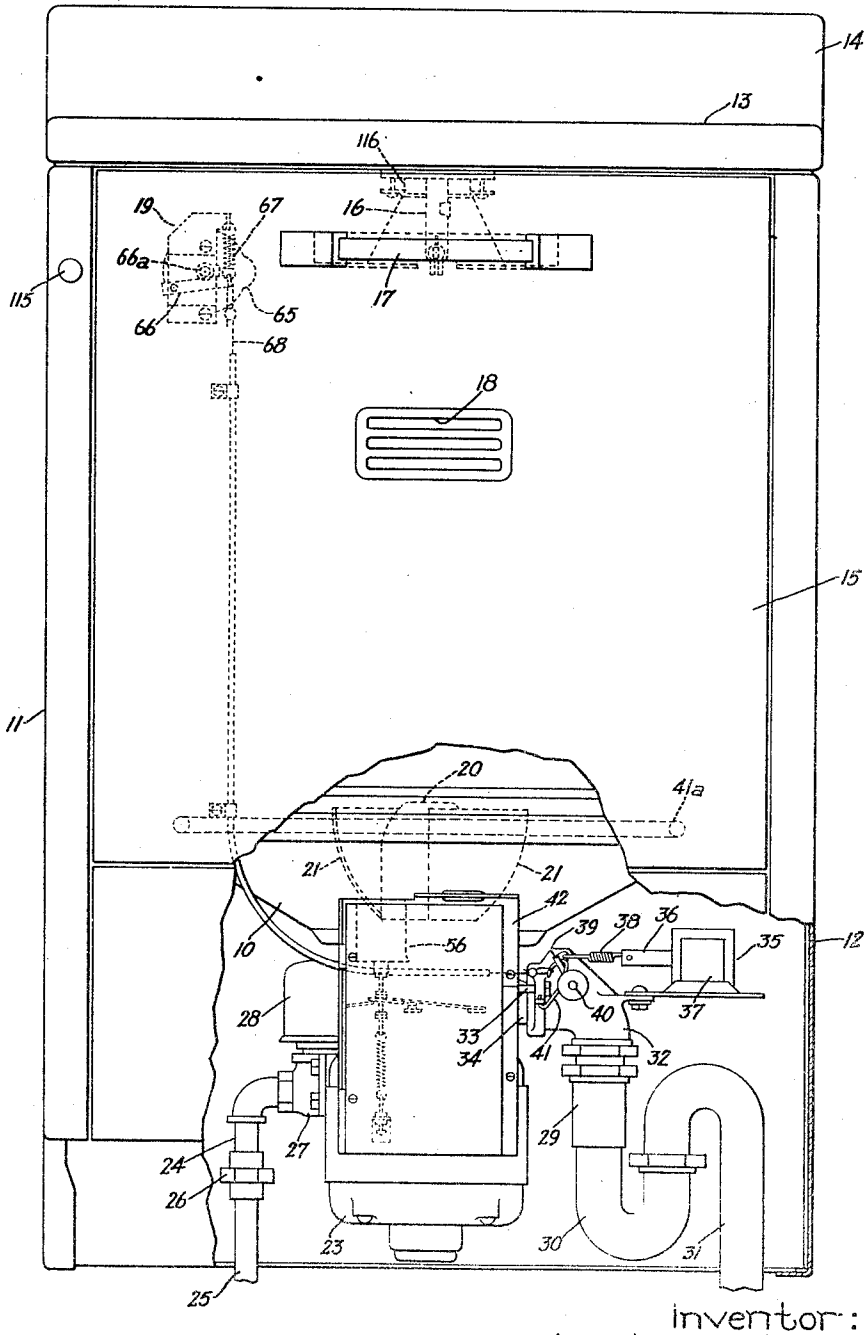
Aug. 12, 1947. L. A. KEMPTON 2,425,620

DISHWASHING APPARATUS

Filed Dec. 5, 1941 4 Sheets-Sheet 1

Fig. 1.



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DISHWASHING APPARATUS

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Fig.2.

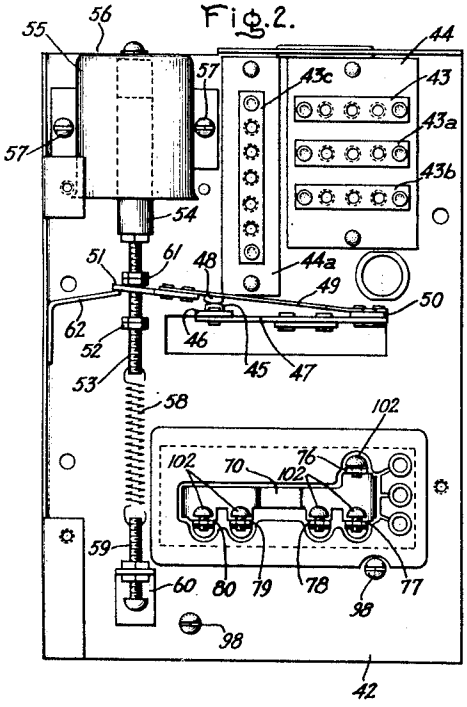


Fig.3.

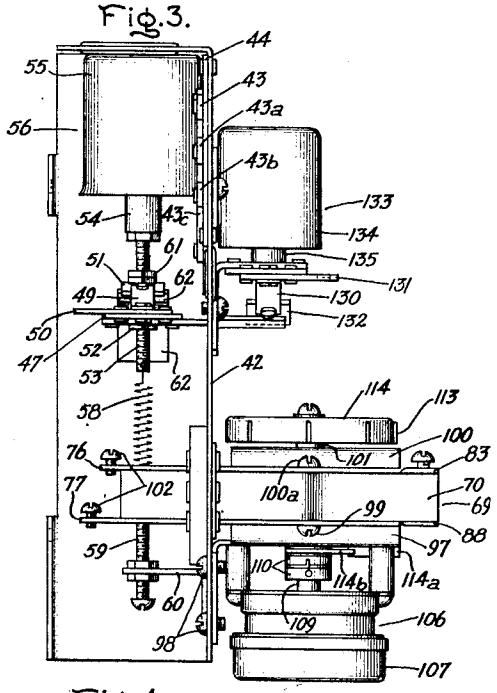


Fig.4.

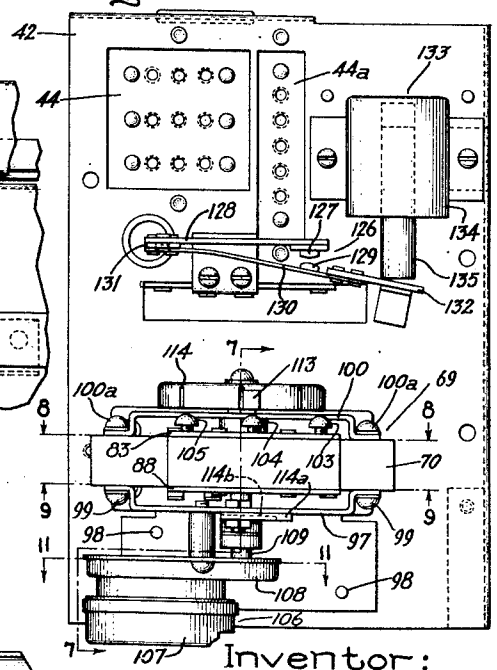


Fig.5.

