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[54] **HEAT SYSTEM FOR DISHWASHER**

[75] Inventor: **Richard L. Perl,** Mansfield, Ohio

[73] Assignee: **The Tappan Company,** Mansfield, Ohio

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Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 195,197, Nov. 3, 1971, Pat. No. 3,750,951.

[52] **U.S. Cl.** **137/340;** 417/367; 310/61
[51] **Int. Cl.** **H02k 1/32;** H02k 9/00
[58] **Field of Search** 417/367, 366; 137/340; 310/61

[56] **References Cited**

UNITED STATES PATENTS

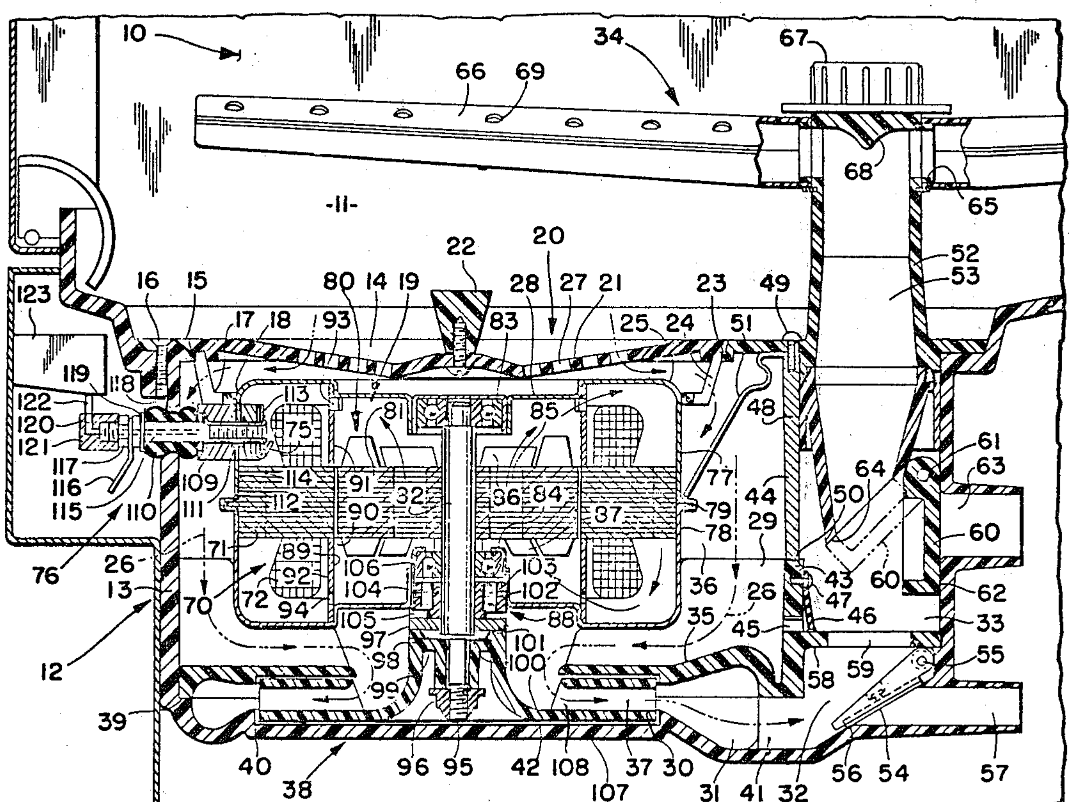
2,107,481	2/1938	Johnson	417/367
2,321,126	6/1943	Breuer	417/367
3,576,378	4/1971	Hilmanowski	417/366

Primary Examiner—Henry T. Klinksiek
Attorney, Agent, or Firm—Donnelly, Maky, Renner & Otto

[57] **ABSTRACT**

A dishwasher in which the temperature of washing fluid and/or a load heating medium is elevated by the direction thereof into heat transferral contact with the electric drive motor that supplies the conventional pumping power. A split phase motor is employed having main and phase windings connected in parallel, and the entire motor is enclosed in an oil bearing jacket throughout which the oil is circulated over both the rotor and stator. A collar positioned near the rotor-stator gap directs oil flow in the gap reducing friction and wearing of insulation. Alternatively, a shaded pole type of induction motor can be used. Proper valving permits the wash fluid to flow to lower and/or upper spray arms and to a drain, and a flexible diaphragm or a reservoir provides for oil expansion in the jacket.

