

April 16, 1940.

J. M. MURPHY

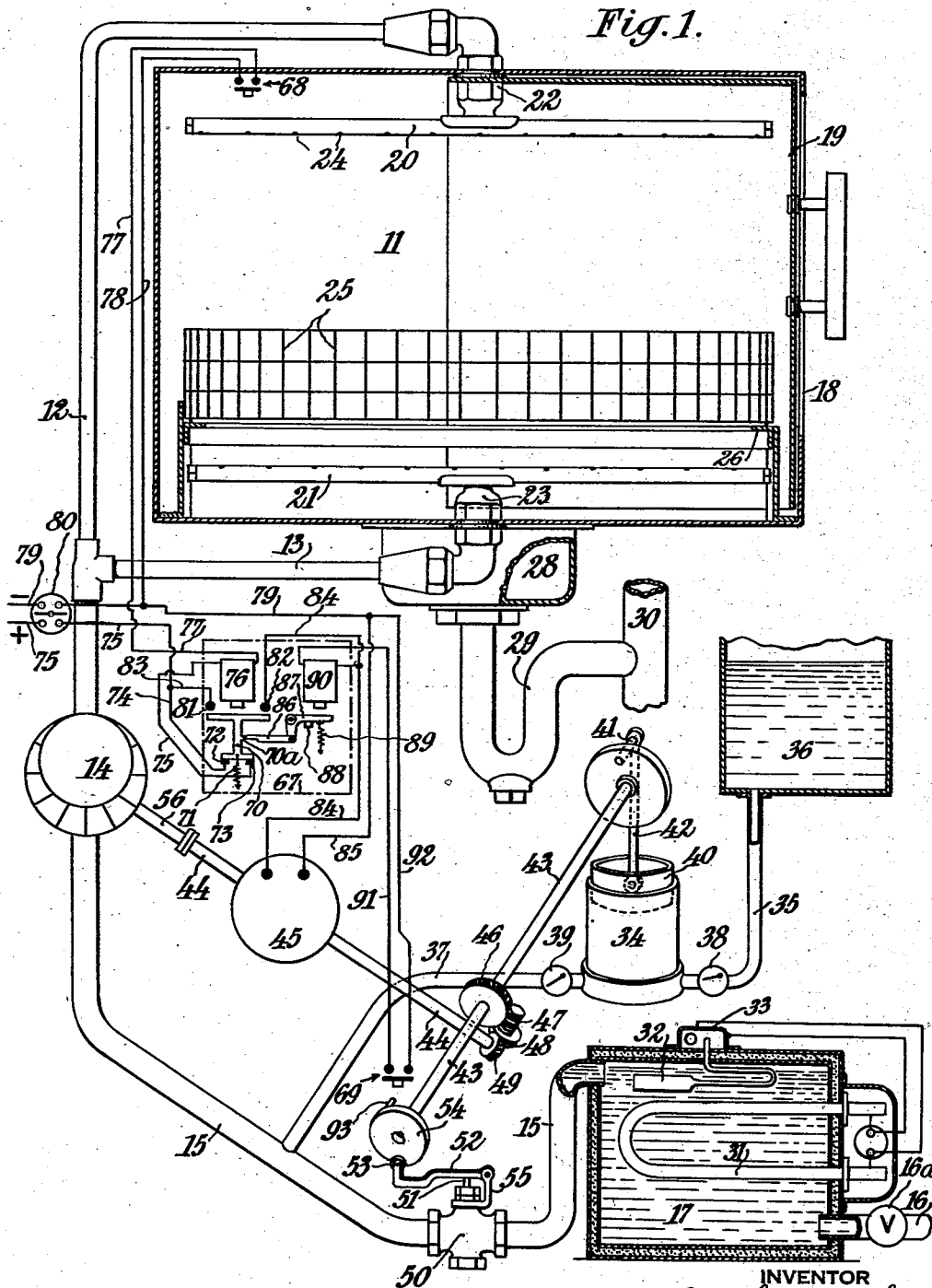
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DISHWASHING MACHINE

Filed Feb. 15, 1938

3 Sheets-Sheet 1

Fig. 1.



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Fig. 3.

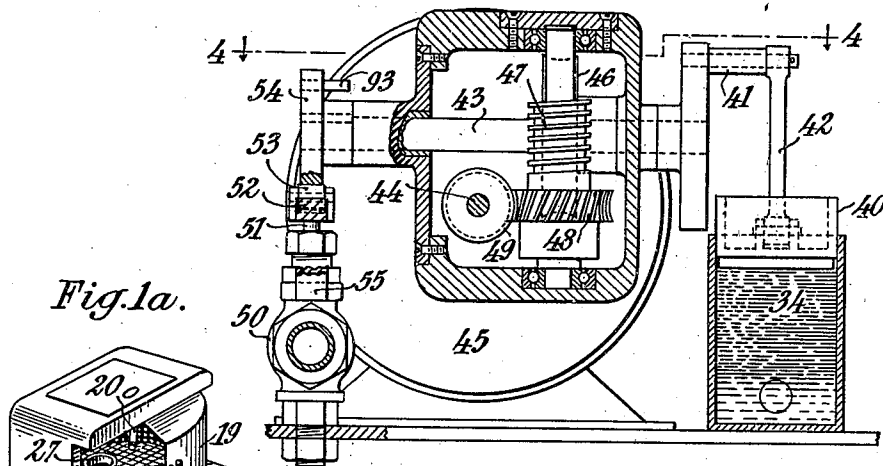


Fig. 1a.

