US 20150074917A1

(19) **United States**

(12) **Patent Application Publication**

Flesch

(10) **Pub. No.: US 2015/0074917 A1**

(43) **Pub. Date: Mar. 19, 2015**

(54) **WASHING MACHINE APPLIANCE AND A METHOD FOR DETECTING AN OVERSUDS CONDITION**

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(21) Appl. No.: **14/031,238**

(22) Filed: **Sep. 19, 2013**

Publication Classification

(51) **Int. Cl.**

D06F 33/02	(2006.01)
D06F 39/08	(2006.01)
D06F 37/12	(2006.01)

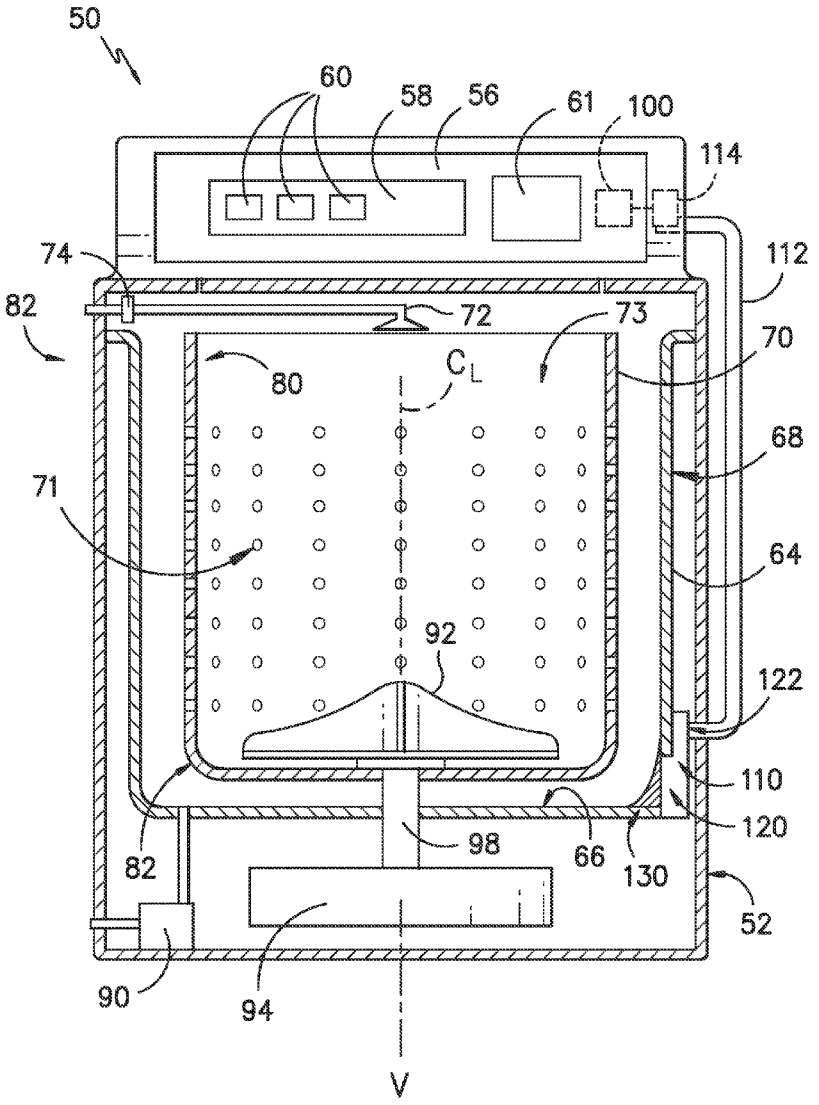
(52) **U.S. Cl.**

CPC ***D06F 33/02*** (2013.01); ***D06F 37/12*** (2013.01); ***D06F 39/082*** (2013.01)

USPC **8/137**; 68/12.02

(57) **ABSTRACT**

Washing machine appliances and methods for detecting oversuds conditions in washing machine appliances are provided. A washing machine appliance has a tub and a basket rotatably mounted within the tub, the basket defining a chamber for receipt of articles for washing. A method includes measuring a pressure within the tub during a spin cycle, comparing the pressure to a threshold oversuds pressure level, and pausing the spin cycle and enacting an oversuds removal cycle if the pressure exceeds the threshold oversuds pressure level.



