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(54) **WASHING MACHINE FOR BOTH OIL AND WATER WASH HAVING SELF-DIAGNOSING AND NETWORKING FUNCTION**

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(57) **ABSTRACT**

The present invention relates to a washing machine which can selectively performs a water washing and an oil washing by using one washing tub, wherein the washing machine has a self-diagnostic function and a communication function. In accordance with the present invention, the water washing and the oil washing can be performed with respect to one washing tub by completely removing alien material and the oil remaining on the washing tub and deterioration of the laundry can be avoided, while providing economic benefits by using the oil reclaimed by a reclamation process. Further, since the present invention has a self-diagnostic function and remote maintenance function for assisting the user, it has an advantage in that the user can easily finish the maintenance in a shorter time.
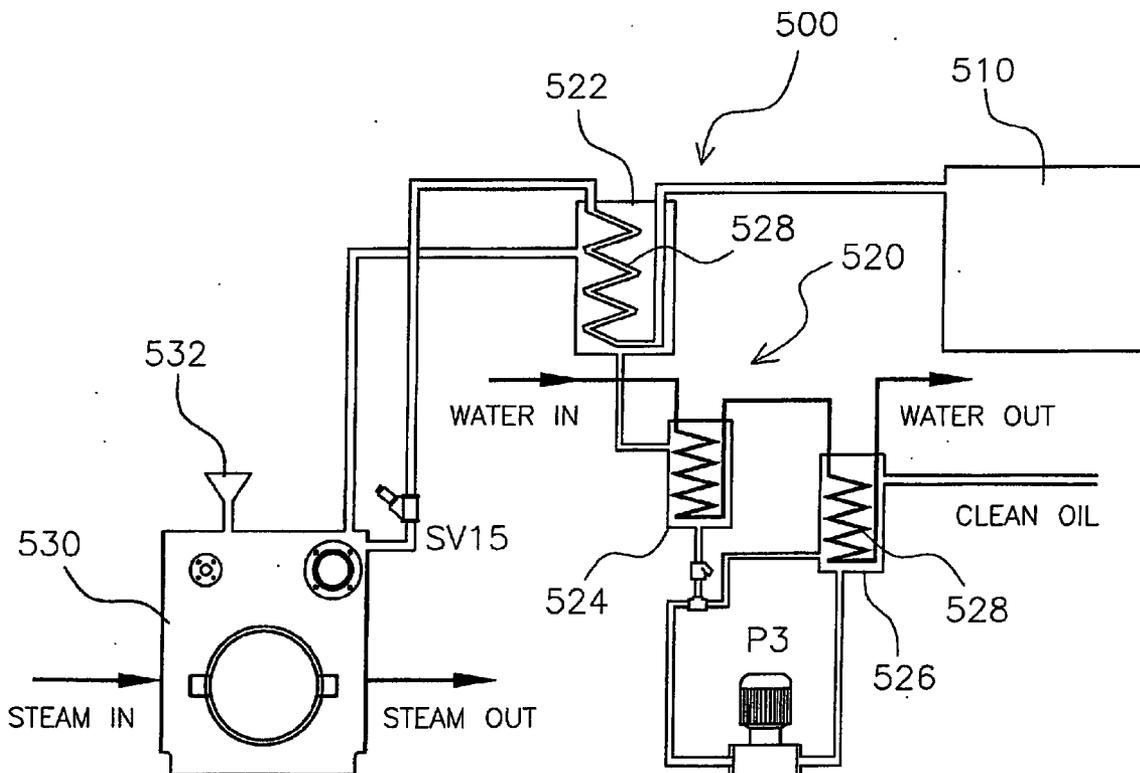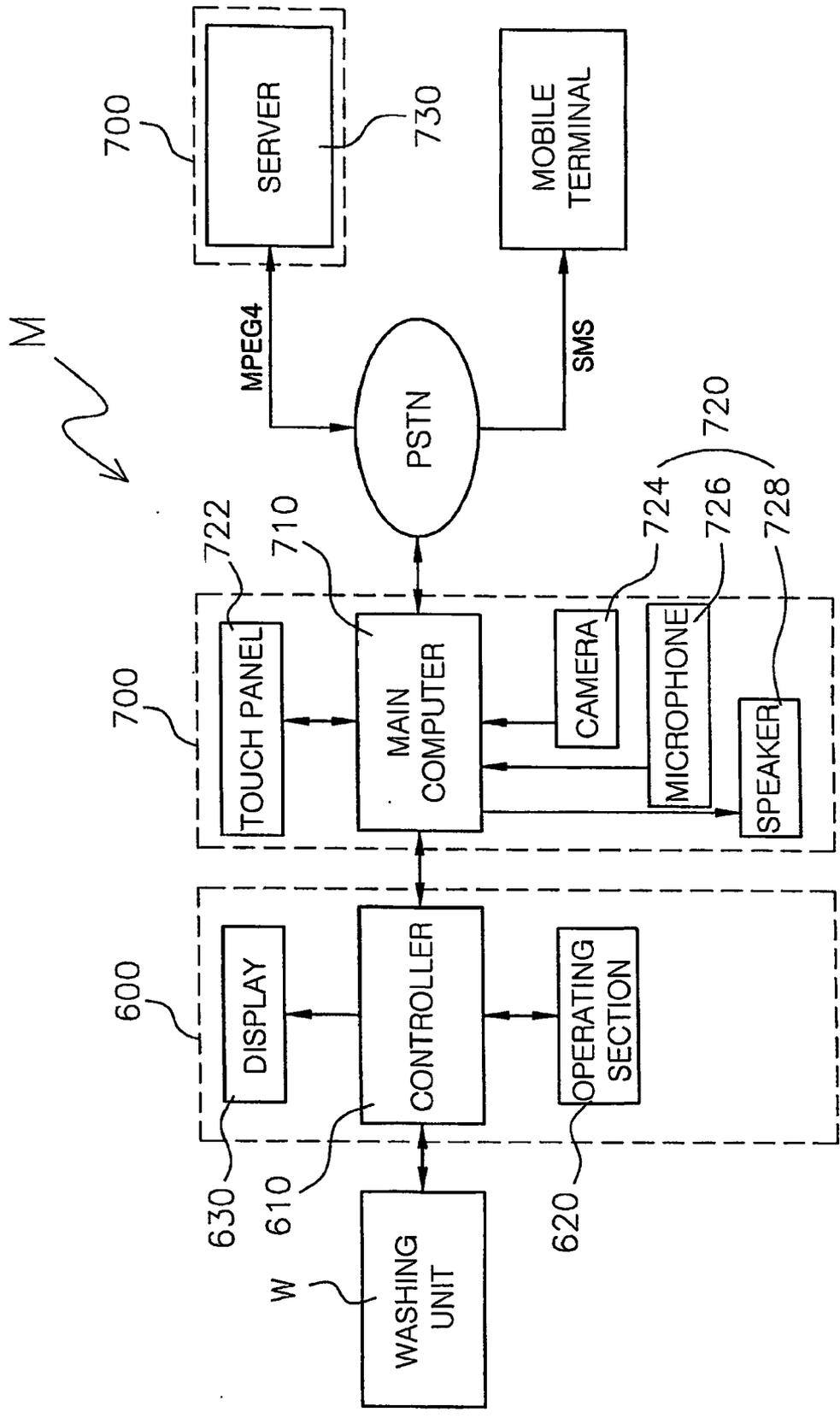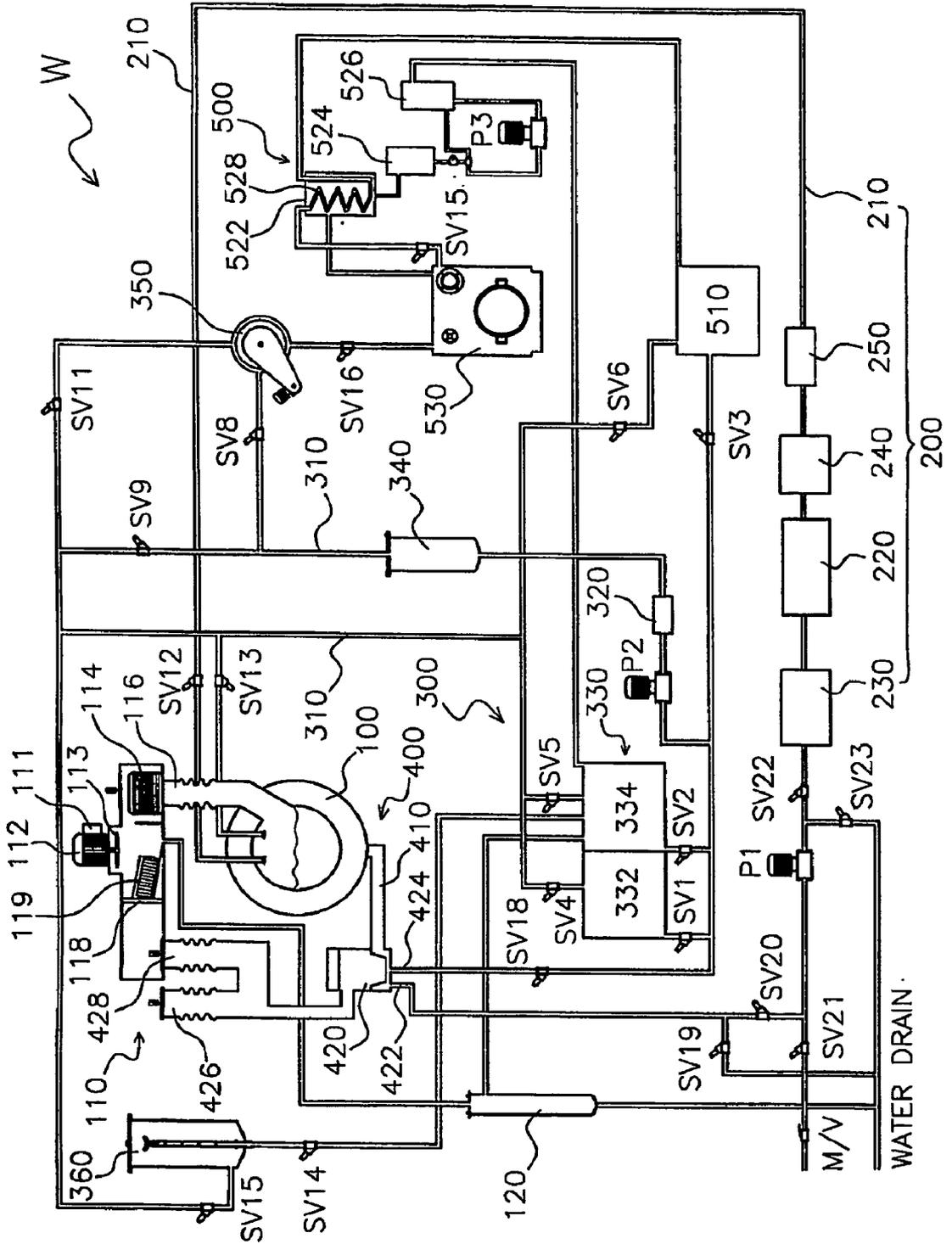
Fig. 1