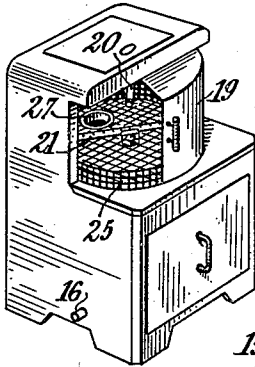


Fig. 4.

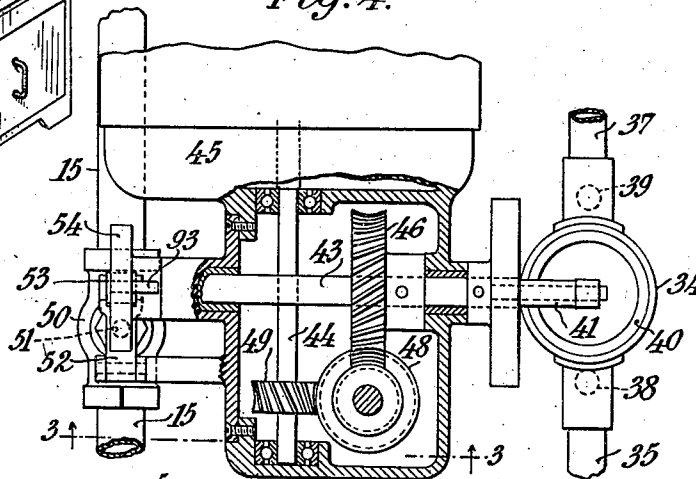


Fig. 5.

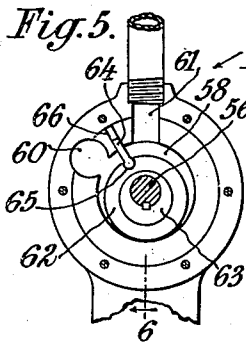
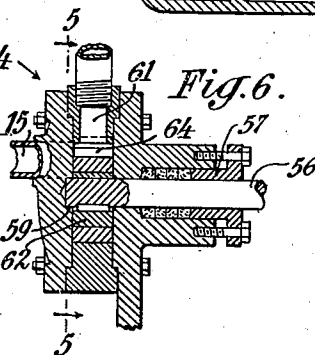


Fig. 6.