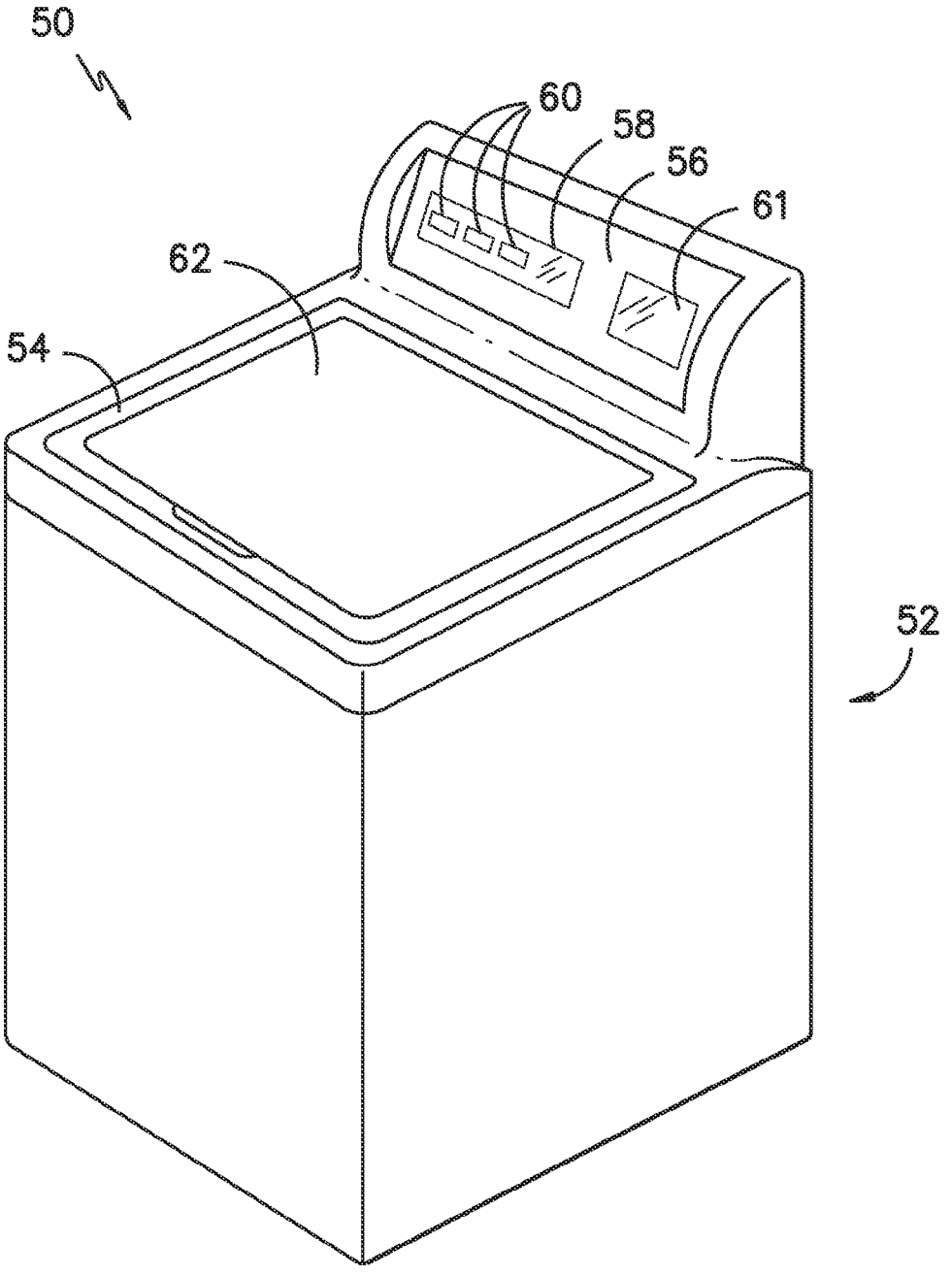


FIG. —1—

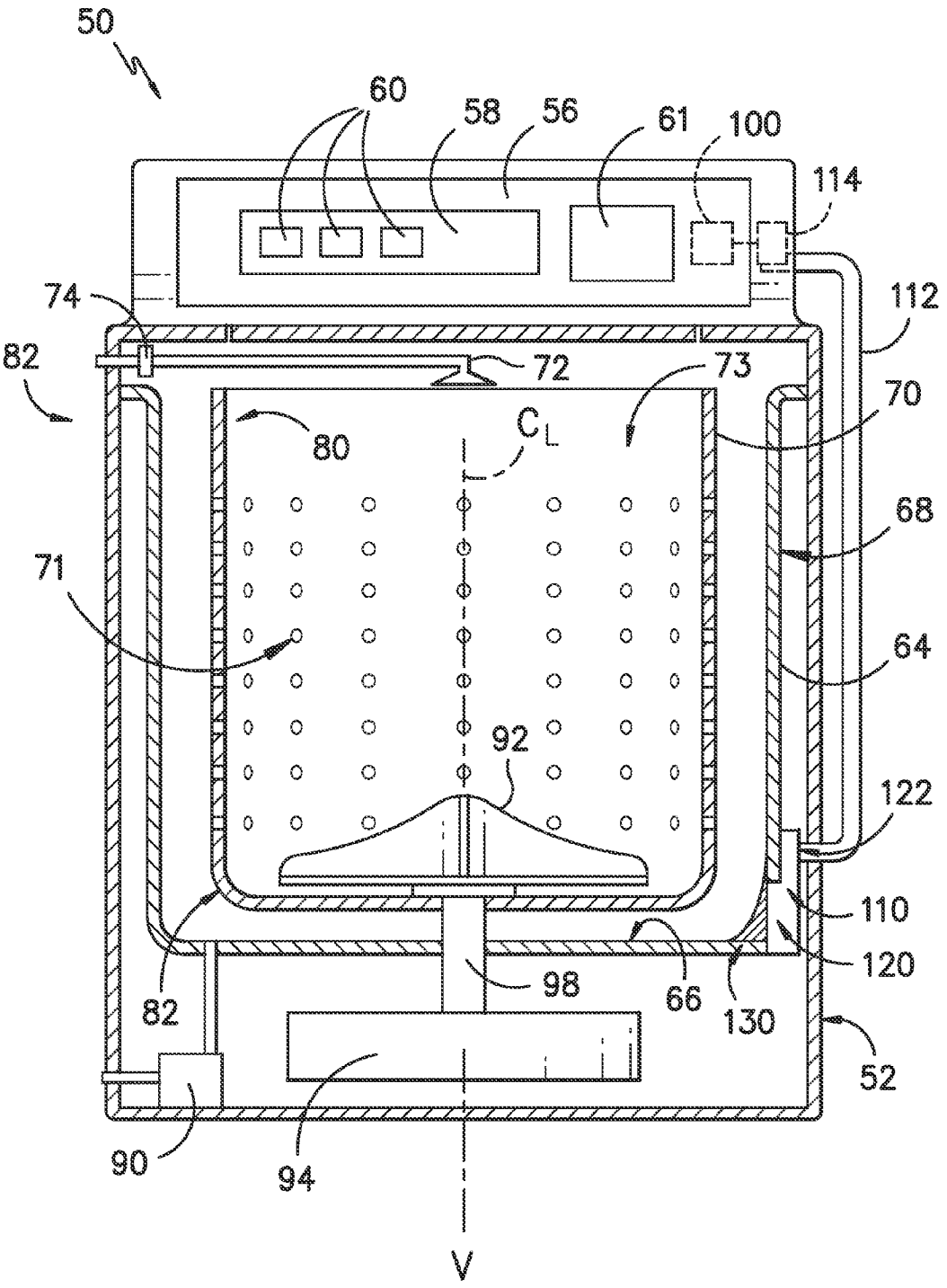

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FIG. 2

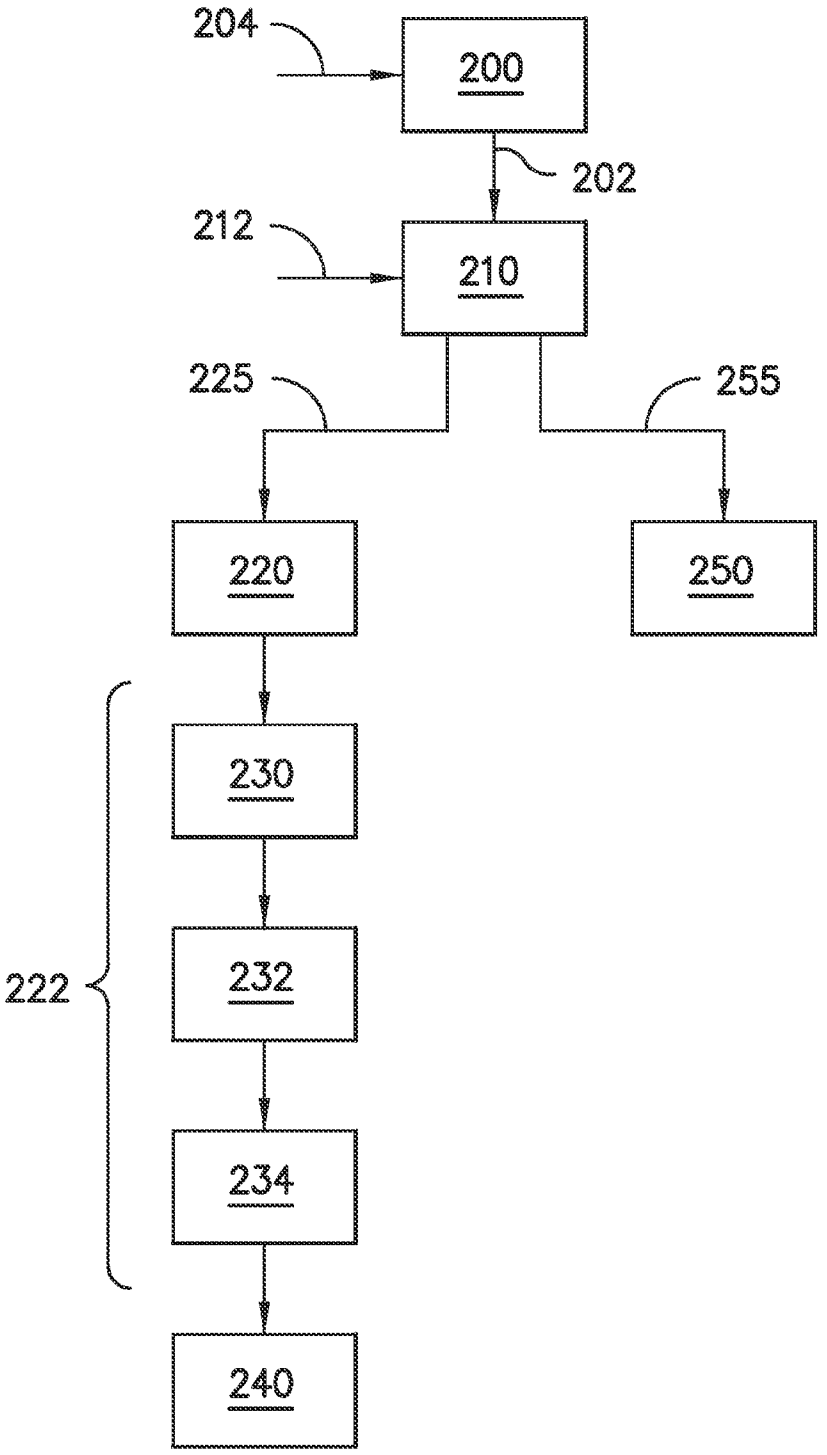

FIG. 3

WASHING MACHINE APPLIANCE AND A METHOD FOR DETECTING AN OVERSUDS CONDITION

FIELD OF THE INVENTION

[0001] The present subject matter relates generally to washing machine appliances and methods for detecting oversuds conditions therein.

BACKGROUND OF THE INVENTION

[0002] Washing machine appliances generally include a tub for containing wash fluid, e.g., water, detergent, and/or bleach. A basket is rotatably mounted within the tub and defines a wash chamber for receipt of articles for washing. During operation of such washing machine appliances, wash fluid is directed into the tub and onto articles within the wash chamber of the basket. The basket can rotate at various speeds to agitate articles within the wash chamber in the wash fluid, to wring wash fluid from articles within the wash chamber, etc.