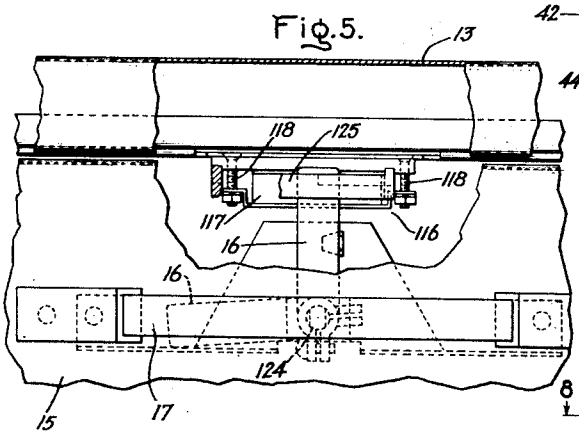
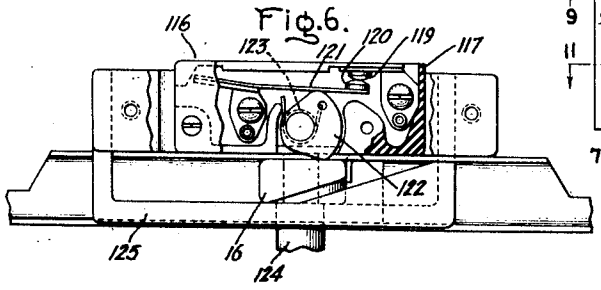


Fig.6.



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DISHWASHING APPARATUS

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Fig. 7.

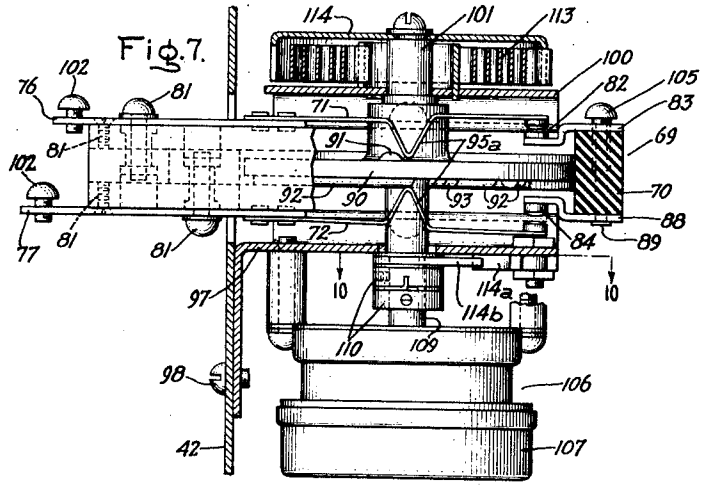


Fig. 10.

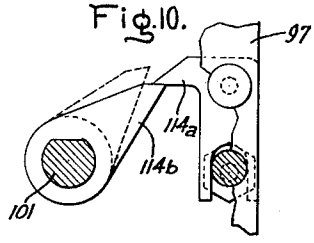


Fig. 8.

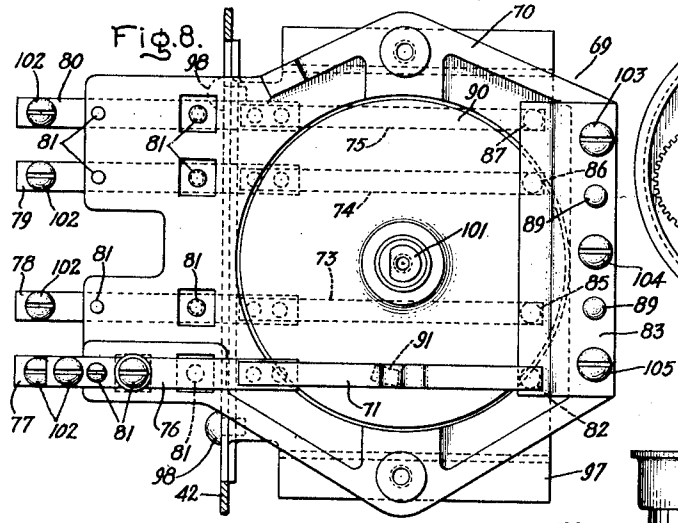


Fig. 11.

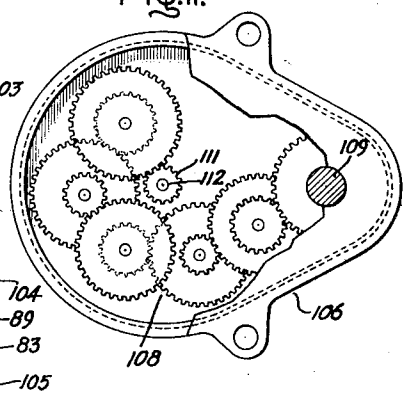


Fig. 12.

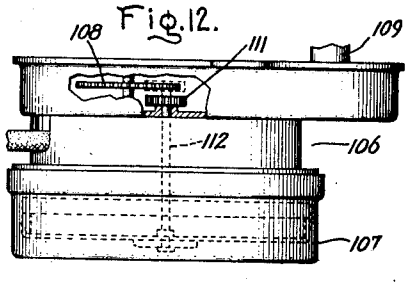
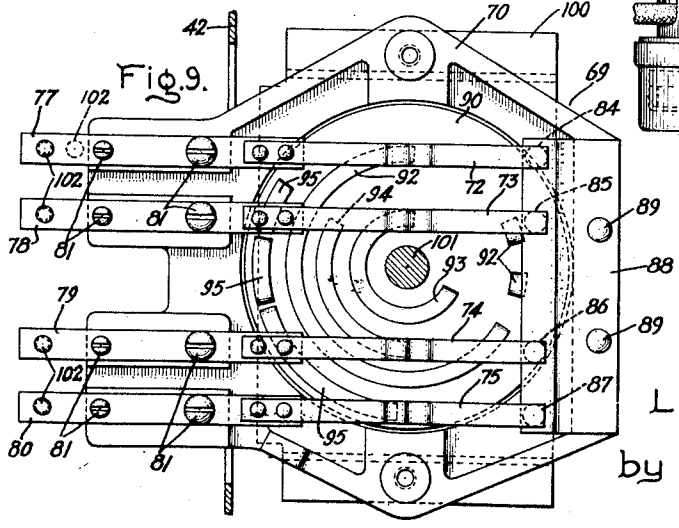


Fig. 9.



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DISHWASHING APPARATUS

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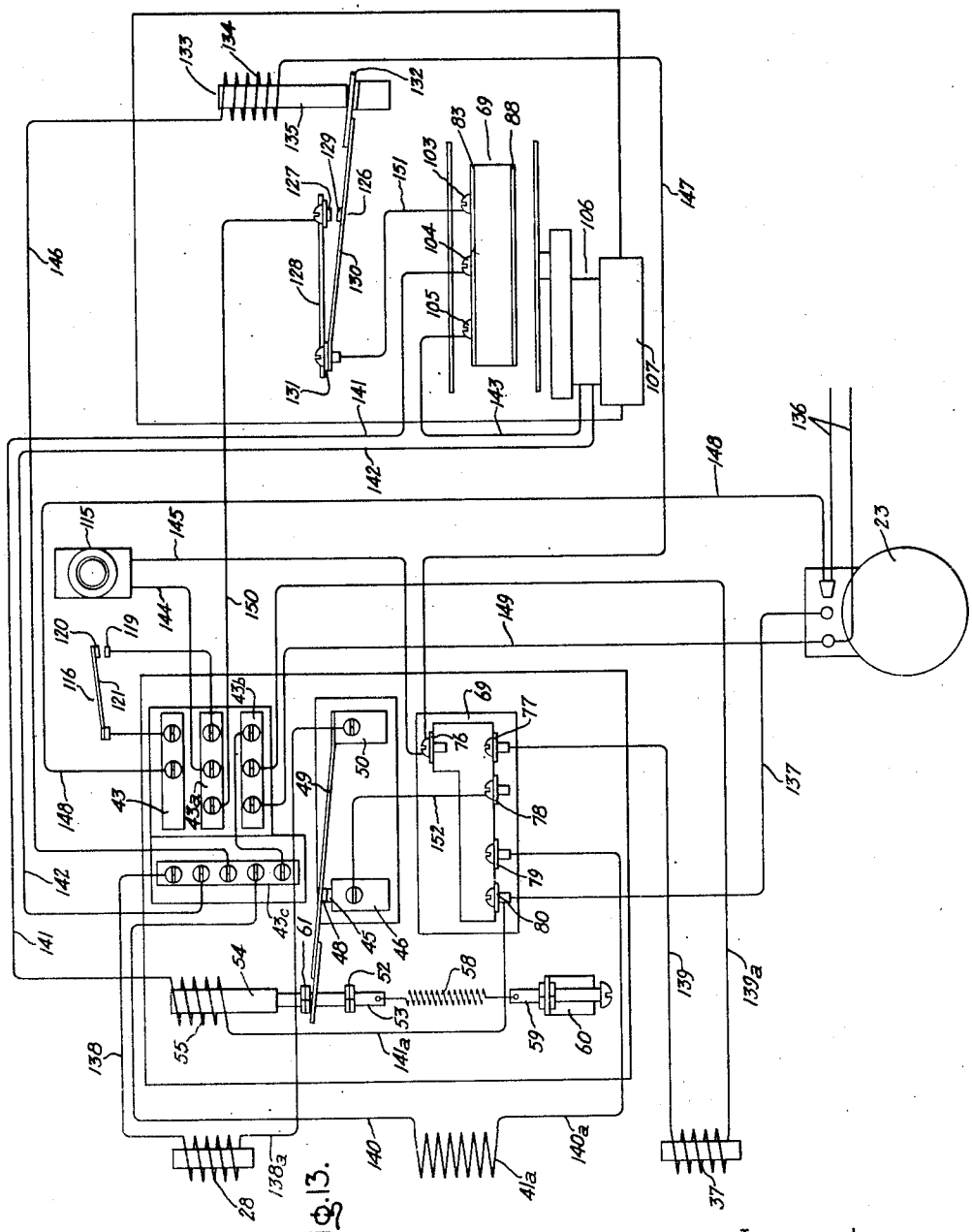