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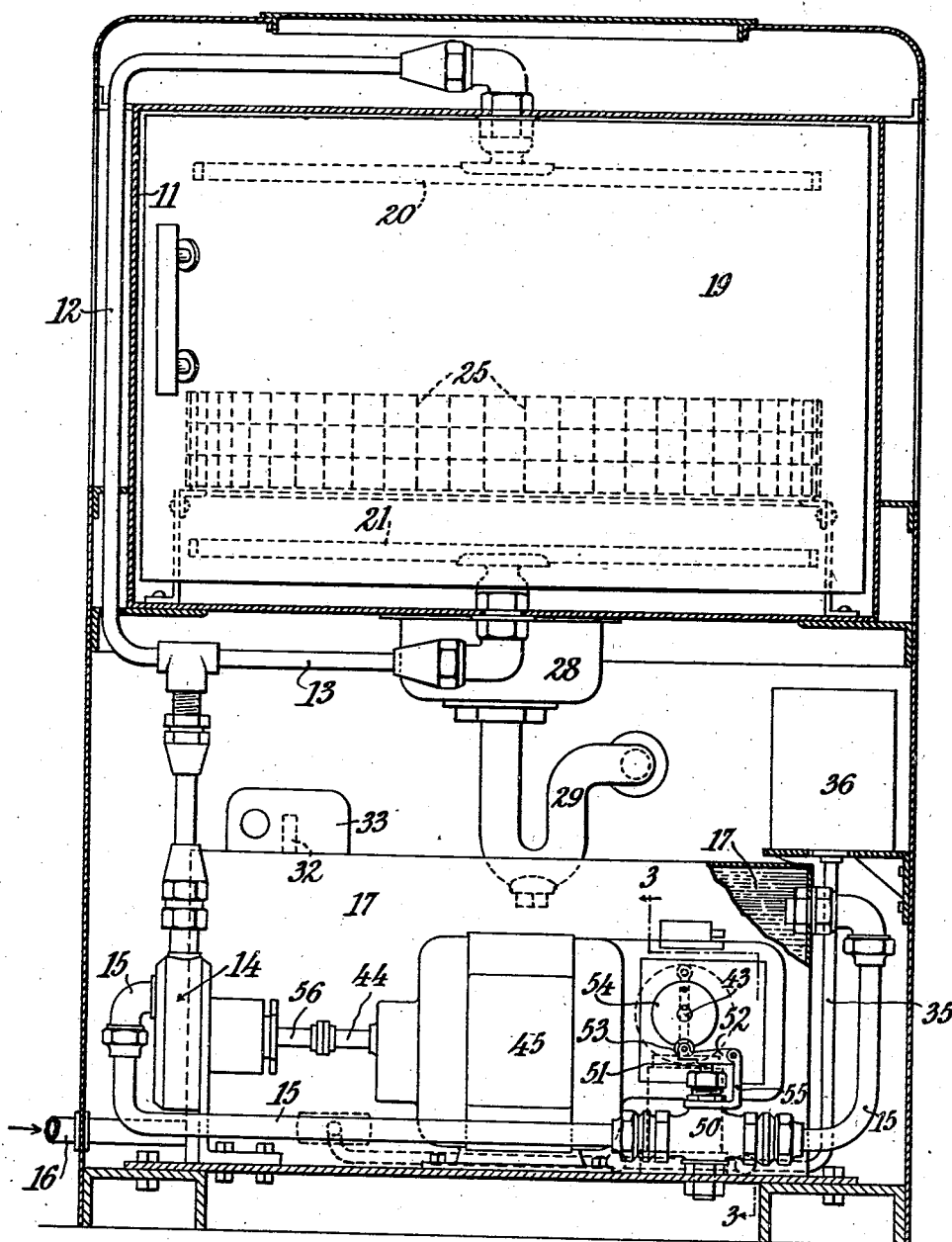
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3 Sheets-Sheet 3

Fig. 2.



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UNITED STATES PATENT OFFICE

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DISHWASHING MACHINE

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Application February 15, 1938, Serial No. 190,537

10 Claims. (Cl. 299—84)

This invention relates to improvements in machines for washing dishes or the like.

An important object of the invention is to provide, in dishwashing machines, a water supply system arranged to deliver and spray hot water forcibly upon dishes or the like at such high pressures and in such fine streams that the quantity of water used in a complete washing operation may be sufficiently low that water need not be repeatedly used and that the cost of the water used and of the energy used to heat the water, nevertheless, may be greatly minimized, thereby rendering such a device economically practical. Such repeated use of water defeats the very objectives of a washing machine and the present invention avoids such repeated use, while deriving economical operation, by scientifically controlling the delivery of only a moderate supply of water in each washing cycle.

A further object of the invention is the provision, in dishwashing machines, of means for automatically measuring a charge of soap or the like and distributing such a measured charge substantially evenly into water being pumped to the dishes during a first part of a complete washing cycle.

A still further object of the invention is the provision of means whereby, upon the washing machine being set into operation, the water supply is automatically turned on, a soap supply is automatically measured accurately and distributed evenly into the water supply during a first part of a washing cycle in order to deliver soapy water, such soap supply being automatically cut off in the beginning of a latter part of a washing cycle whereby to deliver thereafter a supply of clear rinse water, and wherein the device is automatically brought to a stop after a predetermined duration of the washing cycle when by experience it would be known that the washing of the dishes has been effectively completed.

These and further objects, which will be apparent from the following specification, are achieved by my invention as shown, for illustrative purposes, in the accompanying drawings, in which

Figure 1 is a schematic representation of the invention, some parts being shown in elevation, others in cross section, and still others being shown diagrammatically.

Fig. 1a is a perspective view of one form of a complete washing machine according to the invention, the door being partly open to partly show the interior of the device.

Fig. 2 is a vertical sectional view extending from

side to side of a dishwashing machine illustrating a suitable arrangement of the various component parts thereof within a suitable casing.

Fig. 3 is a side view, partly in elevation and partly in section, of reduction gearing and a soap measuring or dispensing device and a switch and valve cam connected to said gearing, the section being substantially on the lines 3—3 of Figs. 2 and 4.

Fig. 4 is a top view, partly in elevation and partly in section, of the parts shown in Fig. 3, the section being substantially on the lines 4—4 of Fig. 3.

Fig. 5 is a diametrical sectional view of a rotary sliding vane water pump as employed in my invention, the section being substantially on the line 5—5 of Fig. 6, most of the component parts of the pump, at that line, however, actually appearing in elevation.

Fig. 6 is a further sectional view of said water pump substantially on the line 6—6 of Fig. 5.