[0003] During operation of certain washing machine appliances, a spin cycle is performed to wring wash fluid from the articles within the wash chamber. The spin cycle typically entails rotating the basket at a relatively high rate of speed for a period of time. Typically, and desirably, the tub is generally empty of wash fluid and suds (caused by interaction between water and detergent, etc.). In some cases, however, an oversuds condition can occur, when suds remain in the tub during the spin cycle. If an oversuds condition occurs, the suds can overflow from the washing machine appliance and potentially damage, for example, surrounding floor areas.

[0004] Attempts have been made to reduce the risk of oversuds conditions in washing machine appliances. For example, additional water has been added before spin cycles in attempts to reduce suds within the tub and basket. The speed at which the basket rotates during the spin cycle has been reduced. The spin cycle ramp up period has been lengthened. Reductions in recirculation have been made. However, these attempts have not suitably reduced the risk of oversuds conditions occurring.

[0005] Accordingly, improved washing machine appliances and methods for detecting oversuds conditions in washing machine appliances are desired. In particular, methods and apparatus that result in improved reductions in the potential for oversuds conditions during spin cycles would be advantageous.

BRIEF DESCRIPTION OF THE INVENTION

[0006] In one embodiment, the present disclosure is directed to a method for detecting an oversuds condition in a washing machine appliance. The washing machine appliance has a tub and a basket rotatably mounted within the tub, the basket defining a chamber for receipt of articles for washing. The method includes measuring a pressure within the tub during a spin cycle, comparing the pressure to a threshold oversuds pressure level, and pausing the spin cycle and enacting an oversuds removal cycle if the pressure exceeds the threshold oversuds pressure level.

