United States Patent [19]

Guth

[11] **3,798,465**

[45] **Mar. 19, 1974**

[54] **CONTROL ARRANGEMENT FOR A WASHING MACHINE**

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[73] Assignee: **General Electric Company,** Louisville, Ky.

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[52] **U.S. Cl.** **307/141**

[51] **Int. Cl.** **H01h 7/00**

[58] **Field of Search** 307/141, 141.4, 141.8, 307/116

[56] **References Cited**

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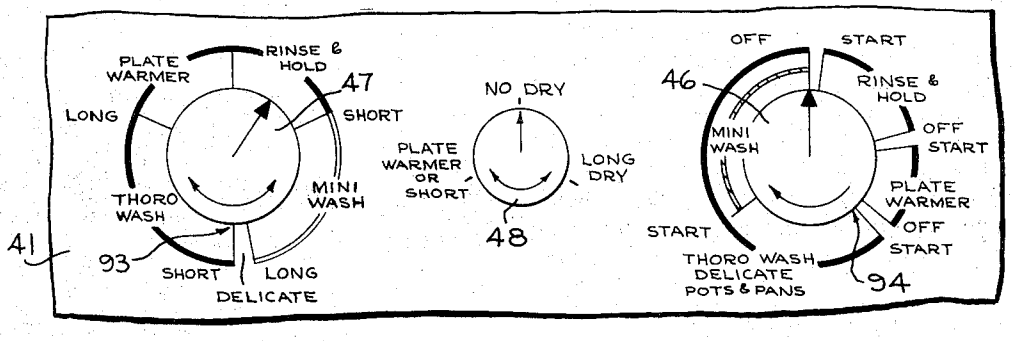
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Primary Examiner—Herman J. Hohauser
Assistant Examiner—M. Ginsburg
Attorney, Agent, or Firm—Francis H. Boos, Jr.

[57] **ABSTRACT**

In an automatic dishwasher, apparatus is provided for improving the cleaning efficiency thereof. The dishwasher is of the type having a plurality of electrical components sequentially operable in an operational cycle controlled by an electrical sequence control timer device adapted for automatic advancement and includes rinsing, washing, drain and fill cycle portions. An electro-mechanical device combines the selection of the operational cycle and the selection of the time duration thereof into a single control and operation. This device includes a cam actuated switch having a plurality of contact points in a package with and operatively linked with an adjustable thermally-responsive switch. A cam associated with the sequence control timer automatically cancels the time extension of the drain and fill portions, effectively limiting the time extension effect to the washing and drying cycle portions of an operational cycle.