Fig. 2

Fig. 3

Fig. 4

Fig. 5

Fig. 6
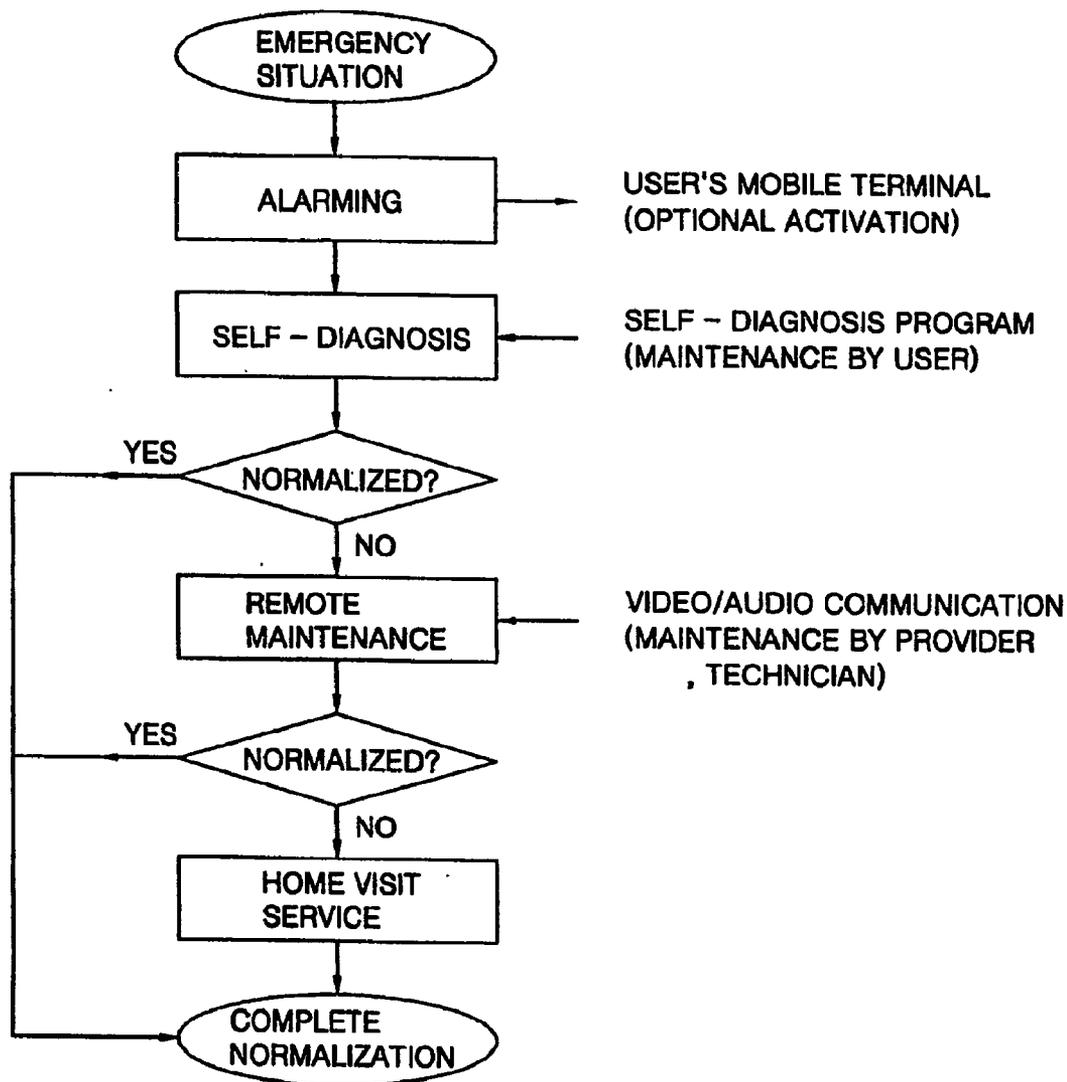
Fig. 7
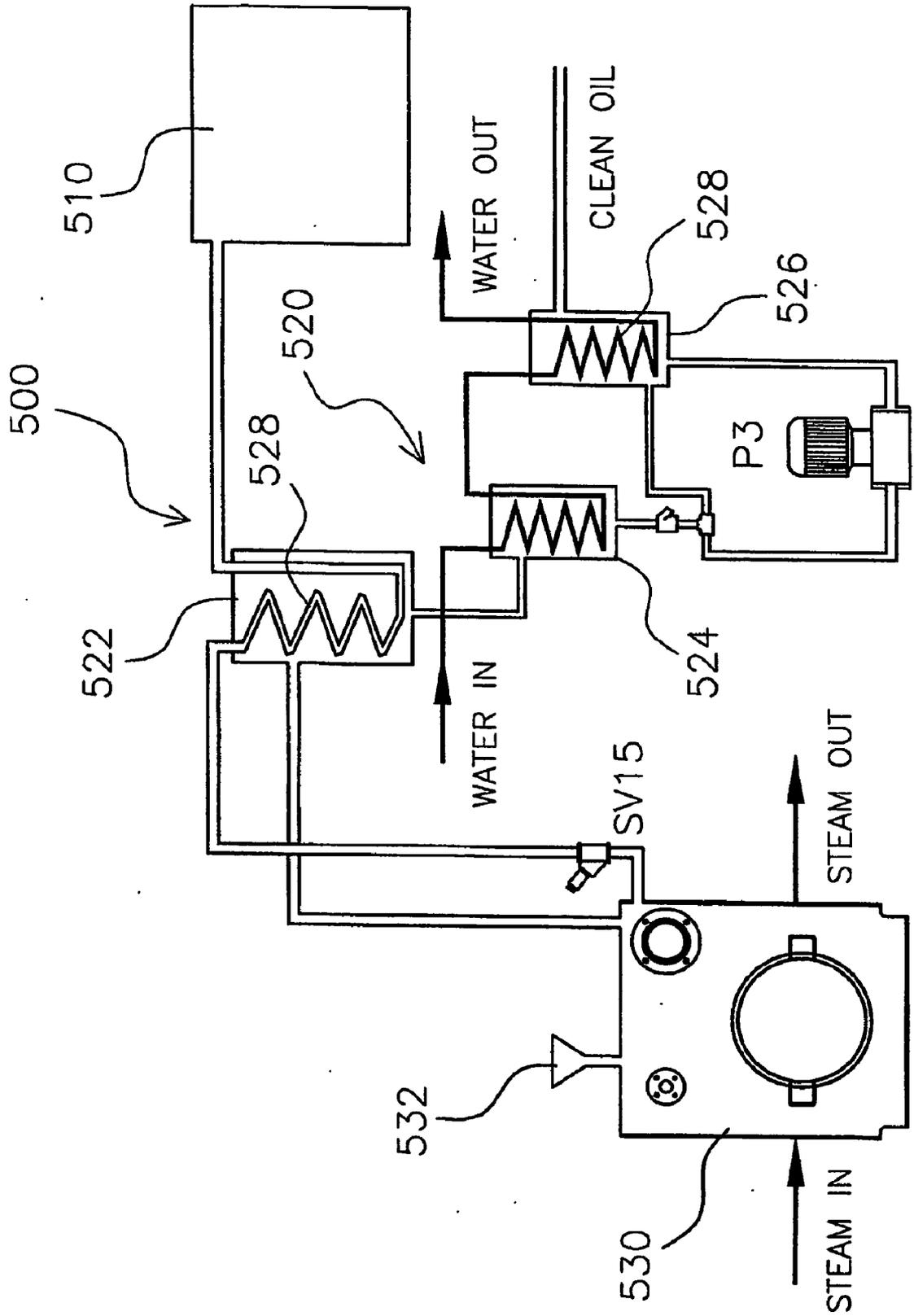
WASHING MACHINE FOR BOTH OIL AND WATER WASH HAVING SELF-DIAGNOSING AND NETWORKING FUNCTION