28 Claims, 3 Drawing Figures



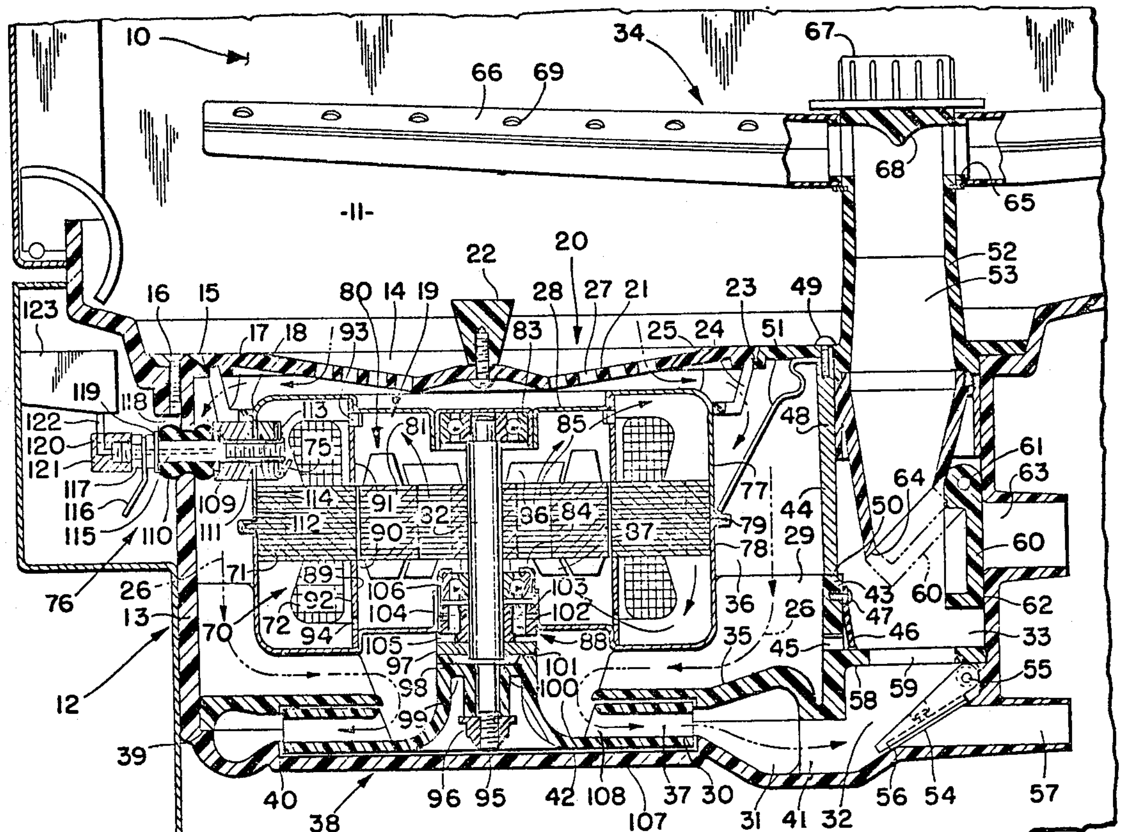


FIG. 1

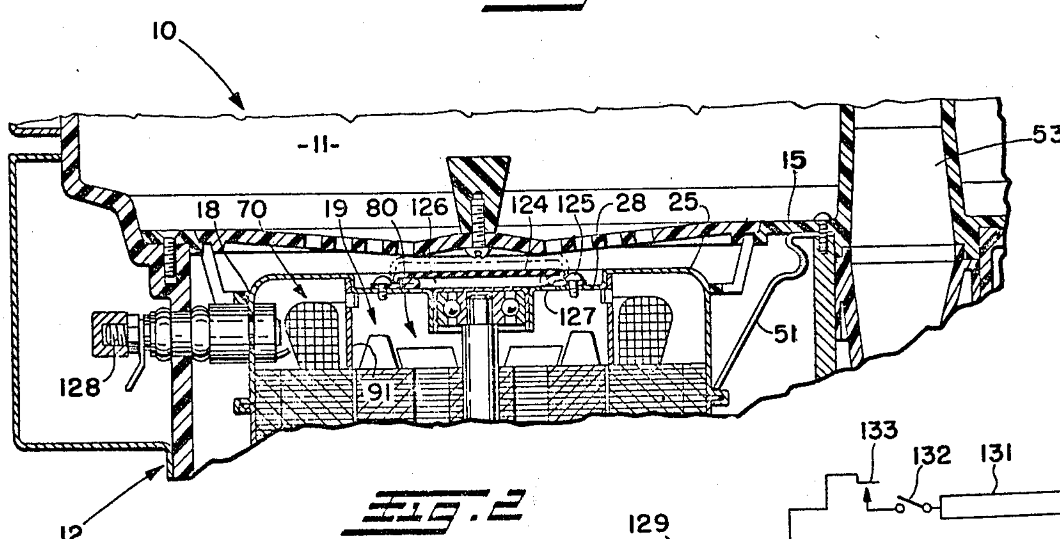


FIG. 2

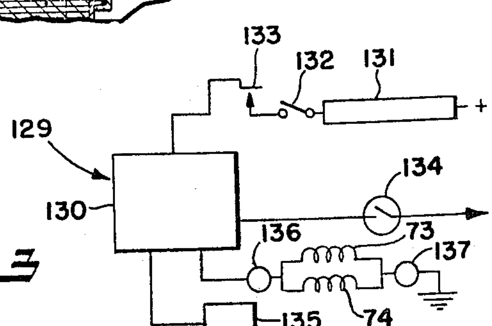


FIG. 3

HEAT SYSTEM FOR DISHWASHER

This is a continuation-in-part of my copending patent application Ser. No. **195,197**, filed Nov. **3, 1971** Now Patent **3,750,951.**

This invention relates to a dishwasher apparatus and more particularly to a novel type of dishwasher construction in which utilization is made of the pump motor as a source of heat energy for elevating the water temperature for cleaning, sanitizing and drying purposes.

