed by the water to start the motor for driving the impeller whereby to circulate the water within the dish washing chamber. Furthermore, the drain valve for controlling the discharge of the waste water is automatically opened and closed at proper intervals and the latch for maintaining the cover for the dish washing chamber in closed position is automatically released to allow the cover to swing to open position as soon as the final rinsing operation is completed.

Referring to the drawings, 10 represents the outer casing of the machine having top and bottom frame members 11 and 12, respectively, to which the side walls of the casing are attached, the frame member 11 carrying the end wall 11a of the receptacle. Suitably supported within the casing is the washing machine proper, designated generally by the reference numeral 13 and comprising a container having a washing chamber 14 into which extends an impeller 15 for circulating and discharging the washing fluid in contact with the dishes 16 supported by any suitable means, such as the rack 17 shown in Fig. 1.

The impeller is mounted on the shaft of an electric motor 18, suitably connected with the lower end of the container 13. The container has a drain pipe 19 extending therefrom which is provided at its outer end with a valve 20 for closing the outlet 21, the valve being normally held in open position by a spring 22 and closed by an electro-magnet 23 included in the motor circuit and operated as described hereinafter.

Surrounding the drain pipe 19 is a heating coil 24 for warming the water contained within the pipe, the coil being in the form of an adjustable resistance for controlling or regulating the flow of the current, as more fully described hereinafter.

Disposed within the casing 10 is a tank 25 for receiving the waste water discharging from the drain pipe when the valve 20 is opened, the tank being removably supported on guides 26 suitably connected with and supported by the casing 10.

Separate tanks or receptacles are provided for the pre-wash, wash, and rinsing water, these being designated by reference numerals 27, 28, and 29, respectively, the receptacle 29 having a small compartment 30 disposed therebeneath through which the rinse water is by-passed on its way to the washing chamber for a purpose described hereinafter. The receptacles or compartments 27 to 30, inclusive, are preferably formed of metal and may, if desired, be constructed as a unit and secured to the front, rear and end walls 31, 32, and 33, respectively, which are disposed within the casing 10 and formed of suitable insulating material.

A measuring tank or receptacle 34 is provided for measuring the water to be delivered to the compartments 27, 28, and 29, said receptacle being supported for a swinging movement from the horizontal position shown in Fig. 2 to the vertical position shown in Figs. 1 and 5 by a plurality of hinges 35 which connect the tank with the front wall of the casing 10. The measuring tank has three compartments 27a, 28a, and 29a for measuring the pre-wash, the wash and the rinsing liquids for discharge respectively to the receptacles 27, 28, and 29 upon swinging the measuring receptacle from the horizontal position shown in Fig. 2 to the vertical position shown in Fig. 1.

The water level of the measuring receptacle is indicated at 36, an overflow passage 37 being provided to insure proper measurement of the water by the several compartments of the receptacle. The adjacent side walls of the liquid measuring compartments are provided with openings 38 for the passage of the liquid from one measuring compartment to another, whereby the receptacle may be filled by discharging the liquid to either of said compartments, said adjacent walls being spaced apart at their inner ends to provide openings 39 to afford clearance for the side walls of the receptacle 27 as shown in Fig. 4.

The measuring receptacle is provided with a suitable lock or latch 40 for cooperation with a keeper 41 on the casing 10 to secure the receptacle in the normal position shown in Fig. 1. The latch is provided with a lever 42 for releasing the same which may be employed to swing the receptacle to and from normal position. The measuring receptacle is provided at its opposite ends with stop lugs 43 for engaging the inner face of the front wall of the casing to hold the receptacle in the horizontal position shown in Fig. 2.

The pre-wash water discharged from the measuring compartment 27a into the receptacle 27 will flow immediately from the latter through a dis-

charge conduit 44 which is extended into the washing chamber 14 and so positioned as to discharge the liquid in contact with the blades of the impeller 15 for proper distribution or circulation by the latter.

As previously stated, the wash and rinsing water will, upon swinging the measuring receptacle from the position shown in Fig. 2 to that shown in Fig. 1, be discharged into the tanks or receptacles 28 and 29, respectively, to fill the same substantially to the level indicated at 45a in Fig. 5. The receptacles 28 and 29 constitute heating compartments for the main supply of wash water and the rinse water, respectively, each being provided with heating means described hereinafter.

Disposed within the heating compartment 28 is an inverted container 28b and mounted within the heating compartment 29 is a similar container 29b. The air trapped within the container 28b by the liquid delivered to the heating receptacle 28 will be forced out by the liquid through a vent pipe 45 extending upwardly within the casing 10 and terminating in a supporting plate 46, Figs. 2 and 3. A similar vent pipe 47 extends from the inverted container 29b to the supporting plate 46 for carrying off the air trapped in said container by the liquid entering the same.

The open ends of the vent pipes are closed by a strip of rubber 49 or other suitable material secured upon the side walls of the measuring compartment 27a at the outer ends thereof as shown in Fig. 4, said member moving into engagement with the supporting plate 46 after the air has escaped from the inverted containers 28b and 29b.

