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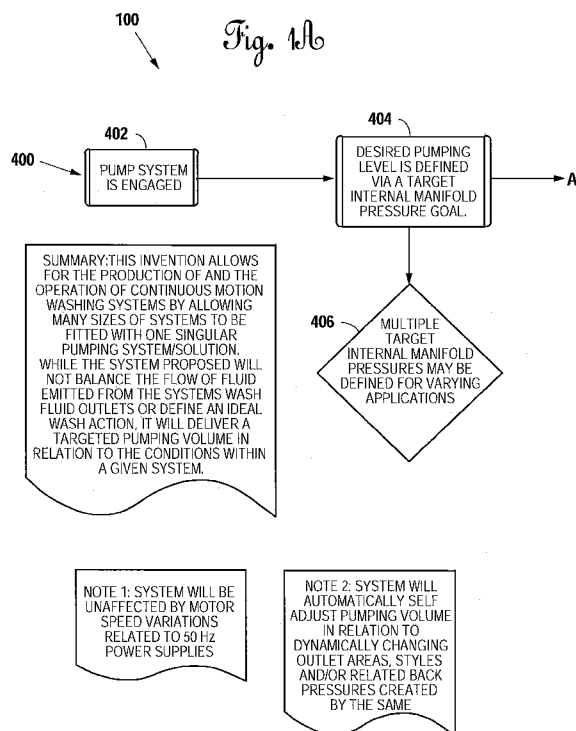
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Declarations under Rule 4.17:

- as to the identity of the inventor (Rule 4.17(i))
- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))
- as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))

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(54) Title: CONDITION RELIANT CONTROL SYSTEM FOR MODULATING ON DEMAND PUMPING VOLUME, WASH FLUID TEMPERATURES AND FILTER CONDITIONS FOR CONTINUOUS MOTION WASHING SYSTEMS



(57) Abstract: A condition reliant control system for modulating on demand pumping volume for continuous motion washing systems comprising at least one manifold, at least one sensor in electronic communication with the manifold, a control module in electric communication with the sensor, and a modulating unit in electronic communication with the control module to receive signals therefrom. The sensor continuously monitors the pressure readings of the manifold. A pumping system is in fluid communication with the manifold and has an impeller that either speeds up or slows down based on feedback readings from the modulation unit. A targeted pumping volume is delivered in relation to the pressure and temperature conditions within a given continuous motion washing system.



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TITLE OF THE INVENTION

Condition Reliant Control System for Modulating On Demand Pumping Volume, Wash Fluid Temperatures and Filter Conditions for Continuous Motion Washing Systems

CROSS REFERENCE TO RELATED APPLICATIONS

This original non-provisional application claims priority to and the benefit of U.S. provisional application serial no. 62/180,144, filed June 16, 2015, and entitled "Condition Reliant Control System for Modulating On Demand Pumping Volume, Wash Fluid Temperatures and Filter Conditions for Continuous Motion Washing Systems," which is incorporated by reference herein.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

None.

BACKGROUND OF THE INVENTION

1. Field of the Invention.

The present invention relates to continuous motion washing systems. More specifically, the present invention relates to a condition reliant control system for modulating on demand pumping volume, wash fluid temperatures and intake filter conditions for continuous motion washing systems.

2. Description of the Related Art.

Continuous motion washing systems that include a tank configured to hold fluid for washing, a pump and an outlet manifold structure fitted with at least one or more flow directing openings or outlets for directing fluid flow into a wash tank have existed for decades. In the food service equipment industry, it is not uncommon for an establishment to have one or more continuous motion washing systems in use at any given time. Generally, the larger the establishment, the higher the probability that the establishment may have a need for multiple continuous motion washing systems.

Continuous motion washing systems come in many varying sizes. For example, continuous motion washing systems may include a relatively small manifold with very few outlets, even as few as a single outlet. On the other hand, continuous motion washing systems may be quite large and have larger outlet manifolds containing many such flow directing outlets. Some systems seek to create required wash flows for a broad array of system sizes by using a broad array of pump sizes, pump impeller designs and motor revolutions per minute (rpm) and/or

multiple pumps—also with potentially varying pump impeller designs and/or motor rpm's. Other providers of these types of systems offer models with modulating units that allow the operator of the system to modulate the pump rpm to choose a wash flow volume such as low, medium or high.

5 Historical systems on the market have used the variable pump size approach, multiple pumps approach and modulating pump approach to provide targeted wash flows. Such historical designs work exceptionally well if designed correctly and used correctly. However, these historical designs are complex to design and produce and, thus, can be expensive to manufacture, sell and even service because of the complexities associated with the array of parts—and
10 arrangements of such parts—required for each system to function properly. In the case of the systems with modulating units that allow the operator of the system to modulate the pump, these systems are typically misused as the operator selects the “high” setting regardless of what is being washed.

 Another challenge of the described historical systems is that motors will run at varying
15 speeds or “rounds per minute” as a result of the characteristics of the various worldwide power supplies that have been historically established. As such, and logically, the varying power supplies worldwide will directly affect motor pumping volumes which result in a need for an entirely different set of the above required construction specifications; specifically, one for areas of the world with 60Hz power supplies and one for areas of the world with 50Hz power supplies.

20 In addition, such historical systems often require separate electric or gas heating systems to maintain wash tank fluid temperatures. This also can add complexity and cost to such systems. Furthermore, the currently marketed systems have not included direct feedback to a controller related to their conditions within their respective outlet manifold structures so that more intelligent operating methods could be achieved. Also, these systems do not contain or
25 include a collection type of filtration system as an integrated component of their pump inlet protection structures and systems.