Fig. 13.

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Patented Aug. 12, 1947

2,425,620

UNITED STATES PATENT OFFICE

2,425,620

DISHWASHING APPARATUS

Leslie A. Kempton, Chicago, Ill., assignor to Hotpoint Inc., a corporation of New York

Application December 5, 1941, Serial No. 421,788

12 Claims. (Cl. 134—58)

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This invention relates to washing apparatus, more particularly to dishwashing apparatus, and it has for its object the provision of improved apparatus of this character which is automatic in its operation, and can be safely and easily operated and controlled.

More specifically, this invention has for its object the provision of improved dishwashing apparatus which will automatically effect a timed washing cycle including washing, rinsing, and drying steps.

While not limited thereto, this invention is of particular application to dishwashing apparatus wherein a cleansing fluid, such as water, is circulated or hurled through the washing chamber or vat by suitable power means, such as a motor driven impeller. Provided in such dishwashing apparatus are means for supplying a quantity of washing fluid to the vat and means for discharging the fluid at the end of a washing cycle. Also, such washing apparatus is provided with an opening in the vat through which articles to be washed may be loaded or unloaded and such opening is closed by a suitable door.

And more particularly, this invention relates to improvements in the washing apparatus described and claimed in my copending application, Serial No. 370,402, filed December 16, 1940, now Patent No. 2,278,268, patented March 31, 1946, and assigned to the same assignee as this invention; and it has as a more specific object the provision of improved control means which operate this apparatus in a timed cycle in which the dishes are washed, rinsed, and dried for predetermined periods of time. The control means is under the control of a simple manually operable member such as single push button which when depressed starts the timed cycle. The control means functions to complete the cycle after the button has been depressed. Moreover, suitable means operate responsively to the operation of the push button for rendering the push button ineffective to interfere with the operation of the apparatus in carrying out the timed cycle after the button has been depressed and released. That is, once the apparatus has been started by the button, the apparatus will function to complete the entire cycle even though the push button be subsequently operated.

This invention further contemplates the provision of improved means for stopping the timed washing cycle instantaneously responsively to a certain condition of the washing apparatus, and for restoring the control to its initial condition, whereby the apparatus is in condition to be operated to start the complete cycle over again by operating the single push button.

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More specifically, in one form of this invention, the cycle is stopped and reconditioned for a repeat operation by opening the door for the vat. This may be done intentionally in order to insert more utensils to the vat, or it may be done accidentally. In any case, the opening of the door stops the washing cycle at once and resets it for a repeat operation.

For a more complete understanding of this invention, reference should be had to the accompanying drawings in which Fig. 1 is a vertical elevation of a dishwashing apparatus embodying this invention, portions being broken away to show details of the operating mechanism for the apparatus; Fig. 2 is a front elevation of a control panel used in the control of the dishwashing apparatus of Fig. 1; Fig. 3 is a side elevation of the panel shown in Fig. 2 and showing certain timing mechanism for controlling the apparatus of Fig. 1; Fig. 4 is a rear elevation of the control panel of Fig. 2; Fig. 5 is a fragmentary vertical elevation partly in section and partly broken away showing details of a door lock and safety device in the apparatus of Fig. 1; Fig. 6 is a plan view partly in section and partly broken away showing additional details of the door lock and safety device shown in Fig. 5; Figs. 7, 8, 9 and 11 are sectional views of the timing mechanism taken through the lines 7—7, 8—8, 9—9, and 11—11 of Fig. 4 and looking in the directions of the arrows associated with these lines respectively; Fig. 10 is a fragmentary sectional view of the timing mechanism taken through the line 10—10 of Fig. 7 and looking in the direction of the arrows; Fig. 12 is a vertical elevation of the timing mechanism, parts being broken away so as to illustrate certain details of construction; and Fig. 13 is a circuit diagram showing the electrical connections between certain of the controlling elements of the apparatus illustrated in Fig. 1.

Referring to the drawings and particularly to Fig. 1, this invention has been shown as applied to a dishwashing apparatus which has in general the construction described in my above-mentioned patent. As shown, it has a vat 10 which is supported in a substantially vertical position in an outer casing having side walls 11 and 12 and a top wall 13 which is provided with a back splasher panel 14. The dishwasher vat 10 is of the front opening type and this opening is closed by a door 15 which is hinged at its lower edge to move between a lower open and an upper closed position, and is latched in its closed posi-

tion by means of a latching bar 16 which is operated by a handle 17 provided on the outside of the door. Provided in the center of the door is a suitable ventilating louver 18; and provided near the upper left-hand corner of the door is a suitable detergent supplying means 19 which is preferably of the type described and claimed in the copending application of Edgar S. Stoddard, Serial No. 369,974, filed December 13, 1940, now Patent No. 2,276,806, patented Mar. 17, 1942, and assigned to the assignee of the present invention. It will be understood that suitable open-work removable racks (not shown) will be provided within the vat 10 for supporting the articles to be washed such as dishes, glasses, and silverware.

In the lower portion of the vat is an impeller 20 which is provided with blades 21 which may have any suitable shape, the important feature being that the blades be given a shape such that the cleansing fluid supplied to the vat and allowed to accumulate in the lower portion thereof will be thrown upwardly and outwardly in an efficient manner through the supporting racks (not shown). The impeller 20 may be formed of any suitable material.

The bottom of the vat is provided with an opening which is closed by means of a suitable casting (not shown) from which is suspended an electric motor 23 for driving the impeller 20. As shown in Fig. 1, the motor is supported so that the impeller rotates about a substantially vertical axis and it will be understood that the motor shaft will extend upwardly through an aperture provided for it in the casting and will be connected with the impeller 20 in any suitable manner.