The receptacles 28 and 29 are each provided with electric heating devices described hereinafter, for heating the liquid to generate steam, the heating devices being so disposed with respect to the inverted containers as to cause the steam to collect within the upper ends of the containers for the purpose of exerting pressure on the liquid sufficient to force it from the containers, thus causing the liquid to be raised to a predetermined level within each of the receptacles at which level it will flow therefrom through a suitable outlet provided for the purpose.

Preferably means is provided for siphoning the liquid from the heating chambers when it reaches a certain predetermined level therein. To this end the receptacle 28 is provided with a siphon tube 50 the shorter leg of which is extended within the receptacle substantially to the bottom thereof, the longer leg being connected with the pipe 44 leading to the dish washing chamber as shown in Fig. 1.

A similar siphon tube 51 has its shorter leg disposed within the receptacle 29 containing the rinse water, but in this case the longer leg of the tube is bent at its lower end and extended within the small liquid receiving compartment 30 immediately below the receptacle 29, the liquid being discharged to said compartment for a purpose described hereinafter. The compartment 30 is connected with the liquid discharge pipe 44 by a short pipe 52, as shown by dotted lines in Fig. 3.

The means for heating the washing and rinsing water in the receptacles 28 and 29 preferably comprises multiple surface immersion heaters of the grid type, one of which is shown at 53 in the receptacle 28, and two of which are shown at 54 and 55 in the upper and lower portions of the receptacle 29 respectively. As will be understood, with liquid contact heaters of this type, the liquid lying between the spaced blades or contacts of the heater serves to complete the circuit. This is true also of the switches 56 and 57 in the upper and lower portions of the container 29b as well as of the switches 58 and 59 in the liquid receiving compartment 30.

The switch and heater construction is shown in Fig. 6, in which the supporting plate 61 has a plurality of laterally extending spaced blades 61a lying between the blades 62a of the supporting plate 62. The blades are held in spaced relation and are insulated one from another by the parts 63, formed of rubber or other suitable insulating material, said parts in certain of the switch and heater units being projected below the blades as shown in Fig. 8 to form supporting means for the units. The number of the blades of any particular switch or heater unit may be varied to vary the capacity of the unit as desired. Furthermore, the size of the blades and the distance between the same may also be varied to regulate or control the capacity of the heater. It is found desirable to place certain of the heater and switch units within small liquid holding containers for maintaining one or more closed circuits after the main supplies of liquid have been discharged from the heating receptacles to the dish washing chamber.

Two of such containers are indicated at 64 in Fig. 3, one adjacent the bottom of the liquid heating receptacle 29 for supporting the heater 55 and switch unit 57 and another in the compartment 30 for supporting the switch units 58 and 59. The construction of the container 64 is best shown in Figs. 7 and 8, in which the blade insulating parts 63 are shown resting on the bottom of the container. The containers 64 are necessary at the points indicated in order to maintain a closed circuit when the rinse water in the compartment 29 is below a predetermined level, as for example when practically all of the supply of rinse water has been discharged to the dish washing chamber, at which time it is desired to prevent opening of the closure 13a for the washing chamber and to keep the motor running whereby to operate the impeller to complete the rinsing operation. Under these conditions of operation the liquid within the receptacles 64 will be sufficient to maintain the motor circuit closed for the desired length of time and the electro-magnets 23 and 60 energized to prevent opening of the drain valve and release of the latch for the closure 13a. The discharge end of the siphon 51 is directed towards the container 64 in the compartment 30, so that the siphon fills the container 64 before any substantial amount of liquid is discharged through the discharge pipe 52.

With the present arrangement the main supply of wash water delivered to the receptacle 28 is about half of the amount of rinse water delivered to the receptacle 29. Since the rinse water is not needed until after the supply of wash water has been exhausted, it is necessary to so proportion the size or capacity of the heaters in the receptacles 28 and 29 as to insure proper timing of the same whereby to start siphoning of the rinse water for discharge to the dish washing chamber as soon as the main washing operation is completed.

The timing operations can be controlled in different ways, as for example by the use of the modified form of heating unit shown in Figs. 9 and 10 in which the heater is mounted on a suitable support 65 which may constitute the bottom wall of the liquid holding receptacle or be in the form of a container similar to that shown at 64 in

Figs. 7 and 8. The modified heater except for the means for controlling its capacity, is of the same construction as the one shown in Fig. 6, and has therefore been given the same reference characters.

The current draw of the heaters in water of any given conductivity depends on the area of the active surfaces of the heater, the distance between the same, and the temperature of the water between said surfaces. It has been found that the conductivity of water increases rapidly with an increase of the temperature and this is an important factor in determining the current draw. If a thin strip of insulation is placed between the active surfaces of two of the heater leaves, the current will be forced to travel around the edges of the strip in order to reach the opposite leaf. In doing so it will travel for a part of the way through water of a lower temperature than that through which it would travel if the strip of insulation were not used. Thus the current will be reduced since its path of travel is increased through water the conductivity of which is decreased. By inserting a variable number of strips of insulation between the leaves of the heater or the switch the current can be limited as desired. An example of this method of current control is illustrated in Figs. 9 and 10 in which two relatively long and short strips 66 and 67 of insulating material are shown between certain of the leaves of the heater.