 Finding a way to produce an entire continuous motion washing system product line with only one pumping solution via the incorporation of a very high capacity (oversized) pumping system would dramatically improve the current washing systems provided that a method of
30 automatically modulating the pump rpm via live feedback of actual manifold conditions could be provided. Such a live feedback system incorporated into the system's controller and coupled with a method of modulating the pump motor rpm would help overcome limitations to the

incorporation of such a pumping system sufficient to overcome the shortcomings of the prior art.

The very large (oversized) pumping system has a capacity to move a very large volume of fluid combined with its integrated system to automatically modulate its speed. Such a
5 pumping system could deliver adequate wash fluid volumes to even the very largest continuous motion washing systems (one having a manifold with many outlets). At the same time, by limiting the rpm of the pumping system, such a pumping system could be a solution for the very smallest systems (one having a manifold with minimal or even just one outlet) as well. Having a single pumping solution for an entire product line and concentrating the purchasing volume to
10 the single pumping solution would theoretically have a cost offset in relation to the pumping system being considerably oversized for the smaller and smallest applications or systems. In addition, having only one pumping solution would greatly simplify the manufacturing of a line of continuous motion washing systems which translates into a lower per unit cost to produce the systems. As well, inventory levels across the entire manufacturing process are reduced since
15 fewer overall parts are required to produce the systems and far fewer finished systems would be required to supply demand.

While the concept of being able to fit an entire continuous motion product line with a single pumping solution is attractive in a number of ways, it is possible that this alone would still not be a significant enough advancement to justify the additional cost and complexity of the very
20 large pumping system and the electronic apparatus required to provide live outlet manifold feedback as well as the required system to modulate the pump rpm.

Also, having such a system and allowing the operator of such equipment the ability to randomly choose the speed or “wash action level” at which the system would operate would potentially be seen as a negative in the industry. Specifically, as stated, the typical operator
25 tends to want to run the system at the highest available speed. However, if such systems are operated with too high of a wash action, they likely will break or damage the items being washed.

As stated, modulating the speed of a pumping system has an associated cost and complexity that must be justified and/or handily offset by other manufacturing savings and/or
30 operational benefits that could be a byproduct of implementing such apparatus or it would likely not be a viable system design element.

Where exists a need for an economic, user friendly and single pumping solution which can be easily integrated with a continuous motion washing system of any size. There is a further

need for a pumping system which has a real-time feedback mechanism for continuous and automatic monitoring and adjusting of wash flow levels being delivered to the manifold in accordance with predetermined acceptable parameters to maintain a particular desired wash action level and wash fluid conditions and for providing notification when present monitored
5 conditions fall outside acceptable pre-defined parameters. There also exists a need to effectively and automatically modulate the wash fluid temperature in such systems without the need for expensive and/or complex gas or electric supplemental wash fluid heating systems. As well, a need exists for a system that incorporates a filtration system ahead of the wash pump inlet that will provide automatic notifications when the filtration system is in need of cleaning and/or when
10 emptying of the filtration system is required.

While such an outlined system will not balance the flow out of the outlets associated with the outlet manifold or determine what the exact ideal outlet manifold pressure would be for a specific washing application, such outlined system would be a significant advancement to the prior art in the areas delineated above. Specifically, this includes the simplification of the
15 specification and manufacturing of such systems along with significant reductions in manufacturing costs via simplification and/or elimination of costly apparatus, *e.g.*, supplemental gas or electric wash fluid heating systems. Operator benefits such as the improved ability to filter debris out of the system and knowledge of when such a filter system needs cleaning would also be an improvement to existing designs currently on the market.

20 BRIEF SUMMARY OF THE INVENTION

The present invention is a condition reliant control system that modulates on demand pumping volume, fluid temperatures and intake filter conditions for continuous motion washing systems of various sizes and addresses the shortcomings of the prior art.

The present invention may be adapted to integrate with an existing continuous motion
25 washing assembly generally comprised of a tank for holding fluid for washing and a pump connected to the tank for circulating fluid within the tank. An outlet manifold is fitted to the continuous motion washing assembly. The outlet manifold is in communication with the pump and contains at least one flow directing opening or outlet for directing fluid for washing into the tank. At least one pressure sensor is located within the outlet manifold. The pressure sensor
30 monitors the pressure level within the outlet manifold. A control system and modulation unit is configured to modulate the speed of the pump upwardly until a pre-defined pressure in the manifold is obtained. An inline intake filtration system collects debris. The present invention further includes a notification device, such as an alert or alarm, that the filtration system requires

maintenance and cleaning based on pre-defined parameters and the monitored conditions within the outlet manifold. In an alternative embodiment, the present invention also includes a wash fluid temperature controlling method.

Different sized manifolds with varying outlets require different amounts of wash flow to achieve a desired pressure to maintain constant flow of a wash fluid dispensing from the manifold outlets and effectively clean the targeted wares. This is based on the number of outlets contained in the manifolds and what types of ware or items are being washed. For example, a large manifold (one containing many outlets) has increased total square inches of total outlet area and requires a higher wash flow to achieve a desired pressure to maintain constant flow of a wash fluid dispensing from the manifold's many outlets than does a smaller manifold (one containing as few as a single outlet). Thus, each manifold will have its own particular required wash flow that would correspond to an outlet manifold pressure wherein the manifold functions most effectively, *e.g.*, its "pre-defined pressure." As alluded to above, this pre-defined pressure may vary depending on what types of wares or items are being washed.

In use, the control system will continually modulate the pump speed within a defined tolerance range to maintain the desired pressure in the outlet manifold after the initial pre-defined pressure in the outlet manifold has been reached. After the initial pre-defined pressure is obtained, the control system will continually modulate the pump speed to maintain the desired pressure in the outlet manifold within a predetermined range. As well, the control system will continually modulate the pump speed to maintain the desired pressure (within an acceptable range) in the outlet manifold as the wash fluid conditions vary from conditions related to air content from detergents, grease and/or soil loads.