Conventional dishwasher configurations employ an electric resistance heating element as a source of power for elevating the temperature of the wash water and for aiding the drying portion of the cycle, such element consisting of a heater coil insulatively supported in the bottom of the dishwasher enclosure, requiring interconnection with the timing mechanism and provision for suitable interconnection wires and the like. The conventional motor is employed solely for pumping purposes typically being mounted outside the dishwasher housing and communicating with an impeller arrangement in a sump section of the dishwasher chamber, developing I^2R losses in the windings and eddy current and the like losses in the core structure which heat energy is mostly lost outside the dishwasher housing.

A known form of dishwasher construction which mounts the motor in a wet sump attached to the dishwasher tub is described in U.S. Pat. No. **3,576,378** issued Apr. **27, 1971,** to James R. Hilmanowski, teaching that motor cooling can be effectively established by a direct communication between the wash water and a portion of the motor structure. Another form of dishwasher construction that heats the water by pumping same through the pump motor which is encapsulated in epoxy to heat the liquid is described in U.s. Pat. No. **3,587,939** issued June **28, 1971,** to Arne M. Nystuen et al. These prior patents do not teach a high order of heating, and the epoxy used in the latter patent is a poor thermal conductor as well as expensive.

When utilizing the motor for elevation of the wash water and drying air temperature numerous problems are encountered. End temperature of the water is significant, dependent in part upon the temperature of the water entering the dishwasher; the rate of elevation of the temperature is of importance in achieving a suitable level during the dishwasher cycle; large particles must be filtered to prevent clogging in the pump chamber and around the motor; and consideration must be given to maintenance of the temperature at such elevated level for a predetermined interval of time to assure optimum cleansing and sanitizing functions. It has been learned that when such dual purpose of the motor is required, i.e. for pumping and for heating, consideration must be given to the type and configuration of motor employed and compromises must be resolved between pumping power and the generation of heating energy. An efficient utilization of such energy must be obtained requiring design configurations different from the conventional air cooled type of motor arrangement. In view of the current stress on ecology, it also is important to provide for conservation of building materials, water and energy, while reducing pollutants to the environment; and with an eye on ever increasing inflation it is important to reduce manufacturing cost generally.

Therefore, it is one object of this invention to provide a new form of dishwasher in which thermal energy from

the pump drive motor is employed for useful elevation of temperature of the washing or working fluid.

It is another object of this invention to provide a new form of dishwasher in which the drive motor serves such a dual function and is located within the dishwasher enclosure.

It is a further object of this invention to provide dishwasher apparatus with a substantially dry sump and having means for directing the water into intimate contact with a drive motor.

An additional object of this invention is the provision of dishwasher apparatus having various forms of motors as the power source, wherein sufficient heat can be generated for useful temperature elevation purposes and transferral of the heat to the working fluid is optimized.

Still another object of this invention is the provision of dishwasher apparatus in which the wash liquid is heated as it passes in heat transferral relation with a fluid filled jacket surrounding the pump motor, with provision to accommodate excess fluid due to expansion thereof as the temperature increases.

Still a further object of this invention is the provision of a pump motor for a dishwasher apparatus, which pump motor is immersed in a fluid filled jacket and circulates fluid in the jacket through the rotor and over the stator while driving a pump mechanism external of the jacket.

Still an additional object of this invention is the provision of a dishwasher apparatus with a pump for pumping water under pressure into the dishwasher enclosure and to provide for nearly complete draining of water from the dishwasher cavity.

Yet another object of the invention is to provide a dishwasher apparatus which uses thermal energy from a sealed drive motor immersed in a fluid filled jacket for elevating the wash water temperature.

A further object of this invention is the provision of a dishwasher apparatus quiet and efficiently operable using a relatively small amount of wash water, having a high power factor, using less detergent, producing less pollution, competitive in cost with conventional dishwashers, and resulting in minimum damage to plastic load items.

These and other objects and advantages of the present invention will become apparent as the following description proceeds.

To the accomplishment of the foregoing and related ends, the invention, then, comprises the features hereinafter fully described, the following description and the annexed drawing setting forth in detail certain illustrative embodiments of the invention, these being indicative, however, of but several of the various ways in which the principals of the invention may be employed.

In the annexed drawing:

FIG. **1** is an elevational view in cross-section of the lower portion of a dishwasher enclosure including a pump housing;

FIG. **2** is an elevational view in cross-section, partially broken away of the lower portion of a modified dishwasher enclosure including a portion of the pump housing; and

FIG. **3** is a schematic one-line electric circuit diagram for energizing and controlling a dishwasher.

Referring now to the drawing wherein like reference numerals refer to like elements in the several figures there is shown in FIG. **1** one embodiment of the invention including a dishwasher **10** comprising a tub **11** forming the dishwasher enclosure and a pump housing **12** associated with the enclosure. The pump housing **12** is a pan-like housing which may be molded or stamped as part of the dishwasher or may be an individual pump enclosure **13** supported in an opening **14** in the bottom of the tub **11** in sealed relation therewith.