Provided in the space in the dishwasher casing below the vat 10 is a suitable fluid supply pipe 24 which is adapted to be connected to a source of supply of cleansing fluid 25 by means of a coupling 26. For example, if the cleansing fluid be water, the source of supply 25 will be a supply of water, preferably heated. The cleansing fluid will be piped from the bottom of the casing up the back wall of the vat 10 and into the top of the vat by suitable piping (not shown). In order to control the flow of fluid from the source 25 through the pipe 24 and into the vat 10, a valve 27 is provided in the conduit 24. This valve is of the electromagnetically operated type and provided at the top thereof is an energizing coil 28 which is adapted to actuate an armature (not shown) connected to the valve 27 in a manner well understood in the art. The valve 27 is of the normally closed type and is adapted to be moved from its closed to its open position in accordance with the energization of the coil 28. When the coil 28 is deenergized, the valve returns to its closed position.

Also provided in the lower portion of the dishwashing casing below the vat 10 is a drain pipe 29 which is adapted to be connected through a suitable trap 30 to a drain connection 31. Provided in the drain pipe 29 is a drain valve elbow 32 in which is positioned a normally open valve element (not shown). The drain elbow is secured by means of suitable bolts 33 to a drain connection 34 leading from the bottom of the vat 10. In order to operate the drain valve electrically there is mounted on the drain elbow 32 an electroresponsive device 35 which has an armature 36 adapted to be actuated in accordance with the energization of a coil 37. Connected to the armature through a suitable spring connection 38 is a lever 39 which in turn is connected to a shaft 40 which extends through the drain elbow 32 and to which the valve element (not shown) is rigidly secured. As previously stated, the drain valve is of the normally open type and it is biased to this position by the coil spring 41. When the coil 37 is energized the armature 36 is retracted so as to rotate the shaft 40 clockwise as viewed in Fig. 1 and move the valve element within the drain elbow to its closed position. The specific details of the above described drain valve mechanism form no part of this invention but are the invention of Edgar S. Stoddard and are fully described and claimed in his copending application, Serial No. 380,853, filed February 27, 1941, now Patent No. 2,271,993, patented Feb. 3, 1942, and assigned to the assignee of the present invention.

Mounted within the lower part of the vat 10 around the impeller 20 is a suitable heater 41*a* for drying the washed utensils; preferably, this heater will be of the sheathed type.

Also provided in the lower portion of the dishwasher casing and supported from the bottom of the vat 10 by suitable means is a control panel 42 shown in more detail in Figs. 2, 3 and 4. This panel is preferably mounted in front of the electric motor 23 so as to be readily accessible from the front of the dishwasher casing. Provided on the front of the panel 42 are a plurality of terminal plates 43, 43*a*, 43*b* and 43*c* for making electrical connections to the various electrical apparatus in the dishwashing apparatus, the plates 43*b* and 43*c* being electrically connected together and constituting "neutral" connection plates. All of the terminal plates are riveted to suitable insulating strips 44 and 44*a*, which in turn are riveted to the panel 42.

Also mounted on the front of the control panel is a fluid measuring relay which is adapted to measure a predetermined quantity of washing fluid for the vat. This fluid measuring relay comprises a relatively stationary contact 45 which is mounted on a bracket 46 which in turn is secured to an insulating strip 47 secured to the front of the panel 42. Arranged to cooperate with the stationary contact 45 is a relatively movable contact 48 which is supported on a resilient contact arm 49 secured to the insulating strip 47 by means of a bracket 50. The contacts 45 and 48 are adapted to be electrically connected so as to control the deenergization of the coil 28 of the water inlet valve electroresponsive means, as will appear more fully hereinafter. Provided at the free end of the contact arm 49 is a projection 51 which is adapted to be engaged by an abutment 52 provided on a movable rod 53. This rod is adapted to move in a substantially vertical direction in accordance with movement of the armature 54 in response to the energization of an energizing coil 55 of the electroresponsive device 56 secured to the panel by means of screws 57. The rod 53 is biased to its lowermost position by means of a tension spring 58, one end of which is secured to the lower end of the rod and the opposite end of which is secured to an adjustable screw 59 which is adjustably supported on an angle bracket 60 secured to the panel. The lowermost position of the rod is determined by the setting of an upper abutment 61 which bears on the upper surface of the extension 51, this extension in turn bearing against a fixed abutment 62 secured to the panel. Both the upper abutment 61 and the lower abutment 52 are adjustable on the rod 53 so that the movement required of the armature 54 in order to move the contact arm 49 an amount sufficient to open the contacts

45 and 48 may be adjusted. These adjustments make it possible to adjust the fluid measuring relay so that different quantities of fluid may be supplied to the washing apparatus.

The energizing coil 55 of the electroresponsive device 56 of the fluid measuring relay is adapted to be electrically connected to the motor 23 so that the relay is actuated in accordance with the armature current of the motor. In this way, the quantity of washing fluid supplied to the washing apparatus will be responsive to the load imposed on the electric motor by the impeller 20 in acting upon the fluid supplied to the washing vat when the drain valve is closed. The accumulation of fluid in the lower portion of the vat 10, of course, determines the load upon the impeller, and the fluid measuring relay functions to deenergize the energizing coil 28 of the water inlet electroresponsive device only when a predetermined quantity of water has been supplied to the vat, and, of course, only when the coil 37 of the drain valve electroresponsive device 35 is energized to close the drain valve.

As pointed out previously, the detergent supply means 19 is of the type described and claimed in the Stoddard Patent No. 2,276,801. As described in that patent, the detergent cup comprises a diaphragm 65 which is held in its loaded position (shown unloaded in Fig. 1) against the force of a spring (not shown here, but which corresponds to the spring 27 of the Stoddard patent) by means of a suitable latch 66 which serves the same function as the latch members 28 of the Stoddard patent. That is, it functions to engage the recess 29 of the bushing 17 of the Stoddard patent to hold the diaphragm in its loading position. The numeral 66*a* designates this bushing in Fig. 1 of the accompanying drawings. The latch 66 is biased to its locking position by means of a tension spring 67, and is moved to release the bushing 66*a* when the drain valve is closed. For this purpose, the latch is secured to the drain valve by means of a cable 68 which has one end connected to the latch, as shown, and its other end connected to the spring 41 of the drain valve, whereby when the valve lever is moved clockwise to close the valve element, the latch is released to empty the detergent cup. Otherwise, the detergent cup is in all respects of substantially the same construction as the Stoddard cup, except that the manually operable button 46 of Stoddard, of course, is not used here.

In accordance with this invention improved means are provided for electrically controlling the operation of the various devices of the washing apparatus so as to effect a predetermined timed washing cycle including spray, rinsing and washing operations, and also a drying operation. It is contemplated that the control means will include improved means for rendering the control means ineffective in the event that it is unsafe to operate the washing apparatus due to the fact that the door 15 is in its open position.

The improved control means comprises a time control switch 69 which is mounted on the panel 42. This switch is shown in detail in Figs. 7 to 12 inclusive; as shown in these figures, this switch comprises a base 70 formed of a suitable electrically insulating material, such as a phenol condensation product. Mounted on the upper side of this base is a resilient switch arm 71, and mounted on the under side of this base are resilient switch arms 72, 73, 74 and 75. The arm 71 is rigidly secured to a fixed terminal 76 on the upper side of the base, and the switch arms 72, 73, 74 and 75 are connected to fixed terminals 77, 78, 79 and 80, respectively, secured to the under side of the base. All of the terminals are secured to the base by means of screws 81. The switch arm 71 carries a contact on its movable end which cooperates with a fixed contact 82 mounted on a conducting plate 83, while the switch arms 72—75 carry contacts on their movable ends which cooperate with fixed contacts 84, 85, 86 and 87, respectively, which are mounted upon a contact plate 88. The two contact plates 83 and 88 are secured to the base and are electrically interconnected by means of rivets 89.

The switch arms 71—75 are actuated between their opened and closed positions by means of a cam 90. This cam is mounted in the base 70 between the contact arms 72, 73, 74, 75, and the contact arm 71. This cam is provided with a riser 91 on one side for operating the switch arm 71, and risers 92, 93, 94 and 95 on its other side for operating the switch arms 72—75, respectively; it will be observed that the risers 92 and 95 are divided into sections for the purpose of operating their associated arms 72 and 75 at the proper times in one revolution of the control cam 90. As shown, each of the switch arms is provided with a V-shaped section 95*a* (Fig. 7) intermediate its ends extending toward the cam and adapted to be engaged by its associated cam riser for actuating the switch arm.