Measurements of the outlet manifold pressure are taken to ensure and maintain a uniform manifold pressure. This manifold pressure can be maintained over an entire line of products having a number of different sizes. The manifold pressure is maintained by a feedback mechanism which determines and controls the rpm of the pump. The pump rpm will speed up or slow down based upon the feedback of the manifold pressure.

In the event the pumping system is unable to maintain the desired initial pressure in the outlet manifold at a first pre-determined level for a pre-determined time period, an initial alert is issued. An elevated alert also is issued in the event the pumping system is unable to maintain the desired initial pressure in the outlet manifold at a second pre-determined level for a pre-determined time period. If this second alert occurs, the wash pump may also be deactivated.

The condition reliant control system of the present invention integrates with a continuous motion washing assembly comprising a tank for containing a wash fluid for washing articles. The pump system has a motor that accommodates either 50 Hz or 60 Hz power supplies. An impeller or prop within the pumping system is rotated at varying speeds to vary the wash fluid flow rate of wash fluid traveling there through, thereby, increasing or decreasing the wash flow to achieve a target pressure within the given outlet manifold. The goal is to reach and maintain a target pressure per square inch (psi) in the given outlet manifold and then maintain the pressure within a given range.

The outlet manifold may be of any size, but has at least one outlet. The outlet manifold also contains at least one outlet manifold pressure sensor to monitor the pressure of the outlet manifold. The pressure sensor measures the pressure in the manifold and transmits these readings or signals to a control module which, in turn, then sends information to a modulation unit. The modulation unit receives the signals in any number of preprogrammed ways. For example, the signal may come from a single pressure sensor. Alternatively, an average of multiple manifold sensors may be used. In either case, the control and modulation unit controls and governs the pumping speed of the pumping system in relation to the present pressure conditions of the outlet manifold as indicated by the readings from the outlet manifold pressure sensor(s).

A wash fluid pumping intake filter may be included within the condition reliant control system design. The wash fluid pumping intake filter is positioned within the pathway of the wash fluid flow from the tank and then into the pumping system. As wash fluid flow is pumped through by the pumping system (in whatever speed results from the rotation of the impeller), the filter traps unwanted debris, *e.g.*, food particles and/or other items, preventing them from re-entering into the manifold and pumping system.

In an alternative embodiment, a temperature controller system containing a thermostatic control and temperature probe is used to monitor the temperature of the wash fluid within the tank of the washing assembly. Readings from the temperature probe are taken. The temperature readings are transmitted to the control module and analyzed. If required, signals are sent to the modulation unit to vary the pump speed (rpm). If the temperature falls outside a pre-defined temperature or temperature range, the temperature control system overrides the standard control programming causing the modulation unit to separately modulate pumping volume up or down to increase or decrease heat from friction to manipulate wash fluid temperatures until the wash fluid returns to the predetermined target temperature. After the desired wash fluid temperature has

once again been achieved, the temperature controller system transmits a signal to the control module permitting the control module to resume the standard programming and operations.

In using the condition reliant control system, the pumping system is engaged (*i.e.*, turned “on”) and the pump motor speed is modulated up at an even and continuous pace until a target
5 internal manifold pressure is obtained. The manifold pressure is subsequently monitored. Monitoring would typically be continuous. Readings from the manifold pressure by a pressure sensor or multiple pressure sensors are typically continuously transmitted to the control and modulation unit. In the case of using multiple pressure sensors, an average of those sensors would typically be used. The control/modulation unit compares the received outlet manifold
10 pressure readings against a set of predefined parameters to determine whether the current pressure conditions within the outlet manifold are acceptable.

The pumping system is then set to an rpm setting in relation to a pre-defined outlet manifold target pressure. A decrease in the outlet manifold pressure suggests the filter must be cleaned and/or maintenance should otherwise be performed on the system.

If the manifold pressure readings are below the target manifold pressure, a signal is
15 transmitted to the pump system to increase the speed of the impeller rotation until the desired target manifold pressure is reached. If the manifold pressure readings are above the target manifold pressure, a signal is transmitted to the pumping system to decrease the speed of the impeller until the desired target manifold pressure is reached.

The target manifold pressure may be set according to the items to be washed (“wash
20 action”). For example, the wash action level for the washing of fruits and vegetables requires a different target manifold pressure than does the wash action level of the washing of pots and pans. Many applications that would require varying washing action levels are contemplated by the present invention which may translate into a particular target manifold pressure for a
25 particular item or items to be washed.

Once the system is on, the pump speed is continually modulated to maintain the desired pressure in the outlet manifold after the initial pre-defined pressure in the outlet manifold has been reached. Similarly, the pump speed is continuously modulated to maintain the desired pressure in the outlet manifold within a predetermined range as the wash fluid conditions vary
30 from changing detergent levels, soil loads or other common factors found in continuous motion washing systems.

To the extent conditions are not maintained within a particular acceptable range, the present invention provides for alerts notifying a user of the anomalous conditions. For example,

an alert is issued in the event that the pumping system is unable to maintain the desired initial pressure in the outlet manifold for a predetermined time period. If the pumping system is unable to continually maintain the desired target pressure in the outlet manifold for a predetermined time, an alert is issued. An alert also issues where the pumping system is unable to continually maintain the pressure in the outlet manifold within a predetermined range after another predetermined time period and the wash pump may also be deactivated as a part of this heightened alert.

It is a primary object of the present invention to reduce the number of required parts for construction to simplify the design and manufacturing of continuous motion washing systems.