TECHNICAL FIELD

[0001] The present invention generally relates to a washing machine, and particularly to, a washing machine which can selectively perform a water-used washing and an oil-used washing by using one washing tub. The washing machine has a self-diagnosis function and a communication or networking function.

BACKGROUND ART

[0002] In general, the washing machines may be classified into a water-based washer using water as washing fluid and an oil-based washer using oil as the washing fluid. Since one type of the washing machine is normally exclusively used from the other, if the user wants both of the water-used washing and the oil-used washi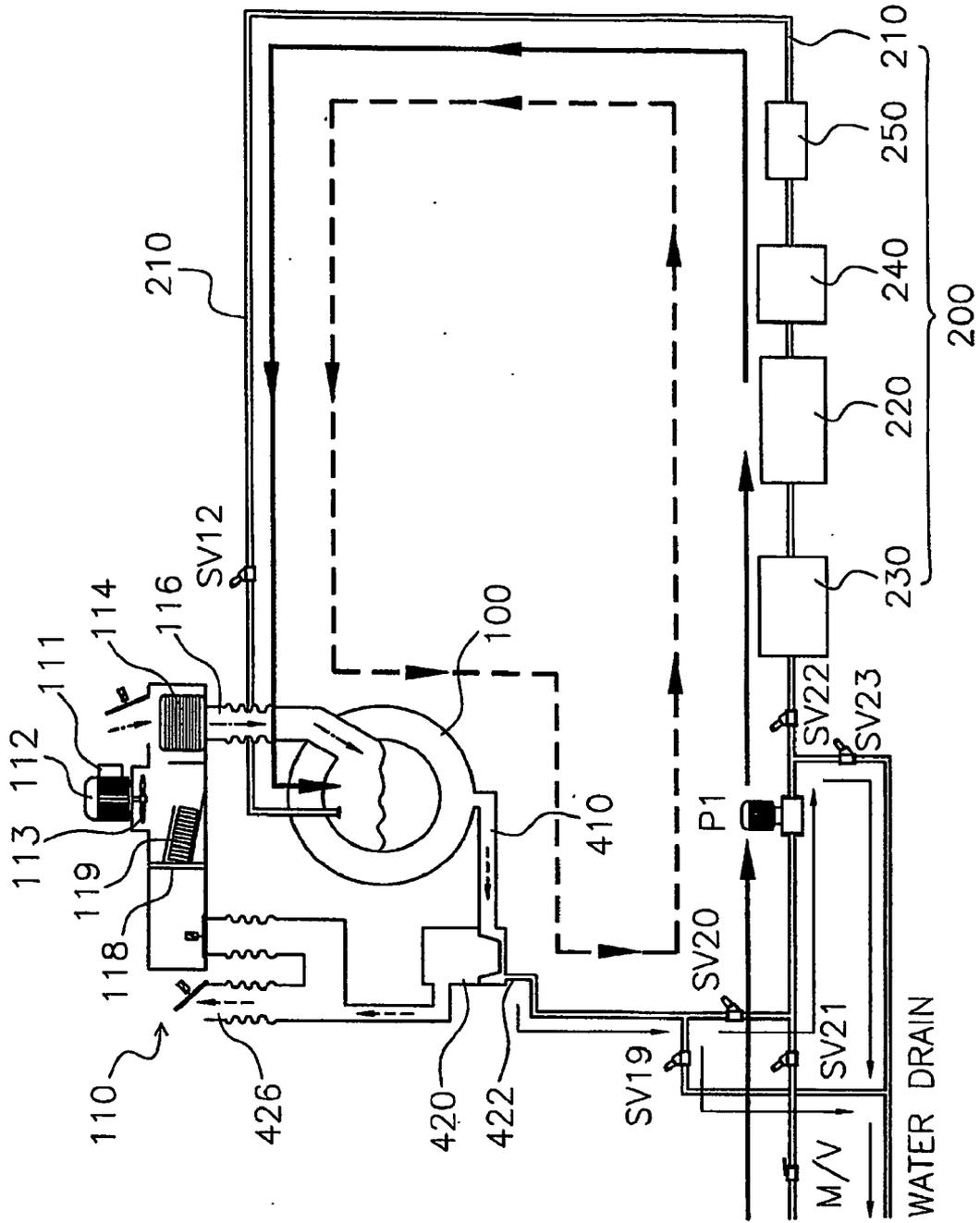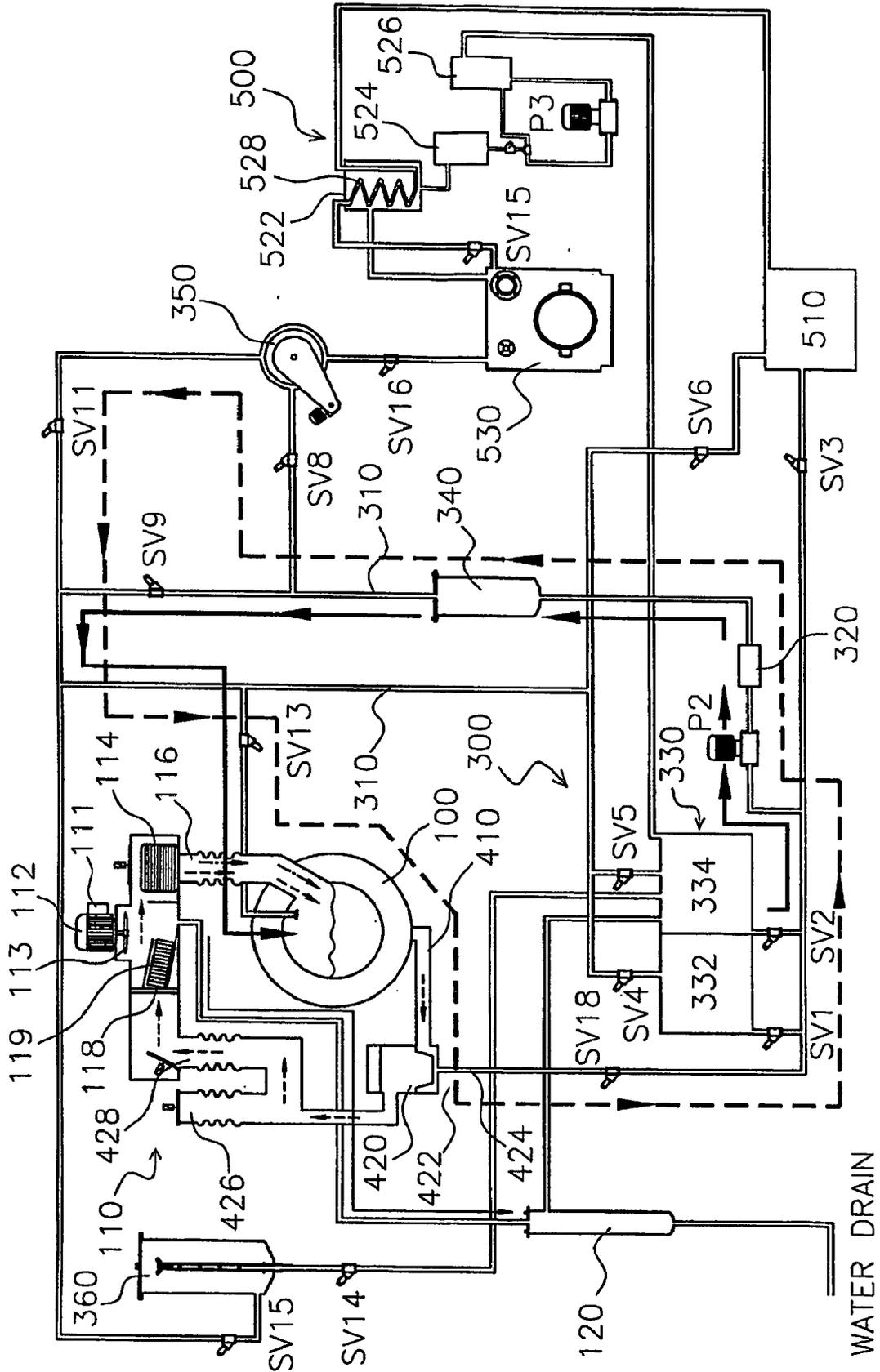ng, he cannot help purchasing all of these two kinds of washing machines. This costs much money and a large space. For this reason, industrial washing machines capable of performing all of these two kinds of washing have been proposed in recent years. However, the proposed washing machines still have many problems to be solved, e.g., a problem related to the efficiency of washing or an economic problem, etc., since a device for removing the oil remaining on the washing tub or a device for purifying the used oil has not been properly provided to them. Further, in the prior art washing machines, a home visit service by the product provider often has to be made for maintenance of the washing machine and for an emergency situation in which the washing machine cannot be abruptly operated. Especially, in case that the product provider is located far away from the user, it will take much time to normalize the washing machine. This results in reduction of the operation hour, reduction of the washing efficiency, and hence reduction of competitive power in the market. Therefore, a prompt effort is required to solve these problems.

DISCLOSURE OF THE INVENTION

Technical Problem

[0003] The object of the present invention is to provide a washing machine which can selectively perform a water-used washing and an oil-used washing by using one washing tub and has a self-diagnosis function and a communication or networking function.

[0004] Another object of the present invention is to provide a washing machine having the self-diagnosis function and the communication function in which a constant amount of detergent is feed under a constant level of pressure to thereby maximize the efficiency of the washing process

[0005] Another object of the present invention is to provide a washing machine having the self-diagnosis function and the communication function in which the water washing and the oil washing can be performed with respect to one washing tub by completely removing alien material and the oil remaining on the washing tub and deterioration of the laundry can be avoided, while providing economic benefits by using the oil reclaimed by a reclamation process.