3 Claims, 4 Drawing Figures



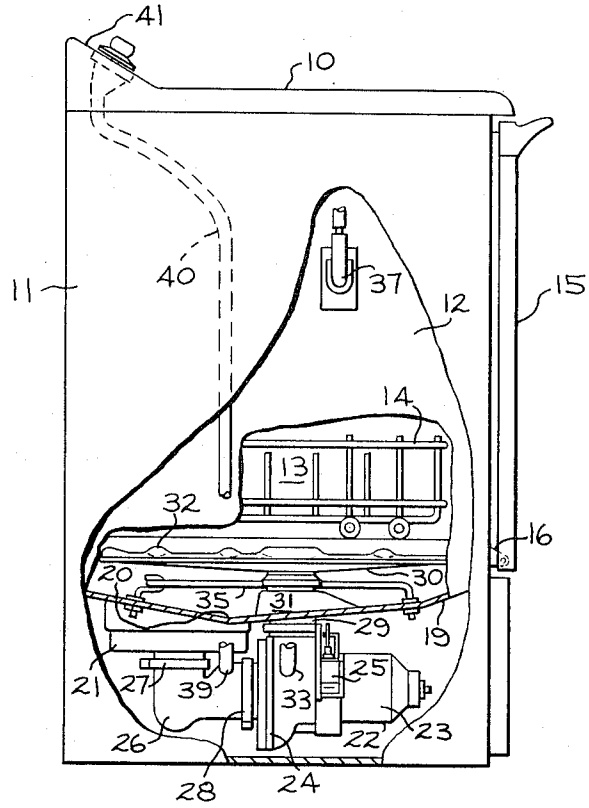

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FIG. 1

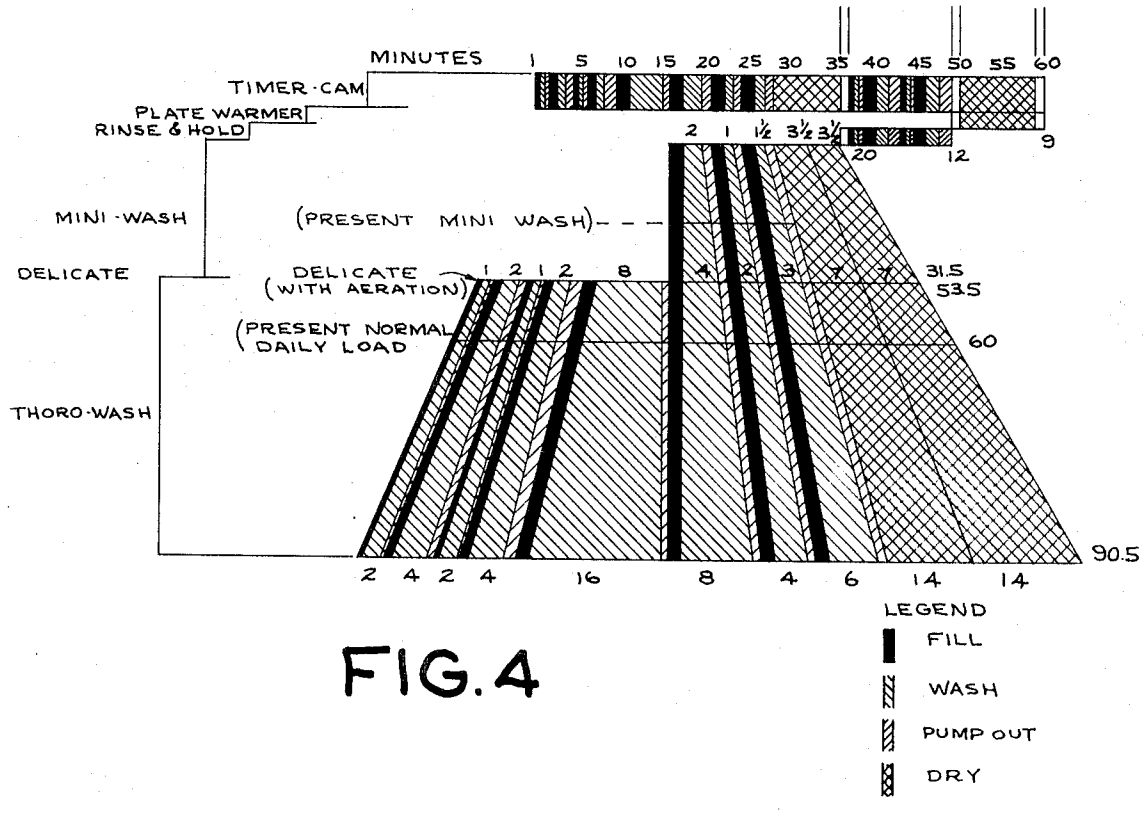
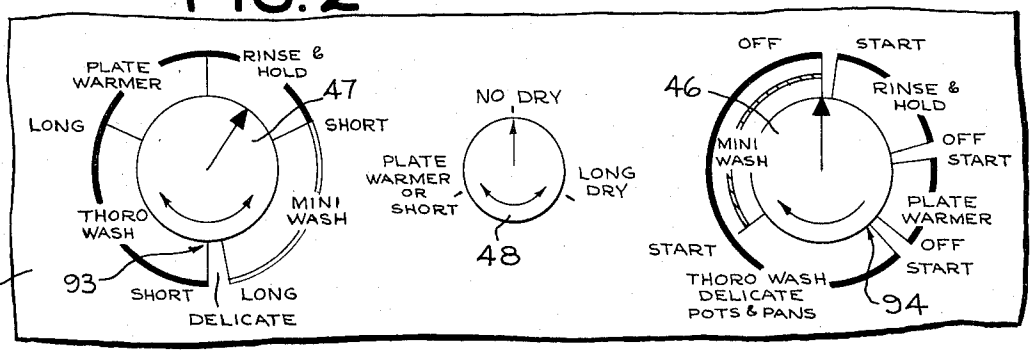

MINUTES
1 5 10 15 20 25 30 35 40 45 50 55 60
TIMER-CAM
PLATE WARMER
RINSE & HOLD
2 1 1½ 3½ 3½
20
12
9
MINI-WASH
(PRESENT MINI WASH)
DELICATE
DELICATE
(WITH AERATION)
1 2 1 2 8 4 2 3 7 7
31.5
53.5
(PRESENT NORMAL
DAILY LOAD
60
THORO-WASH
90.5
2 4 2 4 16 8 4 6 14 14
LEGEND
FILL
WASH
PUMP OUT
DRY

FIG. 4

FIG. 2


PLATE WARMER
RINSE & HOLD
47
LONG
SHORT
THORO WASH
MINI WASH
41
93
SHORT
LONG
DELICATE
NO DRY
PLATE WARMER OR SHORT
LONG DRY
48
OFF
START
46
RINSE & HOLD
MINI WASH
OFF
START
PLATE WARMER
OFF
START
START
THORO WASH
DELICATE
POTS & PANS
94