It is another object of the present invention to reduce the number of parts and separate systems that would be required to achieve desired wash flow volumes and wash fluid wash action conditions.

The present invention reduces the required number of pumping solutions to as few as one. The present invention further eliminates the requirement for a separate electric or gas powered wash tank heating system for maintaining ongoing optimal wash tank temperatures via increasing or decreasing the amount of friction occurring in the system. The present invention has applications in food service operations, food manufacturing operations and many types of industrial facilities where washing of an item or items are required provided these items may be submersed in a fluid.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

FIGS. 1A, 1B and 1C, collectively depict a block diagram of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

FIG. 1A-1C collectively depict a block diagram of the present invention. Condition reliant control system 100 has components 200, as shown in FIG. 1C. Components 200 include control/modulation unit 202, at least one outlet manifold pressure sensor 204, wash tank 203 for holding fluids, wash fluid intake filter 206, wash fluid pumping system 208, an outlet manifold 210, a thermostatic controller/temperature controller 212, and a water fluid heating element 216.

Referring now to FIG. 1B, block 300 shows, generally, the system configuration comprised of components 200. Control/modulation unit 202 is electrically connected to wash fluid pumping system 208. Wash fluid pumping system 208 is comprised of pump motor 209 connected to conduit 207 and having impeller 211 positioned within conduit 207. Impeller 211 rotates in various speeds as dictated by the set of instructions received from control/modulation

unit 202. The pump speed is modulated. The present invention uses a prop style pumping system. However, other styles of pumping systems may be utilized and still be within the contemplation of the present invention.

Wash fluid intake filter 206 is positioned within conduit 207 to collect any debris (*e.g.*, food particles, etc.) that collects during cycling out of the wash fluid. Block 210 depicts various sized outlet manifolds having varying number of outlets thereon. However, it is understood that at least one outlet manifold 210a, as selected by the user, will be used at any one time. In the present invention, outlet manifold 210a may be of various sizes and include varying numbers of outlets, as indicated in block 210. Outlet manifold 210a is in fluid communication with wash fluid pumping system 208. Outlet manifold 210a is incorporated into wash tank 203 which may range in size from approximately 36 inches long to about 72 inches long which are now commonly found in the market place.

Still referring to FIG. 1B, one or more outlet manifold pressure sensors 204 are connected to outlet manifold 210a. One or more outlet manifold pressure sensors 204 may be used in the present invention. While only one outlet manifold pressure sensor 204 is required, the number of outlet manifold pressure sensors 204 used may increase sensibly dependent upon the size of the outlet manifold and the number of outlets contained on the outlet manifold 210a selected.

Generally, outlet manifold pressure sensor 204 has a threaded male portion 204a which is threaded into a corresponding threaded receiving female portion (not shown) within one or more outlets contained along the outlet manifold 210a. However, other comparable fastening means may also be utilized to secure outlet manifold pressure sensor 204 to outlet manifold 210a. As wash fluid passes through outlet manifold 210a and flows out of one or more flow directing outlets contained along outlet manifold 210a, outlet manifold pressure sensor 204 monitors the sustained pressure. Outlet manifold pressure sensor 204 is electronically connected to control/modulation unit 202, as shown in FIG. 1B. While as shown, the control and the modulation system are integrated into one single unit or component (*e.g.*, control/modulation unit 202, as shown in FIGS. 1B and 1C), in an alternative embodiment these could also be separate units or components (*e.g.*, control module and modulation unit) and still be within the contemplation of the present invention.

Control/modulation unit 202, wash fluid pumping system 208, outlet manifold 210a, and outlet manifold pressure sensor 204, thus, provide a continuous communication path which is key to providing the feedback mechanism of the present invention. Once condition reliant control system 100 is turned on, condition reliant control system 100 automatically adjusts to

control and maintain a certain pressure within outlet manifold 210a. In the event the pressure cannot be maintained or is not sustainable, in accordance with a set of pre-defined parameters, condition reliant control system 100 may report an alert or an elevated alert which may also include shutting down the fluid pumping system 208.

5 In an alternative embodiment, and as shown in FIG. 1C, temperature controller 212 is electronically connected to control/modulation unit 202.

Referring now to FIG. 1B, when condition reliant control system 100 is turned on, wash fluid pumping system 208 activates and impeller 211 begins spinning or rotating at a slow speed then gradually ramps up. Condition reliant control system 100 simultaneously monitors the
10 pressure signature within outlet manifold 210a during this ramp up. Impeller 211 continues rotating thereby increasing the pressure within outlet manifold 210a until optimum pressure conditions, *i.e.*, a pre-defined pressure within outlet manifold 210a is obtained. Once the optimum pressure condition is reached, wash fluid pumping system 208 will continue functioning, but only to the extent of maintaining the optimum pressure conditions.

15 When condition reliant control system 100 is turned off, impeller 211 will ramp down decreasing in speed until impeller 211 would typically come to a complete stop. The rate at which impeller 211 ramps up or ramps down is set to occur at a controlled rate or speed which can be varied by application.

Referring now to FIG. 1A, flow diagram 400 provides the general sequence of operation
20 of condition reliant control system 100. In block 402, wash fluid pumping system 208 is engaged. The desired pumping level is defined in block 404 via a target internal manifold pressure goal. There may be multiple target internal manifold pressures defined for varying applications, as indicated in block 406. Varying applications may include various types of washing methods and systems.