The base 70, together with the switch arms, fixed contacts and terminals attached to it, are supported by means of a plate 97 which is rigidly secured to the panel 42 by means of screw fastening means 98, as more clearly shown in Fig. 7. As shown, one side of the base 70 is secured to the plate 97 by means of screw fastening means 99 (Figs. 3 and 4); a plate 100 is secured to the opposite side of the base by means of screw fastening means 100*a*. The cam 90 is mounted upon a shaft 101 which is journaled in the two plates 97 and 100.

Each of the terminals 76, 77, 78, 79 and 80 is provided with a binding screw 102, and the terminal plate 83 is provided with three binding screws 103, 104 and 105 for electrically connecting the switch to the various elements of the washing apparatus which it controls.

The cam 90 is driven at a substantially constant speed by a suitable timing mechanism 106 which comprises a suitable substantially constant speed electric motor 107 that drives the cam shaft 101 through a reduction gearing train 108. The gear train 108 drives a shaft 109 which in turn drives the shaft 101 through a coupling 110. The timer motor 107 operates the gear train 108 by means of a driving gear 111 mounted upon the motor shaft 112. The timing motor is constructed and arranged so that when it is deenergized the shaft 112 occupies a lower position, as shown in Fig. 12, so as to hold the gear 111 out of mesh with the gear train, that is, to uncouple the motor from the gear train, and when the motor is energized to rotate the shaft 112, the shaft 112 is elevated to move the driving gear 111 into mesh with the gear train 108 by the magnetic flux created by the motor windings so as to couple the motor to the gear train; when the motor is deenergized the shaft 112 drops to its lower position under the influence of gravity.

The details of construction of the timing motor and its clutch arrangement per se, just described, form no part of this invention, and it is believed to be unnecessary to describe them in greater

detail. Moreover, any suitable timer motor and gear train may be used. It is important that the motor and gear train include means for connecting the rotor of the motor to the gear train when the motor is energized, and for disconnecting it from the gear train when the motor is deenergized; or that they include means for connecting the gear train to the cam shaft when the motor is energized, and for disconnecting the gear train from the cam shaft when it is deenergized.

The cam 90 is reset to its initial position for a repeat operation upon the completion of the cycle of operation when the motor is deenergized by means of a spiral spring 113. The spring 113 is mounted within a housing 114 which is rigidly secured to the upper end of the cam shaft 101, as viewed in Fig. 7, and to which one end of the spring is anchored; the other end of the spring is anchored to the plate 100. It is to be understood that when the timer is operating the cam it at the same time winds up the spiral spring 113 so that when the timer is subsequently deenergized and its motor 107 released from the cam, the spiral spring will unwind to return the cam to its initial position. This position is defined by a stop 114a (Figs. 7 and 10) secured to the under side of the plate 97, as viewed in Fig. 7, and which engages an arm 114b which is rigidly secured to the cam shaft 101. It will be observed that the motor itself will not exert any retarding force on the spring, because at this time its driving gear 111 will have been moved out of mesh with the gear train 108.

The control system is energized to start the cycle by means of a single push button 115 (Figs. 1 and 13); in other words, the cycle is started merely by depressing the button 115. This button is of the "normally open" type such that when it has been depressed and released, it returns to its outer position.

Safety means are provided for insuring that the system cannot be energized to start the cycle when the push button 115 is depressed if the door 15 is open. This comprises a door switch 116 which is mounted adjacent the latch 16. As shown in Figs. 5 and 6, the switch 116 is provided with a casing 117 formed of a suitable electrically insulating material and supported below the top wall 13 of the dishwasher casing by means of a pair of bolts 118 (Fig. 5). Provided within the casing is a fixed contact 119 and a cooperating relatively movable contact 120 which is secured to a contact arm 121 which biases contact 120 away from contact 119. Pivotally mounted within the casing 117 is a cam 122 which is adapted to engage the contact arm 121 so as to move the contact 120 into engagement with the contact 119. One portion of this cam member is adapted to project outwardly beyond the outer edge of the switch housing, as shown more clearly in Fig. 6, and a coil spring 123 is provided for biasing the cam member to this position. This outwardly projecting portion of the cam is adapted to be engaged by the surface of the latching bar 16 which is secured to the shaft 124 that extends through the door 15 and is operated by the handle 17. The latch bar 16 is adapted to move behind a fixed U-shaped latch plate 125 supported by the casing of the dishwasher so as to latch the door 15 in its closed position. When the bar 16 is moved clockwise from its unlatched position, in which it is shown in dotted lines in Fig. 5, to its full line latching position of this figure, it engages the projecting edge of the cam 122 and causes it to move counter-clockwise, as viewed in Fig. 6, so as to close the contacts 119 and 120. Conversely, when the bar 16 is moved to its nonlatching position, the contacts 119 and 120 of the switch are opened.

It is to be noted here that the contacts 119 and 120 will be located in the control system for the dishwashing apparatus so that when they are open none of the apparatus can be energized even though the push button 115 is depressed.

As pointed out previously, the cycle of operation is started by depressing the push button 115. This operation of the push button effects the closure of a main switch 126 (Figs. 4 and 13). This switch comprises a fixed contact 127 mounted upon an electrically insulating bracket 128 which is supported on the rear of the control panel 42; it also comprises a relatively movable contact 129 mounted upon a flexible switch arm 130 secured to a terminal plate 131 which also is secured to the insulating bracket 128. The switch arm 130 biases the contact 129 toward the fixed contact 127, and it is provided with an insulating extension 132 which is adapted to be operated by means of an electromagnet 133 under the control of the push button 115. This magnet, as shown, comprises a coil 134 and a plunger 135. As will be pointed out in greater detail hereinafter, when the push button is depressed the coil 134 is energized to retract the plunger 135 and thereby permit the switch contacts 127 and 129 to close.

Referring to the circuit diagram shown in Fig. 13, it will be observed that the lower conductor of a suitable source of electrical supply 136 is electrically connected to one terminal of the motor 23, the other terminal of which is connected by a conductor 137 to the switch terminal 80; it will also be observed that one terminal of the inlet valve operating coil 28 is connected to the neutral terminal plate 43c by means of a conductor 138, and that the other side is connected by means of a conductor 138a to the bracket 50 to which the switch arm 49 is connected; one terminal of the drain valve operating coil 37 is connected to the switch terminal 77 by means of a conductor 139, and the other end of this coil is connected by means of a conductor 139a to the neutral plate 43b; this plate, as shown, is electrically connected to the neutral plate 43c; one terminal of the heater 41a is connected by means of a conductor 140 with the neutral terminal plate 43c, while its other terminal is connected to the switch terminal 79 by means of a conductor 140a; one terminal of the measuring coil 55 is connected to the switch binding screw 104 by means of a conductor 141, while its other end is connected to switch terminal 80 by means of a conductor 141a; one terminal of the timer motor 107 is connected to the neutral terminal plate 43c by means of a conductor 142, and its other terminal is connected to the binding screw 105 of the switch by means of a conductor 143; one side of the push button 115 is connected to the terminal plate 43a by means of a conductor 144 and its other side is connected to the switch terminal 76 by means of a conductor 145; the fixed door switch contact 119 is connected, as shown, to the terminal plate 43a, and its movable contact 120 is connected to the terminal plate 43; one side of the push button coil 134 is connected by means of a conductor 146 to the neutral terminal plate 43c, and its other side is connected by means of a conductor 147 to the switch terminal 76; the upper conductor of the electrical supply source 136 is electrically connected to the ter-

minal plate 43 by means of a conductor 148.