Referring particularly to Figs. 1 and 2,—the washing of dishes or the like is accomplished in the present invention by subjecting them to numerous whirling jets or sprays of hot water at high pressure in a washing chamber 11, to which water is pumped through branch pipe lines 12 and 13 by a suitable water pump 14 in a trunk pipe line 15, which derives its supply of water from a conduit 16 connected to a public water supply or other suitable source of supply. Connected between the trunk pipe line 15 and the conduit 16, is a water-heating tank 17 for heating the water to a desired temperature. A shut-off valve 18a is provided in the conduit 16 to permit the water to be shut off when the device is not in use.

The wash chamber 11 is preferably drum-shaped and is provided with an opening 18 at the front thereof which opening may be closed by a rounded slide door 19. The branch pipe lines 12 and 13 are provided with suitable fittings which may preferably extend centrally through the top and bottom of the wash chamber 11 to convey water into rotatable spray tubes 20 and 21 which are pivotally mounted within the said wash chamber upon rotative joints 22 and 23, respectively. The upper joint 22, also, is preferably adapted to serve as a pivot mounting for the door 19, the top of the latter being extended inwardly for this purpose.

The rotative joints 22 and 23 are preferably ball-bearing joints or are otherwise adapted to permit easy rotation of the spray tubes 20 and 21 about a vertical axis. The upper spray tube 20 is provided with a series of small orifices 24 ar-

ranged along opposite lower sides of the opposite arms of the spray tube, the orifices being so positioned that they direct jets of hot water angularly downwardly, the back pressure of water being ejected from the opposite arms of said tube operating, in a manner which is commonly understood, to cause rapid rotation of said spray tube.

The lower spray tube 21 is preferably similar to the said upper tube, the jets from the former, however, being directed upwardly. Thus the two rapidly revolving spray tubes 20 and 21 direct jets toward each other upon dishes or the like disposed between said tubes whereby to subject said dishes to the full cleansing effect of said jets. Although one spray tube alone could be quite effectively used within my invention, the combined and opposing action of jets from two such tubes is preferred.

A removable basket 25, preferably formed of non-corrosive wire or of other suitable structure may be filled with dishes or the like exteriorly of the device and may then be passed into the wash chamber 11 through the opening 18 and rested upon one or more supports 26. It will be seen that, with the illustrated arrangement, the basket with the dishes therein may be disposed intermediate the two spray tubes 20 and 21 whereby the dishes may be subjected to the action of the jets of hot water from the spray tubes 20 and 21 in the manner already described. The water is thrown forcibly upon all sides of the dishes, after which it gravitates to the bottom of the wash chamber, then passes through a strainer 27 into a sump 28 thence into a trap 29, from which it is carried off by a waste pipe 30. The strainer 27 is adapted to prevent the passage into the waste line of sizeable food particles which might stop up the waste pipe.

The water heating tank 17 is preferably provided with an electric resistance heating unit 31, a substantial portion of which extends into the interior of the tank and is immersed in the water therein. Opposite poles of the heating unit extend to the exterior of the tank and are connected to a suitable source of electric energy. A thermostatic element 32 extends into the water in the upper area of the tank 17 and passes to the exterior of the tank where it coacts with a thermostatically controlled electric switch 33 which is suitably connected to the electric leads supplying energy to the heating unit 31 whereby to energize and de-energize said unit as the temperature of the water in the tank goes below or above a desired temperature which in the present apparatus should preferably be about 180° F. Unheated water, from the conduit 16, enters the bottom of the tank 17 and heated water passes out at the top thereof into the trunk line 15.

Means are provided for dispensing a charge of soap or other detergent material and forcing such charge evenly into water being pumped to the wash chamber 11 during a first part of a washing cycle of operation and for discontinuing the supply of soap during a latter part of the cycle so that clear rinse water is then delivered to the dishes to complete the cleansing thereof. A soap measuring cylinder 34 is connected through a pipe 35 to a soap tank 36 or other suitable source of supply of soap, which should preferably be in liquid form so that it may readily pass through the apparatus in the manner hereinafter described.

The tank 36 may be disposed at a higher level than the measuring cylinder 34 so that gravity

may assist the passage of the soap into said cylinder, although, as will hereinafter appear, the said cylinder may be charged with soap without any aid from the force of gravity. The cylinder 34 is connected to the water trunk line 15 by the pipe 37 and check valves 38 and 39 are provided in the pipes 35 and 37, respectively, to assure a uni-directional flow of soap there-through into the trunk line 15.

A piston 40 is reciprocated within the cylinder 34 by a crank 41 which is connected to the said piston by a connecting rod 42. The crank 41 is fixed upon and rotates with a countershaft 43 which is connected to shaft 44 of a motor 45, through worm gears 46, 47, 48, 49. The said gears, as best seen in detail in Figs. 3 and 4, are preferably arranged in two sets, each constituting a worm and worm wheel, thus affording two speed reduction stages whereby to effect a substantial reduction in the speed of shaft 43 relatively to motor shaft 44, the speed reduction between said shafts being, preferably, about 600 to 1, although the reduction may be subject to substantial variation.