A circular support plate **15** is secured at the upper portion of the pump housing **12** by screws **16**, such support plate having a downwardly extending flange portion **17**, and the inner edge **18** of the flange portion **17** forms a substantially circular opening to center the motor **19** within the pump housing **12**. The support plate **15** forms part of a separator **20** which also includes a removable strainer **21** with a handle **22**, resting on a seat **23** of the circular support plate **15** and separating the pump housing **12** from the dishwasher enclosure or tub **11** for purposes of directing water flow therebetween while filtering same. Communication between the tub **11** of the dishwasher enclosure and the pump housing **12** is achieved by a plurality of ports **24** located in the downwardly extending flange portion **17** of the support plate **15** just outside the periphery of the motor **19**, the water flow which passes in intimate contact with a jacket **25** surrounding the motor being indicated by the dashed arrows **26** in FIG. **1**. As the separator **20** provides a tortuous path for the water flow requiring same to pass through the openings **27** in the strainer **21**, across the upper surface **28** of the motor jacket **25**, and through the ports **24** in the flange portion **17**, large particles not able to traverse the path are filtered from the water.

The pump housing **12** has a plurality of planar spacer support members **29** for supporting the motor **19** within the pump housing while permitting unrestricted water flow through the pump housing to a conventional impeller **30** for pumping through a high pressure chamber **31** of scroll or volute form and valving chamber **32** to a standpipe arrangement **33** for distribution to a spray arm mechanism **34** in the dishwasher enclosure. The high pressure chamber **31** is formed by an upper wall portion **35** separating the heating area **36** from the pumping area **37** of the pump **38** and is adapted to rest on a seat **39** formed in the pump housing wall. The lower wall **40** of the pump housing **12** forms the bottom of the high pressure chamber **31**, and a pump outlet **41** connects the latter with the valving chamber **32**. The upper wall portion **35** conforms generally to the shape of the impeller **30** having a central opening **42** to permit water flow through the impeller to the high pressure chamber **31**. A divider wall **43** mates with a stainless steel plate **44** to separate the pump housing **12** from the standpipe arrangement **33**, and a standpipe drain opening **45** near the bottom of the divider wall is covered by a spring biased flapper valve **46** secured thereto by a screw **47**. The stainless steel plate **44** may be secured at one end **48**, for example by a screw **49** to the circular support plate **15** and may be tapered at its other end **50** to mate with the divider wall **43**. A hold down support **51** is also fastened to the circular support plate **15** by a screw **49** and to the motor jacket **25** for maintaining the motor **19** in position within the pump housing **12**. The circular support plate **15** additionally may be formed with a portion **52** forming part of the lower spray arm standpipe **53**.

A drain flapper valve **54** in the valving chamber **32** is rotatable about a shaft **55** to abut a first seat **56** at the drain pipe **57** or a second seat **58** at an opening **59** to the standpipe arrangement **33**, and a diverter flapper valve **60** is rotatable about a shaft **61** to mate with a first seat **62** on a port **63** leading to an upper spray arm standpipe (not shown) or a second seat **64** formed on the lower spray arm standpipe **53**, although the diverter flapper valve may be eliminated if only one spray arm and standpipe are used. The valves **54, 60** may be spring biased cam operated valves, pinch valves, or the like, being operable in known manner for example, by a timer operated motor valve control or pneumatic bellows, and they may be formed of relatively inexpensive material, such as plastic or rubber, since they are not required to withstand the high temperatures developed by electric resistance elements used in prior art dishwashers.

The spray arm mechanism **34** is for the most part conventional consisting of the lower spray arm standpipe **53**, for example in the shape of a conical hood, as a support member defining an enclosure for the fluid under pressure. An apertured support member **65** forming an arbor is affixed to the top portion of the standpipe **53** providing a rotatable support for and communication with a reaction spray arm **66**, the latter being mounted on the arbor for rotation thereabout under the impetus of the fluid under pressure and may be retained on the arbor by a cap **67**, if desired. A deflector **68** in the arbor **65** directs fluid from the standpipe **53** into the spray arm **66** for discharge through spray openings **69** into the dishwasher enclosure. The spray arm **66** may be made from relatively inexpensive plastic, as it is not required to withstand the high temperatures developed by the electric resistance heating element used in conventional dishwashers, as described above. Similarly, because there is no localized high temperature heating, there is less damage to plastic dishes and the like.

The thermal source for elevating the water temperature in the dishwasher, as well as a load heating medium such as air for drying if desired, is the pump motor **19**, which may be a uni-directional split phase type induction motor located within the pump housing **12** and isolated from the tub **11** portion of the dishwasher by the separator **20**. The motor **19** consists of a stator **70** supported in the motor jacket **25**, which may be stainless steel or other thermally conductive and corrosion resistant material. The stator **70** includes an iron core ring **71** formed of stacked laminations defining four poles circumscribed by windings **72** interconnected with the main **73** and phase or start **74** windings (FIG. 3) connected in parallel electrical relation for single phase power energization. Input power to the windings **73, 74** is received via leads **75** (only one of which is shown) passing through the pump housing **12** in a fluid tight connector **76**. Such a split phase motor does not require the inclusion of mechanical switching devices and the like for starting, and is capable of providing sufficient source of thermal energy. Additionally, because the motor is small, the pump housing **12** may be relatively small therefore requiring less water for dishwasher operation than in conventional dishwashers. Also, since the impeller intake is located at a low point and because the valve **60** generally permits water to flow to only one spray arm at a time, the water requirements for the dishwasher may be further reduced. While a four pole motor has been shown and described, a two pole motor alternatively may be used.