A screen 14a is provided in the bottom of the washing chamber 14 which is spaced from and opposite the inlet end of the drain pipe 19 as shown in Fig. 1. The screen forms a pocket between the impeller and the conduit open at one side at the top which is provided for the purpose of trapping food particles released by the washing or cleansing operations, which if allowed to remain in the water would tend to collect on and adhere to the dishes after completing the rinsing operation. Such particles are of course kept in circulation by the action of the impeller, but tend to gravitate toward the bottom of the dish washing chamber. During the course of the agitation of liquid by impeller 15, the food particles tend to be trapped on the right hand side of screen 14a, so that after a comparatively short time substantially all of the particles find their way to the right hand side of screen 14a where they are trapped, later to be discharged through the discharge valve when it is opened. This construction collects practically all of the food particles on the right hand side; but if any remain on the left hand side they are of such small quantity as to be negligible.

The closure 13a for the dish holding container 13 is hingedly connected with the inwardly extending portion 11a of the end wall 11 of the casing 10 by means of a suitable number of hinges, one of which is indicated at 68 in Figs. 16 and 17. These hinges are of a well known type, and each embodies a torsion spring 69, the spring operating to raise the closure substantially to the dotted line position shown in Fig. 1 when the latch for the closure is released, upon completion of the rinsing operation, by the solenoid or electro-magnet 60 supported by a bracket 68a, depending within the casing 10 from the end wall 11a thereof as shown in Figs. 1 and 11. The closure 13a has a forwardly extending member 70 thereon provided with a depending latch bar 71 for cooperation with the latch lever 72 pivoted intermediate its ends upon an arm 73 carried by the brackets 68a for supporting the electro-magnet 60. The latch is held in latching position when the door is closed by a spring 74. The latch has a pivoted dog 75 thereon which is swung outwardly by the lug 76 on the armature 78 of the magnet when the latter is energized, at which time the armature is moved from the position shown in Fig. 11 to that shown in Fig. 12. The magnet is deenergized by the opening of the switch 59 at which time the spring 79 will return the armature to the position shown in Fig. 11. When this is done, the lug 76, through engagement with the dog 75, will trip the latch and release the cover for movement by the springs 69 of the hinges 68 to the dotted line position shown in Fig. 1. The latch many be manually released when desired, by moving the releasing member 80 from the position shown in Fig. 11 in a direction toward the latch to swing the latter upon the arm 73 against the resistance of the spring 74.

In the control of the temperature of the water, it has been found that the current flowing through the blades of the heater and the water therebetween effects a rather rapid generation of steam. It will be obvious of course that the nearer the bottom of the receptacle the heater is placed the longer it will take to collect sufficient steam in the upper end of the inverted container to force the water therefrom due to the fact that a greater quantity of steam must be condensed before the temperature of the water can be raised to a point at which the steam will be given off at the level of the liquid. In other words, if the heater is placed adjacent or even with the surface of the water, the steam generated by the heater will be quickly liberated since the amount of water to be heated before the steam will begin to escape will be relatively small compared to the quantity to be heated when the heating unit is placed in the bottom of the receptacle.

It will be seen therefore that if the heater is made adjustable for movement up and down within the receptacle, that the time required to accumulate sufficient steam above the level of the liquid in the inverted container to raise the liquid to a level within the receptacle at which it will start operation of the siphon can be controlled and varied as desired. To this end the heater 53 in the receptacle 28 is provided with supporting parts 81 which are apertured to receive the upstanding threaded rods 82 fixed upon the bottom of the receptacle. The rods are provided with nuts 83 adjustable thereon to raise or lower the supports 81 to position the heater 53 at the desired level within the receptacle.

The modification shown in Fig. 18 embodies a single unitary heating device which can be used for heating liquids for various purposes, said unit being adapted for use in laboratories, bath rooms or wherever it may be desired to provide for a relatively quick supply of hot water or other liquid. This device comprises a receptacle 31a having a hinged cover 32a, the receptacle being provided with an inverted container 33a from which extends a vent pipe 34a having its upper end terminating in a support 35a and closed by the cover 32a after the receptacle has been filled with liquid to a predetermined level as indicated for example at 36a.

A multiple surface heater of the type shown for example at 53 in Fig. 3 is disposed within the receptacle, the heater and the parts for raising and lowering it within the receptacle being the same as those shown in Fig. 2, have been given

the same reference numerals. The adjustable strips of insulation 66 and 67 shown in Figs. 9 and 10 are also shown in Fig. 18, being provided for the same purpose in both cases.

A siphon tube 50a has its short leg disposed within the receptacle 31a, the longer leg of which can be adapted for discharging the hot water or liquid to any desired point. When the liquid is delivered to the receptacle it will rise within the inverted container 33a, and cause the air to escape through the vent pipe 34a, which however will be closed by the cover 32a when the latter is moved to closed position, whereby to prevent the escape of steam from the inverted container.

The multiple surface heater 53 will serve both as a means for heating the liquid and for closing the circuit, the circuit connections not being shown. However, if preferred, a switch corresponding to the switch 57 of Figure 3 can be placed within the receptacle for controlling the circuit if found advisable. Furthermore, an additional heater can be positioned within the receptacle above the one shown, corresponding to the heater 54 shown in Fig. 3, to increase the temperature of the liquid if desired. It will be understood that the modified heating device is entirely automatic, the only operation required being that of placing the required amount of liquid within the receptacle.