It will be seen that on the upstroke of the piston 40, check-valve 39 closes and check-valve 38 opens and soap is drawn from the soap tank 36 into the cylinder 34. The said cylinder is designed to hold a charge of soap sufficient for one washing cycle and on the downstroke of the piston 40, check-valve 38 closes and check-valve 39 opens, and such charge of soap is forced out of the cylinder 34, through the pipe 37 into the water trunk line 15.

The countershaft 43, in addition to controlling the delivery of soap into the water trunk line 15, also actuates a valve 50 which controls the passage of water through said trunk line. The said valve is opened and closed respectively by the inward and outward movement of a plunger 51 which may be urged to and normally held in an outermost position, wherein the valve is closed, by a suitable spring (not shown). A lever 52, having an intermediate portion which may press the plunger inwardly to open the valve, may be provided at one end with a roller 53 which rides upon a circumferential cam surface of a cam wheel 54 keyed to the countershaft 43, and the said lever 52 may be pivoted at its other end upon a bracket 55 which may be mounted upon the body of the valve 50.

The water pump 14, preferably of the rotary sliding vane type, is preferably directly driven by the motor 45 through the medium of a pump shaft 56 suitably coupled to shaft 44 of the motor. The shaft 56, as best understood from Figs. 5 and 6, extends through a stuffing box 57 into a pump chamber 58 and terminates at its inner end in a suitable bearing or recess 59. Water from the pipe 15 may enter the pump chamber 58 through a port 60. The chamber 58 is substantially drum-shaped, and water entering said chamber is forced to pass from the point of its entrance to the said chamber to a discharge port 61 by means of a rotary ring 62 of substantially the same axial diameter as the chamber 58, which ring is caused to move in a circular orbit around and in contact with the interior surface of the said pump chamber by an eccentric 63 keyed to or otherwise suitably fixed upon the shaft 56.

A sliding vane 64 extends from one side to the other of the chamber 58 and is pivoted along an inner portion thereof in a coaxial elongated recess 65 in the ring 62. The outer portion of

the vane 64 extends into and slides within a slot 66 in the pump casing. The said slot is located between the ports 60 and 61 so that as the ring 62 moves in its orbit, the vane 64 substantially prevents passage of fluid from the port 60 to the port 61 except in advance of the said ring, and as the latter is in constant contact with the circular wall and both side walls of the pump chamber 58 and as the vane 64 is in intimate engagement with both side walls of said chamber, the fluid is forced positively through the pump whence it passes through the port 61, thence it continues through trunk line 15 into the branch pipe lines 12 and 13 and into the spray tubes 20 and 21.

The orifices 24 in the said spray tubes have a collective area which is preferably substantially less than the area of the trunk line 15 at the point where the latter receives fluid discharged from the pump, and hence it is apparent that very substantial pressure may be established in the spray tubes 20 and 21 and that such fluid would therefore be ejected through the small orifices 24 in extremely fine jets and at very high velocity, so that such jets may impinge upon dishes or other articles being washed, with sufficient force that such articles may be thoroughly cleansed during a relatively short washing operation.

The motor 45, which may be an electric motor of a suitable type, is preferably controlled so that it will automatically start with the closing of the door 19 and will automatically stop after each complete revolution of the countershaft 43. The means for effecting such control are shown diagrammatically in Fig. 1 and may comprise relay apparatus 67, as indicated within the broken line enclosure, suitably connected to the motor and also to a momentary contact starting switch 68 associated with the door 19 and a momentary contact starting switch 69 associated with the cam wheel 54.

The relay apparatus 67 and the several switches referred to may be of a conventional type and therefore are disclosed and described herein primarily with reference to their mode of operation and without reference to their actual design or arrangement of parts. This being understood, a double-acting contact member 70 is normally held, by a tension spring 71, in engagement with and electrically connecting contacts 72 and 73. The contact 72 is connected through a conductor 74 to one of two main leads, indicated in the drawing as the positive lead 75, carrying electric current from a suitable source of supply of electric energy. The contact 73 is connected by a conductor 75 to one end of the coil of a circuit closing solenoid 76 and the other end of the latter's coil is connected through conductors 77 and 78, and the starting switch 68, to the other main lead, indicated as negative lead 79. Both leads 75 and 79 may be connected to and controlled by a double pole snap switch 80, by means of which the electrical apparatus may be disconnected when the machine is not in use.

The starting switch 68 is preferably arranged adjacent the door 19 so that the latter or some member carried thereby will actuate the said switch when the door is closed thus momentarily energizing the solenoid 76 which moves the contact member 70 into engagement with contacts 81 and 82, the former being connected through conductor 83 to main lead 75 and the latter being connected through conductor 84 to the motor 45. The circuit continues through the said motor and

through conductor 85 which is connected to main lead 79, thus completing the motor circuit.