25 Referring now to FIG. 1B, either a single outlet manifold pressure sensor 204 or a plurality of outlet manifold pressure sensors 205 may be used in the system. Either a single reading (from a single manifold sensor) may be used or, alternatively, an average of the readings of the plurality of outlet manifold pressure sensors 205 may be used, as explained in block 408. In either case, the readings are of the real-time pressure conditions within outlet manifold 210a.
30 Readings from the single or plurality of outlet manifold pressure sensors 204, 205 are transmitted to a control processor or control/modulation unit 202, as indicated in block 410.

Block 412 indicates that the speed of wash fluid pumping system 208 will continue to be modulated up until the desired pressure within the outlet manifold 210a is reached. Referring

now to FIG. 1C, as shown in block 414, the pressure will then be maintained. At this point, if the pressure within outlet manifold 210a falls outside a predetermined acceptable pressure or pressure range, control/modulation unit 202 sends a signal to wash fluid pumping system 208 to modulate or vary the speed of wash pump 209. Pump 209 then either increases or decreases the rotational speed of impeller 211, which in turn increases or decreases the flow of wash fluid entering into outlet manifold 210a, whichever the case may be, to return outlet manifold 210a to acceptable pressure conditions.

Once acceptable pressure conditions have resumed, the desired pumping level is automatically maintained, as shown in block 414. As the purpose of a filter is to remove unwanted materials from a medium, *e.g.*, wash fluid, eventually a filter will become clogged when used. It is undesirable to maintain or even increase the pumping speed of the wash fluid pumping system 208 to attempt to maintain the desired pressure in the outlet manifold 210a when the filter is becoming excessively clogged. Doing so may damage the system (*e.g.*, filter ruptures releasing trapped contents, pump motor burns out, etc...).

Still referring to FIG. 1C, as indicated in block 416, if the outlet manifold internal pressure is at the desired pressure, but then falls below a separate target level, this is an indication that probably wash fluid pumping system 208 cannot get a sufficient amount of wash fluid to outlet manifold 210a. Due to the reduction in wash fluid flow (as a result of the reduction in open intake area in the intake filter 206), the cleanliness of washed articles will begin to deteriorate and the time it takes to clean the articles will increase. These factors negatively affect productivity and efficiency. In this case, condition reliant control system 100 issues a "Clean Filter" notification notifying the user that wash fluid intake filter 206 requires maintenance and cleaning.

In use, when condition reliant control system 100 is turned on, control/modulation unit 202 governs the pumping speed of wash fluid pumping system 208 in relation to the present pressure conditions in outlet manifold 210a.

In an alternative embodiment, a traditional wash fluid heating element 216 heats wash fluid within the tank of the continuous motion washing assembly (not shown) to a predetermined temperature sufficiently hot to provide efficient and effective cleaning of articles, but at a safe operational temperature for the user should a user need to remove an article from the wash fluid.

In yet another alternative embodiment, the traditional wash fluid heating element 216 can be eliminated or supplemented. In the embodiment, temperature controller 212 monitors the temperature of this wash fluid via temperature probe 214. In the event the temperature reading

from temperature probe 214 indicates temperatures falling outside the acceptable range, temperature controller 212 immediately signals control/modulation unit 202 to cease its current function, essentially overriding the standard programming of control/modulation unit 202 and causing control/modulation unit 202 to cause wash fluid pumping system 208 to speed up or slow down, as shown in FIGS. 1B and 1C. This speeding up or slowing down of the pumping system increases or reduces friction, *i.e.*, modulation of the wash flow and/or outlet manifold pressure translates into an increase or decrease of friction, *i.e.*, heat, occurring within the system to vary or modulate the temperature of the wash fluid back to acceptable temperature conditions, as indicated in block 418. Increased friction increases the temperature. Decreased friction decreases the temperature. In an alternative embodiment, a friction creating mechanical device could also be engaged to supplement or replace the friction creating the effect of increasing the speed of wash fluid pumping system 208.

Outlet manifold pressure sensor 204 transmits a signal to control/modulation unit 202 which interprets the received signal as indicative of the current pressure conditions within outlet manifold 210a.

The feedback mechanism of the present invention allows control/modulation unit 202 to monitor the pressure conditions in real-time within outlet manifold 210a, so that outlet manifold 210a maintains a constant pressure therein. Whether control/modulation unit 202 causes wash fluid pumping system 208 to speed up or slow down depends upon the current pressure conditions within outlet manifold 210a. For example, if the sensor(s) indicate the pressure within the outlet manifold is within an acceptable range, which is previously set and known by the user, no change is made to the dynamics of the system (*i.e.*, the pumping system speed is not modulated). The feedback mechanism, therefore, allows for condition reliant control system 100 to automatically “self-monitor” and “self-adjust” maintaining acceptable pressure conditions within outlet manifold 210a, without the need for a user to be present to perform these functions manually which, as indicated, is problematic. The present invention remains unaffected by variations in motor speed related to systems operating 50Hz or 60Hz power supplies and performs equally sufficient with either electrical supply format. As well, the present invention will automatically maintain outlet manifold pressures when wash fluid conditions change in relation to either detergent levels, soil levels or any combination thereof.

The various embodiments described herein may be used singularly or in conjunction with other similar devices. The present disclosure includes preferred or illustrative embodiments in which a modulating on demand pumping volume is described. All various steps concerning the

method or methods disclosed in the present invention are not necessarily described in a particular order such that, for example, one step is required prior to the procession of another step. Alternative embodiments of such a system can be used in carrying out the invention as claimed and such alternative embodiments are limited only by the claims themselves. Other aspects and advantages of the present invention may be obtained from a study of this disclosure and the drawings, along with the appended claims.