[0006] Another object of the present invention is to provide a washing machine having the self-diagnosis function and the communication function in which a soft-start control is applied to a fan motor at the time of an initial rotation thereof by being equipped with an inverter, thereby minimizing vibrations or shocks caused by the fan motor.

[0007] Another object of the present invention is to provide a washing machine having the self-diagnosis function and the communication function in which the washing tub is initially rotated at a lower speed for a given time and then is rotated at a higher speed to prevent an imbalance problem of the laundry and to minimize rotational vibrations due to the eccentricity, thereby enabling the washing tub to perform a stable dehydration process in reduced noises and vibrations during the dehydration process.

[0008] Another object of the present invention is to provide a washing machine having the self-diagnosis function and the communication function in which a reclamation unit is independently formed from the washing machine to increase an efficiency in installing process of the washing machine and to enable the reclamation unit to be applied to a number of washing machines or different types of washing machines.

[0009] Another object of the present invention is to provide a washing machine having the self-diagnosis function and the communication function in which fins used in a heat exchanger are of a high-fin type to thereby provide a maximized efficiency in heat transfer and to reduce the mounting place thereof.

[0010] Another object of the present invention is to provide a washing machine having the self-diagnosis function and the communication function which has a self-diagnostic function and an assisting function for assisting the user in performing maintenance.

[0011] Another object of the present invention is to provide a washing machine having the self-diagnosis function and the communication function which can perform a remote monitoring and communication through a connection to a PSTN.

Technical Solution

[0012] The present invention is to provide a washing machine in which the water washing and the oil washing can be performed with respect to one washing tub by completely removing alien material and the oil remaining on the washing tub and a real time remote maintenance is achieved by using a main computer connected to the PSTN.

Advantageous Effects

[0013] The present invention has an advantage in that both of the water washing and the oil washing can be performed with respect to one washing tub.