[0007] In another embodiment, the present disclosure is directed to a washing machine appliance. The washing machine appliance includes a tub and a basket rotatably mounted within the tub, the basket defining a chamber for receipt of articles for washing. The washing machine appliance further includes a valve, a spout configured for directing fluid from the valve into the tub, and a motor in mechanical communication with the basket, the motor configured for selectively rotating the basket within the tub. The washing machine appliance further includes a pressure sensor configured for measuring a pressure within the tub, and a controller in operative communication with the valve, the motor and the pressure sensor. The controller is configured for comparing the pressure measured during a spin cycle to a threshold oversuds pressure level, and pausing the spin cycle and enacting an oversuds removal cycle if the pressure exceeds the threshold oversuds pressure level.

[0008] These and other features, aspects and advantages of the present invention will become better understood with reference to the following description and appended claims. The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate embodiments of the invention and, together with the description, serve to explain the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] A full and enabling disclosure of the present invention, including the best mode thereof, directed to one of ordinary skill in the art, is set forth in the specification, which makes reference to the appended figures.

[0010] FIG. **1** provides a perspective view of a washing machine appliance according to an exemplary embodiment of the present subject matter.

[0011] FIG. **2** provides a front, section view of the exemplary washing machine appliance of FIG. **1**.

[0012] FIG. **3** is a flow chart illustrating a method according to an exemplary embodiment of the present disclosure.

DETAILED DESCRIPTION

[0013] Reference now will be made in detail to embodiments of the invention, one or more examples of which are illustrated in the drawings. Each example is provided by way of explanation of the invention, not limitation of the invention. In fact, it will be apparent to those skilled in the art that various modifications and variations can be made in the present invention without departing from the scope or spirit of the invention. For instance, features illustrated or described as part of one embodiment can be used with another embodiment to yield a still further embodiment. Thus, it is intended that the present invention covers such modifications and variations as come within the scope of the appended claims and their equivalents.

[0014] FIG. **1** is a perspective view of a washing machine appliance **50** according to an exemplary embodiment of the present subject matter. As may be seen in FIG. **1**, washing machine appliance **50** includes a cabinet **52** and a cover **54**. A backsplash **56** extends from cover **54**, and a control panel **58** including a plurality of input selectors **60** is coupled to backsplash **56**. Control panel **58** and input selectors **60** collectively form a user interface input for operator selection of machine cycles and features, and in one embodiment, a display **61** indicates selected features, a countdown timer, and/or other items of interest to machine users. A lid **62** is mounted to cover **54** and is rotatable between an open position (not shown) facilitating access to a wash tub **64** (FIG. **2**) located within cabinet **52** and a closed position (shown in FIG. **1**) forming an enclosure over tub **64**.

[0015] FIG. **2** provides a front, cross-section view of washing machine appliance **50**. As may be seen in FIG. **2**, tub **64** includes a bottom wall **66** and a sidewall **68**. A wash basket or wash drum **70** is rotatably mounted within tub **64**. In exemplary embodiments as shown, basket **70** is rotatable about a vertical axis V. Thus, washing machine appliance **50** in these embodiments is generally referred to as a vertical axis washing machine appliance. Basket **70** defines a wash chamber **73** for receipt of articles for washing and extends, e.g., vertically, between a bottom portion **80** and a top portion **82**. Basket **70** includes a plurality of openings or perforations **71** therein to facilitate fluid communication between an interior of basket **70** and tub **64**.

[0016] A spout **72** is configured for directing a flow of fluid into tub **64**. In particular, spout **72** may be positioned at or adjacent top portion **82** of basket **70**. Spout **72** may be in fluid communication with a water supply (not shown) in order to direct fluid (e.g., liquid water) into tub **64** and/or onto articles within chamber **73** of basket **70**. A valve **74** regulates the flow of fluid through spout **72**. For example, valve **74** can selectively adjust to a closed position in order to terminate or obstruct the flow of fluid through spout **72**. A pump assembly **90** (shown schematically in FIG. **2**) is located beneath tub **64** and basket **70** for gravity assisted flow to drain tub **64**.

[0017] An agitation element **92**, shown as an impeller in FIG. **2**, is disposed in basket **70** to impart an oscillatory motion to articles and liquid in chamber **73** of basket **70**. In various exemplary embodiments, agitation element **92** includes a single action element (i.e., oscillatory only), double action (oscillatory movement at one end, single direction rotation at the other end) or triple action (oscillatory movement plus single direction rotation at one end, singe direction rotation at the other end). As illustrated in FIG. **2**, agitation element **92** is oriented to rotate about vertical axis V. Basket **70** and agitation element **92** are driven by a pancake motor **94**. As motor output shaft **98** is rotated, basket **70** and agitation element **92** are operated for rotatable movement within tub **64**, e.g., about vertical axis V. Washing machine appliance **50** may also include a brake assembly (not shown) selectively applied or released for respectively maintaining basket **70** in a stationary position within tub **64** or for allowing basket **70** to spin within tub **64**.