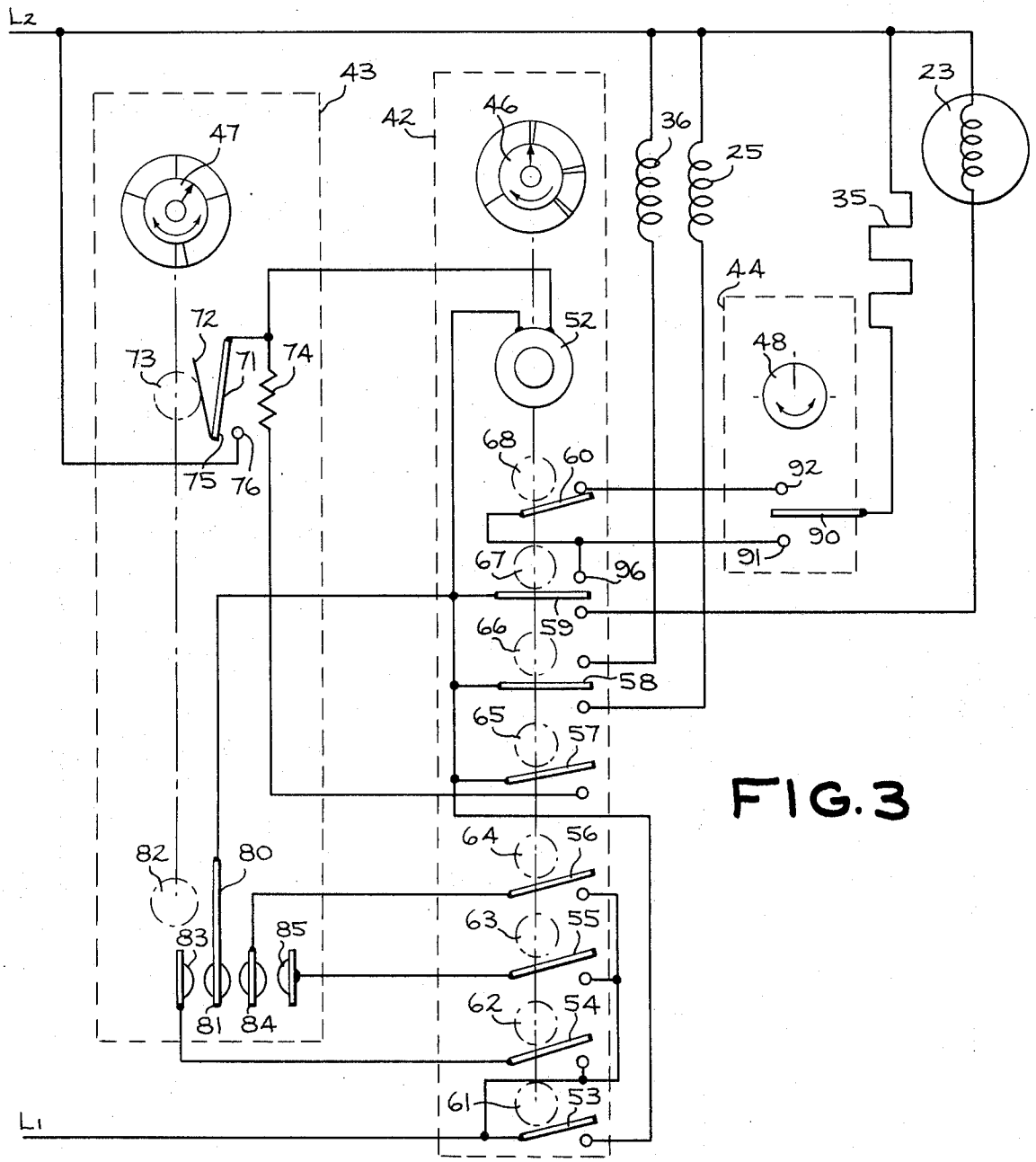

L2
43
42
47
46
36
25
23
35
44
48
52
72
73
71
74
75
76
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60
92
90
91
67
96
66
59
58
65
57
64
56
63
55
62
54
61
53
82
80
83
85
81
84
L1

FIG. 3

CONTROL ARRANGEMENT FOR A WASHING MACHINE

BACKGROUND OF THE INVENTION

The present invention relates to an automatic dishwashing machine, and more particularly to apparatus including circuitry in such machines for providing manual means for simultaneously selecting a particular operational cycle and the time duration or extension thereof.

The provision, in the automatic control of dishwashers, of operational cycles that are adjustable as to sequence of operation of the various electrical components of the machine, has been found very desirable, and allows for more versatility in the machine's operation toward accomplishing the cleaning task for which it was designed. The prior dishwasher art, recognizing the desirability of operational cycle variance to enable a dishwasher to effectively clean a load of soiled utensils, including heavily soiled pots and pans or lightly soiled tableware, has provided means to permit selective extension of the operational cycle to obtain a more thorough washing action. U.S. Pat. No. 2,934,925-Henshaw et al. has shown the use of a non-adjustable, thermally-responsive type of cycle extender device. U.S. Pat. No. 3,070,714—Jacobs has shown the use of an adjustable, thermally-responsive type of cycle extender device in a dishwashing machine. U.S. Pat. No. 3,600,602—Yartz has shown the use of two such adjustable, thermally-responsive cycle extender devices plus an operational cycle selector control, and a sequence control mechanism providing rather thorough washability in a dishwashing machine. While the principle has been shown of interrupting the energizing circuit to the sequence control timers to provide extended operational time in the machine cycles and components, there are drawbacks in those machines where it has been applied. For example, as taught by Yartz, it may be necessary for the operator to manipulate as many as four separate controls to obtain the correct operational cycle for a particular load of soiled cooking and eating utensils. The circuitry as disclosed by Yartz forces periodic interruption of electrical power to the drying cycle heating element when the drying cycle time extender is in operation. As taught by Jacobs, the thermally-responsive switch heating element is connected directly to the power source when the fill period bypass switch is closed. The heater then is no longer in series with the thermally-responsive switch, and this results in a need for a heating element that is sturdier and more expensive, to operate at near 100% rating on line voltage.