[0014] The present invention has an advantage in that a constant amount of detergent is feed in a constant level of pressure to thereby maximize the efficiency of the washing process

[0015] The present invention has an advantage in that deterioration of the laundry can be avoided, while providing economic benefits by completely removing alien material and the oil remaining on the washing tub.

[0016] The present invention has an advantage in that economic benefits such as saving of the operative costs can be resulted by using the oil reclaimed by a reclamation process.

[0017] The present invention has an advantage in that a soft-start control is applied to a fan motor at the time of an initial rotation thereof by being equipped with an inverter, thereby minimizing vibrations or shocks caused by the fan motor.

[0018] The present invention has an advantage in that the washing tub is initially rotated at a lower speed for a given time and then is rotated at a higher speed to prevent an imbalance problem of the laundry and to minimize rotational vibrations due to the eccentricity, thereby enabling the washing tub to perform a stable dehydration process or a stable deoiling process in reduced noises and vibrations during the dehydration process or deoiling process.

[0019] The present invention has an advantage in that a reclamation unit is independently formed from the washing machine to increase an efficiency in installing process of the washing machine and to enable the reclamation unit to be applied to a number of washing machines.

[0020] The present invention has an advantage in that fins used in a heat exchanger are of a high-fin type to thereby provide a maximized efficiency in heat transfer and to reduce the mounting place thereof.

[0021] The present invention has an advantage in that it allows the maintenance to be easily and conveniently performed with its self-diagnostic function and assisting function for assisting the user in performing the maintenance.

[0022] The present invention has an advantage in that it can perform a wide area communication and maintenance through a connection to a PSTN.

DESCRIPTION OF DRAWINGS

[0023] The above and other objects and features of the present invention will become apparent from the following description of the embodiments provided in conjunction with the accompanying drawings.

[0024] FIG. 1 is a block diagram showing a configuration of a preferred embodiment of the present invention.

[0025] FIG. 2 is a diagram showing a configuration of a washing unit of the preferred embodiment of the present invention.

[0026] FIG. 3 is a diagram showing a first detergent supply of the washing unit shown in FIG. 2.

[0027] FIG. 4 is a diagram showing components performing the water-used washing of the washing unit shown in FIG. 2.

[0028] FIG. 5 is a diagram showing components performing the oil-used washing of the washing unit shown in FIG. 2.

[0029] FIG. 6 is a flow chart of a process for restoring or maintaining the washing machine in accordance with the preferred embodiment of the present invention.

[0030] FIG. 7 is a diagram showing a configuration of a reclamation unit for purifying the oil, wherein the unit is in an independent form from the washing unit shown in FIG. 2.

BEST MODE

[0031] In accordance with one aspect of the present invention, a washing machine with a self-diagnostic function and a communication function comprises a washing tub for selectively performing a water washing or an oil washing depending on the laundry; a water supply for supplying water to the washing tub; an oil supply for supplying oil to the washing tub; a drainage for discharging the water or the oil contained in the washing tube to the outside; a first detergent supply mounted to the water supply to mix an amount of detergent in the water being supplied to the washing tub; and a second detergent supply mounted to the oil supply to mix an amount of detergent in the oil being supplied to the washing tub.

[0032] In accordance with another aspect of the present invention, the washing tub comprises a drying unit having a heater for heating an air to generate a hot air, and a fan motor equipped with an inverter and a fan for blowing the hot air into the washing tub, whereby the laundry in the washing tub after a washing process is dried by the hot air.

[0033] In accordance with another aspect of the present invention, the first detergent supply comprises a detergent tank for keeping therein detergent, a metering pump for feeding a constant amount of the detergent, and a safety relief valve for maintaining a pressure of an output side of the metering pump in a constant level.

[0034] In accordance with another aspect of the present invention, the water supply comprises a water conversion unit for a conversion of hard water into soft water.

[0035] In accordance with another aspect of the present invention, the water supply further comprises a first temperature control unit for adjusting temperature of the water being supplied into the washing tub to a level optimal to the washing.

[0036] In accordance with another aspect of the present invention, the washing machine further comprises a reclamation unit having a reclamation tank keeping therein wasted oil, a plurality of heat exchangers for previously heating the wasted oil and for liquidizing oil vapor, and an oil vaporizer for vaporizing the pre-heated oil to separate alien material from oil, wherein the reclamation unit is integrally formed with the washing machine or is formed in an independent form from the washing machine.

[0037] In accordance with another aspect of the present invention, said heat exchanger has a plurality of coolers for cooling the oil vapor reclaimed in the oil vaporizer step-by-step to liquidize the oil vapor, and a pre-heater for previously heating the oil to be reclaimed which is supplied from the reclamation tank and for previously cooling the reclaimed oil vapor to feed the oil vapor to the cooler through a heat exchange between the oil being introduced into the oil vaporizer and the oil vapor being discharged from the oil vaporizer, wherein heat transfer tubes used in the heat exchanger is of a high-fin type.

[0038] In accordance with another aspect of the present invention, the washing machine further comprises a communication system having a main computer for monitoring and controlling the washing machine in a real time to allow the user to solve a problem by himself under an assistance by a program for self-diagnosis in an emergency situation of

the washing machine, and for performing a communication and a control through a connection to a PSTN, a touch panel (TFT-LCD) for displaying information in visual manner such as a graph or figures, a camera, a microphone and a speaker enabling the user to perform a real time maintenance through a visual and audible dialogue with a product provider or a technical expert in remote place based on MPEG4 technology, and a server connected to the main computer through the PSTN.

[0039] In accordance with another aspect of the present invention, said main computer transmits an alarm signal and information about a current state of the washing machine to a mobile terminal of the user by using a SMS (Short Message Service).

[0040] as shown in **FIG. 1**, the inventive washing machine M includes a washing unit W which is a hardware for performing a real washing operation, a control unit **600** for performing a control, an operation and a self-diagnosis, and a communication system **700** providing a visual audio communication function between the user and the product provider based on a wide area network technology.

[0041] As shown in **FIG. 2**, the washing unit W is provided with a washing tub **100** selectively performing the water-washing or the oil-washing, a water supply **200** for supplying water to the washing tub **100**, an oil supply **300** for supplying oil to the washing tub **100**, a drainage **400** for discharging the water or oil in the washing tub **100**, and a reclamation unit **500** for reclaiming the contaminated oil after washing. The washing unit W is controlled by the control unit **600** and is also monitored and controlled by the communication system **700**.

[0042] The washing tub **100** performs sequentially washing, rinsing, dehydration and drying in this order. The processes are performed inside the washing tub **100**. The drying process is assisted by a drying unit **110** which exists outside the washing tub **100** and provides a hot wind.

[0043] It is preferable that the washing tub **100** be provided with a sensor (not shown) for detecting an unbalanced distribution of the laundry in the washing tub **100** during dehydration or deoiling.

[0044] As shown in **FIG. 2**, the drying unit **110** is provided with a heater **114** for heating the air, a fan motor **112** equipped with a fan **113** which introduces the hot wind into the washing tub **100** by its rotational force, and a hot-wind supply passageway **116** guiding the heated air, i.e., the hot wind, into an inner space of the washing tub **100**.

[0045] Further, the drying unit **110** is also provided with a lint filter **118** for filtering alien material from oil vapor generating inside the washing tub **100** during the drying process, a condenser **119** for liquidizing the oil vapor having passed through the lint filter **118**, and a separator **120** for separating water from the liquidized oil.

[0046] The oil from which water has been removed by the separator **120** is then fed to a second oil tank **334** of the oil supply **300**, while the water component being discharged outside.

[0047] It is desirable that the fan motor **112** be operated in a soft-start manner in order to minimize vibrations or shocks which may damage the washing machine. This can be achieved by providing an inverter **111** to the fan motor **112**.