In the operation of the washing apparatus, it will be understood that after the dishes have been placed in the washing vat 10, the door 15 has been closed, and the latch 16 operated to its locking position by means of the handle 17, the push button 115 should be depressed to start the washing operation. It is to be noted here that at the start of the operation, the switch blades 71 and 75 are closed, while the remaining switch blades are open. When the push button is depressed, a circuit is completed from the upper conductor of the supply source 136, through the conductor 148, terminal plate 43, door switch 116, terminal plate 43a, conductor 144, push button 115, conductor 145, switch terminal 76, conductor 147, push button coil 134, conductor 146, neutral terminal plates 43c and 43b, conductor 149 to the lower side of the supply source 136. This operation, therefore, energizes the coil 133 and thereby causes it to retract its plunger 135; and this operation permits the closure of the main switch contacts 127 and 129.

The closure of the contacts 127 and 129 starts the impeller motor 23, starts the timer motor 107, and shunts the push button 115.

The energizing circuit for the impeller motor 23 may be traced as follows: Beginning with the upper conductor of the supply source 136, the circuit is directed through the conductor 148, terminal plate 43, door switch 116, terminal plate 43a, conductor 150, contacts 127 and 129, switch blade 130, conductor 151, binding screw 103, conducting plate 83, conducting plate 88, fixed contact 87, switch blade 75, terminal 80, and conductor 137 to one side of the motor, and thence through the motor to the lower conductor of the supply source.

The energizing circuit for the timing motor 107 is established from the upper conductor of the supply source 136, through the conductor 148, terminal plate 43, door switch 116, terminal plate 43a, conductor 150, contacts 127 and 129, switch blade 130, conductor 151, binding screw 103, plate 83, binding screw 105, conductor 143, thence through the timer motor 107, conductor 142, neutral terminal plate 43c, neutral plate 43b, and thence through the conductor 149 to the lower side of the supply source.

As pointed out above, not only does the closure of the contacts 127 and 129 start the impeller and timer motors, but this operation also shunts out the push button switch 115 so that even though it be depressed after it has been initially depressed and released it will have no effect whatsoever upon the control. The push button coil 134 is now energized by a circuit through the switch contacts 127 and 129, which circuit may be traced from the upper conductor of the supply source 136, through the conductor 148, terminal plate 43, door switch 116, terminal plate 43a, conductor 150, closed contacts 127 and 129, switch blade 130, conductor 151, binding screw 103, fixed contact 82, switch blade 71 which at the start of the operation will be closed, terminal 76, conductor 147, coil 134, conductor 146, neutral terminal plate 43c, plate 43b, and thence through conductor 149 to the lower conductor of the supply source 136.

Now the timer motor 107 is functioning to drive the cam 90.

Shortly after the timer motor 107 has started to function it will cause the switch blade 73 to engage its fixed contact 85. This operation energizes the water inlet coil 28 through the following circuit: From the upper conductor of the supply source 136, through the conductor 148, terminal plate 43, door switch 116, terminal plate 43a, conductor 150, switch contacts 127 and 129, switch blade 130, conductor 151, binding screw 103, terminal plates 83 and 88, fixed contact 85, switch blade 73, terminal 78, conductor 152, contacts 45 and 48, switch arm 49, conductor 138a, operating coil 28 of the inlet valve, conductor 138, terminal plate 43c, terminal plate 43b, and thence through conductor 149 to the lower conductor of the supply source.

This operation opens the inlet valve 27 and the water is supplied to the vat. At this time, the drain valve is open so that the water flowing into the vat can flow therefrom into the drain. Usually this supply of water at the start is used to spray the dishes, a suitable spray device (not shown) being provided in the upper portion of the vat through which the water flows.

The cam 90 next functions to close the drain valve 32 after the dishes have been sprayed for a predetermined interval of time. This is accomplished by causing the switch blade 72 to close its fixed contact 84. The resulting energizing circuit for the drain valve operating coil 37 is as follows: from the upper conductor of the supply source 136, through conductor 148, terminal plate 43, door switch 116, terminal plate 43a, conductor 150, switch contacts 127 and 129, switch blade 130, conductor 151, binding screw 103, terminal plates 83 and 88, fixed contact 84, switch blade 72, switch terminal 77, conductor 139, operating coil 37 of drain valve, conductor 139a, terminal plate 43b, and thence through conductor 149 to the lower conductor of the electrical supply source.

The water that is supplied to the vat is now caused to accumulate in the vat because the drain valve is closed. As previously pointed out, the measuring coil 55 will function when the proper supply of water has been supplied to the vat to cause the deenergization of the inlet valve coil 28 to shut off the water. At the start of the operating cycle, the measuring coil 55 is not included in the circuit of the motor 23 because the switch arm 75 is closed to shunt the coil. However, a predetermined interval after the drain valve closes, the measuring coil 55 is connected into the motor armature circuit by the opening of the switch blade 75; the circuit for the coil 55 may be traced as follows: From the upper conductor of the supply source 136, conductor 148, terminal plate 43, door switch 116, terminal plate 43a, conductor 150, switch contacts 127 and 129, switch blade 130, conductor 151, binding screw 103, terminal plate 83, binding screw 104, conductor 141, through the measuring coil 55, conductor 141a, switch terminal 80 and the conductor 137 to one side of the impeller motor 23, through the motor armature circuit to the lower conductor of the electrical supply source 136; this circuit, therefore, places the measuring coil 55 in series with the motor armature circuit.

Therefore, water is now flowing into the vat 10, the drain valve 32 is closed to cause it to accumulate therein, and the motor 23 is operating to drive the impeller 20. As the quantity of water in the vat increases, the load imposed on the impeller increases, and hence the motor armature current increases; therefore, the energization of the measuring coil 55 increases. When a predetermined quantity of water has been supplied to the vat, the energization of the measuring coil 55 becomes so great that it will retract its plunger 54

causing the abutment 52 to engage the switch arm extension 51 to open the contacts 45 and 48. This operation deenergizes the operating coil 28 of the inlet valve permitting it to close.

It is to be noted that at the time the drain valve 32 closes, it operates the detergent device 19 to supply the detergent therein to the vat in the manner previously described.

The impeller motor 23 will now continue to operate to circulate the cleansing fluid through the vat to wash the utensils in the vat for a predetermined length of time until the drain valve is again opened. At the end of this predetermined interval of time, the cam 90 will open the switch blade 72 to effect the deenergization of the drain valve operating coil 37 thus permitting the drain valve to open to drain the vat.

The vat is permitted to drain for a relatively short predetermined interval of time. Following this, but while the drain valve is still open, the water supply valve 27 is opened to spray the dishes a second time for a predetermined interval. This is accomplished by the cam 90 which closes the switch blade 75; this operation shunts the measuring coil 55 from the motor armature circuit and thereby permits the contacts 45 and 48 to reclose and energize the water valve operating coil 28 through the circuit previously described. The dishes will be sprayed until the cam 90 operates the switch blade 72 to permit it to close to reenergize the drain valve operating coil 37 to close the drain valve through the circuit previously described. A short predetermined interval of time after this, the switch blade 75 will be operated by the cam 90 to open its contacts, thereby placing the measuring coil 55 in the motor armature circuit, which coil will operate as previously described to effect the closure of the inlet valve 27 when a predetermined quantity of water has been supplied. The impeller then operates to circulate the water supplied to rinse the dishes.

Following this in a predetermined interval of time, the cam 90 opens the switch blade 72 to deenergize the drain valve coil 37 to permit the drain valve to open, and then, as before, the switch blade 75 is permitted to close to shunt out the measuring coil 55 so as to permit the contacts 45 and 48 to reclose, which operation reenergizes the inlet valve coil 28 to open the inlet valve and to permit the water to flow into the vat to effect a final spray. As before, a predetermined interval after the inlet valve is opened the drain valve operating coil 37 will be energized to close the drain valve 32 by the closure of the switch contact 72 by the cam 90, and as before, the measuring coil 55 will be connected in the impeller motor armature circuit by the opening of the switch blade 75 by the cam 90, so that it may function when the predetermined quantity of water has been supplied to the vat to open the contacts 45 and 48 to deenergize the operating coil 28 of the inlet valve to permit it to close.