It would be beneficial then, to provide the operator with a better understanding of the capabilities of her dishwashing machine. Such would certainly be the case if the number of operations needed to set the machine into motion were reduced. Further, it would be financially advantageous to reduce the number of electrical and mechanical components and to simplify the operational circuitry. It is therefore an object of the present invention to provide an automatic dishwashing machine having certain of its operational controls combined.

It is a more specific object of the present invention to provide, in a dishwashing machine, a combination operational cycle selector and cycle time duration extender selector, and further, to provide means for cancelling the extension effect during the fill and drain portions of the cycle.

SUMMARY OF THE INVENTION

In accordance with the present invention, there is provided apparatus for improving the cleaning efficiency in an automatic dishwasher of the type having a plurality of electrical components sequentially operable in an operational cycle controlled by an electrical sequence control means adapted for automatic advancement and including at least washing action cycle portions for rinsing and washing and draining and fill cycle portions.

More particularly, the presently preferred embodiment comprises:

selectively operable means therewith for enabling simultaneously manual selection of a particular operational cycle and extension of the total time duration of the cycle; and

means for automatically cancelling the time extension of the draining and fill portions of the cycle whereby the tiem extension effect is restricted to the washing action cycle portions.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an elevational view taken from the side of an improved automatic dishwasher in accordance with the present invention, wherein portions of the side wall are cut away to illustrate certain internal components of the dishwasher;

FIG. 2 is a fragmentary view of the control panel of the dishwasher shown in FIG. 1;

FIG. 3 is a schematic representation of the preferred embodiment of the electrical circuitry in the dishwasher shown in FIG. 1; and

FIG. 4 is a graph type chart showing various cycles provided by implementation of the control means of the dishwasher shown in FIG. 1, in accordance with the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, there is illustrated an automatic dishwasher **10** having an outer cabinet **11** and an inner cabinet **12.** Inner cabinet **12** defines a washing chamber **13** which contains a pair of vertically separated dish supporting racks **14,** only one of which is shown. Each rack is slidable outwardly from the chamber **13** and is adapted to receive and support articles to be washed within the washing chamber **13.** A closure member or door **15** is pivotal about a substantially horizontal axis defined by a pair of hinges **16,** only one of which is visible in FIG. **1.** The door **15** provides access to the washing chamber **13** so that articles may be inserted into and removed from the racks **14.**

It is also illustrated in FIG. **1** that the lower extremity of the washing chamber **13** has a floor or bottom wall **19** which gradually slopes to a low point **20.** Downwardly adjacent the low point **20** is a sump **21** wherein washing liquid from the washing chamber **13** will tend to gravitate. Below the bottom wall **19** and supported therefrom is a motor-pump assembly **22** which includes an electric motor **23,** a pump **24** and an electrically operated valve **25.** The sump **21** and the inlet of the pump **24** are interconnected by a large diameter drainage conduit **26.** The conduit **26** is secured to the

lower outlet end of the sump 21 by the means of a clamp 27. The opposite end of the conduit 26 is secured to the intake or the inlet side of the housing of the pump 24. The main outlet of the pump 24 communicates with a conduit 29 leading to a rotatable spray arm 30 of the reaction-driven type. The conduit 29 extends upwardly through a humped portion 31 of the washing chamber's bottom wall 19 and serves as a pedestal upon which the spray arm 30 is rotatably mounted.

The spray arm 30 comprises a horizontally elongated hollow body in communication with the conduit 29 and is provided with a plurality of spaced-apart orifices 32 in its upwardly facing surface which serve to discharge a spray of washing liquid therefrom and throughout the washing chamber 13. At least one of the orifices 32 is faced generally laterally relative to the longitudinal axis of the rotatable spray arm so that force of the liquid discharged therefrom exerts a counterforce upon the spray arm 30 and causes it to rotate relative to its conduit 29.

The valve 25 of the pump 24, shown in FIG. 1, includes a pivotal valve element (not shown) within the housing of the pump 24 that is movable between two positions. In one of these positions, the movable valve element closes an effluent discharge conduit or drain outlet 33 and, at the same time, opens the pump's main outlet through the vertically oriented conduit 29. In the other of its two positions, the movable valve closes the pump's main outlet to the spray arm 30 and simultaneously opens the drain outlet 33 whereby effluent is discharged therethrough to the household sewage system.