[0018] Operation of washing machine appliance **50** is controlled by a processing device or controller **100**, that is operatively coupled to the user interface input located on washing machine backsplash **56** (shown in FIG. **1**) for user manipulation to select washing machine cycles and features. In response to user manipulation of the user interface input, controller **100** operates the various components of washing machine appliance **50** to execute selected machine cycles and features.

[0019] Controller **100** may include a memory and microprocessor, such as a general or special purpose microprocessor operable to execute programming instructions or microcontrol code associated with a cleaning cycle. The memory may represent random access memory such as DRAM, or read only memory such as ROM or FLASH. In one embodiment, the processor executes programming instructions stored in memory. The memory may be a separate component from the processor or may be included onboard within the processor. Alternatively, controller **100** may be constructed without using a microprocessor, e.g., using a combination of discrete analog and/or digital logic circuitry (such as switches, amplifiers, integrators, comparators, flip-flops, AND gates, and the like) to perform control functionality instead of relying upon software. Control panel **58** and other components of washing machine appliance **50** may be in communication with controller **100** via one or more signal lines or shared communication busses.

[0020] In an illustrative embodiment, laundry items are loaded into chamber **73** of basket **70**, and washing operation is initiated through operator manipulation of control input selectors **60**. Tub **64** is filled with water and mixed with detergent to form a wash fluid. Valve **74** can be opened to initiate a flow of water into tub **64** via spout **72**, and tub **64** can be filled to the appropriate level for the amount of articles being washed. Once tub **64** is properly filled with wash fluid, the contents of the basket **70** are agitated with agitation element **92** for cleaning of laundry items in basket **70**. More specifically, agitation element **92** is moved back and forth in an oscillatory motion.

[0021] After the agitation phase of the wash cycle is completed, tub **64** is drained. Laundry articles can then be rinsed by again adding fluid to tub **64**, depending on the particulars of the cleaning cycle selected by a user, agitation element **92** may again provide agitation within basket **70**. One or more spin cycles may also be used. In particular, a spin cycle may be applied after the wash cycle and/or after the rinse cycle in order to wring wash fluid from the articles being washed. During a spin cycle, basket **70** is rotated at relatively high speeds.

[0022] While described in the context of a specific embodiment of washing machine appliance **50**, using the teachings disclosed herein it will be understood that washing machine appliance **50** is provided by way of example only. Other washing machine appliances having different configurations (such as horizontal-axis washing machine appliances), different appearances, and/or different features may also be utilized with the present subject matter as well.

[0023] Referring still to FIG. **2**, a pressure chamber **110** may be defined in the tub **64**. The pressure chamber **110** may be provided for facilitating tub pressure measurements. For example, a hose **112** may connect the pressure chamber **110** to a pressure sensor **114**. Pressure sensor **114** may measure the pressure in the pressure chamber **110** or at another suitable location within the tub **64**, and may be in operative communication with the controller **100**. The pressure sensor **114** may be a component of controller **100**, or may be a separate component from the controller **100** which is in communication with the controller **100** through a suitable wired or wireless connection. A pressure sensor **114** may, for example, be an analog pressure sensor, a digital pressure sensor, a mechanical pressure switch, or any other suitable device capable of measuring pressure as required herein. Pressure chamber **110** may include an inner opening **120** and an outer opening **122**, and may extend between these openings to place the interior of the tub **64** and the hose **112** in fluid communication. Inner opening **120** may thus be defined in a sidewall **68** of the tub **64**.

[0024] Further, a deflector **130** may be disposed within and mounted to the tub **64**, such as to a sidewall **68** and/or tub bottom **66** thereof. Deflector **130** generally extends inwardly from the sidewall **68** and tub bottom **66** between the tub **64** and basket **70**, and deflects and redirects water therein. Inner opening **120** may be defined adjacent to the deflector **130**, such that deflector **130** redirects water from the inner opening **120**.