CLAIMS

I claim:

1. A condition reliant control system for modulating on demand pumping volume for a continuous motion washing assembly comprising:

5 a tank configured to hold fluid for washing;
at least one pump outlet manifold connected to said tank with at least one flow directing opening directed into the tank;

at least one sensor monitoring conditions within said at least one outlet manifold;

a control module in electronic communication with said at least one sensor;

10 a modulation unit in electronic communication with said control module, said modulation unit receiving signals from said control module related to conditions reported from said at least one sensor; and

a pumping system including a pump inlet and pump outlet, said pumping system in fluidic communication with said at least one pump outlet manifold and wherein said pumping
15 system is further in electronic communication with said modulation unit.

2. The system, as recited in claim 1, wherein said at least one sensor is a pressure sensor.

3. The system, as recited in claim 2, further comprising a filter in fluidic communication
20 with said pumping system and positioned between said tank and said at least one pump inlet.

4. The system, as recited in claim 3, further comprising at least one notification device in electric connection with said control module, said at least one notification device for providing an alarm upon receipt of signal that pressure from within said at least one pump outlet manifold is outside of acceptable pressure limits.

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5. The system, as recited in claim 4, further comprising a temperature controller system in communication with said control module.

6. The system, as recited in claim 5, wherein said temperature controller system comprises a
30 heating element and a temperature sensor.

7. A method for modulating on demand pumping volume for a continuous motion washing system, said method consisting of the steps of:

prescribing an internal pressure parameter for an outlet manifold;

engaging a pumping system connected to said outlet manifold;
obtaining an initial target internal pressure within said outlet manifold;
monitoring the internal pressure of said outlet manifold;
transmitting pressure readings to a control module;
5 comparing said pressure readings against said internal pressure parameter;;and
transmitting signals to a modulation unit to manipulate the speed of said pumping system
to maintain the prescribed internal pressure parameter.

8. The method, as recited in claim 7, wherein the obtaining, monitoring, transmitting and
10 comparing of the said pressure readings against said internal pressure parameter occurs
continuously or at pre-determined intervals.

9. The method, as recited in claim 8, wherein in said prescribing step further prescribing a
plurality of internal pressure parameters for said outlet manifold, each internal pressure
15 parameter corresponding to a specific washing task.

10. The method, as recited in claim 8, wherein after said initial target internal pressure is
obtained, converting an acceptable target internal pressure to a range of pressure that is a
predefined percentage above and below said acceptable target internal pressure.

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11. The method, as recited in claim 10, wherein if said pressure readings are below a
predefined low pressure range, transmitting a signal to said pumping system to increase the speed
of an impeller contained therein to deliver increasing pumping volumes to said outlet manifold
until said acceptable target internal pressure is obtained.

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12. The method, as recited in claim 11, further comprising the step of issuing of an alert if
said pumping system is unable to maintain said acceptable target internal pressure within said
pre-defined low pressure range for a first pre-determined time period.

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13. The method, as recited in claim 12, further comprising the step of issuing an elevated
alert if said pumping system is unable to maintain said pre-defined low pressure range within
said outlet manifold for a second pre-determined time period.

14. The method, as recited in claim 13, further comprising the step of deactivating said wash pump if said pumping system is unable to maintain said pre-defined low pressure range within said outlet manifold for said second pre-determined time period.

5 15. The method, as recited in claim 10, wherein in the comparing step, if said pressure readings are above a predefined high pressure range, transmitting a signal to said pumping system to decrease the speed of an impeller contained therein to deliver decreasing pumping volumes to said outlet manifold until said acceptable target internal pressure is obtained.

10 16. The method, as recited in claim 8, wherein the pre-defined internal pressure parameter for said outlet manifold is temporarily overridden based on the temperature of said wash fluid in said tank being above or below a pre-defined target temperature or temperature range.

15 17. The method, as recited in claim 16, further comprising downwardly modulating said pump speed by a pre-determined increment to decrease the heat produced by friction until said wash fluid returns to a pre-determined target temperature.

20 18. The method, as recited in claim 17, further comprising upwardly modulating said pump speed by a pre-determined increment to increase said heat produced by friction in said system until said wash fluid returns to said pre-determined target temperature.