The motor canister or jacket **25** has upper and lower portions **77, 78** crimped together, for example about an O-ring seal **79**, and is substantially filled with fluid, such as transformer oil or other non-conductive liquid having suitable lubricating, electrical, and viscosity properties. The stator laminations in the iron core **71** are electrically insulated in known manner and abut the motor jacket **25** to facilitate heat transfer therebetween. The stator may be generally circular or square in cross section, as desired and depending on the number of poles employed.

The rotor **80** of the motor **19** is centrally oriented within the motor jacket **25** and consists of a circular core or body **81** of stacked laminations mounted on a motor drive shaft **82**, in turn supported for rotation about a longitudinal axis at upper and lower bearing housings **83, 84** in a dual bearing arrangement. The core **81** of the rotor **80** includes plural generally axial apertures **85** extending through the laminations adjacent the drive shaft **82** in the center of the core to provide a flow path for the oil through the interior of the rotor **80.** The apertures **85** are sufficiently wide to provide little restriction to the oil flow, and a plurality of vanes **86, 87** at the top or bottom of the rotor **80** assist to pump oil through the apertures and to circulate same throughout the jacket **25.** Although both upper and lower vanes are shown, usually only one or the other would be used. Within and partially below the lower bearing housing **84** is a seal **88** to prevent the entry of water into the motor jacket **25** and the exit of oil from the jacket, while permitting connection of the drive shaft **82** to the impeller **30.**

A collar **89** positioned near the gap **90** defined between the motor stator **70** and rotor **80** is formed by upper or lower substantially cylindrical barriers or dividers **91, 92** having plural openings **93, 94** about their circumferences and is positioned between the stator core **71** and the motor jacket upper and lower portions **77, 78.** Although both upper and lower parts **91, 92** of the collar **89** are shown, usually only one or the other would be used. The collar **89** divides the jacket **25** into two chambers, the first containing the stator and the second containing the rotor, and controls oil flow in the gap **90** eliminating excessive wearing or erosion of the stator insulation, the oil eliminating the possiblity of corrosion in the motor, and thereby increasing the life of the motor.

The end **95** of the drive shaft **82** is threaded and is connected by a nut **96** to rotate the impeller **30** while the seal **88** maintains fluid isolation between the inside and outside of the motor jacket **25.** The seal **88** includes a ceramic member **97** annularly disposed about the drive shaft **82** and supported against a rubber seal **98,** gasket **99,** and O-ring **100** in recess **101** in the impeller for rotation therewith. The upper surface of the ceramic member **97** is substantially planar and mates with the lower planar surface of a substantially annular graphite fitting **102** surrounding the drive shaft **82** but not connected thereto. The fitting **102** alternatively may be formed of ground carbon or other material having solid body with lubricant properties. A spring **103** surrounded on three sides by a rubber boot **104,** which may abut the outer surface and a flange portion **105** of the substantially annular graphite fitting **102** and a fixed seat portion **106** forming part of the lower bearing housing **84** urges the lower planar surface of the graphite fitting **102** into abutment with the upper surface of the ceramic member **97,** such as for example alumina. Thus, as the impeller **30** rotates, the ceramic member **97** slides over the fixed graphite fitting **102,** the abutting surfaces thereof providing a fluid tight seal for the motor jacket **25.**

The impeller **30** consists of a thin housing **107** having a plurality of impeller blades **108** welded or formed on the interior thereof. In one form the impeller consists of a single molded part. The upper portion of the impeller is apertured for receipt of fluid and is secured to the motor drive shaft **82** as previously described. Upon rotation of the impeller **30,** fluid is forced outwardly thereof into the high pressure or volute chamber **31** for delivery to the valving chamber **32,** the standpipe arrangement **33,** and one of the lower or upper spray arms. The drain flapper type valve **54** may be controlled to close the drain pipe **57** during the dishwasher washing, rinsing, or drying cycles and to open while the pump is operating for quick evacuation of the pump housing **12** and the tub **11** when desired.

It is significant to note that relatively thick laminations are indicated in both the stator **70** and rotor **80** of the motor **19** inasmuch as optimum pumping efficiency of the motor both by the impeller **30** and by the vanes **86, 87** is not the sole criterion but rather a compromise between same and the thermal energy generated so that both functions may be accomplished in the most efficient manner. Thus this form of structure is designed to introduce relatively high levels of eddy current flow and hysteresis loss within the iron structure of the motor **19** and this combined with I^2R loss in the windings **73, 74,** which can be controlled in a known manner, can supply sufficient thermal energy for elevating the temperature of the wash fluid to a desired level. Also, the number of turns in the phase or start windings **74** may be increased or decreased from the usual number employed, thereby achieving a high power factor for the motor to provide for the most efficient use of current supplied thereto. The fluid circulating within the motor jacket **25** is in direct contact with all parts of the motor, i.e. the rotor and stator, and transmits heat therefrom to the jacket so that an optimum heat transferral relation to the water and/or the load heating medium such as drying air can be achieved.