Inasmuch as the solenoid 76 is only momentarily energized to move the contact member 70 into engagement with the contacts 81 and 82 to close the motor circuit, a locking arrangement is provided for preventing the return of the contact member 70 to its normal position in response to the pull exerted on it by the tension spring 71. This locking mechanism may comprise a suitably mounted latch 86 pivoted to one arm of a bell-crank lever 87, the other arm of the latter being normally held in one extreme position against a stop 88 by a tension spring 89.

The latch may be arranged to coact with a lug 70a on the contact member 70 and both said members may have coacting bevelled surfaces which cause said latch to recede as the member 70 is moved from its normal position and snap back into place underneath the lug in order to hold the member 70 in engagement with contacts 81 and 82. The latter arm of the bell-crank lever 87 is disposed within the field of a release solenoid 90 so that when the latter is energized the bell-crank will be operated and will withdraw the latch 86 from engagement with the lug 70a, whereupon the latter will be drawn by the spring 71 out of engagement with the contacts 81 and 82, thus breaking the motor circuit.

The coil of the release solenoid 90 is connected with the main lead 75 through conductors 83 and 84 and contact member 70, hence, it will be seen that said solenoid may only be energized when the motor circuit is closed. The other end of the coil of said solenoid is connected through conductors 91 and 92 and stopping switch 69 to main lead 79. The switch 69 is arranged to be operated by a pin 93 on the cam wheel 54 at the end of a complete revolution of said wheel whereby to momentarily energize the solenoid 90 and release the latch 86, thus permitting the contact member 70 to be moved out of engagement with the contacts 81 and 82, thereby breaking the motor circuit and stopping the apparatus.

The operation of the device may best be understood by reference to Fig. 1. Assuming that the door 19 is open and that all the parts are in the positions shown in said figure and that the valve 16a and the double-pole snap switch 80 have been set so that the apparatus is connected to suitable sources of supplies of water and electric energy, a basket 25 may be filled with dishes and other articles to be washed and placed within the wash chamber 11. The door 19 is then closed, whereupon it actuates starting switch 68, energizing the solenoid 76 which draws the contact member 70 into engagement with contacts 81 and 82, thus closing the motor circuit and starting the motor.

Although the solenoid 76 is only momentarily energized, the contact member 70 nevertheless is held in position as a part of the motor circuit by the latch 86. With the starting of the motor, the pump 14 immediately commences to pump water (preferably heated in the tank 17 to about 180° F.) through the trunk line 15 into the wash chamber 11 and the countershaft 43, being connected to the motor, immediately commences to rotate slowly. Upon commencement of the rotation of the countershaft, the roller 53, which has been resting in a recess in the circumferential surface of the cam wheel 54 is forced out of said recess by the rotation of the cam wheel, thereby actuating the lever 52 and pressing the plunger 51 of the valve 50 inwardly to open the latter.

Upon commencement of the rotation of the countershaft 43, the piston 40 of the soap dispenser starts to descend from its initial uppermost position and forces soap from the cylinder 34 through the open check valve 39 and the pipe 37 into the trunk line 15. The soap thus passed into the trunk line had, during a latter part of a previous cycle of operation, been drawn into the cylinder 34 from the tank 36. The check valve 38 is held closed and the check valve 39 held open during the downstroke of the piston 40 as a result of the pressure set up in the cylinder 34 in a manner which is well understood.

During the downstroke of the piston 40 the passage of soap into the trunk line 15 has been substantially regular, such regularity being assured because of the fact that the passage of soap is positively controlled by the descent of said piston. When the piston 40 reaches its lowermost position, one-half of a washing cycle has been completed and during that half cycle there has been an even merging of soap with clear water to form soapy water which has been pumped through the trunk line 15 into the spray tubes 20 and 21 being ejected from orifices 24 in the latter in jets of high velocity which impinge upon the dishes with great force, the spray tubes meanwhile revolving rapidly whereby such jets are thrown upwardly and downwardly in all directions to assure that all parts of the dishes will be reached by the jets and cleansed.

During the second half of the washing cycle, the piston 40 of the soap dispenser is moving upwardly creating a suction in the cylinder 34 which suction closes the check valve 39, and opens the check valve 38, whereupon soap is drawn from the soap tank 36 into said cylinder so that such soap may be available for the next washing cycle. In the meantime no soap is being delivered to the trunk line 15 and hence the water passing therethrough and being ejected from the spray tubes is clear water which operates to very effectively rinse the dishes.