An electrical resistance heating element 35 may be provided in the lower end of the washing chamber 13 for heating washing liquid accumulated in the lower end of the chamber and particularly for liquid extraction or drying of articles within the washing chamber 13 upon completion of the wash and rinse steps in the machine's operational cycle. Admittance of water to the chamber 13 is controlled by an electrical solenoid-type fill valve 36 shown in FIG. 3 and referred to later in this specification. The water enters through a conduit 37 leading to a fill funnel (not shown). The funnel is mounted between the inner cabinet 12 and the outer cabinet 11 in communication with an opening through the inner cabinet 12 whereby incoming water is directed into the washing chamber 13 so that it will gravitate downwardly to the chamber's lower end. The latter fill step occurs prior to each wash or rinse step in the operational cycle of the machine after which the motor 23 is energized to drive the pump 24 to recirculate continuously the liquid from the chamber 13 outwardly through the spray arm 30 onto the articles stored within the chamber 13.

Each rinse or wash step continues for a predetermined time after which the motor 23 is automatically de-energized followed by energization of the valve 25 which closes off the main pump outlet through the conduit 29 and opens the drain outlet 33. The motor 23 is then re-energized whereby the effluent accumulated in the bottom of the chamber 13 is pumped outwardly to the household sewage system. As in most dishwashers of the type described, the rinse and wash steps differ primarily in the respective length of time alloted to each and the fact that detergent is added by automatic means (not shown) early in the wash cycle. A heating means such as heating element 35 may also be energized during the wash step to raise the temperature of the washing liquid and thereby increase its effectiveness.

The machine shown in FIG. 1 is also provided with a comparatively small aerator inlet 39 that communicates with the conduit 26 and has a tube 40 leading therefrom upwardly between the outer sidewall 11 and the inner sidewall 12 to the area behind the machine's control panel 41. The latter apparatus is provided in accordance with the teaching of L. W. Guth, in U.S. Pat. No. 3,621,856, and assigned to the assignee of the present invention. As disclosed by Guth, this apparatus permits selective injection of ambient air at the intake side of pump 24 during a particular cycle of the machine whereby the energy level of the washing liquid pumped from the pump 24 is reduced to permit gentle washing of particularly fragile items.

In FIG. 2, a portion of the control panel 41 of dishwasher 10 is shown. In accordance with the present invention there are provided, mounted on the back side of the control panel 41, certain control means which are illustrated in the schematic diagram of FIG. 3. As shown in FIG. 3, the main control means of the dishwasher 10 is an electrical sequence control means or sequential control timer contained within a dotted line rectangle and identified by the numeral 42. Another control means for dishwasher 10 is selectively operable means or electro-mechanical device for enabling simultaneously manual selection of a particular operational cycle and extension of the total time duration of the cycle, such as the combination cycle selector-extender device illustrated in a dotted line rectangle and identified by the numeral 43 in FIG. 3. The cycle selector-extender device 43, in addition to being used for selecting the proper cycle for a particular application, is adapted to enable selective extension of certain steps in the dishwasher's operational cycle. A third control means for the dishwasher 10 is a dry cycle selector device 44. As illustrated both in FIGS. 2 and 3, manual control knobs 46, 47, and 48 are provided whereby the operator of the dishwasher 10 can manually respectively operate control means 42, 43, 44.

Timer 42 is a typical mechanism utilized for advancing a dishwasher through its operational cycle and comprises a synchronous timer motor 52 with switch operating means in the form of cams driven by the timer motor 52 which are disposed to operate a switch means controlling the energization of the electrical components heretofore described. The switch means of the timer 42 includes switches 53, 54, 55, 56, 57, 58, 59 and 60 which are adapted to be activated respectively by cams 61, 62, 63, 64, 65, 66, 67 and 68. The plurality of sequence control cams, including cams 61 through 68, are not specifically shown as a unit; however, the manner in which they are driven by the timer motor 52 to sequentially operate the switches 53 through 60 is wellknown in the art.

The cycle selector-extender device 43 includes a normally-closed, thermally-responsive switch means such as switch 71 preferably including a normally-closed bimetallic element constituting a switch in series with the energizing circuit for the timer motor 52. Switch 71 has a biasing means in the form of a leaf spring 72 associated therewith that is adapted to be biased toward the bimetallic element by cam means such as cam 73. The cam 73 is operatively linked by a manually rotatable

shaft to be driven by the manipulation of a knob **47**. The presently preferred construction of the thermally-responsive switch **71** is of a known type that includes a pair of metallic strips each having a different coefficient of expansion relative to the other, laminated together, whereby they form a heat sensitive device prone to curl or deflect in response to being heated. An electric heating means such as heating element **74** is provided adjacent the switch **71** and coupled serially therewith, whereby heat generated by the heating element **74** will cause the switch **71** to react and break contact between a contact point **75** on the end of the bimetallic element and a contact point **76**.