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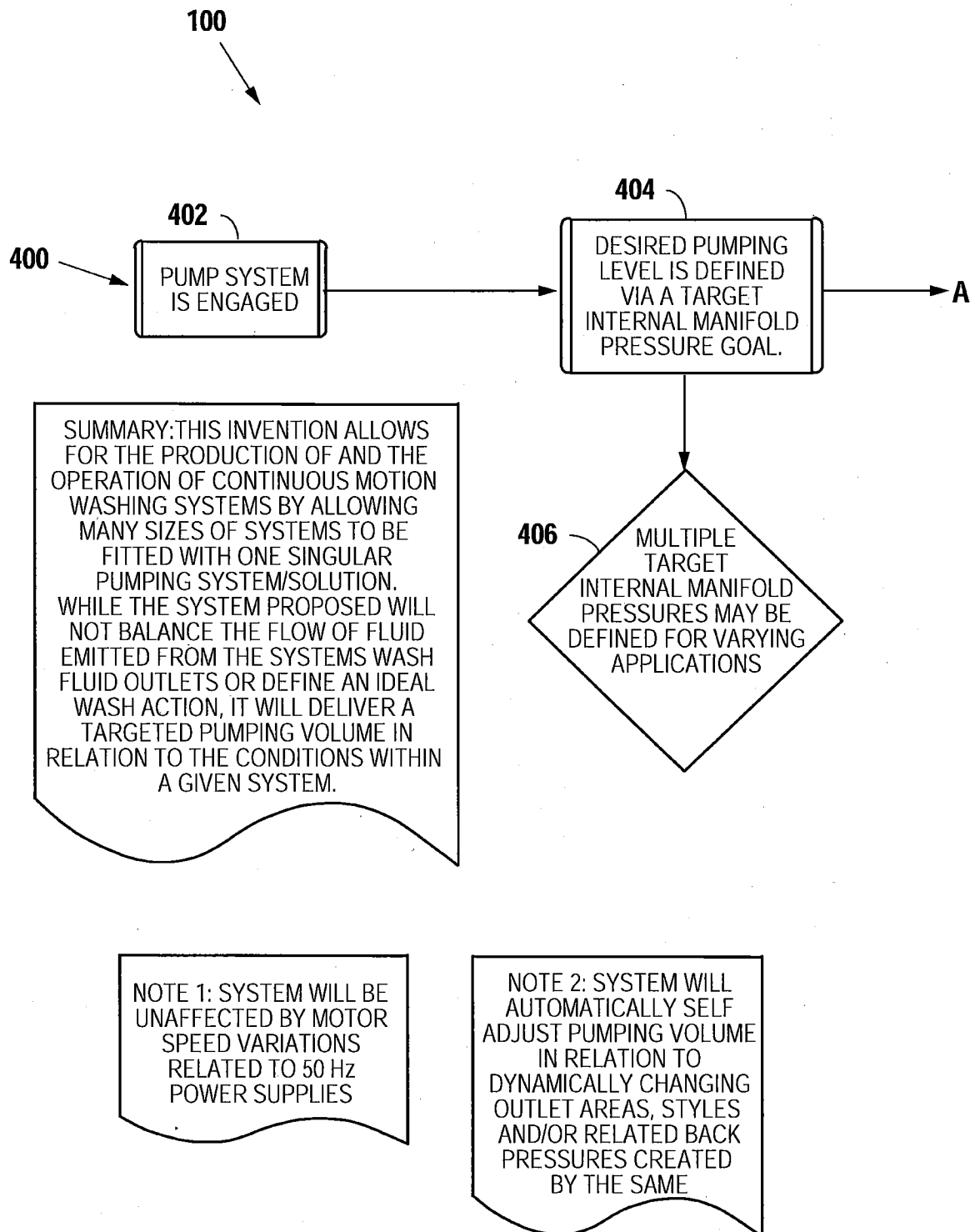


Fig. 1A

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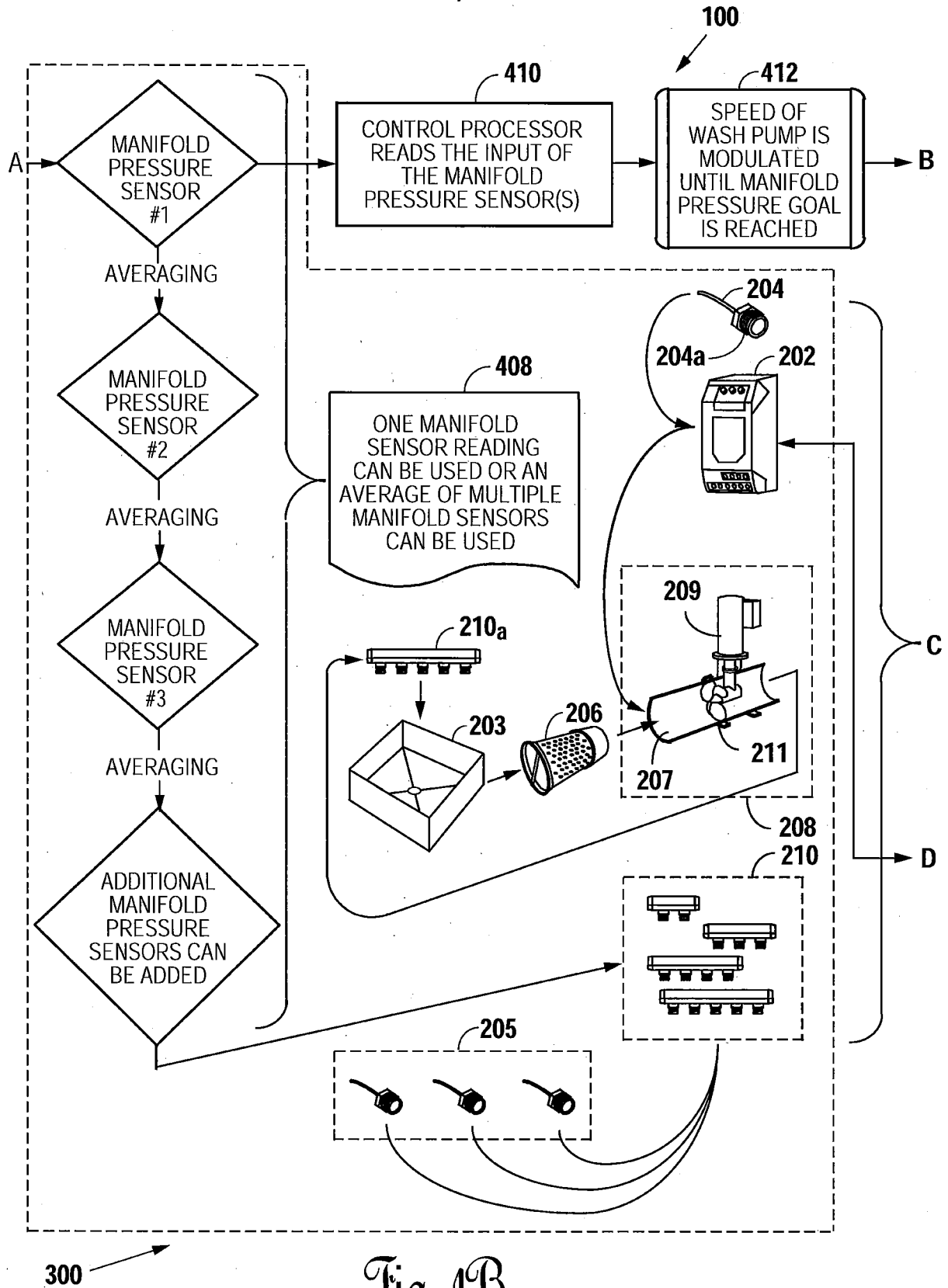