[0025] As discussed, improved methods and apparatus for detecting, as well as reducing or eliminating, oversuds conditions are desired in the art. The present disclosure is thus further direction to methods for detecting oversuds conditions in washing machine appliances **50**. Such methods may advantageously reduce leakages and other issues caused by oversuds conditions by efficiently detecting and facilitating elimination of such conditions. Such methods are additionally unlikely to confuse oversuds conditions with normal washing machine appliance operations, thus increasing the efficiency and reliability of the washing machine appliances. Further, such methods are advantageously robust, and do not require parameter adjustments, when utilized with varying loads, fluid levels, detergent brands and amounts, fluid temperatures and hardnesses, etc.

[0026] For example, a method according to the present disclosure may include the step **200** of measuring a pressure **202** within the tub **64** during a spin cycle **204**. Such measurement may be taken in exemplary embodiments by pressure sensor **114** and in pressure chamber **110**.

[0027] During a typical spin cycle, the pressure **202** may generally read as approximately an atmospheric pressure level (gauge) due to the relative lack of fluids, such as wash fluids and suds. However, if an oversuds condition occurs, the pressure **202** may change. An oversuds condition is generally a condition wherein excess fluids, such as wash fluids and suds, are present in a tub. For example, in some embodiments, the existence of a deflector **130** adjacent to the pressure chamber **110** inner opening **120** may create a vacuum within the pressure chamber **110**, such as adjacent or in the inner opening **120**, during an oversuds condition. This may cause a negative pressure reading relative to the atmospheric pressure level. In other embodiments, the existence of an oversuds condition may cause a positive pressure reading relative to the atmospheric pressure level.

[0028] Accordingly, a method according to the present disclosure may further include the step **210** of comparing the pressure **202** to a threshold oversuds pressure level **212**. The threshold level **212** may be, for example, a relative positive or negative pressure level which is higher than or lower than the atmospheric pressure level. In some embodiments, for example, a threshold oversuds pressure level **212** may be between approximately 0.2 inches H_2O and approximately 3.0 inches H_2O above or below the atmospheric pressure level, such as between approximately 0.5 inches H_2O and approximately 2.0 inches H_2O above or below the atmospheric pressure level, such as in some exemplary embodiments approximately 0.5 inches H_2O above or below the atmospheric pressure level.

[0029] Further, a method according to the present disclosure may include the step **220** of pausing the spin cycle **204** and enacting an oversuds removal cycle **222** if the pressure **202** exceeds the threshold oversuds pressure level **212**. Thus, a determination may be made by, for example controller **100** in communication with pressure sensor **114**, that the pressure **202** exceeds a threshold oversuds pressure level **212**. Such determining step may be denoted, for example, as step **225**. In embodiments wherein a threshold oversuds pressure level **212** is a relatively positive threshold pressure, the pressure **202** exceeds the threshold oversuds pressure level **212** when it is greater than the threshold oversuds pressure level **212**. In embodiments wherein a threshold oversuds pressure level **212** is a relatively negative threshold pressure, the pressure **202** exceeds the threshold oversuds pressure level **212** when it is less than the threshold oversuds pressure level **212**.

[0030] An oversuds removal cycle **222** may generally be a cycle which lessens the amount of suds within the tub **64**, thus reducing or eliminating the oversuds condition. For example, in some embodiments, an oversuds removal cycle **222** may include the step **230** of adding a fluid to the tub **64**. The fluid may, for example, in exemplary embodiments be a liquid such as water. Valve **74** and spout **72** may be utilized to supply such fluid. An oversuds removal cycle **222** may further include the step **232** of agitating the basket **70**. For example, motor **94** may be utilized to spin the basket **70**, as discussed above. An oversuds removal cycle **222** may further include the step **234** of draining the fluid from the tub **64**. For example, the fluid may be drained through conventional drain apparatus in the tub **64** and appliance **50**. Such steps, and the oversuds removal cycle **222** comprised thereof, may serve to dilute the existing suds in the tub **64** and reduce or eliminate the suds, thus reducing or eliminating an oversuds condition.

[0031] Details of one suitable oversuds removal cycle **222** may be established in accordance with methods described in U.S. Pat. No. 4,410,329 to Blevins et al. which issued on Oct. 18, 1983, the disclosure of which is incorporated by reference herein.

[0032] In some embodiments, a method according to the present disclosure may further include the step **240** of continuing the spin cycle **204** after the oversuds removal cycle **222** has concluded. Thus, normal operation of the appliance may continue after the oversuds condition has been reduced or eliminated.

[0033] In some embodiments, a method according to the present disclosure may further include the step **250** of continuing the spin cycle **204** in the pressure **202** does not exceed the threshold oversuds pressure level **212**. For example, pressures **202** may be compared to threshold oversuds pressure levels **212** during operation of the appliance **50**, and specifically during spin cycles, constantly or intermittently. Thus, a determination may be made by, for example controller **100** in communication with pressure sensor **114**, that the pressure **202** does not exceed a threshold oversuds pressure level **212**. Such determining step may be denoted, for example, as step **255**. If a pressure **202** does not exceed a threshold oversuds pressure level **212**, the spin cycle **204** may not pause, and rather may continue as per normal appliance **50** operation.