[0048] As shown in **FIGS. 2 and 4**, the water supply **200** is provided with a water supply line **210** and a first pump P1 which function to supply water to the washing tub **100** from the outside, and a first detergent supply unit **220** connected to the water supply line **210** to supply detergent to the water being supplied through the water supply line **210**.

[0049] Further, the water supply **200** is provided with a water conversion unit **230** mounted on a leading portion of the water supply line **210** for a conversion of hard water being supplied into soft water by using ionization, an agitator **240** mounted near the first detergent supply **220** and agitating the mixture of water and detergent for a well mixed state therebetween, and a first temperature control unit **250** for adjusting the temperature of the water being supplied into the washing tub **100** to a proper level.

[0050] The first detergent supply **220** supplies a determined amount of detergent in a constant level of pressure. As shown in **FIG. 3**, it has a detergent tank **222** for keeping therein detergent, a valve **223** mounted to the detergent tank **222** to serve as an exit for detergent, a metering pump **224** for discharging the determined amount of detergent into the water supply line **210**, and a safety relief valve **226** and a solenoid valve **227** for preventing any variation and fluctuation of the flow rate by maintaining the pressure of an output side of the metering pump **224** in a constant level.

[0051] The first detergent supply **220** also has a fluctuation prevention unit **228** mounted to the output side of the metering pump **224** to prevent the flow of the detergent from fluctuating.

[0052] As shown in **FIGS. 2 and 5**, the oil supply **300** is provided with an oil tank **330** for keeping therein the oil before/after the washing process, an oil supply line **310** connected to the oil tank **330** to supply oil to the washing tub **100**, a second pump P2, and a second detergent supply **320** connected to the oil supply line **310** to supply detergent thereto.

[0053] The oil supply **300** is also provided with a second temperature control unit **340** for maintaining the temperature of the oil being supplied into the washing tub **100** in a proper level, a spin filter **350** for removing the laundry particles remaining after the washing process and the alien material which may be mixed with oil during the washing process, and a carbon filter **360** for filtering various odor components contained in oil.

[0054] The oil tank **330** has two tanks, i.e., a first oil tank **332** and a second oil tank **334**. The oil before use or the reclaimed oil is contained in the first oil tank **332** and is supplied to the washing tub **100** later. The second oil tank **334** is for the oil from which water component is removed by the separator **120**, the oil from which the odor components are removed by the carbon filter **360**, and the oil reclaimed from the oil contained in a reclamation tank **510** of the reclamation unit **500** which serves to reservoir therein the contaminated oil. The reclaimed oil of the second oil tank **334** is supplied to the first oil tank **332** again. The supply of the reclaimed oil from the second oil tank **334** to the first oil tank **332** is achieved when the reclaimed oil in the second oil tank **334** overflows, over an upper end wall of the first oil tank **332** which is adjacent to the second oil tank **334**, into the first oil tank **332**.

[0055] Because the second detergent supply **320** has a configuration similar to that of the first detergent supply **220**, a detailed description of it will be omitted.

[0056] The drainage **400** includes a discharge line **410**, connected to the washing tub **100**, through which water or oil is discharged, a button trap **420** connected to the discharge line **410** to eliminate the alien material. The button trap **420** is equipped with a water discharge passageway **422** and an oil discharge passageway **424** through which water and oil are discharged, respectively, and a water vapor discharge passageway **426** and an oil vapor discharge passageway **428** through which water vapor and oil vapor, being generated from the drying process, are discharged, respectively.

[0057] The water vapor generated from the washing process is discharged outside through the water vapor discharge passageway **426**, while the oil vapor generated in the washing tub **100** is flown to the drying unit **110** through the oil vapor discharge passageway **428**.

[0058] The oil vapor introduced into the drying unit **110** is purified and liquidized by the lint filter **118** and the condenser **119**. After that, it is fed to the separator **120** in which the water component is removed from it and then is contained in the second oil tank **334**.

[0059] As shown in **FIG. 2**, the reclamation unit **500** includes the reclamation tank **510**, a heat exchanger **520**, an oil vaporizer **530** and a third pump **P3**.

[0060] The reclamation tank **510** reservoirs the contaminated oil to be reclaimed.

[0061] The heat exchanger **520** has a pre-heater **522**, and a first and a second cooler **524**, **526**.

[0062] The pre-heater **522** is positioned between the reclamation tank **510** and the oil vaporizer **530** and serves to previously heat the liquid oil before the liquid oil is fed to the oil vaporizer **530** in which the liquid oil is vaporized by steam. The pre-heater **522** also previously cools the reclaimed oil vapor being discharged from the oil vaporizer **530** in which the liquid oil is vaporized and then is reclaimed before the reclaimed oil vapor is introduced into the first cooler **524**.

[0063] In other words, a heat exchange occurs between the liquid oil being introduced into the oil vaporizer **530** and the oil vapor being discharged from the oil vaporizer **530**, so that the liquid oil to be reclaimed being supplied from the reclamation tank **510** is pre-heated, while the oil vapor is pre-cooled and then is fed to the first cooler **524**.

[0064] This can assist the operation of the oil vaporizer **530** and the first and the second coolers **524**, **526**, thereby increasing the thermal efficiency.

[0065] The first cooler and the second cooler **524**, **526** cool the oil vapor to change the phase of the oil vapor into the oil in liquid state by using heat transfer tubes **528** equipped within the first and the second coolers **524**, **526**. The second cooler **526** discharges the final reclaimed oil, which is fed to the second oil tank **334**.

[0066] The first cooler **524** and the second cooler **526** are connected to each other through the third pump **P3**. The operation between them will be described later.

[0067] Meanwhile, it is preferable that the heat transfer tubes **528** used in the heat exchanger **520** be of a high-fin type which may provide a maximized efficiency in heat transfer and an easy piping work thereof and requires a reduced mounting place, thereby minimizing a spatial problem which may be resulted.

[0068] The oil vaporizer **530** vaporizes the introduced oil by using steam to separate the alien material from the oil and then the oil is fed to the pre-heater **522**. It is desirable that the reclamation unit **500** be equipped with a level detector (not shown) for enabling an amount of the oil being treated to be adjusted to a proper level.

[0069] Meanwhile, as shown in **FIG. 7**, the reclamation unit **500** can be independently formed from the washing machine, although it may be integrally formed therewith. Independent formation of the reclamation unit **500** from the washing machine increases an efficiency in installing process of the washing machine. Further, it enables the reclamation unit **500** to provide a number of washing machines with the reclaimed oil at one time and to be applied to different types of washing machines.

[0070] The control unit **600** includes a controller **610** controlling components of the washing machine based on a program for washing, an operating section **620** for running and changing the washing program, and a display **630** for informing the user of a current state of the washing machine.

[0071] The controller **610** controls the washing machine by itself, based on built-in programs for washing and self-diagnosis and, if necessary, it may be controlled by a communication system **700**.

[0072] When an emergency situation occurs, the display **630** displays a problem report for every sections of the washing machine to thereby assist the user to understand the problem. After that, the user may normalize the washing machine through a manipulation of the operating section **620**.

[0073] The communication system **700** performs communication based on a WAN (wide area network) through the internet and the PSTN (public switched telephone network) and functions as a system which performs a diagnosis and transmits video and audio information. The communication system **700** includes a main computer **710**, a user's interface **720**, and a product provider's server **730**.

[0074] The main computer **710** can directly control the washing machine through the communication with the control unit **600**. When it is connected to the PSTN, it is possible to perform a wide area communication with the washing machine provider or a technical expert. The wide area communication may be implemented based on MPEG 4.