When the piston 40 reaches its uppermost position, corresponding to the end of a washing cycle, the roller 53 again drops into the recess in the circumferential cam surface of the cam wheel 54, whereupon the lever 52 is again actuated to close the valve 50 and automatically cut-off the delivery of water to the wash chamber. At the same time the pin 93 on the said cam wheel engages and closes the stop switch 69, thus energizing the solenoid 90 and operating the bell-crank lever 87 and the latch 86 to release the contact member 70 from its engagement with the contacts 81 and 82, thus breaking the motor circuit and automatically stopping the operation of the apparatus.

This invention, by employing fine jets of water at very high velocity, uses a minimum quantity of water and renders it economically practical to heat such moderate quantity of water and to avoid the very objectionable re-use of it. Hot water, being more effective for cleansing purposes than cold water, contributes to the effectiveness of the relatively small quantity of water used. In short, economical usage of water makes it feasible to heat it and use it only once and the fact that it is heated minimizes the quantity of water required for each washing cycle.

The pump and other apparatus already described are preferably designed and arranged to use about six quarts of water for each washing cycle. The water heating tank 17 may prefer-

ably be of about three gallon capacity so that each washing cycle uses only about one-half the capacity of the tank and the temperature of the water in the tank may be restored by the heating apparatus, already described, during the period between each washing cycle. A motor is preferred having a speed of approximately 1800 revolutions per minute and the reduction between the motor shaft 44 and the countershaft 43 should preferably be about 600 to 1. Thus, each revolution of the countershaft would correspond to one washing cycle, and the time duration of each washing cycle would be approximately twenty seconds, during which period the dishes should be effectively washed.

By using water, in this apparatus, at a temperature of approximately 180° F., substantial drying of the dishes is effected when the door is opened upon the completion of a washing cycle, this being occasioned by the very sudden drop of about 110° F. between the water temperature and the approximate room temperature, which sudden drop causes any moisture on the dishes to very rapidly evaporate.

The foregoing description of the invention and the particular apparatus disclosed in the accompanying drawings are set forth only for the purpose of illustrating the invention and its operation. It should, therefore, be understood that many variations may be employed in a complete washing machine or in the parts thereof without departing from the spirit of the invention as defined in the accompanying claims.

What I claim is:

1. The combination, in a dishwashing machine or the like, of a main conduit adapted to pass water from a source of water supply to a discharge point proximate to dishes or the like to be washed, a valve in said main conduit adapted to control the passage of water there-through, an auxiliary conduit adapted to pass soap or the like from a separate source of supply into said main conduit, a pump in said auxiliary conduit, adapted to facilitate the movement of such soap or the like through said auxiliary conduit into the said main conduit, and means, common to both said pump and valve for driving the pump and for opening and closing the valve, the said valve and pump being constrained by said common means to operate in timed relationship wherein the valve opens upon the commencement of a cycle of operation and closes upon the termination of such a cycle, and the pump moves the soap or the like through said auxiliary conduit into water passing through said main conduit only during a first part of such cycle.

2. The combination, in a dishwashing machine or the like, of a main conduit adapted to pass water from a source of water supply to a discharge point proximate to dishes or the like to be washed, a valve in said main conduit adapted to control the passage of water there-through, an auxiliary conduit adapted to pass soap or the like from a separate source of supply into said main conduit, a reciprocating-piston pump in said auxiliary conduit, adapted to facilitate the movement of such soap or the like through said auxiliary conduit into the said main conduit, and means common to both said pump and said valve for driving the former and for opening and closing the latter, the said common means being adapted to open and close said valve at the commencement and termination respectively of a washing cycle, and being further

adapted to impart a force stroke to said pump during a first part of such washing cycle whereby to force soap or the like out of said pump, toward said main conduit, and to impart a return stroke to said pump during a later part of such washing cycle whereby to move soap or the like from such soap supply into said pump.

3. The combination, in a dishwashing machine or the like, of a main conduit adapted to pass water from a source of water supply to a discharge point proximate to dishes or the like to be washed, a valve in said main conduit adapted to control the passage of water therethrough, an auxiliary conduit adapted to pass soap or the like from a separate source of supply into said main conduit, a reciprocating-piston pump in said auxiliary conduit, adapted to facilitate the movement of such soap or the like through said auxiliary conduit into the said main conduit, and means for driving said pump and operating said valve in timed relationship, said means comprising a motor-driven shaft, a cam turned by said shaft, a valve operating member actuated by said cam, and a crank turned by said shaft and connected to the piston of said pump, the said cam and said crank being so mounted upon said shaft that the valve opens and closes at the beginning and end respectively of a cycle of operation coinciding with one revolution of said shaft, and that the piston of said pump commences a force stroke at the beginning of such a cycle and terminates a return stroke at the end of such a cycle.