The fluid tight connector **76,** through which the lead **75** passes for connection to the motor windings, is nonconductive and includes a first relatively rigid seal member **109** and a second relatively pliable seal member **110,** which is an elastomer with proper electrical and resistant properties. The first seal member **109** is fitted on both sides of an opening **111** through the motor jacket **25** with an O-ring **112** positioned about the circumference of the opening. A compression plate **113** to which the motor winding lead **75** is attached is held in place against the first rigid seal member **109** by a flared hollow threaded rivet **114,** which in turn is connected to a drilled threaded stud **115** having a power lead **116** connected thereto by a nut **117.** The rivet **114** maintains the first rigid seal member **109** in position, while the second pliable seal member or elastomer **110** is compressed into strong sealing relation with an opening **118** in the pump housing **12** by force exerted between a further compression plate **119** and the first rigid seal member. The second pliable seal member or elastomer **110** must be capable of withstanding effects of the fluids on the both sides thereof. The rivet **114,** stud 115, and compression plates 113, 119 are electrically conductive and together form an electrical connection between the power lead 116 and the lead 75. The oil within the motor jacket 25 expands when its temperature increases; and the hollow rivet 114, drilled stud 115, and an opening 120 in a cap 121 connect through a tube 122 to a reservoir 123 for expanded oil. The reservoir 123 also provides an oil source to maintain the motor jacket 25 in filled condition as the oil temperature decreases.

The dishwasher shown in FIG. 2 is similar to that in FIG. 1 except the reservoir 123 has been replaced by a folded expandable diaphragm 124 fixed, for example, by screws 125 drilled into the upper surface 28 of the motor jacket 25 thereby providing an expandable reservoir chamber 126 (shown enlarged in dotted outline) for expanded oil as the latter increases in temperature during motor 19 operation. The expandable reservoir chamber 126 communicates with the interior of the motor jacket 25 through openings 127, and the drilled stud described above in FIG. 1, may be replaced in this embodiment by a solid stud 128 threaded into a hollow rivet 114 for convenience of assembly.

An electric power control circuit 129 for the dishwasher apparatus shown in FIG. 3 includes a timer motor and switching assembly 130 energized from a power supply 131 through a switch 132, operable, for example, either manually and/or automatically upon closure of the dishwasher door. A thermostat safety switch 133 is connected to break any possible electric circuit to the dishwasher apparatus in the event of an inadvertant excessive temperature rise, and a float switch 134 may control operation of a filling valve and/or drain valve 54 for supplying and/or removing water from the dishwasher. As discussed above, the main 73 and phase or start 74 windings of the motor 19 are connected in parallel, and the valve controls 135, for example for operating the diverter flapper valve 60 and the drain valve 54 are connected for energization by the timer motor and switching assembly 130. Also, if desired, one or more thermal protectors or thermostats 136, 137 may be connected in the motor circuit to protect the latter from generating excessive heat.

While the invention has been described above as using a split phase motor, alternatively a shaded pole motor may be used. As in conventional, a portion of each pole of the shaded pole motor is surrounded by a shading coil consisting of a short circuited turn of wire to cause a flux lag in the shaded portion and, as a result, a rotating magnetic field for production of starting torque. In the preferred embodiment, however, using a split phase motor of either the two pole or four pole varieties, current is drawn through both the start and the main windings throughout motor operation, and there is more heat loss in the motor than in the conventional split-phase motor which uses a start switch or a relay to couple the start winding in the motor circuit only during starting. Thus, not only has the instant invention provided a dishwasher with improved heating capability but the conventional split phase motor start switch or relay has also been eliminated.

While the elevation of wash water temperature is of primary significance, it will be clear that when the dishwasher is evacuated of water a heating effect occurs upon the air therein while the motor 19 is energized; and the impeller 30 pumps the heated air throughout the dishwasher enclosure to aid in drying and sanitizing. It will be apparent that overall efficiencies in the cost and operation of the dishwasher are enhanced both by the elimination of the requirement for a separate heater element and in the less stringent requirements for design of the motor. Still, further, it will be clear that the teachings of this invention apply not only to dishwashers but to any device which requires the combination of a thermal and mechanical source of power.

In operation the dishwasher 10 is electrically energized and wash water is provided from a source (not shown). The motor 19 rotates the impeller 30 which pumps the water into the valving chamber 32 for delivery to either the upper or lower standpipe and into the dishwasher tub 11 through the associated spray arm for washing. If an upper standpipe is used with an upper spray arm, the diverter valve 60 may be adjusted periodically to the position shown in dotted outline to block water flow to the lower standpipe 53 and to permit water flow to the upper standpipe, or in the position shown to block water flow to the upper standpipe while permitting flow to the lower standpipe. Alternatively, the valve 60 may be located in a neutral position to permit water flow to both upper and lower standpipes, if desired, but such operation usually requires more water. If only one standpipe and one spray arm are used, then the diverter valve may be eliminated.

As the motor 19 runs, heat is generated thereby due to I^2R and eddy current losses. The apertures 85 and vanes 86, 87 in the rotating rotor 80 pump the transformer oil throughout the motor jacket 25 about the rotor and stator 70 removing heat therefrom. The oil flows through the openings 93, 94 in the upper or lower part 91, 92 of the collar 89, while the latter prevents oil from flowing only through the rotor to reduce wearing of the insulation on the windings in the stator. As the transformer oil temperature increases, it expands, and some of the expanded oil flows through the hollow rivet 114, drilled stud 115 and tube 122 into the reservoir 123 for storage. In the embodiment shown in FIG. 2, as the oil expands, it flows through the openings 127 into the expandable reservoir chamber 126. The diaphragm 124 expands to provide adequate space for the oil. Also, if desired, the motor jacket may be only partially filled with transformer oil with an air space left therein for expansion of the transformer oil.