[0075] Further, the main computer **710** has built-in programs classified by the washing courses, which can be edited. Further, it may perform a real time download of the programs for the washing process and then upload those programs to the control unit **600**.

[0076] The interface **720** is provided with a touch panel (TFT-LCD) **722**, a camera (CCD camera) **744**, a microphone **746** and a speaker **748**.

[0077] The touch panel **722** functions as an input/output means for the main computer **710** and provides an interactive real time communication function with the user.

[0078] The touch panel **722** may provide visual outputs in the form of graph or figure and various input interfaces such as key pads or touch screen.

[0079] The camera **724**, the microphone **726** and the speaker **748** enable a visual and audible dialogue with the product provider or the technical expert in remote place. In implementing this, wire transmission or radio transmission can be properly selected under a consideration of functions or convenience.

[0080] The server **730** which is managed by the product provider in remote place is connected to the main computer **710** through the PSTN, so that it can receive information about the current state or the emergency situation of the washing machine. Further, the server **730** builds a database of the information, performs analysis, and determines future problems which may be issued. Therefore, it can inform the user of a proper solution for the problem and assist the user to establish a future maintenance plan.

[0081] Operations of the above described washing machine in accordance with the preferred embodiment of the present invention will be described in detail with classification into the water washing and the oil washing.

[0082] First of all, the water washing includes the washing→the rinsing→the dehydration→the drying in this order and detailed description thereof will be given hereunder with reference to **FIG. 4**.

[0083] In **FIG. 4**, a thick solid line indicates a water supply path, a thick dashed line indicates a water circulation path, a thin dash-dot line indicates a path of the hot wind, a thin dashed line means a path of the water vapor, and a thin solid line means a path of the liquid water.

[0084] The washing process is started in following manners. When the first pump P**1** is switched on after opening of the main valve M/V and the solenoid valves SV**21**, SV**22**, SV**12**, water is supplied to the water supply line **210** from the outside. The water being supplied in a state of hard water is changed into soft water by the water conversion unit **230** mounted to the leading portion of the water supply line **210**.

[0085] Next, the first detergent supply **220** supplies the predetermined detergent to the water being introduced and the agitator **240** agitates the mixture of water with detergent for a well mixed state therebetween. Next, the temperature of the detergent-added water being introduced is adjusted to an optimal level by the first temperature control unit **250** and then the detergent-added water is fed to the washing tub **100**.

[0086] When the washing tub **100** is charged with a predetermined amount of water, the solenoid valve SV**21** is closed while the solenoid valve SV**20** being opened. After that, while the washing tub **100** starts to rotate, the washing process begins.

[0087] In this process, the solenoid valve SV**21** is closed to shut-off the water supply from the outside, whereas the solenoid valve SV**20** is opened to establish a closed loop defined with the discharge line **410**, the button trap **420** and the water supply line **210**, through which the water contained in the washing tub **100** continuously circulates during the washing process.

[0088] After that, when the washing is completed, the wasted water charging the washing tub **100** is discharged by opening the solenoid valve SV**19** or is forcibly discharged by opening the solenoid valve SV**23** and by operating the first pump P**1** at the same time.

[0089] Next, the rinsing process is started. Water is supplied into the washing tub **100** in a manner similar to that of the washing process. Although detergent is not supplied in the rinsing process, rinse is provided to prevent damage of the laundry (clothes) in the final round of the rinsing process.

[0090] Next, the dehydration is started. Like the washing process and the rinsing process, the water is discharged by opening the solenoid valve SV**19** or is forcibly discharged by opening the solenoid valve SV**23** and by operating the first pump P**1** at the same time.

[0091] The dehydration is processed in two steps, i.e., a rotation of the washing tub **100** at a lower speed and a rotation of the washing tub **100** at a higher speed. Initially, the washing tub **100** is rotated at a lower speed to give the laundry having an imbalance problem a chance to evenly redistribute in the washing tub **100**, thereby allowing the washing tub **100** to be in balanced position. This is to minimize vibrations of the washing tub **100** due to its eccentric position at the time when the washing tub **100** is rotated at a high speed for an actual dehydration.

[0092] In the process, when a detection value of the sensor detecting a distributed state of the laundry in the washing tub **100** runs within a predefined range, the rotational speed of the washing tub **100** is changed to a high speed from a low speed.

[0093] Finally, the drying process is started. When the fan motor **112** is operated, outside air is introduced into the drying unit **110** by the fan **113** and then is heated by the heater **114**.

[0094] The hot wind generated by heating is introduced into the washing tub **100** through the hot wind supply passageway **116** to dry the laundry. The water vapor being generated in this process is discharged outside through the water vapor discharge passageway **426**.

[0095] Soft-start control is applied to the fan motor **112** at the time of initial rotation thereof by being equipped with the inverter **111** allowing an easy control of the speed. As a result, influences by the factors resulting in physical fatigue, i.e., vibrations or shocks can be minimized.

[0096] Now, operations of the washing machine performing the oil washing in accordance with the preferred embodiment of the present invention will be explained in detail with reference to **FIG. 5**.

[0097] In **FIG. 5**, a thick solid line indicates an oil supply path, a thick dashed line indicates an oil circulation path, a thin dash-dot line indicates a path of the hot wind, a thin dashed line means a path of the oil vapor, and a thin solid line means a path of the liquid oil.

[0098] First of all, the oil washing includes the washing→the deoiling→the drying→the oil vaporizing in this order.

[0099] The washing process is started in following manners. When the second pump P**2** mounted to the oil supply line **310** is switched on after opening of the solenoid valve SV**1** mounted to the first oil tank **332**, the oil contained in the first oil tank **332** is supplied to the oil supply line **310**. The oil is supplied to the washing tub **100** through the second

detergent supply **320**, the second temperature control unit **340** and the solenoid valves SV**9**, SV**13**.

[0100] When the washing tub **100** is charged with a predetermined amount of oil, the solenoid valve SV**1** is closed while the solenoid valve SV**8** being opened. After that, while the washing tub **100** starts to rotate, the washing process begins. As shown in **FIG. 5**, the oil contained in the washing tub **100** continuously circulates during the washing process, through a closed loop defined with the button trap **420**, the second temperature control unit **340**, the spin filter **350** and the solenoid valve SV **11**.

[0101] At the moment, the solenoid valve SV**9** is closed.

[0102] After the completion of the washing process using oil, the rotation of the washing tub **100** is stopped, the wasted oil in the washing tub **100** is contained in the reclamation tank **510** through the discharge line **410**, the button trap **420**, and the solenoid valves SV**18**, SV**3**.

[0103] The deoiling process is for removing the oil component remaining on the laundry by rotating the washing tub **100** at a high speed. The oil being removed is discharged to the reclamation tank **510**.

[0104] The deoiling is processed in two steps, i.e., a rotation of the washing tub **100** at a lower speed and a rotation of the washing tub **100** at a higher speed. Initially, the washing tub **100** is rotated at a lower speed to give the laundry having an imbalance problem a chance to evenly redistribute in the washing tub **100**, thereby allowing the washing tub **100** to be in balanced position. This is to minimize vibrations of the washing tub **100** due to its eccentric position at the time when the washing tub **100** is rotated at a high speed for an actual deoiling.

[0105] In the process, when a detection value of the sensor detecting a distributed state of the laundry in the washing tub **100** runs within a predefined range, the rotational speed of the washing tub **100** is changed to a high speed from a low speed.

[0106] After the deoiling process, the drying process for removing the oil component remaining on the laundry and the washing tub **100** is performed.

[0107] The drying process is achieved in such a way that, when the fan motor **112** is operated, the air having been heated by the heater **114** in the drying unit **110** is introduced into the washing tub **100** by the rotation of the fan **113** through the hot wind supply passageway **116**.