In order to start the machine the measuring tank 34 is filled and the contents of receptacles 27a, 28a, and 29a thereof discharged into the receptacles 27, 28, and 29, respectively. The prewash water received by the intermediate receptacle 27 will begin immediately to discharge through the supply pipe 44 to the washing chamber 14. The switch 57 in the receptacle 29 being immersed within the liquid, will close the motor circuit, current flowing through the conductor 85, switch 57, conductor 86, motor 18, and back through conductor 87. Current will also flow through resistance 24, heaters 53 and 55 in receptacles 28 and 29 respectively.

As soon as the water reaches a predetermined level in the inverted container 29b, the upper switch 56 therein will be closed, current flowing through conductors 85 and 88, switch 56, conductors 89 and 90, electro-magnet 23 and conductors 91 and 87, thus energizing the magnet to effect closing of the drain valve 20 to retain the prewash water in the washing chamber 14. This water serves to dissolve the soap or washing compound, and being cooled by the walls of the washing chamber will soften the particles of food adhering to the dishes, such for example as egg, flour and other material which might become baked on the dishes if hot water were first used within the washing chamber.

As soon as steam is generated within the receptacle 28, it will collect in the upper portion of the inverted container 28b, and will then begin to force the water from the container whereby to raise the level within the receptacle 28 to a point at which to start operation of the siphon 50, which will deliver the main body of washing water to the supply conduit 44 for discharge to the washing chamber 14, where it will be mixed with the small amount of pre-wash water therein after the latter has been circulated by the impeller in contact with the dishes to effect softening of the food particles and other materials adhering to the dishes. The main washing operation will then begin, and will continue until the drain valve is opened.

In the meantime, the multiple surface heater 55 within the receptacle 29 will serve to heat the rinse water therein, steam being generated which will collect in the upper end of the inverted container 29b whereby to force the water from the container to raise the level within the receptacle 29. As soon as the steam has forced the water below the level of the switch 56, current will cease to flow through the electro-magnet 23 which will then become de-energized and allow the spring 22 to open the drain valve 20 to permit the wash water to escape into the tank 25. As soon as the water reaches the heater 54 the latter will be included in the motor circuit and will afford additional heating means for the liquid substantially at the level of its discharge from the receptacle.

At about the time the heater 54 becomes immersed the rinse water in the receptacle 29 will have reached the inlet end of the by-pass pipe 51a through which a small amount of water will flow to and through the supply pipe 44, and into the washing chamber where it will serve as a pre-rinse supply for washing out the soapsuds and food particles which may have accumulated in the lower portion of the chamber 14 but without disturbing the soapy film or suds adhering to the walls of the upper portion of the chamber and the dishes, it being understood that this will be done with the drain valve at open position and with the motor circuit closed through switch 57 to continue operation of the impeller.

After the pre-rinse operation is completed, the water will be raised to a level in receptacle 29 at which it will start operation of the siphon 51 to withdraw the main supply of rinse water from the receptacle. The rinse water is discharged by the siphon tube into the small compartment 38 containing the switch units 58 and 59, at which time the switch 58 will be closed to again energize the electro-magnet 23 to effect closing of the valve 20 for maintaining the rinse water in the washing chamber, current then flowing through switch 57, conductors 92 and 93, switch 58, conductors 94 and 90, electro-magnet 23 and conductors 91 and 87.

Switch 59 will also be closed by the water entering compartment 30, current flowing through switch 57, conductor 92, switch 59, conductor 95, electro-magnet 60 and conductors 96 and 87. Thus the electro-magnet 60 for releasing the closure 13a will be energized whereby its armature will be moved from the position shown in Fig. 11 to that shown in Fig. 12, at which it will be held during the final rinsing period. After the main supply of rinsing water has been withdrawn from the receptacle 29, there will still remain a certain amount of water in the small container 64 within which the switch 57 is disposed which will be sufficient to keep the motor circuit closed and the motor running.

At the same time the water within the small containers 64, within which the switches 57 and 59 are disposed, will be sufficient to close said switches so that the electro-magnets 23 and 60 will remain energized for the desired length of time. When the water in the containers 64 has boiled down to a level below the blades of the switches therein, the motor circuit will be opened and the electro-magnets 23 and 60 will become de-energized at which time the drain valve 20 will be moved by the spring 22 to open position and the armature 78 of magnet 60 released for movement by the spring 79 to release the cover

latch 72 whereby the springs 69 will raise the cover to the dotted line position shown in Fig. 1 in order to provide for ventilation of the washing chamber and proper drying of the dishes before removing the same from said chamber.

It will be understood as previously stated, that the adjustable resistance 24, in series with the water heaters 53 and 55, is employed not only to limit the current draw of the heaters when waters of different degrees of conductivity are used, but also to heat the drain pipe 19 to warm or heat the water held therein during the washing and rinsing operations.

It will be understood that either hot or cold water may be used in starting the machine, but that if hot water is used the time required to generate sufficient steam in the receptacles 28 and 29 to raise the liquid to a level at which to start operation of the siphons will be considerably reduced.

It will also be understood that where the machines are used in different localities having water the conductivity of which varies, that the current can be regulated accordingly by means of the variable resistance indicated diagrammatically at 24 in Fig. 15.