During washing, wash water passes through the openings 24 in the strainer 21, which filters large particles therefrom, and flows along the upper, side, and lower surfaces of the motor jacket 25 in intimate heat transferral contact therewith, while the heated transformer oil and the hot stator laminations provide heat to the motor jacket. The wash water is thus heated and then flows into the impeller 30 for pumping to one of the upper or lower standpipes for delivery into the dishwasher tub 11. Also, the water in the pump housing damps the motor noise to result in relatively quiet operation. Since all the heat transferred to the water is developed by the motor 19, the dishwasher may operate with a substantially dry sump, the only criterion for efficient operation being that sufficient water be used to maintain the pump housing 12 substantially filled during washing and rinsing cycles.

Between operating cycles substantially all the water in the dishwasher 10 is removed. Draining is achieved by rotating the drain flapper valve 54 on the shaft 55 to a position against the valve seat 58, and the impeller then pumps water from the motor housing directly into the drain pipe 57. It is desirable to remove most of the water from the dishwasher, and therefore the flapper valve 46, which is normally biased closed to cover the standpipe drain opening 45 by the high water pressure occurring in the standpipe arrangement 33, opens by its own spring force since the pressure in the standpipe arrangement is relatively low when the drain valve 54 is in the drain position. The water from the standpipe arrangement then flows into the motor housing 12 through the standpipe drain opening 45 for pumping by the impeller 30 to the drain pipe 57.

The dishwasher control circuit 129 provides electric power from the power supply 131, which may be an electrical outlet, to the dishwasher 10 when the switch 132 is closed, for example upon closing the dishwasher door. The timer motor and switching assembly 130, which may include a start button, provides electric power selectively to the motor windings 72, 73 and to the valve controls 135, while the thermostat safety switch 133 and the float switch 134 protect the dishwasher from excess heat or excess water.

Comparative tests between a conventional dishwasher heater system using a 750 W heating element and pump motor combination and the heating system of the instant invention using a split phase type of motor in an oil filled jacket indicates that higher rates of heat rise of washing fluid can be obtained in the instant apparatus for equal quantities of input power. Fluid temperatures suitable for washing and drying purposes are readily achieved and maintained even though it is expected with the apparatus of the instant invention that a somewhat higher than conventional fluid temperature would be most practical. An optimum range of fluid temperature is expected to fall between 145° and 165° F. with desired sanitizing temperature attained in 10–15 minutes, assuming adequate supply water temperature.

Using the apparatus of the instant invention, the dishwasher may be designed without the normally required sump space, all the wash water passing into the pump housing 12 and immediately being pumped through the the pump outlet 41 through the valving arrangement 33 to only one spray arm at a time for delivery into the dishwasher tub 11 to clean dishes therein. Thus, the amount of water required has been proportionately reduced resulting in less environmental pollution. It has also been found that the elimination of the electric resistance heating element and the use of the simplified pump motor disclosed, has resulted in the elimination of some formerly required mechanical components. Since, "spot" or localized temperatures in the tub 11 are not raised as high as those occurring in the conventional dishwasher using an electric resistance heating element, it is not necessary that the spray arms and other accessories used in the tub be of expensive heat resistant materials. Thus, manufacturing costs can be reduced as much as one-fourth relative to conventional dishwashers.

The embodiments of the invention in which an exclusive property or privilege is claimed are described as follows:

1. Dishwasher apparatus comprising a tub portion and a pump housing portion; means within said housing portion for distributing a washing liquid therein to said tub portion for the washing of dishes or the like in the latter; a motor within said housing portion, said motor having a stator and a relatively movable rotor, and a jacket enclosing said stator and said rotor, said jacket being substantially filled with an electrically non-conductive second liquid, said motor being positioned in said housing portion to permit the washing liquid to pass in heat transferral contact with said jacket for appreciably elevating the temperature of the washing liquid for washing and sanitizing; and pump means operatively connected with said rotor for pumping said washing liquid under pressure to said distributing means.

2. Dishwasher apparatus as set forth in claim 1 wherein said second liquid comprises a dielectric liquid.

3. Dishwasher apparatus as set forth in claim 1 wherein said rotor comprises a body portion mounted for rotation about a longitudinal axis, said body portion having apertures therethrough extending in a direction substantially parallel to said longitudinal axis, whereby upon energization of said motor said rotor rotates about said longitudinal axis thereby pumping said second liquid throughout said jacket.

4. Dishwasher apparatus as set forth in claim 3 further comprising vane means positioned on said rotor for facilitating pumping said second liquid throughout said jacket.

5. Dishwasher apparatus as set forth in claim 1 further comprising a gap defined between said rotor and said stator, and collar means positioned proximate said gap for controlling liquid flow therein.

6. Dishwasher apparatus as set forth in claim 5 wherein said collar means comprises divider means for dividing said jacket into first and second chambers, said first chamber including said stator and said second chamber including said rotor, and openings in said divider means for permitting liquid flow between said first and second chambers.