[0034] It should be understood that various method steps as discussed herein may be performed during appliance **50** operation by the controller **100** thereof. Thus, for example, a controller **100** may be configured for comparing the pressure **202** measured during a spin cycle **204** to a threshold oversuds pressure level **212**, and pausing the spin cycle **204** and enacting an oversuds removal cycle **222** if the pressure **202** exceeds the threshold oversuds pressure level **212**. The controller **100** may further be configured for continuing the spin cycle **202** after the oversuds removal cycle **222** has concluded, and continuing the spin cycle **204** if the pressure **202** does not exceed the threshold oversuds pressure level **212**.

[0035] This written description uses examples to disclose the invention, including the best mode, and also to enable any person skilled in the art to practice the invention, including making and using any devices or systems and performing any incorporated methods. The patentable scope of the invention is defined by the claims, and may include other examples that occur to those skilled in the art. Such other examples are intended to be within the scope of the claims if they include

structural elements that do not differ from the literal language of the claims, or if they include equivalent structural elements with insubstantial differences from the literal languages of the claims.

What is claimed is:

1. A method for detecting an oversuds condition in a washing machine appliance, the washing machine appliance having a tub and a basket rotatably mounted within the tub, the basket defining a chamber for receipt of articles for washing, the method comprising:

measuring a pressure within the tub during a spin cycle;

comparing the pressure to a threshold oversuds pressure level; and

pausing the spin cycle and enacting an oversuds removal cycle if the pressure exceeds the threshold oversuds pressure level.

2. The method of claim **1**, further comprising continuing the spin cycle if the pressure does not exceed the threshold oversuds pressure level.

3. The method of claim **1**, further comprising continuing the spin cycle after the oversuds removal cycle has concluded.

4. The method of claim **1**, wherein the oversuds removal cycle comprises:

adding a fluid to the tub;

agitating the basket; and

draining the fluid from the tub.

5. The method of claim **4**, wherein the fluid is water.

6. The method of claim **1**, wherein the threshold oversuds pressure level is a positive pressure relative to an atmospheric pressure level in the tub.

7. The method of claim **1**, wherein the threshold oversuds pressure level is a negative pressure relative to an atmospheric pressure level in the tub.

8. The method of claim **1**, wherein the pressure is measured in a pressure chamber defined in the tub.

9. The method of claim **8**, wherein a deflector is disposed in the tub adjacent to the pressure chamber.

10. The method of claim **1**, wherein the washing machine appliance is a vertical axis washing machine appliance.

11. A washing machine appliance, comprising:

a tub;

a basket rotatably mounted within the tub, the basket defining a chamber for receipt of articles for washing;

a valve;

a spout configured for directing fluid from the valve into the tub;

a motor in mechanical communication with the basket, the motor configured for selectively rotating the basket within the tub;

a pressure sensor configured for measuring a pressure within the tub; and

a controller in operative communication with the valve, the motor and the pressure sensor, the controller configured for:

comparing the pressure measured during a spin cycle to a threshold oversuds pressure level; and

pausing the spin cycle and enacting an oversuds removal cycle if the pressure exceeds the threshold oversuds pressure level.

12. The washing machine appliance of claim **11**, wherein a pressure chamber is defined in the tub, and wherein the pressure sensor measures the pressure within the pressure chamber.

13. The washing machine appliance of claim **12**, further comprising a deflector, the deflector mounted to the tub.

14. The washing machine appliance of claim **13**, wherein an inner opening of the pressure chamber is defined adjacent to the deflector.

15. The washing machine appliance of claim **11**, wherein the controller is further configured for continuing the spin cycle if the pressure does not exceed the threshold oversuds pressure level.

16. The washing machine appliance of claim **11**, wherein the controller is further configured for continuing the spin cycle after the oversuds removal cycle has concluded.

17. The washing machine appliance of claim **11**, wherein the threshold oversuds pressure level is a positive pressure relative to an atmospheric pressure level in the tub.

18. The washing machine appliance of claim **11**, wherein the threshold oversuds pressure level is a negative pressure relative to an atmospheric pressure level in the tub.

19. The washing machine appliance of claim **11**, wherein the basket defines a plurality of openings, the plurality of openings permitting fluid flow between the chamber of the basket and the tub.

20. The washing machine appliance of claim **11**, wherein the washing machine appliance is a vertical axis washing machine appliance.

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