Further included in the cycle selector-extender device **43** is cycle selector means such as switch **80** including contact point **81**, the switch **80** being adapted to be biased by a cam **82** so as to make contact with one or more of a series of contact points **83, 84** and **85**. The cam **82** is operatively linked by the manually rotatable shaft to be driven by a manipulation of the knob **47**, whereby turning the control knob **47** to any one of a number of panel indicated positions closes the contact points therein necessary to instigate a particular single cycle and at the same time cancels any earlier selected cycle. The control system utilized with the preferred embodiment of the present invention provides five separate cycles of operation as shown in FIG. **2**. The present invention provides that the control device **43** be adapted to instigate a chosen single cycle and at the same time to selectively vary the wash, rinse and dry times in two of the cycles of operation provided in the dishwasher **10**, i.e., the "mini-wash" and "thoro-wash" cycles.

The control means or dry cycle selector device **44** includes switch **90** operatively linked by a manually rotatable shaft to be driven by a manipulation of knob **48** so as to make contact with contact points **91** or **92** or neither. The device **44** is adapted to be manually set to any of its three positions by rotation of the knob **48** as indicated in FIG. **2** and has internal detent means (not shown) for holding the chosen position until such time that a different cycle is selected.

An important aspect of the present invention is that the selective variance of the wash, rinse and dry steps heretofore described is accomplished without affecting the water fill and effluent draining activities in the operational cycle. Also unaffected are the "rinse and hold" cycle and the "plate warmer" cycle. The manner in which the devices **43** and **44** may be utilized to affect particular steps in the cycles of the dishwasher **10** will be developed hereinafter as a part of the description of the dishwasher **10** when operated in one of its cycles.

The control system of the dishwasher **10** provides five separate cycles of operation as graphically represented in FIG. **4**. These five regular cycles of operation, namely "plate warmer," "rinse and hold," "mini-wash," "delicate," and "thoro-wash," are made possible through the utilization of various cycle circuits by bringing switch **80** and its contact point **81** into contact with certain of the contact points **83, 84, 85** of the cycle selector-extender device **43** in respectively different combinations. FIG. **2** shows that the knob **47** of the device **43** is adapted to be manually set to any one of a plurality of positions. Additionally, knob **47** and thereby the control device **43** may be used to selectively vary the length of the wash, rinse and dry steps in either the "mini-wash" or the "thoro-wash" cycles.

To place the dishwasher **10** into operation in the "thoro-wash" or normal cycle, the selector knob **47** is rotated so that its arrow points somewhere within the area indicated on the panel as "thoro-wash." Since the same control knob **47** and thereby device **43** are used to selectively vary the length of the wash and dry times in this cycle and since this cycle time is infinitely variable within indicated spaces and thereby duration of time alloted for the "thoro-wash" cycle, the arrow will be placed so as to align with the indicated "short" **93** so as to produce a wash cycle that is approximately normal. With the arrow of knob **47** aligning with the short part of the "thoro-wash" cycle and with knob **48** set for "long dry," a total cycle time of approximately 53½ minutes will result. (This compares with a total time of 90½ minutes in a situation where the arrow points to the "long" variation of the "thoro-wash" cycle). The main control knob **46** of sequence control means **42** is rotated clockwise until its arrow aligns with the "start" position **94** of the "thoro-wash" cycle. (It will be noted that knob **46** has three other starting points for use with various other cycles). This latter operation serves to move the cam **63** of the sequence control timer **42** to close switch **55** and the former operation serves to rotate the cam **82** of device **43** so as to bring switch **80** and its contact point **81** into contact with contact points **84** and **85**. This then completes the energizing circuit to the timer motor **52**, and control of the operation of the motor **23**, the heater **35**, the diverter valve **25** and the water fill valve **36** is placed in switches **58, 59** and **60** of the sequence control means **42** which are respectively controlled by the cams **66, 67** and **68** thereof. The cams of the sequence control timer **42** controlling the latter switches are adapted to provide a sequence of operations which include, chronologically, a wash, a rinse, several successive washes and rinses, each including a fill and an effluent discharge, and a final liquid removal or drying operation. The latter operational sequence is graphically set forth in FIG. **4**.

As has been already mentioned, thermally-responsive switch **71**, which is normally closed, is in series in the circuit for energizing the timer motor **52**. The circuit for energizing the timer motor **52** may be traced from the power supply conductor L1 through the switch **55** closed by cam **63**, through contacts **85, 84**, and **81**, thus completing one leg of the circuit to timer motor **52**. The other leg of timer motor **52** is then connected through the normally-closed, thermally-responsive switch **71** which in turn may be traced through the power supply conductor L_2, thus completing the timer motor energizing circuit. Electric heating element **74** is connected in a separate parallel circuit to the timer motor energizing circuit through switch **57**. The heating element **74** is in series with thermally-responsive switch **71** that responds to heat generated thereby. Switch **57** is designed to be normally closed; however, cam **65** has been adapted to cause switch **57** to open during the complete "rinse and hold" cycle, the "plate warmer" cycle and for all water fill and effluent discharges, thus avoiding energization of the heating element **74** and thereby allowing switch **71** to remain closed, further allowing timer motor **52** to remain energized.