Then the dishes will be given a final rinse for a predetermined period of time, at the expiration of which the drain valve 27 will be opened by the deenergization of its operating coil 37 due to the opening of the switch blade 72 by the cam 90.

A short predetermined interval of time after the drain valve 32 opens, the switch blade 73 is opened by the cam 90 which prevents the reenergization of the inlet valve operating coil 28 when the contacts 45 and 48 are subsequently closed. Following this, the switch blade 75 is

permitted to close which operation shunts the measuring coil 55 from the impeller motor armature circuit and permits the contacts 45 and 48 to close. However, inasmuch as the switch blade 73 is open the energizing circuit for the water valve operating coil 28 is also opened, and the water valve 27 remains closed. The motor 23, however, will continue to operate because the switch blade 75 remains closed.

Now the drying heater 41*a* is energized by the cam 90 which closes the switch blade 74. The energizing circuit for this heater may be traced as follows: from the upper conductor of the supply source 136, through the conductor 148, terminal plate 43, door switch 116, terminal plate 43*a*, conductor 150, switch contacts 127 and 129, switch blade 130, conductor 151, binding screw 103, terminal plate 83, fixed contact 86, switch blade 74, switch terminal 79, conductor 140*a*, heater 41*a*, conductor 140, terminal plate 43*c*, terminal plate 43*b*, and thence through conductor 149 to the lower conductor of the supply source 136.

It will be understood that the impeller blades 21 will function at this time to cause circulation of the heated air in the vat. The heater 41*a* will remain energized to supply heat to the vat and the impeller will operate to circulate the heated air through the vat for a predetermined interval of time, at the expiration of which the switch blade 71 will be opened by cam 90; this operation will deenergize the push button coil 134 thereby permitting its plunger 135 to drop to open the contacts 127 and 129. This operation deenergizes all the circuits, and permits the timer spring 113 to restore the cam 90 to its initial position for a repeat cycle, the timing motor 107 at this time being uncoupled from the gear train 108.

It will be observed that it will be impossible to start the cycle of operation even though the push button 115 be depressed unless the door 15 is closed because when it is open the door switch 116 will be open.

Also, it will be observed that if at any time during the cycle of operation the door latch 16 be unlatched to open the door, the door switch 116 will open immediately to deenergize the complete circuit and stop the washing cycle.

A very important feature of this invention is that if the door 15 should be opened at some time during the cycle of operation so as to cause the door switch 116 to open and deenergize the system, the timing control mechanism will immediately be restored to its initial condition so that after the door has been reclosed and the push button 115 depressed, the cycle of operation will start and complete the entire washing, spraying, rinsing and drying steps. This is particularly important in case it is desired to load more dishes into the vat after the cycle has been started. It will be observed that if the control was not restored to its initial condition, these dishes might not be properly washed because they would only be subjected to whatever steps remainded in the cycle.

While I have shown a particular embodiment of my invention, it will be understood, of course, that I do not wish to be limited thereto since many modifications may be made, and I, therefore, contemplate by the appended claims to cover any such modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. In dishwashing apparatus provided with a

vat, a door for closing said vat, latching means for said door movable to a position to latch the door closed and to a position to release the door, means for supplying liquid to and draining liquid from said vat, and means for circulating liquid in said vat, control means for said apparatus comprising electroresponsive means for controlling said liquid supply and draining means to control the admission of liquid to and the drainage of liquid from said vat, and also controlling the operation of said liquid circulating means, switching means controlling the operation of said electroresponsive means, a control member for said switching means operable from an "off" position to succeeding controlling positions operating said switching means so as to effect the operation of said electroresponsive means to operate said liquid supply and drain valves and said circulating means to perform a series of timed operations in a timed washing cycle, an electroresponsive timing motor, a clutch for effecting a driving connection between said timing motor and said control member, means operating said clutch to connect said control member with said timing motor and for energizing said timing motor to drive said control member, and for disconnecting said control member from said timing motor when said timing motor is deenergized, a spring tensioned when said control member is being driven by said timing motor for driving said control member to its "off" position when said control member is disconnected from said timing motor, and a switch operated by the movement of said latching means to its latching position controlling said timing motor so that said timing motor can not be energized unless said door is latched, and said switch being operated to deenergize said timing motor so as to permit said spring to restore said control member to its "off" position if said latching means is moved to its said released position during the interval of time that said timing motor is driving said control member.

2. In washing apparatus which can perform a series of operations in a washing cycle and in which the operation being performed is determined by the position of a control member, an electroresponsive timing motor for driving said control member to different positions in which said apparatus is caused to perform said series of operations, a manually operable switch, a second switch under the control of said manually operable switch arranged to be closed by the operation thereof so as to initiate the energization of said timing motor to drive said control member and operating thereafter to maintain the energization of said timing motor independently of said manually operable switch, and said second switch controlled by said timing motor to deenergize said timing motor at the end of said cycle.

3. In dishwashing apparatus provided with a vat, valves for supplying liquid to and draining liquid from said vat, and an impeller for circulating liquid in said vat, control means for said apparatus comprising electroresponsive means for controlling said liquid supply and drain valves to control the admission of liquid to and the drainage of liquid from said vat, and also controlling the operation of said liquid circulating impeller, switching means controlling the operation of said electroresponsive means, a control member for operating said switching means when moved from an initial position in a predetermined direction so as to effect a predetermined sequence in the operation of said valves and impeller so that said apparatus performs a series of operations in a washing cycle, a timing motor for driving said control member in said one direction, a manually operable switch for initiating the operation of said timing motor, a switch operated by said timing motor for maintaining its operation independently of said manually operable switch after the operation of said timing motor has been initiated and until said cycle has been completed, and means controlled by said timing motor for releasing said control member therefrom and returning it to said initial position at the end of said washing cycle.

4. In dishwashing apparatus provided with a vat, liquid supply and drain valves for said vat, an impeller for circulating liquid in said vat, means for driving said impeller, a heater for applying heat to said vat for effecting a drying operation, a control member movable to a series of controlling positions for controlling the operation of said supply valve, said drain valve, said driving means and said heater so as to effect a predetermined sequence in their operation to cause said washing apparatus to perform a series of operations in a washing cycle including washing and drying operations, auxiliary control means controlled by said control member arranged to control said supply valve and constructed and arranged when said control member is in one position to respond to the load imposed on said driving means in operating said impeller to close said supply valve when said load attains a predetermined high value, and said auxiliary control means being rendered non-responsive to said load to cause said inlet valve to reclose when said control member is in another position, said control member when operated to its controlling positions rendering said auxiliary control means responsive and non-responsive to said load to control the opening and closing of said supply valve and said control member also controlling the opening and closing of said drain valve so as to supply a predetermined quantity of liquid to said vat for circulation by said impeller and for draining it from said vat in a series of cleansing operations, and further, said control member when in one controlling position functioning to cause said heater to apply heat to said vat while maintaining the operation of said impeller, to render said auxiliary control means non-responsive to said load, and to render said supply valve nonresponsive to the operation of said auxiliary control means.