While the liquid contact switches shown in Figs. 3 and 5 are provided primarily as circuit controlling means they nevertheless constitute electric heating devices which will serve to increase or raise the temperature of the liquid by reason of the discharge of the current therethrough and through the leaves of the heater.

By placing the leaves of the heater 54 in superimposed relation as shown in Fig. 3, the supply of heat will be gradually increased as the level of the liquid rises since the leaves will be successively contacted by the liquid. Furthermore, by placing the heater 54 near the level of discharge of the liquid from the receptacle 29, the rinsing liquid can be delivered to the dish washing chamber at relatively high temperatures which may be controlled or regulated by increasing or decreasing the capacity of the heater.

It will be noted that the vent pipe 45 is extended a considerable distance within the inverted container 28b and it will be understood that the liquid within the container will not rise above the level of the lower end of the pipe by reason of the air trapped within the upper portion of the container, which cannot escape since the pipe will be closed by the liquid when raised to the level indicated in Fig. 2. It will be further understood that the air trapped within the upper end of the container will tend to expand upon being heated by the liquid whereby to increase the pressure on the latter. When steam is generated within the container the pressure will be increased and the liquid raised to the desired level within the receptacle 28.

The modification shown in Fig. 19 embodies a liquid heating device or receptacle of a type which may be substituted for the heating receptacles shown in Figs. 1 to 5, inclusive, if desired. The modified receptacle is indicated at 84a and has a liquid supply pipe 85a which may be connected with any suitable supply source such, for example, as a water supply pipe having a valve for controlling the flow of the water. Extending from the receptacle is a discharge conduit 86a adapted to be projected within the dish washing chamber 14 and to deliver the liquid thereto for circulation therein by the impeller 15.

Any desired number of liquid heating or circuit controlling devices of any preferred type may be disposed within the receptacle 84a for heating and controlling the flow of the liquid, one of such heaters being shown by way of example at 87a in Fig. 19, which may be of the liquid contact type shown in Figs. 1 to 5, inclusive, or of any preferred design.

It will be understood that liquid heating receptacles of the type shown in Fig. 19 may be substituted for the receptacles 28 and 29 of Figs. 2 and 3 and provided with the same or corresponding liquid heating and circuit controlling devices for cooperation in heating and controlling the flow of the liquid and for energizing the electro-magnets for controlling the operation of the drain valve and latch means for the closure of the washing container. It will be further understood that in such an arrangement the siphon tubes will be omitted, but that a compartment corresponding to that shown at 30 in Fig. 3 and including the switches or circuit control devices therein may be connected with the receptacle 84a containing the rinsing liquid to function in the manner and for the purpose previously described herein.

Furthermore, since with the modified type of receptacle shown in Fig. 19 the liquid is discharged directly to the washing chamber by the pressure of the steam within the receptacles, they may be located within the casing 10 below the washing container or so arranged therein as to permit the size of the casing to be reduced to a minimum.

A self closing valve 88a is provided at the discharge end of the supply pipe 85a which will be automatically closed by the pressure of the steam within the receptacle. The level of the liquid in the receptacle 84a is indicated at 89a, it being understood, however, that the quantity of liquid placed within the receptacle may be varied as desired and that the heating devices may be adjusted or placed at different levels within the receptacles, as different conditions may require.

In the operation of the machine the compartments of the measuring tank are first provided with the desired quantities of pre-wash, wash, and rinsing water and upon swing the tank from the position shown in Fig. 2 to that shown in Fig. 1, the water will be discharged to the receptacles 27, 28, and 29, respectively, the pre-wash water being preferably discharged by gravity to the washing chamber 14 as shown along line 100 of Fig. 20. Upon discharging the washing and rinsing water to the receptacles 28 and 29, respectively, the heaters 53 and 55 will begin to heat the water therein. At the same time the motor control switch 57 within the receptacle 29 will be closed by the water to start operation of the motor and likewise the switch 56 will also be closed by the water to permit the coil 23 to become energized to effect closing of the drain valve 20. The impeller 15 will then circulate the cold or tepid pre-wash water within the washing chamber and mix it with the detergent placed therein, the circulation of the mixture in contact with the dishes serving to soften and loosen the food or foreign particles adhering to the dishes, and particularly the albuminous materials which are difficult to remove when allowed to dry on the dishes as diagrammatically indicated between the line 100 and 101 of Fig. 20. At the completion of the period of circulation of the pre-wash water the main supply of wash water, under the pressure of the steam generated within the receptacle 28, will be discharged to the washing chamber and mixed with

the pre-wash water and circulated in contact with the dishes to wash the same as indicated at line 101 of Fig. 20. At about the time the washing operation is completed the rinsing water within the receptacle 29 will be forced below the switch 56 by the steam in the inverted receptacle 29b, thus de-energizing the magnet 23 for closing the drain valve and allowing the latter to be opened by the spring 22 to permit the water to discharge from the washing chamber as indicated between lines 101 and 102 of Fig. 20.