Electric heating element **74** will be energized during each and every wash and rinse step and the final liquid

removal or drying operation. Control knob **47** of the control device **43** is adapted to permit selective movement of cam **73** whereby the thermally-responsive switch **71** may deflect in response to the heat generated by the heating element **74** to separate contacts **75** and **76** interrupting the timer motor energizing circuit. Such deflection of the thermally-responsive switch **71** also breaks the circuit to the heating element **74,** whereby the thermally-responsive switch **71** is permitted to cool and reclose to complete the timer motor energizing circuit. The latter action will continue to repeatedly occur with its frequency of occurrence depending upon the extent to which the leaf spring **72** is biased by the cam **73.** As previously mentioned, knob **47** of the control device **43** may be manually rotated to increase or decrease the bias or deflection of the leaf spring **72** relative to the thermally-responsive switch **71** in order to vary the frequency of response of the switch **71.** In this manner, the frequency and duration of the repeated energization and de-energization of the timer motor **52** can be selectively varied. This enables the operator of the dishwasher to choose the length of time the total washing action of the cycle will take in accordance with the nature and amount of soil on the items to be washed therein. As provided here in the "thoro-wash" cycle, a short time may be chosen by knob **47** where, in accordance therewith, the cam **73** will hold the leaf spring **72** at such a deflection toward the thermally-responsive switch **71** so as to limit its opening and interruption of the timer motor energizing circuit. Thus, with the knob **47** in the "short" position, normal or minimum wash time can be selectively attained for each wash, rinse and dry step in the "thoro-wash" cycle.

It should be noted that the cams **66** and **67** are formed such that, for each wash and rinse step, they will operate switches **58** and **59** to first open the fill valve **36** for a predetermined time, after which the fill valve **36** is de-energized and the motor **23** is energized to commence the washing action in the wash chamber. The diverter valve **25** is energized to divert the washing fluid through the pump to the washing chamber just prior to the energization of the motor **23** and is then re-energized at the end of the wash and rinse steps whereby the washing liquid is drained out of the machine.

Referring to FIG. **4,** it will be seen that, had selector knob **48** been set for "normal dry" and at the same time selector knob **47** had been placed in the "short" position of the "thoro-wash" cycle, the liquid removal or drying time duration would have been seven minutes rather than the fourteen minutes provided by the setting of knob **48** in the "long dry" position. Likewise, had the selector knob **47** been rotated to align with the "long" position of the "thoro-wash" cycle, the drying time would have been 14 minutes as compared with 28 minutes had the knob **48** been set for the "long dry." Further, knob **48** may be set to provide no drying time at all as provided by the choice of settings as shown in FIG. **2.** As shown in FIG. **4,** this choice of dry time, that is, "long," "normal," or "no dry" at all, applies to the "mini-wash" and "delicate" cycle as well as to the "thoro-wash."

A better understanding may be had of the operation of dry cycle selector device **44** and its operation when looked at in conjunction with sequence control timer **42.** When, in the course of operation of the dishwasher **10** in the "thoro-wash" cycle, and the timer motor **52** advances the timer **42** through to the point where the final liquid removal or drying step is to commence, cam **67** will allow switch **59** to come into contact with contact **96.** Then, by placing control knob **48** of the dry cycle selector device **44** into the "long" position, switch **90** will close the circuit with contact **91** thus causing heating element **35** to become activated and to operate uninterruptedly. Should the operator desire to place the knob **48** of the dry cycle selector device **44** in the "normal" position, he may do so and switch **90** will close the circuit with contact **92.** Simultaneous with the closing of switch **59** with contact **96,** an operation caused by cam **67,** cam **68** will cause switch **60** to close. This completes the circuit through the normal cycle thereby allowing heater element **35** to again be activated. The difference in time results by the fact that cam **68** only allows switch **60** to be closed approximately 50 percent of the time that cam **67** allows switch **59** to be in contact with contact **96.** In other words, the "normal" period of the dry cycle is approximately one-half the "long" portion. When the dry cycle selector knob **48** is placed in the "no-dry" position, the circuit to heating element **35** is left open and element **35** is therefore not energized.

FIG. **4** also shows the range of total cycle times allowable for the "mini-wash" cycle as provided by the device **43** and in particular by the selector knob **47.** It can be seen then that with knob **47** aligned with the "short" position of the "mini-wash" cycle and with the knob **48** aligned with the "long dry," a total cycle time of 20 minutes is available. Likewise, with the knob **47** pointing to the "long" position of the "mini-wash" cycle and with the knob **48** pointing to the "long dry," a total cycle time of 53½ minutes is obtainable. Virtually any total cycle time within these two limits is obtainable by the selective variation of time of knob **47** within the allowable limits in the "mini-wash" cycle.