7. Dishwasher apparatus as set forth in claim 1 further comprising means coupled to said jacket for receiving and holding excess amounts of said second liquid as the latter increases in temperature and expands.

8. Dishwasher apparatus as set forth in claim 7 wherein said means for receiving and holding comprises diaphragm means forming at least a portion of said jacket, whereby expansion of said second liquid causes said diaphragm means to expand thereby increasing the volume of said jacket.

9. Dishwasher apparatus as set forth in claim 7 wherein said means for receiving and holding comprises reservoir means and means coupling said reservoir means with said jacket to permit liquid flow therebetween, whereby as said second liquid expands in said jacket a portion of said second liquid flows to said reservoir means and as said liquid in said jacket contracts a portion of said second liquid in said reservoir means flows to said jacket.

10. Dishwasher apparatus as set forth in claim 7 wherein said means for receiving and holding comprises a gas fluid spaced within said jacket, whereby expansion of said second liquid compresses gas in said gas space thereby producing additional volume for said expanded second liquid.

11. Dishwasher apparatus as set forth in claim 1 further comprising bearing means in said jacket, drive shaft means journaled in said bearing means for supporting said rotor for rotation, said jacket having an opening therein and said drive shaft means having an end extending through said opening, and means for

sealing said opening at said end for preventing said washing liquid from entering said jacket and said second liquid from escaping said jacket, said means for sealing including resilient means for urging said means for sealing closed.

12. Dishwasher apparatus as set forth in claim **11** wherein said means for sealing comprises ceramic means having a planar surface and solid means with lubricant properties having a planar surface, one of same being rotatable with said drive shaft means and the other of same being fixed relative to said jacket, and said resilient means being positioned for urging said respective planar surfaces into abutment to form a fluid tight seal therebetween.

13. Dishwasher apparatus as set forth in claim **11** wherein said pump means comprises impeller means fixed to said end of said drive shaft means.

14. Dishwasher apparatus as set forth in claim **1** further comprising means for coupling said motor to a source of electric energy.

15. Dishwasher apparatus as set forth in claim **14** wherein said means for coupling comprises an electrically conductive means extending from a location exterior of said pump housing to a location interior of said motor jacket through respective openings therein, electrically non-conductive pliable seal means substantially encircling said electrically conductive means at least proximate one of said openings, and compression means for maintaining said seal means in position sealing said opening.

16. Dishwasher apparatus as set forth in claim **15** wherein said electrically conductive means comprises hollow fluid conductive means, and further comprising means associated with said jacket for accommodating said second liquid as the latter increases in temperature including reservoir means coupled in fluid communication with said electrically conductive means, whereby as said second liquid expands in said jacket a portion thereof flows to said reservoir means through said electrically conductive means and as said second liquid in said jacket contracts a portion thereof in said reservoir means flows to said jacket.

17. Dishwasher apparatus as set forth in claim **1** further comprising filter means for filtering the washing liquid prior to contact with said jacket.

18. Dishwasher apparatus as set forth in claim **1** wherein said means for distributing comprises at least one standpipe means for directing the washing liquid from said pump means to said tub portion.

19. Dishwasher apparatus as set forth in claim **18** further comprising drain means for conducting the washing liquid from said pump means from said dishwasher apparatus, said drain means including a drain outlet means and valve means for selectively opening and closing a liquid flow path to said standpipe means and said drain outlet means.

20. Dishwasher apparatus as set forth in claim **19** further comprising further valve means for coupling said standpipe means with said pump means when said drain valve means closes said standpipe means from said pump means, whereby when said pump means is operative to pump the washing liquid to said drain outlet means, the washing liquid in said standpipe means flows through said further valve means into said pump means and to said drain outlet means.

21. Dishwasher apparatus as set forth in claim **1** wherein said motor comprises an induction motor.

22. Dishwasher apparatus as set forth in claim **21** wherein said induction motor comprises a split phase induction motor having start windings and main windings, said start windings and said main windings being electrically connected in permanent parallel relation.

23. Dishwasher apparatus as set forth in claim **21** wherein said induction motor comprises a unidirectional induction motor.

24. Dishwasher apparatus as set forth in claim **21** wherein said rotor includes a plurality of apertures therein providing a flow path for said second liquid interiorly of said motor, and said stator and said rotor comprise stacks of relatively thick laminations to increase eddy current losses therein for facilitating generation of heat by said motor.

25. Dishwasher apparatus as set forth in claim **1** further comprising spacer support means for supporting said jacket in said housing and providing space for the washing liquid to flow over said jacket.

26. An electric motor comprising a substantially liquid filled jacket, a relatively fixed stator positioned in said jacket, rotatable rotor means positioned in said jacket means for rotation about a longitudinal axis, a gap formed between said stator and said rotor means, and means for circulating the liquid throughout said jacket including apertures extending through said rotor means in a direction substantially parallel to said longitudinal axis, whereby upon energization of said electric motor said rotor means rotates about said longitudinal axis thereby circulating the liquid throughout said jacket.

27. An electric motor as set forth in claim **26** further comprising vane means positioned on said rotor means for facilitating circulation of the liquid throughout said jacket.

28. An electric motor as set forth in claim **26** further comprising collar means for controlling liquid circulation in said gap.

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