At about the time this operation is completed the water within the receptacle 29 will be forced upwardly therein by the pressure of the steam to a level at which a small amount of pre-rinse water will discharge through the restricted by-pass 51a to and through the conduit 44 to the washing chamber where it will be discharged in contact with the upper ends of the impeller blades at which time the impeller is still being driven by the motor as indicated at line 103 of Fig. 20. Due to the relatively small amount of pre-rinse water permitted to discharge through the by-pass 51a and its rather slow rate of discharge from the conduit 44, the greater portion of the water will be acted upon by the upper ends of the blades of the impeller and thrown off by the same in a lateral direction within the lower portion of the washing chamber only, whereby to effect discharge of the soap-suds and food particles which may have accumulated therein, it being understood that at this time the drain valve is still at open position. However, since the pre-rinse water is not permitted to circulate within the upper portion of the washing chamber the soap-suds adhering to the walls thereof and to the dishes will remain thereon and be taken up by the main supply of rinse water which is discharged by the impeller to all parts of the washing chamber with the drain valve in closed position.

By the time the pre-rinse operation is completed the steam in the receptacle 29 will have raised the water to a level sufficient to start operation of the siphon 51 which will then begin to deliver the water to the compartment 30 for passage therethrough to and through the conduits 52 and 44 to the washing chamber as indicated at line 104 of Fig. 20. When the water is discharged to said compartment it will close the switches 58 and 59 therein to energize magnets 23 and 60, respectively, the former for operating the drain valve to close the outlet of the washing chamber and the latter for moving the door-controlling armature 78 from the position shown in Fig. 11 to that shown in Fig. 12 for effecting release of the latch for the door when the final rinsing operation is completed, whereby to admit air to the washing chamber to facilitate drying of the dishes therein.

Upon delivery of the main supply of rinse water to the washing chamber it will be circulated therein by the impeller at which time the soap-suds or film of soap adhering to the upper walls of the washing chamber and to the dishes will become mixed with the rinsing water and circulated therewith in contact with the dishes as indicated between lines 104 and 105 of Fig. 20.

After substantially all of the rinsing water has been discharged from the receptacle 29 and the compartment 30 to the washing chamber, the motor will continue to operate for a short period to complete the rinsing operation, the motor switch during this time being kept closed by the small amount of water held within the upper container 64 within which the switch is disposed. The switches 58 and 59 disposed within the lower container 64, which serve to control the magnets 23 and 60, respectively, are likewise kept closed by the wather therein during the completion of the rinsing period. However, as soon as the water has boiled down within the switch holding containers 64, the motor will stop and the magnets become de-energized to allow the drain valve and door for the washing chamber to be automatically opened by the springs associated therewith as indicated at line 105 of Fig. 20.

I claim:

1. In washing apparatus, a container for the washing liquid, means including an electric motor for circulating the liquid within the container, a receptacle in which to heat the liquid, said receptacle having an outlet for the liquid connected with the container, electric heating means within the receptacle for heating a body of liquid therein normally below the level of said outlet to generate steam within the receptacle, means for maintaining the steam in such relation to the liquid as to cause it to exert pressure thereon sufficient to discharge it through said outlet to said container, and an energizing circuit for said motor and electric heating means, said heating means operating as a switch and being closed by contact with the liquid within the receptacle.

2. In washing apparatus, a container for the washing liquid, an impeller for circulating the liquid within the container, an electric motor for operating the impeller, a receptacle in which to heat the liquid, a conduit for discharging the liquid from the receptacle to the container, an electric heater within the receptacle for heating a body of liquid therein to generate steam, means for maintaining the steam in such relation to the liquid as to cause it to exert pressure thereon sufficient to discharge the liquid through said conduit to said container, said heater having spaced contacts closed by the liquid, and an energizing circuit for said motor in which the heater is included.

3. In washing apparatus, a container for the washing liquid having an outlet, an impeller for circulating the liquid within the container, an electric motor for operating the impeller, a receptacle in which to heat the liquid, a conduit for discharging the liquid from the receptacle to the container, an electric heater within the receptacle for heating a body of liquid therein to generate steam, means for maintaining the steam in such relation to the liquid as to cause it to exert pressure thereon sufficient to discharge the liquid through the conduit to the container, said heater having spaced contacts closed by the liquid, an energizing circuit for said motor in which the heater is included, a drain valve for said outlet, and an electro-magnet for operating the valve.

4. In washing apparatus, a container for the liquid having an outlet, an impeller for circulating the liquid within the container, an electric motor for operating the impeller, a receptacle in which to heat the liquid, a conduit for discharging the liquid from the receptacle to the container, an electric heater within the receptacle for heating a body of liquid therein to generate steam, means for maintaining the steam in such relation to the liquid as to cause it to exert pressure thereon sufficient to discharge the liquid through the conduit to the container, an ener-

gizing circuit for said motor and heater, a drain valve for said outlet, an electro-magnet for operating the valve connected to the circuit, a closure for the container, latching means for the closure, and an electro-magnet for controlling the operation of the latching means connected to said circuit.

5. In washing apparatus, a container having a washing chamber, a receptacle for the washing liquid, a second receptacle for the rinsing liquid, conduit means connecting said receptacles with the washing chamber, an electric heating device within each of said receptacles for generating steam therein, said devices including spaced contacts closed by the liquid, means within each receptacle for causing the steam to exert pressure on the liquid to discharge the liquid through the conduit means to the washing chamber, said heating devices completing their respective operations in a predetermined sequence whereby the rinsing liquid will be delivered to said washing chamber at a predetermined time subsequent to the delivery of the washing liquid thereto, an impeller within the washing chamber, an electric motor for operating the impeller, and means forming an energizing circuit in which one of said electric heating devices and said motor are included.