Fig. 1B

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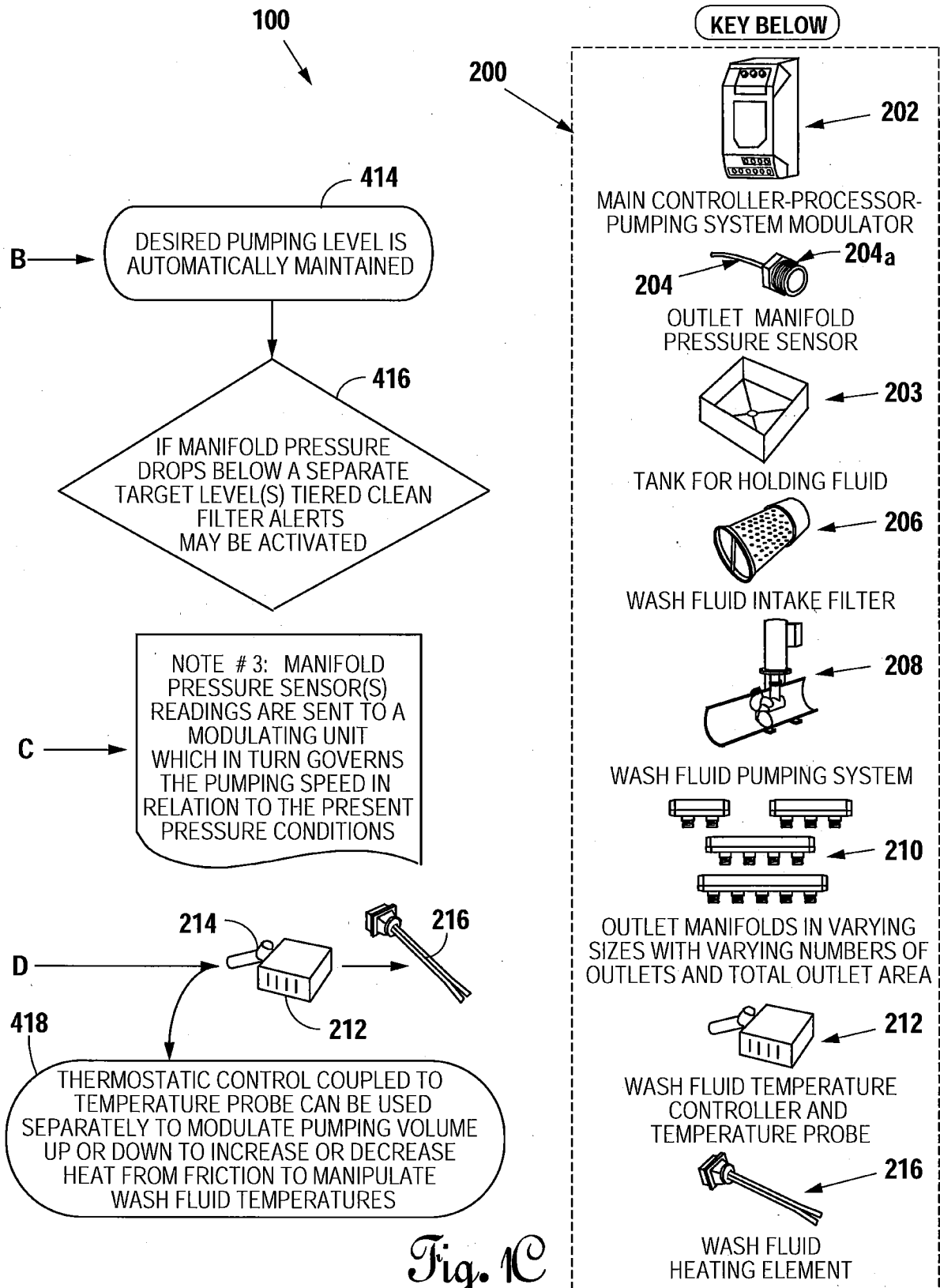


Fig. 1C

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2016/037739

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - F04B 49/08, F04B 49/06, F04B 49/00 (2016.01)

CPC - F04D 15/0066, F04B 49/106, F04D 15/0209 (2016.05)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC - F04B 49/00; F04B 49/06; F04B 49/08

CPC - F04B 49/106; F04D 15/0066; F04D 15/02; F04D 15/0209

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

USPC - 417/42.000; 417/44.100; 417/44.110; 700/282.000 (keyword delimited)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

Orbit, Google Patents, Google Scholar

Search terms used: pressure pwm pump pressure sensor washer control

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 8,540,493 B2 (KOEHL) 24 September 2013 (24.09.2013) entire document	1, 2, 7-9, 16-18
Y		3-6, 10-15
Y	US 6,116,861 A (HOGAN et al) 12 September 2000 (12.09.2000) entire document	3-6
Y	US 5,878,817 A (STASTKA) 09 March 1999 (09.03.1999) entire document	10-15
A	US 8,226,374 B2 (PETERSON et al) 24 July 2012 (24.07.2012) entire document	1-18
A	US 7,394,182 B2 (PELRINE et al) 1 July 2008 (01.07.2009) entire document	1-18

☐ Further documents are listed in the continuation of Box C.☐ See patent family annex.

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

18 August 2016

Date of mailing of the international search report

13 SEP 2016

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