5. In dishwashing apparatus provided with a vat, electroresponsive liquid supply and drain valves for said vat, an impeller for circulating liquid in said vat, and an electric motor for driving said impeller, an electric heater for applying heat to said vat for effecting a drying operation, main switching means movable to a series of controlling positions for controlling the energization of said electroresponsive supply valve, said electroresponsive drain valve, said motor and said heater so as to effect a predetermined sequence in their operation to cause said washing apparatus to perform a series of operations in a washing cycle including washing and drying operations, an auxiliary electroresponsive switch controlled by said main switching means arranged to control said electroresponsive supply valve and constructed and arranged to be connected in the armature circuit of said motor by said main switching means when in certain controlling positions, so as to respond to the magnitude of the armature current to close said supply valve when

said current attains a predetermined high value, and to be shunted out of said armature circuit when said main switching means is in other controlling positions to reclose said supply valve, said main switching means when operated to said controlling positions alternately connecting said auxiliary switch in said motor armature circuit and shunting it out of said circuit and controlling the opening and closing of said drain valve so as to supply a predetermined quantity of liquid to said vat for circulation by said impeller and for draining it from said vat in a series of washing operation, and further, said switching means functioning to energize said heater while maintaining the operation of said impeller, to shunt said auxiliary switch out of said motor armature circuit, and to render said electroresponsive supply valve non-responsive to the operation of said auxiliary switch.

6. In dishwashing apparatus provided with a vat, electroresponsive liquid supply and drain valves for said vat, an impeller for circulating liquid in said vat, and an electric motor for driving said impeller, an electric heater for applying heat to said vat for effecting a drying operation, main switching means movable from an "off" position to a series of controlling positions for controlling the energization of said electroresponsive supply valve, said electroresponsive drain valve, said motor and said heater so as to effect a predetermined sequence in their operation to cause said washing apparatus to perform a series of operations in a washing cycle including washing and drying operations, means for operating said main switching means from said "off" position to said series of controlling positions at a substantially constant speed, and controlled by said switching means to stop the operation thereof at the end of said series of operations, an auxiliary electroresponsive switch controlled by said main switching means arranged to control said electroresponsive supply valve and constructed and arranged to be connected in the armature circuit of said motor by said main switching means when in certain controlling positions, so as to respond to the magnitude of the armature current to close said supply valve when said current attains a predetermined high value, and to be shunted out of said armature circuit when said main switching means is in other controlling positions to reclose said supply valve, said main switching means when operated to said controlling positions alternately connecting said auxiliary switch in said motor armature circuit and shunting it out of said circuit and controlling the opening and closing of said drain valve so as to supply a predetermined quantity of liquid to said vat for circulation by said impeller and for draining it from said vat in a series of washing operations, and further, said switching means functioning to energize said heater while maintaining the operation of said impeller, to shunt said auxiliary switch out of said motor armature circuit, and to render said electroresponsive supply valve non-responsive to the operation of said auxiliary switch, whereby said apparatus effects a drying operation as the final step in said washing cycle.

7. Washing apparatus comprising a vat, a door for closing said vat, latching means for said door movable to a position to latch said door closed and to a position to release said door, means for supplying liquid to and draining liquid from said vat, and means for circulating liquid in said vat, control means for said apparatus having a control member for controlling the operation of said means for supplying liquid to and draining liquid from the vat and for circulating liquid in the vat, said control member being operable from an "off" position to succeeding controlling positions to cause them to perform a series of operations in a timed washing cycle, a timing motor, connection means for effecting a driving connection between said timing motor and said control member, means controlled by said control member controlling said connection means to disconnect said control member from said timing motor to terminate the washing cycle, driving means for driving said control member to restore it to said "off" position when it is disconnected from said timing motor, and auxiliary means operated by said latching means when operated to said release position for disconnecting said control member from said timing motor at any time during said washing cycle in order to terminate said cycle and permit said driving means to restore said control member to its "off" position.

8. Washing apparatus comprising a vat, a door for closing said vat, latching means for said door movable to a position to latch said door closed and to a position to release said door, means for supplying liquid to and draining liquid from said vat, and means for circulating liquid in said vat, control means for said apparatus having a rotatable control member for controlling the operation of said liquid supplying and draining means and said circulating means, a timing motor for rotating said control member from an initial "off" position to different positions in which said means are controlled to perform a series of operations in a washing cycle, a clutch between said timing motor and said control member, means operated by said control member for deenergizing said timing motor and for operating said clutch to disconnect said control member from said timing motor to terminate said washing cycle, restoring means energized by said timing motor when rotating said control member from said "off" position to said different positions for restoring said control member to its initial position when it is disconnected from said timing motor, means operated by said latching means when operated to said release position during said washing cycle for disconnecting said control member from said controlling motor to permit said restoring means to restore said control member to its controlling position.

9. In dishwashing apparatus provided with a vat, latching means for said door movable to a position to latch the door closed and to a position to release the door, a door for closing said vat, means for supplying liquid to and draining liquid from said vat, and means for circulating liquid in said vat, control means for said apparatus comprising a control member for controlling the operation of said means for supplying liquid to and draining liquid from the vat and for circulating liquid in the vat, said control member being operable from an "off" position to succeeding controlling positions to cause them to perform a series of operations in a timed washing cycle, a timing motor, connection means for effecting a driving connection between said timing motor and said control member, means operating said connection means to connect said control member with said timing motor and for starting the operation of said timing motor to drive said control member to effect said timed washing cycle, means controlled by said control member controlling said connection means to disconnect

said control member from said timing motor to terminate the washing cycle, tension means tensioned when said control member is being driven by said timing motor for subsequently driving said control member to its "off" position when said control member is disconnected from said timing motor, and means operated by the movement of said door latching means controlling said timing motor so that it cannot be operated unless said means is in latching position, and said last-named means being operated when said latching means is operated to its door releasing position during the washing cycle to disconnect said control member from said motor to stop the washing cycle and to permit said spring to restore said control member to its "off" position.

10. In dishwashing apparatus provided with a vat, valves for supplying liquid to and draining liquid from said vat, and an impeller for circulating liquid in said vat, control means for controlling said liquid supply and drain valves to control the admission of liquid to and the drainage of liquid from said vat, and said control means also controlling the operation of said liquid circulating impeller, a control member for controlling the operation of said control means so that when moved from an initial position in a predetermined direction it effects a predetermined sequence in the operation of said valves and impeller so that said apparatus performs a series of operations in a washing cycle, an electroresponsive timing motor for driving said control member in said one direction, a manually operable switch for initiating the operation of said timing motor, a switch operated by said timing motor for maintaining its operation independently of said manually operable switch after the operation of said timing motor has been initiated and until said cycle has been completed, and means controlled by said timing motor for automatically releasing said control member therefrom and returning it to said initial position at the end of said washing cycle.

11. In dishwashing apparatus provided with a vat, valves for supplying liquid to and draining liquid from said vat, and an impeller for circulating liquid in said vat, control means for controlling said liquid supply and drain valves to control the admission of liquid to and the drainage of liquid from said vat, and said control means also controlling the operation of said liquid circulating impeller, a control member for controlling the operation of said control means so that when moved from an initial position in a predetermined direction it effects a predetermined sequence in the operation of said valves and impeller so that said apparatus performs a series of operations in a washing cycle, a timing

motor for driving said control member in said one direction, a manually operable control device for said motor for initiating its operation, and means controlled by said timing motor for automatically releasing said control member therefrom and returning it to said initial position at the end of said washing cycle.

12. In dishwashing apparatus provided with a vat, means for supplying liquid to and draining liquid from said vat, and means for circulating liquid in said vat, control means for said apparatus comprising electroresponsive means for controlling said liquid supply and draining means to control the admission of liquid to and the drainage of liquid from said vat, and also controlling the operation of said liquid circulating means, switching means controlling the operation of said electroresponsive means, a control member for said switching means operable from an "off" position to succeeding controlling positions operating said switching means so as to effect the operation of said electroresponsive means to operate said liquid supply and drain valves and said circulating means to perform a series of timed operations in a timed washing cycle, an electroresponsive timing motor, a clutch for effecting a driving connection between said timing motor and said control member, means operating said clutch to connect said control member with said timing motor and for energizing said timing motor to drive said control member from said "off" to said succeeding controlling positions, and for disconnecting said control member from said timing motor when said timing motor is deenergized, and a spring tensioned when said control member is being driven by said timing motor to said succeeding controlling position for returning said control member to its "off" position when said control member is disconnected from said timing motor.

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