6. In washing apparatus, a washing chamber, a plurality of liquid holding receptacles, means for heating the liquid within the receptacles, means for conveying the liquid of the different receptacles to the washing chamber at predetermined intervals, means for circulating the liquid within the washing chamber discharged thereto from each receptacle, and means controlled by a variation in the level of the liquid in certain of the receptacles and operating at the expiration of each period of circulation to effect discharge of the liquid from the washing chamber.

7. In washing apparatus, a washing chamber, a plurality of liquid holding receptacles, means for heating the liquid within the receptacles, means for conveying the liquid of the different receptacles to the washing chamber at predetermined intervals, means for circulating the liquid within the washing chamber discharged thereto from each receptacle, and means operating automatically at the expiration of each period of circulation to effect discharge of the liquid from the washing chamber, said means including an electro-magnet and a circuit therefor having switch means controlled by a variation in the level of the liquid within certain of the receptacles.

8. In washing apparatus, a washing chamber, a plurality of liquid holding receptacles, means for conveying the liquid of the different receptacles to the washing chamber at preretermined intervals, means for circulating the liquid within the washing chamber discharged thereto from each receptacle, said means comprising an electrically operated device having a circuit including switch means disposed within one of the receptacles and closed and opened by the liquid when it is at different predetermined levels therein.

9. In washing apparatus, a washing chamber, a plurality of liquid holding receptacles, means for conveying the liquid of the different receptacles to the washing chamber at predetermined intervals, means for circulating the liquid within the washing chamber discharged thereto from each receptacle, said means comprising an electrically operated device having a circuit including switch means disposed within one of the receptacles and closed and opened by the liquid when it is at predetermined levels therein, and means operating automatically at the expiration of each period of circulation to effect discharge of the liquid from the washing chamber.

10. In washing apparatus, a washing chamber, a plurality of liquid feeding receptacles, means for conveying the liquid of the receptacles to the washing chamber at predetermined intervals, means for circulating the liquid of the different receptacles within the washing chamber, said means comprising an electrically operated device having a circuit including switch means disposed within one of the receptacles and closed and opened by the liquid when at different predetermined levels therein, and means operating automatically at the expiration of the different periods of circulation to effect discharge of the liquid of the different receptacles from the washing chamber, said last mentioned means including an electro-magnet connected to the circuit and a plurality of switches for controlling the same connected to said circuit, said switches being disposed within certain of the receptacles and closed and opened by the liquid when at different predetermined levels therein.

11. In washing apparatus, a washing chamber, a plurality of liquid feeding receptacles, means for discharging the liquid of the receptacles to the washing chamber at predetermined intervals, means for circulating the liquid of the different receptacles within the washing chamber for predetermined periods, said means comprising an electrically operated device having a circuit including an electric switch disposed within one of the receptacles and closed and opened by the liquid when at predetermined levels therein, and means operating automatically at the expiration of the different periods of circulation to effect discharge of the liquid of the different receptacles from the washing chamber, said last mentioned means including a drain valve for the washing chamber and also including an electro-magnet connected to the circuit, and switches connected to the circuit for controlling the operations of the magnet, said switches being disposed in different receptacles and each being closed and opened by the liquid at different levels therein, the opening of the different switches being timed to occur, respectively, at the expiration of the different periods of circulation.

12. In washing apparatus, a washing chamber, a plurality of liquid feeding receptacles, electric heaters therein, one disposed within each of the receptacles for heating the liquid to a predetermined temperature, means connected with the receptacles for discharging the liquid therefrom to the washing chamber at predetermined intervals, electric means operable when energized to circulate the liquid of the different receptacles within the washing chamber for predetermined periods, electric switch means closed and opened by the liquid of one of the receptacles controlling the operation of said electric means, and means operating automatically at the expiration of each period of circulation to discharge the liquid from the washing chamber.

13. In washing apparatus, a washing chamber, a plurality of liquid feeding receptacles, means connecting the receptacles with the washing chamber, electric heaters therein, said heaters being disposed within certain of the receptacles for generating steam therein under pressure sufficient to effect discharge of the liquid from the different receptacles at predetermined intervals

through said connecting means to the washing chamber, electric means operable when energized to circulate the liquid of the different receptacles within the washing chamber for predetermined periods, electric switch means controlling the operation of said electric means closed and opened by the liquid of one of the receptacles, and means operating automatically at the expiration of each period of circulation to discharge the liquid from the washing chamber.

14. In washing apparatus, a container having a discharge conduit, a plurality of liquid holding receptacles, means for discharging the liquid of the different receptacles to the container at predetermined intervals, means for circulating the liquid of the different receptacles within the container for predetermined periods, said means comprising an impeller and an electric motor for operating the same, an electric circuit for the motor including switch means disposed within one of the receptacles and closed and opened by the liquid when at predetermined levels therein, a heating coil for said discharge conduit connected to the circuit, and means connected to said circuit and operating automatically at the expiration of each period of circulation to effect discharge of the liquid from the container through said conduit.