[0108] The oil vapor being generated in this process circulates along the path indicated with the thin dash-dot line in **FIG. 5**.

[0109] At the moment, the hot wind heated by the heater **114** vaporizes the oil component remaining in the button trap **420** and then returns to the drying unit **110**.

[0110] Soft-start control is applied to the fan motor **112** at the time of initial rotation thereof by being equipped with the inverter **111** allowing an easy control of the speed. As a result, influences by the factors resulting in physical fatigue, i.e., vibrations or shocks can be minimized.

[0111] The alien material is removed from the oil vapor introduced into the drying unit **110** through the oil vapor discharge passageway **428** by the lint filter **118**. The oil

vapor is then liquidized by the condenser **119**. After that, removing the water component from the liquid oil is performed at the separator **120** and the oil is fed to the second oil tank **334**, while the water component being discharged outside.

[0112] An actual washing operation is completed by finishing the washing process, the deoiling process, and the drying process. The reclamation process in which the oil wasted in the washing process is reclaimed for a future use is performed in following manners.

[0113] First, the heat exchanger **520** and the oil vaporizer **530** are vacuumed by the operation of the third pump P**3** connected to the first and the second coolers **524**, **526** in order to introduce the oil contained in the reclamation tank **510** into the oil vaporizer **530** via the pre-heater **522**.

[0114] The oil being introduced into the oil vaporizer **530** is vaporized by steam circulating the oil vaporizer **530**, being separated from the alien material and the oil vapor being vaporized enters the first cooler **524** through the pre-heater **522**.

[0115] Water-cooling type first and the second coolers **524**, **526** liquidize the oil vapor having a high temperature, wherein the oil initially cooled in the first cooler **524** is overflowed into the second cooler **526** and is secondly cooled in the second cooler **526**. After that, the cooled oil which has been treated by the reclamation process is discharged to be fed to the second oil tank **334**.

[0116] When the oil level in the second oil tank **334** arrives at a predefined level, the oil overflows into the first oil tank **332**.

[0117] As shown in **FIG. 7**, if the reclamation unit **500** is separately formed from the washing unit W, it is desirable that the reclamation unit **500** be equipped with a separate reservoir (not shown) for containing therein the reclaimed oil.

[0118] Further, it is desirable that the oil vaporizer **530** be equipped with a funnel **532** which can be used to introduce the oil to be reclaimed through a different path.

[0119] The operations described above or the washing operation is performed by the control unit **600** according to the programs for the washing operation restored in the controller. It may be performed by the main computer **710** monitoring the washing unit W in real time via the control unit **600**.

[0120] Meanwhile, since the main computer **710** is connected to the server **730** through the PSTN, it can transmit the information about the current state and use-history of the washing unit W to the server **730** to assist the technical expert to establish the future maintenance plan and hence the schedule therefor. The main computer **710** can download from the server **730** the information analyzed by the server, the information about the inspection schedule and updated programs for the washing process and upload those to the control unit **600**.

[0121] If an emergency situation or a situation requiring a maintenance occurs to the washing unit W performing a normal operation in a manner described above, an audio alarm signal is emitted, while the information related to the alarm being displayed in the display **622** of the operating

section **620**, by the self-diagnostic function of the control unit **610**. In case of a simple problem, a help program for solving the problem is triggered by the self-diagnostic function.

[0122] The user may normalize the washing machine M by himself by solving the problem or by performing the maintenance under the guidance by the help program.

[0123] However, in case those serious problems occur to the whole washing machine M, the information about that situation is displayed in the touch panel **722** of the interface **720** and at the same time a mobile terminal of the user is informed of the information about the washing machine M as well as the emergency situation. Further, a help program for performing the self-diagnostic function or for solving the problem may be run.

[0124] During the process, informing the mobile terminal of the occurrence of the emergency situation may be implemented by a SMS (Short Message Service). This alarm function may be selectively activated by the user. Further, the user may be informed of the information or alarms from a plurality of washing machine M.

[0125] If the user who is trying to solve the problem occurring to the washing machine M under an assistance by the self-diagnosis program fails to solve the problem in this manner, he can have a real time talk with the product provider or the technical expert in remote place in audible or visual manner through the PSTN in order to restore the washing machine M.

[0126] At the moment, the user performs the remote communication by using the camera **724**, the microphone **726**, the speaker **728** and the touch panel **722**.

[0127] Meanwhile, the server **730** builds the database of the information, performs analysis about that, and determines future problems which may be issued. Therefore, it can inform the user of a proper solution for the problem and assist the user to establish a future maintenance plan.

INDUSTRIAL APPLICABILITY

[0128] While the present invention has been shown and described herein with respect to the particular embodiments, those skilled in the art will recognize that many exchanges and modifications may be made without departing from the scope of the invention as defined in the appended claims.

1. A washing machine with a self-diagnostic function and a communication function comprising:

a washing tub for selectively performing a water washing or an oil washing depending on the laundry;

a water supply for supplying water to the washing tub;

an oil supply for supplying oil to the washing tub;

a drainage for discharging the water or the oil contained in the washing tube to the outside;

a first detergent supply mounted to the water supply to mix an amount of detergent in the water being supplied to the washing tub; and

a second detergent supply mounted to the oil supply to mix an amount of detergent in the oil being supplied to the washing tub.

2. The washing machine of claim 1, wherein the washing tub comprises a drying unit having a heater for heating an air to generate a hot air, and a fan motor equipped with an inverter and a fan for blowing the hot air into the washing tub, whereby the laundry in the washing tub after a washing process is dried by the hot air.

3. The washing machine of claim 1, wherein the first detergent supply comprises a detergent tank for keeping therein detergent, a metering pump for feeding a constant amount of the detergent, and a safety relief valve for maintaining a pressure of an output side of the metering pump in a constant level.

4. The washing machine of claim 1 or 3, wherein the water supply comprises a water conversion unit for a conversion of hard water into soft water.

5. The washing machine of claim 4, wherein the water supply further comprises a first temperature control unit for adjusting temperature of the water being supplied into the washing tub to a level optimal to the washing.

6. The washing machine of claim 1, further comprising a reclamation unit having a reclamation tank keeping therein wasted oil, a plurality of heat exchangers for previously heating the wasted oil and for liquidizing oil vapor, and an oil vaporizer for vaporizing the pre-heated oil to separate alien material from oil, wherein the reclamation unit is integrally formed with the washing machine or is formed in an independent form from the washing machine.

7. The washing machine of claim 6, wherein said heat exchanger has a plurality of coolers for cooling the oil vapor reclaimed in the oil vaporizer step-by-step to liquidize the oil vapor, and a pre-heater for previously heating the oil to be reclaimed which is supplied from the reclamation tank and for previously cooling the reclaimed oil vapor to feed the oil vapor to the cooler through a heat exchange between the oil being introduced into the oil vaporizer and the oil vapor being discharged from the oil vaporizer, wherein heat transfer tubes used in the heat exchanger is of a high-fin type.

8. The washing machine of claim 1, further comprising a communication system having a main computer for monitoring and controlling the washing machine in a real time to allow the user to solve a problem by himself under an assistance by a program for self-diagnosis in an emergency situation of the washing machine, and for performing a communication and a control through a connection to a PSTN, a touch panel (TFT-LCD) for displaying information in visual manner such as a graph or figures, a camera, a microphone and a speaker enabling the user to perform a real time maintenance through a visual and audible dialogue with a product provider or a technical expert in remote place based on MPEG4 technology, and a server connected to the main computer through the PSTN.

9. The washing machine of claim 1, wherein said main computer transmits an alarm signal and information about a current state of the washing machine to a mobile terminal of the user by using a SMS (Short Message Service).

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