4. The combination, in a dishwashing machine or the like, of a main conduit adapted to pass water from a source of water supply to a discharge point proximate to dishes or the like to be washed, a continuous-delivery pump in said main conduit adapted to facilitate the movement of water therethrough toward said discharge point, an auxiliary conduit adapted to pass soap or the like from a separate source of supply into said main conduit, an intermittent-delivery pump in said auxiliary conduit, adapted to facilitate the movement of such soap or the like through said auxiliary conduit into the said main conduit, driving means for driving both said pumps, and means for controlling said driving means whereby to start said first-mentioned pump at the beginning of a washing cycle and to stop it at the end of such cycle, the said second-mentioned pump being adapted to substantially facilitate the movement of soap or the like intermittently through said auxiliary conduit into the said main conduit.

5. The combination, according to claim 4, further characterized in that the said driving means comprises a motor, and the said controlling means comprises a switch adapted to control the supply of energy to said motor and a switch actuating member driven by said motor and adapted to open said switch at the end of such a washing cycle whereby to stop said motor and both said pumps.

6. The combination, according to claim 4, further characterized in that the said intermittent-delivery pump is a reciprocating-piston pump and the said driving means comprises a high-speed rotatable shaft adapted to drive said continuous-delivery pump, a low-speed rotatable shaft, connected through reduction gearing to said high-speed shaft and adapted to drive said intermittent-delivery pump, and a crank, turned by said low-speed shaft and connected to the piston of said intermittent-delivery pump, where-

by during an early part of a washing cycle, coinciding with one revolution of said low-speed shaft, the piston of said latter pump executes a force stroke, and during a later part of such cycle the said piston executes a return stroke.

7. The combination, in a dishwashing machine or the like, of a main conduit adapted to pass water from a source of water supply to a discharge point proximate to dishes or the like to be washed, a pump in said main conduit, adapted to facilitate the movement of water therethrough toward said discharge point, a valve in said main conduit, adapted to control the passage of water therethrough, an auxiliary conduit adapted to pass soap or the like from a separate source of supply into said main conduit, a pump in said auxiliary conduit, adapted to facilitate the movement of such soap or the like through said auxiliary conduit into said main conduit, means common to both said pumps and said valve for driving both said pumps and for opening said valve upon the commencement of a cycle of operation and closing said valve upon the termination of such a cycle, the said pumps and the valve being constrained by said common means to operate in timed relationship wherein water may pass through said main conduit toward said discharge point continuously during the entire period of such cycle and soap or the like may substantially move through said auxiliary conduit into water passing through said main conduit, only during a first part of such cycle.

8. The combination, in a dishwashing machine or the like, of a main conduit adapted to pass water from a source of water supply to a discharge point proximate to dishes or the like to be washed, a continuous-delivery pump in said main conduit, adapted to facilitate the movement of water therethrough toward said discharge point, a valve in said main conduit, adapted to control the passage of water therethrough, an auxiliary conduit adapted to pass soap or the like from a separate source of supply into said main conduit, an intermittent-delivery pump in said auxiliary conduit, adapted to facilitate the movement of such soap or the like through said auxiliary conduit into said main conduit, and means for driving said pumps and operating said valve in timed relationship, said means comprising a high-speed rotatable shaft, adapted to drive said continuous-delivery pump, a low-speed rotatable shaft, connected through reduction gearing to said high-speed shaft and adapted to drive said intermittent-delivery pump and to open and close said valve, the said low-speed shaft being adapted to coact with the latter pump and with said valve in such manner that the latter is opened and closed at the beginning and end respectively of a washing cycle, and that the latter pump substantially moves soap or the like through said auxiliary conduit into water passing through said main conduit only during an early part of such a washing cycle.

9. The combination, according to claim 8, characterized in that the said intermittent-delivery pump is a reciprocating-piston pump, and the low-speed shaft has a crank, adapted to turn therewith, connected to the piston of said latter pump and a cam, adapted to turn therewith, coacting with a part of said valve whereby to operate the latter, the said crank and cam being so connected to said low-speed shaft that the said valve is opened and closed at the beginning and

end respectively of a washing cycle, coinciding with one revolution of said low-speed shaft, and that the piston of said pump executes a force stroke during an early part of such washing cycle and a return stroke during a later part of such cycle.

10. The combination, according to claim 8, characterized in that the said intermittent-delivery pump is a reciprocating-piston pump, and the low-speed shaft has a crank, adapted to turn therewith, connected to the piston of said latter pump and a cam, adapted to turn therewith, coacting with a part of said valve whereby to operate the latter, the said crank and cam being so connected to said low-speed shaft that

the said valve is opened and closed at the beginning and end respectively of a washing cycle, coinciding with one revolution of said low-speed shaft, and that the piston of said pump executes a force stroke during an early part of such washing cycle and a return stroke during a later part of such cycle, the said combination being further characterized in including a motor adapted to drive said shafts, a switch adapted to control the supply of energy to said motor, and a switch actuating member carried by said low-speed shaft and adapted to open said switch at the end of a washing cycle whereby to stop said motor and both said pumps.

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