15. In washing apparatus, a washing chamber, a closure for the chamber, latching means for the closure, a plurality of liquid feeding receptacles, means for delivering the liquid of the receptacles to the washing chamber at predetermined intervals, means for circulating the liquid of the different receptacles within the washing chamber for predetermined periods, said means comprising an electrically operated device having a circuit including switch means disposed within one of the receptacles and closed and opened by the liquid when at predetermined levels therein, means operating automatically at the expiration of each period of circulation to effect discharge of the liquid from the washing chamber, said last mentioned means including an electro-magnet and a plurality of switches connected to said circuit, said switches being disposed within certain of the receptacles and closed and opened by the liquid when at different predetermined levels therein, and means connected to and controlled by said circuit and operating automatically upon completion of the washing operations to effect release of said latching means.

16. A washing machine comprising a plurality of feed receptacles, means for heating liquid in said receptacles, a washing chamber, an impeller in said chamber, means for feeding liquid from said receptacles to said chamber sequentially automatically when the liquid in said receptacles has been properly heated, liquid discharge means for said washing chamber, and means controlling operation of said discharge means automatically in response to liquid conditions in said receptacles.

17. In washing apparatus, a washing chamber, a plurality of liquid feeding receptacles, electric heaters therein, one disposed within each of the receptacles for heating the liquid to a predetermined temperature, means connected with the receptacles for discharging the liquid therefrom to the washing chamber at predetermined intervals, electric means operable when energized to circulate the liquid of the different receptacles within the washing chamber for predetermined periods, electric means operating automatically at the expiration of each period of circulation to discharge the liquid from the washing chamber and an electric switch means closed and opened by the liquid in one of the receptacles controlling the operation of one of said electric means.

18. In a dish washing machine, liquid-holding means, heating means for said liquid-holding means, means responsive to a rising temperature of one body of liquid in said liquid-holding means for exerting a control on an operation of said dish washing machine, means responsive to rising temperature of another body of liquid in said liquid-holding means to exert another control on said operation, and means utilizing liquid heated in said liquid-holding means for washing dishes in said machine.

19. In a washing machine, a washing chamber, a liquid circulator for said chamber, a plurality of liquid holding devices, heating means for said devices, starting means for said circulator, means dependent on the heating of liquid in one of said devices for introducing liquid into said washing chamber and exerting a control on a washing operation, and means dependent on the heating of liquid in another of said devices for terminating said washing operation.

20. In a washing machine, a washing chamber, a liquid circulator for said chamber, a plurality of liquid holding devices, heating means for said devices, starting means for said circulator, means dependent on the heating of liquid in one of said devices for introducing liquid into said washing chamber and exerting a control on a washing operation, and means dependent on the heating of liquid in another of said devices for terminating said washing operation and initiating a second washing operation in said chamber.

21. In a washing machine, a washing chamber, a liquid circulator for said chamber, a plurality of liquid holding devices, heating means for said devices, liquid measuring means for said devices, means responsive to the operation of said liquid measuring means for initiating the operation of said liquid circulator, means responsive to the heating of liquid in one of said devices for introducing liquid heated in one of said devices into said chamber and exerting a control on a washing operation, means dependent on the heating of liquid in another of said devices for terminating said washing operation, introducing liquid heated in one of said devices into said chamber, and initiating a second washing operation.

22. In a washing machine, a washing chamber, a liquid circulator for said chamber, a liquid holding receptacle provided with a steam trap, heating means for said liquid holding receptacle, means responsive to the accumulation of steam in said steam trap for discharging liquid from said receptacle into said washing chamber, and means responsive to the presence of liquid in said receptacle governing the operation of said circulator.

23. In a washing machine, a washing chamber, operating means for effecting a washing operation in said washing chamber, a liquid holding device, heating means for said device, means for starting said operating means, and means dependent on the heating of liquid in said device for terminating the operation of said operating means.

24. In an apparatus of the character disclosed, a first liquid holding means, a second liquid holding means, means for heating liquid in both said liquid holding means, control means responsive to the heating of said first liquid holding means for initiating an operation, control means re-

sponsive to the heating of said second liquid holding means for terminating said first operation after a predetermined time and initiating a second operation.

25. In washing apparatus, a washing chamber, liquid holding means, means for conveying liquid from said liquid holding means to the washing chamber, means for circulating the liquid within the washing chamber discharged thereto from said liquid holding means, said means comprising an electrically operated device having a circuit including switch means disposed within said liquid holding means and closed and opened by the liquid when it is at different predetermined levels therein.

26. A washing machine comprising feed receptacle means, means for heating liquid in said receptacle means, a washing chamber, means for feeding different bodies of water from said receptacle means to said chamber sequentially automatically when the liquid in said receptacle means has been properly heated, liquid discharge means for said washing chamber, and means controlling operation of said discharge means automatically in response to liquid conditions in said receptacle means.

27. In a washing machine, a washing chamber, a plurality of liquid holding devices, heating means for said devices, means dependent on the heating of liquid in one of said devices for introducing liquid into said washing chamber and exerting a control on a washing operation, and means dependent on the heating of liquid in another of said devices for terminating said washing operation.

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