The "delicate" cycle, as explained in greater detail in the aforementioned U.S. Pat. No. 3,621,856—Guth, is provided so that particularly fragile items may be washed in a relatively safe fashion. Preferably, in accordance with the teachings of the Guth Patent, provision is made for introduction of air into the machine's pump during the "delicate" cycle whereby the energy level of the washing liquid is substantially reduced to protect the delicate items being washed. In accordance with the present invention, with the knob **47** aligned with the "delicate" cycle and with the knob **48** aligned with the "long dry," a total cycle time of 53½ minutes is obtainable. Here, the total dry time is 14 minutes which may be varied to either 7 minutes or no dry time at all by the proper manipulation of knob **48.**

While it has been shown that a dishwasher constructed with provision for increasing the wash time through the control system is a desirable way of obtaining cleanability in a dishwasher, those systems in present use leave much to be desired. For example, in one well-known dishwasher, it is necessary for the operator to operate four different controls; namely, a cycle selector, a wash time extender selector, a dry time extender selector and a sequence timer control. As such, the standard dishwasher controls make use of two cycle extender controller devices. One particular machine also interrupts the power to the drying heating element when the drying cycle selector extender is in operation. In other words, the heating element for the drying cycle

is operated intermittently. Here, however, in accordance with this invention, the cycle selector and the cycle extender have been incorporated within one control, whereby the operator need only make one setting to choose the correct cycle for the particular operation she wishes to have performed, as well as to choose the length of that particular cycle appropriate to the amount of soil on the load to be washed. Further, by leaving the dry cycle selector in the "normal" dry position and which would ordinarily suffice for most dishwashing operations, even the dry cycle is extended through the use of the one above-mentioned control with the dry cycle heating element operating uninterruptedly. It is therefore obvious that the understanding and operation of such a dishwasher is much simplified. The operator can get a much wider range of choices of cycle duration than was previously available, while at the same time being able to make the choice much more quickly and with a much more thorough understanding of the system. After having selected the cycle and its duration, the operator need only to set the machine into motion by the appropriate setting on the sequence control timer device. By utilizing the foregoing construction and the circuitry described and shown, a dishwasher is provided with selective versatility in washing and drying time which is tailored to the needs of the particular utensils to be washed in the dishwasher and in a straightforward fashion. Not only has the operation and understanding of the dishwasher been simplified, but by joining the cycle selector and the cycle extender together in one unit, the circuitry has been much simplified. As has been shown, there is a need for only one thermally-responsive switch means such as the bimetallic element with associated heating element. What has been affected then is a superior dishwashing machine providing desirable and improved versatility at a lesser expense than has been formerly available.

It should be apparent to those skilled in the art that while what is described, at present, is considered to be the preferred embodiment of this invention in accordance with the Patent Statutes, changes may be made in the disclosed apparatus without actually departing from the true spirit and scope of this invention.

What is claimed is:

1. In an automatic dishwasher of the type having a plurality of electrical components sequentially operable in at least one operational cycle controlled by an electrical sequence control means, the cycle including at least water fill, drain, and washing action portions, a control arrangement comprising:

a. a manually operable device adapted to provide simultaneous visual selection of an operational cycle and the duration thereof, the device including;

1. cycle extender means coupled to the sequence control means for periodically interrupting operation of said sequence control means to extend the operation thereof for desired durations as a function of the setting of the manual device;

2. selector means coupled to the sequence control means to permit operation of said sequence control means only when said sequence control means and the manual device are set for the same cycle; and

b. means responsive to the sequence control means for disabling operation of the cycle extender means during predetermined cycle portions.

2. The invention of claim **1** wherein said manually operable device comprises a movable shaft having a plurality of cam surfaces thereon, the cycle extender means includes a thermally-responsive switch and control means coupling said thermal switch with one of said cam surfaces for selectively varying the response time of said thermal switch, and the selector means includes a switch having a plurality of contact positions coupled with the sequence control means and being operative with a second of said cam surfaces for selection of a particular operational cycle.

3. In an automatic dishwasher of the type having a plurality of electrical components sequentially operable in a plurality of operational cycles controlled by an electrical sequence control timer, and including at least washing action cycle portions for rinsing and washing, drain and fill cycle portions and a drying cycle portion, a control arrangement comprising:

a. a manually operable, electromechanical device for simultaneously selecting particular operational cycles and the time duration of at least one of the cycles, the electromechanical device comprising:

1. a rotatable shaft having a plurality of cams;

2. a first switch having a plurality of contact points and responsive to one of the cams to supply power to the timer only when the selected cycle corresponds to the cycle on the timer;

3. a second, thermally-responsive switch operative only during predetermined portions of a dishwashing cycle for periodically interrupting power to the timer thereby extending the normal time duration;

4. biasing means coupled to the thermally-responsive switch and responsive to a second cam on the shaft for variably adjusting the off-time of the timer;

b. a cam means associated with the timer for disabling the time extension of the drain and fill cycle portions whereby the time extension effect is restricted to the washing action and drying cycle portions.

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